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VOLUME 52 NUMBER 129

BULLETIN

OF THE

Massachusetts Institute of Technology

CATALOGUE

OF THE

OFFICERS AND STUDENTS

WITH A STATEMENT OF THE REQUIREMENTS FOR ADMISSION

AND

A DESCRIPTION OF THE COURSES OF INSTRUCTION

DECEMBER, 1916

T171
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YEARLY CALENDAR

1916

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CALENDAR

1916

Sept. 25, Monday	**FIRST TERM** of the year 1916–1917 begins.
Oct. 11, Wednesday	Stated meeting of the Corporation.
Oct. 12, Thursday	Columbus Day (exercises suspended).
Oct. 28, Saturday	End of the first five weeks of the term.
Nov. 4, Saturday	End of the first six weeks of the term.
Nov. 30, Thursday	Thanksgiving Day (exercises suspended).
Dec. 2, Saturday	End of the second five weeks of term.
Dec. 13, Wednesday	Stated meeting of the Corporation.
Dec. 20, Wednesday	Third-year students file choice of second-term General Study.

Christmas Recess December 25 to January 1, inclusive

Dec. 30, Saturday	First-year students file choice of Course.

1917

Jan. 17, Wednesday	Last exercises of the first term.
Jan. 17–27	Semi-annual examinations.

Recess from January 28 to February 4, inclusive

Feb. 5, Monday	**SECOND TERM** begins. Registration completed.
Feb. 22, Thursday	Washington's Birthday (exercises suspended).
March 1, Thursday	Applications for Graduate Scholarships due for next school year.
March 14, Wednesday	Stated meeting of the Corporation.
March 17, Saturday	End of the first six weeks of the term.
March 31, Saturday	Limit of time for making up certain first term deficiencies.
April 9, Monday	Applications for Undergraduate Scholarships due for next school year. Applications for Cambridge Scholarships must be made in May or June.

Recess April 18, 19, 20, and 21

1917

May 25, Friday	Second-year students file choice of option in General Studies for third year, first term.
May 25, Friday	Last exercises of the second term.
May 26, Saturday	Theses due.
May 26 to June 8	Final Examinations.
May 30, Wednesday	Memorial Day (exercises suspended).
June 8, Friday	Stated meeting of the Corporation.
June 11, Monday	Class Day.
June 12, Tuesday	Graduation.
June 20–22, Wednesday to Friday	Entrance Examinations of the Massachusetts Institute of Technology.
June 18–23, Monday to Saturday	Entrance Examinations of the College Entrance Examination Board (see page 66).

Summer Vacation June 13, 1917, to September 23, 1917, inclusive

SUMMER SCHOOL (in June, July, August and September).

SUMMER SURVEYING CAMP (in August and September).

Sept. 13, Thurs	Advanced Standing Examination begins.
Sept. 15–18, Sat. to Tues	Second Entrance Examinations.
Sept. 20, Thurs	Registration begins.
Sept. 24, Mon	**FIRST TERM** of the year 1917–1918 begins.
Oct. 10, Wed	Stated meeting of the Corporation.
Oct. 12, Fri	Columbus Day (exercises suspended).
Oct. 27, Sat	End of the first five weeks of the term.
Nov. 3, Sat	End of the first six weeks of the term.
Nov. 29, Thurs	Thanksgiving Day (exercises suspended).
Dec. 1, Sat	End of the second five weeks of term.
Dec. 12, Wed	Stated meeting of the Corporation.
Dec. 21, Wed	Third-year students file choice of second term General Study.

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JAMES PHINNEY MUNROE

Treasurer
FRANCIS RUSSELL HART.

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LOUIS ALOYSIUS FERGUSON.
ARTHUR DEHON LITTLE.

Term expires March, 1918.
CASS GILBERT.
CHARLES HAYDEN.
CHARLES THOMAS MAIN.

Term expires March, 1919.
FREDERIC HAROLD FAY.
FRANKLIN WARREN HOBBS.
GERARD SWOPE.

Term expires March, 1920.
WILLIAM HERBERT KING.
JAMES WINGATE ROLLINS.
JASPER WHITING.

Term expires March, 1921.
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HENRY JOHN HORN.
SAMUEL JASON MIXTER.

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HON. [illegible] PRENTICE RUGG, *Chief Justice of the Supreme Court.*
Dr. PAYSON SMITH, *Commissioner of Education.*

[1] Address correspondence to Professor Allyne L. Merrill, Secretary of the Faculty.

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WILLIAM H. KING.

Department of Mathematics

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Department of Biology and Public Health

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Department of Naval Architecture and Marine Engineering

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Walter Francis Wyeth *Assistant Treasurer.*	39 Chestnut Terrace, Newton Center
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Obadiah Firth Wells *Assistant Registrar.*	15 Fairview St., Roslindale 10–100

[1] Correspondence should be addressed to the Secretary of the Faculty.

Officers of Instruction[1]

Residence and Office

RICHARD COCKBURN MACLAURIN, M.A., LL.D., Sc.D.
President of the Institute. 187 Bay State Rd., Boston
3–202

OFFICERS EMERITUS AND RETIRED

GEORGE ABBOTT OSBORNE, S.B. 249 Berkeley St., Boston
Walker Professor of Mathematics, Emeritus.

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Professor of Mining Engineering and Metallurgy, Emeritus. 32 Eliot St., Jamaica Plain

GAETANO LANZA, B.Sc.; C. & M.E. Montevista, Philadelphia, Pa.
Professor of Theoretical and Applied Mechanics, Emeritus.

FRANCIS WARD CHANDLER 195 Marlborough St., Boston
Professor of Architecture, Emeritus.

ARLO BATES, A.M., LITT.D. 4 Otis Pl., Boston
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Professor of Machine Design; Retired.

CALVIN FRANCIS ALLEN, S.B. 88 Montview St., W. Roxbury
Professor of Railroad Engineering; Retired.

THOMAS ELIOT POPE, A.M. 345 Crafts St., Newtonville
Professor of Inorganic Chemistry; Retired.

WILLIAM OTIS CROSBY, S.B. 9 Park Lane, Jamaica Plain
Professor of Geology; Retired.

SAMUEL HOMER WOODBRIDGE, A.B. 281 Otis St., W. Newton
Associate Professor of Heating and Ventilation; Retired.

HENRY KINGSBURY BURRISON, S.B. 26 Lincoln Park, W. Newton
Assistant Professor of Mechanical Drawing and Descriptive Geometry; Retired.

[1] With the exception of the special teachers and lecturers the names are arranged in the order of seniority of appointment to the different grades.

PROFESSORS Residence and Office

CHARLES ROBERT CROSS, S.B. 100 Upland Rd., Brookline
Thayer Professor of Physics; in charge of the Department; Director of the Rogers Laboratory. 4–234

GEORGE FILLMORE SWAIN, S.B., LL.D.
Gordon McKay Professor of Civil Engineering. (Absent) 1–153
1988 Commonwealth Ave., Brighton

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Professor of Naval Architecture and Marine Engineering; in charge of the Department; Chairman of the Faculty. 1–215

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Walker Professor of Mathematics; in charge of the Department. 2–261

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88 Robinwood Ave., Jamaica Plain

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ARTHUR AMOS NOYES, PH.D., LL.D., SC.D. 58 Fenway, Boston
Professor of Theoretical Chemistry; Director of the Research Laboratory of Physical Chemistry. 4–463

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Professor of Mining and Metallurgy. 3–329

Residence and Office

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Professor of History and Political Science; in charge of the Department. 8–107

WILLIAM HOVGAARD. 91 Marion St., Brookline
Professor of Naval Design and Construction. 3–305

ARTHUR EDWIN KENNELLY, A.M., S.D. 1 Kennedy Rd., Cambridge
Professor of Electrical Engineering; Director of the Research Division of the Department of Electrical Engineering. 4–206

THOMAS AUGUSTUS JAGGAR, PH.D. Volcano House, Hawaii
Professor of Geology; Director of the Hawaiian Volcano Observatory.

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Gordon McKay Professor of Electrical Engineering. 4–208

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Professor of Mathematics. (Absent) 2–265

ALLYNE LITCHFIELD MERRILL, S.B. Payson Park, Belmont
Professor of Mechanism; Secretary of the Faculty. 3–210

EDWARD FURBER MILLER, S.B. 538 Ward St., Newton Center
Professor of Steam Engineering; in charge of the Department of Mechanical Engineering; Director of Engineering Laboratories. 3–182

WILLIAM HULTZ WALKER, PH.D., ENG.D. 226 Bay State Rd., Boston
Professor of Chemical Engineering; in charge of the Course in Chemical Engineering and Director of the Research Laboratory of Applied Chemistry. 2–125

LEWIS JEROME JOHNSON, A.B., C.E. 90 Raymond St., Cambridge
Professor of Civil Engineering. 1–280

COMFORT AVERY ADAMS, S.B., E.E. 13 Farrar St., Cambridge
Abbott and James Lawrence Professor of Engineering. 4–212

ALBERT SAUVEUR, S.B. 20 Elmwood Ave., Cambridge
Professor of Metallurgy and Metallography.

FREDERICK SHENSTONE WOODS, PH.D. 123 Sumner St., Newton Center
Professor of Mathematics. 2–213

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Professor of Physics and Electrochemistry; in charge of the Course in Electrochemistry. 4–112

	Residence and Office
DUGALD CALEB JACKSON, C.E. *Professor of Electrical Engineering; in charge of the Department.*	3 Linnaean St., Cambridge 10–220
JOHN OSBORNE SUMNER, A.B. *Professor of History.*	225 Marlborough St., Boston Rogers 22c
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HENRY FAY, PH.D., SC.D. *Professor of Analytical Chemistry.*	11 Worthington Rd., Brookline 2–325
LIONEL SIMEON MARKS, S.B., M.M.E. *Professor of Mechanical Engineering.*	192 Brattle St., Cambridge 3–282
EDWARD DYER PETERS, M.D., DR.ING. *Gordon McKay Professor of Metallurgy.*	38 Percival St., Dorchester
WILLIAM HENRY LAWRENCE, S.B. *Professor of Architectural Engineering; Chairman of the Department of Architecture.*	72 Sumner St., Dorchester Rogers 18a
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AUGUSTUS HERMAN GILL, PH.D. *Professor of Technical Chemical Analysis.*	1334 Washington St., Canton 4–053
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CHARLES MILTON SPOFFORD, S.B. *Hayward Professor of Civil Engineering; in charge of the Department of Civil and Sanitary Engineering.*	61 Colbourne Crescent, Brookline 1–165
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General Information

Historical Sketch. — The foundation of the Massachusetts Institute of Technology was laid in a "Memorial" prepared in 1859 by Professor William Barton Rogers, and presented, by a Committee, to the Legislature of 1860. In this Memorial "reference is made to the expected early establishment of a comprehensive Polytechnic College, furnishing a complete system of industrial education supplementary to the general training of other institutions, and fitted to equip its students with every scientific and technical principle applicable to the industrial pursuits of the age."

On May 28, 1860, a sub-committee, consisting of Professor Rogers and Messrs. E. B. Bigelow and J. M. Beebe, was appointed to "mature a plan for a polytechnic institution." To this subcommittee Messrs. M. D. Ross and C. H. Dalton were subsequently added, and for it Professor Rogers, during the summer of 1860, prepared an elaborate report entitled, "Objects and Plan of an Institute of Technology."

On April 10, 1861, an Act was passed by the General Court of Massachusetts to incorporate The Massachusetts Institute of Technology "for the purpose of instituting and maintaining a society of arts, a museum of arts, and a school of industrial science, and aiding generally by suitable means the advancement, development, and practical application of science in connection with arts, agriculture, manufactures, and commerce."

A lot of State land on the Back Bay in Boston was set apart for the uses of the Institute, with the restriction that not more than one-third of the land should be covered by buildings erected upon it. The Institute was authorized to hold property to an amount not exceeding two hundred thousand dollars, and by a later Act (passed May 17, 1905) has been permitted to hold property up to any amount whatever.

The first meeting of the Institute for organization was held April 8, 1862. The Society of Arts began its meetings on December, 17, 1862, and has maintained them ever since. The Civil War led to the postponement of the opening of the School of Industrial Science. A preliminary session of the School was opened on February 20, 1865, fifteen students attending. The regular courses of instruction began October 2, 1865.

By the Act of April 27, 1863, of the Legislature of the State of Massachusetts, the Institute was constituted the Land Grant College of Mechanic Arts of the State, and was awarded one-third of the appropriation provided by the United States Land Grant Act of July 2, 1862, for the "endowment, support and maintenance of at least one college [in each State] where the leading object shall be, without excluding other scientific and classical studies, and including military tactics, to teach such branches of learning as are related to agriculture and the mechanic arts. . . ." The same proportion of the proceeds of the land grants authorized by the Acts of Congress of August 30, 1890, and March 4, 1907, is also assigned to the Institute. These grants are subject to the condition that instruction in military tactics shall be provided, and that the Governor, the Chief Justice of the Supreme Court, and the State Commissioner of Education shall be each a member *ex-officio* of the government of the Institute. In addition, the Institute receives direct support from the State through an annual grant of $100,000 for ten years from January 1, 1912, to be used for its general purposes, and for the maintenance of eighty free scholarships granted through the State Board of Education for the benefit of students from the various Senatorial districts of the State (see page 389).

For fifty years the Institute developed on the original site granted by the State. During this time the number of students increased from 15 to 1900, the staff of instruction from 10 to 300, and the number of courses of study leading to the degree of Bachelor of Science from 6 to 15. In 1865 one building served all the purposes of the Institute, the assets amounted to $128,941.45 and the current income for the year was $6,558.05. In 1915 the Institute occupied ten buildings, its assets were $10,818,604.88 and its current income was $721,703.79. Detailed financial and other statistics may be found in the Report of the President and Treasurer issued in January of each year.

In 1916 the Institute moved to a new site on the Charles River Basin, and on this tract of fifty acres has erected an entirely new plant which in every respect is perfectly adapted to the needs and purposes of a technological college. Here in future will be developed all the activities of the Institute.

Government. — The government of the Institute is vested by its charter in the Corporation. Its by-laws prescribe that the Corporation shall consist of not more than thirty-five life members, of the three *ex-officio* members, and of fifteen members elected by the Corporation, three each year for a term of five years, from a group of candidates nominated by those Alumni of the Institute who have graduated not less than five years previously.

The Corporation confirms appointments, confers degrees, authorizes the purchase and sale of land and the erection of buildings. It receives reports from the President, the Treasurer, and the Visiting Committees, and acts upon them. The President of the Institute presides at its meetings.

The Executive Committee of the Corporation consists of the President and the Treasurer and of five members, who are chosen by the Corporation from among its members for a term of five years. This Committee has power to appoint the President and Treasurer, also the professors and teachers and all other persons to be employed in any department of the Institute, subject to confirmation by the Corporation. It fixes the salaries and prescribes the duties of all officers so appointed and has power to remove them. It has charge of the buildings and other property of the Institute, and has the general superintendence of all matters relating to the School of Industrial Science.

In regard to other committees of the Corporation see pages 12 and 13.

The Faculty, which consists of all members of the instructing staff of the grades of Professor, Associate Professor, and Assistant Professor, has the immediate supervision of all matters relating to the courses of instruction and to the admission, registration and conduct of students. The degrees of the Institute are conferred upon the recommendation of the Faculty.

The Society of Arts. — This is a department of the Institute which is especially devoted to the general dissemination of scientific knowledge. It aims to awaken and maintain an interest in

the recent advances and practical applications of the sciences. For this purpose meetings, over which the President of the Institute presides, are held semi-monthly from October to May, at which reports of inventions, discoveries, and matters of scientific and technical interest are presented. These meetings are open to students of the Institute and to other persons interested in the aims of the Society. The Society publishes the *Science Conspectus* in December, January, February, March and April which is sent to all its members. In this publication the Society aims to give, as far as possible, a general survey of the field of science and its applications in such a way that every article will have some educational value for every reader. All persons interested in the promotion of science or its application are eligible to membership.

The School of Industrial Science. — The School of Industrial Science constitutes the best known and most important part of the Institute. Its primary purpose is to afford to students such a combination of general, scientific, and professional training as will fit them to take leading positions as engineers, scientific experts, and teachers and investigators of science. It is also one of its important functions to contribute to the existing store of scientific knowledge and to the promotion of industrial development through the prosecution in its laboratories of original researches in pure and applied science.

The School consists of the Departments of Mathematics; Drawing and Descriptive Geometry; English; History and Political Science; Economics and Statistics; Modern Languages; Civil and Sanitary Engineering; Mechanical Engineering; Applied Mechanics and Mechanic Arts; Mining Engineering and Metallurgy; Architecture; Chemistry and Chemical Engineering; Electrical Engineering; Biology and Public Health; Physics; Geology; Naval Architecture and Marine Engineering; Military Science; and Physical Training. A description of the organization of these departments, of the general character and purposes of the instruction afforded, and of the specific subjects of instruction offered by them will be found on pages 171 to 352.

In connection with the School the Institute also maintains a Research Laboratory of Physical Chemistry, a Research Laboratory of Applied Chemistry, a Research Laboratory of Electrical

Engineering, a Sanitary Research Laboratory and Sewage Experiment Station, an Aërodynamic Research Laboratory and the Hawaiian Volcano Observatory.

The Institute offers to its students both undergraduate and graduate courses of study. The former lead to the degree of Bachelor of Science; the latter, to the degrees of Master of Science, Doctor of Philosophy, or Doctor of Engineering. It also affords to advanced students and to more experienced investigators excellent opportunities for the pursuit of original scientific investigations in its departmental special research laboratories.

The Undergraduate Courses of Study. — In these Courses, which are its most important and largely attended ones, the Institute aims to afford to students with the preparation furnished by the better high schools, the additional instruction in English, Modern Languages, History and Political Science which are essential to a liberal education; to give them a thorough training in the fundamental sciences of Mathematics, Chemistry, and Physics, and in the important applications of the principles of these sciences to the various branches of engineering and applied science. It lays far more stress on the development of the power to deal effectively with new engineering or scientific problems than on the acquirement of an extensive knowledge of details. In order to attain these results, most of its class-room instruction is given to small sections of students, and in its laboratories and drawing-rooms students receive a large amount of personal attention. The independent solution of assigned problems forms a large part of nearly all its Courses. Its curriculum differs from that of technical schools of the narrower type in the respect that a large proportion of liberal studies of a literary and general scientific character are insisted upon, and in the respect that courses upon technological methods and other highly specialized subjects are largely excluded; for, while the latter are sometimes important in special industries, they are not essential to a broadly trained engineer, who can readily acquire later the necessary technical knowledge. Its system of instruction differs from the university plan of education in that cultural studies are closely correlated and interwoven with the professional work, while under the latter plan the two groups of studies are ordinarily pursued successively, in separate undergraduate and graduate schools. The Institute lays, more-

over, especial emphasis on training in science and scientific method, not only as an essential to professional success, but as an important element in culture and in life. Its Courses differ, too, from those of many colleges in that electives are introduced to a much less extent, in the belief that better results are obtained by prescribing, after the student has selected the profession for which he desires to prepare himself, the principal studies which he is to pursue. He is given, however, the choice among groups of optional studies relating to different branches of his profession and between a variety of electives in the group of general studies. While the Faculty encourages a moderate participation of students in social and athletic activities and while it has welcomed the development of student life which has taken place in these directions in the past few years, it demands of its students a standard of scholarship which is inconsistent with an excessive devotion to such pursuits.

Four-Year Undergraduate Courses. — Regular Four-Year Courses of Study leading to the degree of Bachelor of Science are offered in the following branches of science and engineering:

I. CIVIL ENGINEERING.
II. MECHANICAL ENGINEERING.
III. MINING ENGINEERING AND METALLURGY.
IV. ARCHITECTURE.
V. CHEMISTRY.
VI. ELECTRICAL ENGINEERING.
VII. BIOLOGY AND PUBLIC HEALTH.
VIII. PHYSICS.
IX. GENERAL SCIENCE.
X. CHEMICAL ENGINEERING.
XI. SANITARY ENGINEERING.
XII. GEOLOGY.
XIII. NAVAL ARCHITECTURE AND MARINE ENGINEERING.
XIV. ELECTROCHEMISTRY.
XV. ENGINEERING ADMINISTRATION.

In most of these Courses distinct options are offered in the later years which enable the student to concentrate more of his attention upon some one side of his profession. In no case, however, is the specialization carried so far as to preclude a thorough training in all the fundamental branches of the subject. The more important of these options are as follows:

CIVIL ENGINEERING.	1. *Hydraulic Engineering.* 2. *Railroad Engineering.* 3. *Highway Engineering.*
MECHANICAL ENGINEERING.	1. *Engine Design.* 2. *Locomotive Engineering.* 3. *Mill Engineering.* 4. *Steam Turbine Engineering.*
MINING ENGINEERING AND METALLURGY.	1. *Mining and Metallurgy.* 2. *Metallurgy.* 3. *Mining.*
ARCHITECTURE.	1. *Architecture.* 2. *Architectural Engineering.*
CHEMISTRY.	1. *General.* 2. *Analytical.* 3. *Sanitary and Municipal.*
BIOLOGY AND PUBLIC HEALTH.	1. *Bacteriology and Industrial Microbiology.* 2. *Sanitary Biology and Public Health.*
PHYSICS.	1. *Chemistry.* 2. *Mathematics.* 3. *Industrial Physics.*
ENGINEERING ADMINISTRATION.	1. *Civil Engineering.* 2. *Mechanical and Electrical Engineering.* 3. *Chemical Engineering.*

Descriptions of these Courses and of the professional work for which they afford a preparation, as well as schedules showing the subjects of instruction included and their arrangement, will be found on pages 83 to 134.

It will be observed that in addition to the Courses in the various branches of engineering, the Institute offers Courses in the other important branches of applied science. Thus the Courses in Applied Chemistry, Metallurgy, Electrochemistry, and Sanitary

and Industrial Biology serve to prepare students as scientific experts and for professional positions in manufacturing establishments and government laboratories. Thorough courses in pure science, namely, in Chemistry, Physics, Biology, Geology, and General Science, are also offered. These give the training required for teaching positions in technological institutions, colleges, and preparatory schools, and for research positions in the departments of the government and in private laboratories. The Course in Biology and Public Health furnishes, too, an exceptional training for the subsequent study of medicine in medical schools of the graduate type.

The Course in Architecture, with its two options in Architecture and Architectural Engineering, is a course of an artistic as well as a scientific character, involving a large amount of instruction and training in the fine arts.

The Course in Engineering Administration provides a training for men who expect to enter upon administrative work in enterprises which demand a knowledge of scientific and engineering principles.

All these Courses are identical, in the first term of the first year, except as regards the Modern Language requirement, and nearly so in the second term of that year. The student therefore makes a provisional choice of his Course of study at the beginning of the second term of his first year, and a final choice at the beginning of his second year. In making this choice, the primary consideration should be the student's tastes and aptitudes, as shown by the results of his previous work at the Institute and in his preparatory school, rather than any supposed pecuniary or other advantages attaching to special professions. To assist students in making this choice, a special circular upon the Choice of Courses has been prepared and will be sent upon application.

Five-Year Undergraduate Courses. — Five-Year Courses of study leading to the degree of Bachelor of Science are also offered. These are designed to meet the needs of three different classes of students: —

First: Those who wish to complete in five years the work of two allied Courses.

Second: Those who wish to combine with the work of a single professional Course a larger proportion of humanistic studies and of work in general science.

Third: Those who wish to distribute the work of a single Course over five years without undertaking additional required studies.

For all three classes the foundation is a common five-year schedule including all the studies of one of the professional Courses, the difference lying in the use of the free time not assigned in this schedule. In all cases, moreover, the work of the first year is identical with that of one of the regular Four-Year Courses, thus affording the student an opportunity to base his choice on a year's experience and on conference with members of the Faculty.

Under the first plan the work of the Five-Year Course is arranged so as to include all the subjects required in two of the professional Four-Year Courses (including two theses, one in each line of study); for example, in Civil and Sanitary Engineering, in Mechanical and Electrical Engineering, in Mechanical and Chemical Engineering, in Mechanical Engineering and Naval Architecture and Marine Engineering. Students pursuing such a double Course take in each year an amount of work approximately equivalent to that required in the regular Four-Year Courses, and upon its completion receive the degree of Bachelor of Science in two departments of study, instead of in a single one.

For certain combinations of Courses the student can, if he prefer, complete all the work required in one Course in four years, receiving the degree in that department of study, and then in a fifth year complete the remaining subjects required in an allied Course, for which he will then receive a second Bachelor's degree in the new line of study. Owing to the sequence of studies in the successive years, this plan does not, however, permit of certain combinations of Courses which can be arranged for only under a consistent five-year program laid out longer in advance.

A knowledge of more than one branch of science or engineering is so often required in professional practice that men who have received the double training which is given by such Courses are particularly well fitted to deal successfully with large industrial and engineering problems.

Under the second plan the Five-Year Course is arranged so as to include all the subjects of one of the regular professional Courses distributed over a period of five years, and supplemented by the introduction in the extra time thus made available of much additional work, which is in part elective, in general science, history, language, literature, art, and economics. This Course provides

in large measure the breadth of scholarship which a college course is designed to supply; but it does this by methods and in the atmosphere of the scientific school and with special emphasis upon general scientific studies as a part of a liberal education.

Under the third plan the work of the last three years of the regular Four-Year Courses is distributed over four years without additional requirements, thus reducing the number of subjects required in any term. This affords the opportunity for more thorough work in each subject by devoting more time to outside study and to practice in the laboratories, drawing-rooms and in the field, and for the pursuit, as electives, of general studies and collateral professional subjects which are not included in the Four-Year Courses. The standard of scholarship required of the student is in every way the same as in the Four-Year Courses, and so long as he maintains his standing in the Course which he is pursuing, he is classed in the year in which he takes a majority of his studies.

Definite schedules have been prepared for such Five-Year Courses in Civil, Mechanical and Electrical Engineering, and similar schedules will, so far as possible, be arranged for individual students in the other branches of engineering.

Opportunities for College Students in the Undergraduate Professional Courses. — Students who have attended other colleges or scientific schools granting degrees, and who have had at least the approximate equivalent of the work of the first year at the Institute, are generally excused without examination from those subjects in the regular Courses of which they have already had a substantial equivalent. Graduates of such institutions are thus often able to complete the work for the Bachelor's degree after a residence at the Institute of two or three years, according to the length and character of their previous collegiate training. College students planning to enter the Institute with advanced standing will find it advantageous to arrange their college work with some reference to the requirements of the Course which they are to pursue at this institution. An opportunity to complete their preparation in some of the fundamental subjects required in the first and second years is offered by the Summer Courses of Instruction at the Institute. A special course in Descriptive Geometry for college students who may not have had this subject is offered during the first term of each year. A special circular relating to

the terms of admission of applicants from other colleges will be sent upon request. See also pages 79 and 80.

Summer Schools. — The Institute conducts summer school work of two kinds. Courses of instruction are offered which correspond to some of those given during the regular school year. The object and arrangement of these courses are described in detail on page 135, and in a special circular issued each year in April. Secondly, professional summer schools in Civil Engineering, Mining Engineering and Metallurgy, Chemistry, and Geology and Mineralogy are carried on either regularly or at intervals. Some of this work is supplementary to and different in character from that given during the regular terms, but much of it is now required in certain Courses. Further details will be found on pages 139 to 142.

Graduate Courses of Study and Research. — To graduates of the Institute, and to others who have had a training substantially equivalent to that given in any of its Undergraduate Courses, is offered the opportunity of pursuing a further year of study and research leading to the degree of Master of Science. Such a graduate course serves to supplement the undergraduate work in the same field by more thorough instruction in underlying principles and their mathematical development, by a more specialized study of important branches of the profession, and by training in the investigation of scientific and technical problems. At the best it is difficult for the student to acquire an adequate professional education from an undergraduate course of four years, especially since much of this time needs to be given to preparatory and general educational studies. It is therefore highly desirable that at least one additional year be devoted to graduate work. The character of such work and the conditions under which it is carried on differ so much from those in the Undergraduate Courses that the fifth year is almost sure to give, not merely much additional professional knowledge, but a new and valuable kind of training. The closer individual contact with the instructors, the general use of original articles and scientific monographs rather than text-books, and especially the larger proportion of time devoted to research, develop originality and independent power, and inculcate the principles and spirit of investigation, which are necessary to success not less in technological than in scientific pursuits.

The degrees of Doctor of Philosophy or Doctor of Engineering are awarded by the Institute for advanced courses of two or three years duration. Such courses serve not merely to give a more thorough knowledge of the branch of science or engineering pursued as a major subject and of the allied branches pursued as minor subjects, but also to train the student thoroughly as a scientific investigator, by far the larger proportion of the time being devoted to an extensive research of a scientific or technical character. Such courses give the thorough training needed by teachers in the higher institutions of learning, by scientific experts employed in government or industrial research laboratories, or by engineers who are to do creative work of the highest order in their professions.

Opportunities for such research work are offered in connection with all the Departments of the Institute and in specially equipped laboratories, — the Research Laboratory of Physical Chemistry, the Research Laboratory of Applied Chemistry, the Research Laboratory of Electrical Engineering, the Sanitary Research Laboratory and Sewage Experiment Station, the Aërodynamic Laboratory, and the Hawaiian Volcano Observatory.

For more detailed information see pages 143 to 170 and the special Bulletin on Advanced Study and Research.

Physical Training. — Provision is made for giving gymnasium instruction to all students at the Institute who desire it. In addition to this optional attendance, students in the first year are required to take two hours a week of physical exercise under the direction of the Instructor in Physical Training.

Bronze medals, known as the Cabot Medals for Improvement in Physical Development, are awarded at the end of the school year to those men who have shown the greatest physical improvement during the year.

There is an athletic field on the Institute's property in Cambridge where opportunity is afforded for track-team contests and inter-class games. See page 186 for further information.

Requirements for Admission. — Detailed information in regard to the requirements for admission to the courses of instruction in the Institute will be found on pages 64 to 82. In general the preparation necessary to enable an applicant to pursue successfully one of the regular Undergraduate Courses corresponds to that afforded by high schools or academies of the better grade offering

a four years' course of study. Applicants for admission as special students must be prepared in all subjects that are required for admission to the particular courses desired.

School Year. — The first term begins on the Monday following September 20. There is a recess of one week after the Semi-annual Examinations, and the second term begins on the first Monday in February. On legal holidays, for one week at Christmas, and for four days including the 19th of April, the exercises of the school are suspended. Graduation exercises are held on the first Tuesday after June 7 in ordinary years, and on the first Tuesday after June 6 in leap years.

Registration; Attendance Card. — At the opening of each term the student is required to fill out and present to the Registrar an attendance card, blank forms for which are supplied. The attendance card is the direct means by which the student places before the Faculty his wishes in regard to his professional Course or selection of studies. The card must be presented at the earliest possible moment, to give opportunity for the immediate determination of qualifications and status. *For registration after five o'clock of the first day of the term a fee of five dollars will be charged.* All subjects applied for must be regularly pursued, and no others can be taken except by special permission.

Attendance. — Students are expected to attend all exercises in the subjects applied for on their attendance cards, unless excused by special vote of the Faculty. With the exception of an interval of one hour in the middle of the day, exercises are held and students are in general expected to devote themselves to the work of the school between the hours of 9 A.M. and 5 P.M. There are no exercises on Saturday after 1 P.M., and the rooms are closed.

Status of Students. — The ability of students to continue their courses is determined in part by means of examinations; but regularity of attendance and faithfulness to daily duties are considered equally essential.

Examinations. — General examinations are held each year in January and in May. The January examinations are confined to the work of the first half of the year and begin on the Wednesday following January 12, extending through the Saturday of the following week. The May examinations may cover the work of the

entire year. These examinations begin in ordinary years on the Saturday following May 21, in leap years on the Saturday following May 20, and continue through Friday of the second week following. In the fourth year the annual examinations may cover, in addition, professional subjects of earlier years. In certain subjects, students are marked upon term work without examinations, but in exceptional cases particular students may be examined.

Examinations for students conditioned in May in subjects of the first, second, and third years are held on the Thursday preceding the September entrance examinations and following days and for first-term subjects at the time of the May examinations.

Intermediate examinations, the results of which are not made a matter of permanent record, but are primarily for the information of students and their parents or guardians, may be held at any time in place of regular exercises.

Students conditioned in any subject and failing to make up the condition at the time appointed for the examination are not entitled to another examination.

Students having clear records at the end of the first term of the first year are allowed to choose their Courses without restriction. Students will not be admitted to professional work of the several courses without satisfactory records in those previous subjects on which the former especially depend. Exceptions to this rule may be made in individual cases after special consideration by the Faculty.

Reports of Standing. — Intermediate informal reports for all first and second-year subjects are sent during each term; formal semi-annual reports are sent at the close of each term; and special votes of the Faculty are transmitted in cases requiring consideration. These reports are sent to students, and to the parents or guardians of those not of age, but reports will be sent to a parent or guardian in any other case also on application to the Registrar, and notification will be made to parents or guardians in all cases of students advised or required to withdraw, or placed on probation.

Conduct. — It is assumed that students come to the Institute for a serious purpose, and that they will cheerfully conform to such regulations as may be from time to time made by the Faculty. In case of injury to any building, or to any of the furniture, apparatus, or other property of the Institute, the damage will be

charged to the student or students known to be immediately concerned: but, if the persons who caused the damage are unknown, the cost of repairing the same may be assessed equally upon all the students of the school.

Students are expected to behave with decorum, to obey the regulations of the school, and to pay due respect to its officers. Conduct inconsistent with the general good order of the school, or persistent neglect of work, if repeated after admonition, may be followed by dismissal, or, in case the offense be a less serious one, the student may be placed upon probation. The student so placed upon probation may be dismissed if guilty of any further offense. This probation may be removed by the Faculty after a period of continued good conduct on the part of the student.

It is the aim of the Faculty so to administer the discipline of the school as to maintain a high standard of integrity and a scrupulous regard for truth. The attempt of any student to present as his own any work which he has not performed, or to pass any examination by improper means, is regarded by the Faculty as a most serious offense, and renders the offender liable to immediate expulsion. The aiding and abetting of a student in any dishonesty is also held to be a grave breach of discipline.

Advisers. — The Dean is the general consulting officer for students, and coöperates with the President in matters touching discipline and other student relations. In coöperation with the Technology Christian Association a number of upper classmen have been selected to act as advisers to incoming students. These men have been assigned to students who have taken entrance examinations, and they will be expected to help new men in matters of registration, in the selection of rooms, etc.

On request to the Dean, advisers will also be assigned to new students from the instructing staff.

It is not intended by this rule that the advisers shall become, in any sense or in any degree, guardians of the students assigned to them; nor does the Faculty by this action assume any responsibility for the conduct and deportment of students outside the halls of the Institute.

Medical Adviser. — Dr. J. Arnold Rockwell, 26 Garden Street, Cambridge, a graduate of the Institute, is the medical adviser for students, and will address them during the year on personal hygiene.

He may be consulted by students any Monday or Thursday afternoon between four and five o'clock in his office at the Institute, without payment of fee.

Requirements for Graduation. — To receive the degree of Bachelor of Science the student must have attended the Institute not less than one year, which must be that immediately preceding his graduation, except as postponement may be specially authorized. He must have completed the prescribed studies of the four years, and must, in addition, pass final examinations, if required, on subjects relating particularly to his Course.

The student must, moreover, prepare a thesis on some subject included in his course of study; or an account of some research made by him; or an original report upon some machine, work of engineering, industrial works, mine, or mineral survey; or an original design accompanied by an explanatory memoir. This thesis or design must be approved by the Faculty. Theses are to be written on one side only on paper of good quality, $8 \times 10\frac{1}{2}$ inches in size, with not less than an inch margin on each side. Theses must be handed to the Secretary of the Faculty not later than the day on which the first annual examination occurs.

All theses and records of work done in preparation of theses are the permanent property of the Institute, and cannot be published, either wholly or in part, except by authorization of the heads of the respective Departments. This rule applies also to the theses prepared by candidates for advanced degrees.

The degree of the Institute represents not only the formal completion of the subjects in the selected Course of study, but also the attainment of a satisfactory standard of general efficiency. Any student who does not show in the fourth-year work of his Course that he has attained such a standard may be required before receiving the degree to take such additional work as shall test his ability to reach that standard. This additional work shall consist in the preparation of a thesis during the last term of residence, unless otherwise provided by a special vote of the Faculty, and in the pursuance of such new studies and the repetition of such of those previously taken as may be required by the Faculty; and in general, an amount of work per term substantially equivalent to that involved in the regular Courses of study will be required during any subsequent period of residence.

No degree can be conferred until all dues to the Institute are discharged.

Students leaving the Institute of their own accord before graduation are entitled to receive a statement of attendance from the Registrar.

For requirements for higher degrees, see pages 143 to 165.

Coöperation with Harvard University. — In accordance with an agreement between Harvard University and the Massachusetts Institute of Technology, male students registering at the Institute in September, 1914, or thereafter, may receive certain benefits from the University. These benefits are confined to those students who register in Courses I, II, III, VI or XI, namely: Civil Engineering, Mechanical Engineering, Mining Engineering and Metallurgy, Electrical Engineering, or Sanitary Engineering. Such students will be entitled to the same rights and privileges as students in the professional schools of the University, and will be eligible for degrees from the University in addition to those that they may receive from the Institute. The opportunity of obtaining the degree of Bachelor of Science from both institutions will be confined to new students registering at the Institute in September, 1914, or thereafter. Similarly, the opportunity of obtaining higher degrees from both institutions will be confined to those who began to pursue courses at the Institute leading to those degrees in September, 1914, or thereafter.

Information regarding the School for Health Officers conducted in coöperation with Harvard University will be found on page 395.

Fees. — The tuition fee for students pursuing regular Courses, other than Courses XIIIA and XIIIB, is $250 per year, and must be paid *in advance* as follows, — $150[1] on or before the last Monday in September, and $100 on or before the first day of the second term. *No bills are sent.* For one-half or any less fraction of the school year, the fee is $150. Payment is required also for chemicals used and for apparatus injured or destroyed in the laboratories, and for the cost of repair of damage by students to any other property of the Institute. Special students pay, in general, the

[1] Students entering the first year who have paid the entrance examination fee of five dollars mentioned on page 65 will be credited with this amount on presentation of the receipt.

full fee; but when a few branches only are pursued, and the time required for instruction is limited, application for reduction may be made to the Bursar. The fee for Course XIIIA for Naval Constructors is for the present year $500, but is subject to change according to arrangement with the United States Navy Department. The fee for Course XIIIB, Naval Architecture, is also $500 per year.

It is desired that students pursuing Courses of study leading to the Bachelor's degree whose financial necessities are such as to prevent their continuance at the Institute communicate with the Chairman of the Faculty Committee on Undergraduate Scholarships. For detailed information in regard to scholarships and fellowships see pages 386 to 394.

Deposit for Breakage. — No bond is required, but a deposit must be made to defray the expense of breakage. This deposit will be required of all students in the first year, but in subsequent years only of students taking work in the chemical, bacteriological or the mining laboratories. The amounts of such deposits will be as follows: for the first year, $15; for higher years, in the chemical laboratories, $50, in the mining laboratory, $10 ($20, in the fourth year); in the bacteriological laboratories, $10. Any balance remaining at the end of each year will be refunded *on application*, or, if the student chooses, will be held to his credit for the succeeding year. No refund of deposits will be made during the school year except in the case of students leaving the Institute. All deposits must be made at the time when the tuition fee for the first term is due and students will not be allowed to enter upon laboratory work until all fees are paid.

Payments. — All payments should be made to Horace S. Ford, Bursar. *Students are strongly advised to make payments by mail, as they will find it greatly to their convenience to do so.* If by check, remittance from points out of New England should be in New York or Boston funds.

Residence and Expenses. — As the exercises of the school begin at nine o'clock in the morning, and end by five o'clock in the afternoon, students may conveniently live in any of the

nearer cities or towns, on the lines of the various railroads, if they prefer to do so.

The cost of board and rooms in Cambridge and the neighboring cities and towns need not exceed six to eight dollars a week. The cost of books, paper, etc., exclusive of chemical breakage, is from twenty-five to thirty-five dollars a year. At the beginning of the first year about twenty dollars will be needed for drawing instruments and supplies.

Student Employment. — To assist students in securing employment, either during the school year or the summer, a Student Employment Office is maintained by the Institute. This Office is conducted by the Dean, to whom application may be made by students desiring to help themselves in meeting their expenses. Prospective students should, however, realize that the demands of the Institute curriculum are such as to make it impracticable to devote a large amount of time to outside employment during the school year, and that therefore they should not rely mainly on such employment to provide the funds needed for their expenses.

Location. — After occupying for fifty years its original location in Boston the Institute moved during the present year to a new site on the Charles River Basin. This site comprises a tract of fifty acres extending along the esplanade on the Cambridge side of the river and affording an extensive panoramic view of the City of Boston. Here are located the Educational Buildings, the Walker Memorial and Student Club House, the Dormitories, the Athletic Field and the Power House. Many street car and subway lines afford easy access from all parts of Boston, Cambridge, the suburbs, and the railroad stations for trains from the north, south and west. The location of the Institute in proximity to the great collections and libraries of Boston and Cambridge, and in the neighborhood of a great manufacturing district, with which the Institute maintains close relations, is of great advantage to technological students.

For the present the Department of Architecture is located in Boston and occupies the Rogers Building on the old site on Boylston Street.

Educational Buildings. — The plans for the development of the Institute on its new site provide for the utilization of the entire fifty acres and are the result of years of the most careful expert study and investigation. As a result the Institute now possesses an entirely new plant that is unrivalled in its facilities and adaptation to the purposes of technological instruction. The most important part of the buildings now completed consists of the Educational Group, comprising twelve distinct but connected units which occupy and enclose an area of about thirteen acres with a floor space of about fifteen acres. As the need arises new building units will be added until ultimately this group will enclose an area of about thirty acres with a floor area of about thirty-five acres. Within this group of buildings is carried on all the educational work of the Institute except that in the Department of Architecture, which for the present will be given in the Rogers Building on the old site on Boylston Street in Boston.

Laboratories and Libraries. — Information regarding the equipment of the laboratories, museums, and libraries, which form conspicuous features in the work of the Institute, will be found on pages 353 to 385.

Dormitories. — It is the intention of the Institute to develop an extensive dormitory system and as a beginning a group of buildings has been erected which will provide accommodations for about two hundred students. In the design of these dormitories the best modern practice has been followed and the utmost attention has been given not only to the safety but also to the comfort and convenience of the students. The dormitories are situated on the Institute property a short distance from the educational buildings. Information in regard to obtaining accommodations in the dormitories may be had by addressing Horace S. Ford, Bursar.

Walker Memorial. — As an important part of its new development, the Institute is now able to make adequate provision for the physical and social needs of its students in the Walker Memorial. Funds for this purpose were contributed not long after the death of the late President Walker, as a memorial to him, and the building now under erection is expected to be completed in the fall of 1917.

It will contain dining-rooms estimated to serve more than fifteen hundred persons, a library, reading-room, offices for student activities, and a gymnasium, together with bowling alleys, squash courts, etc., Provision is made for associate membership open to instructing staff and alumni. The income of a considerable bequest by the late Mr. Frank H. Cilley, of the Class of '89, is also available for purposes connected with the memorial.

Requirements for Admission

APPLICANTS for admission to the Massachusetts Institute of Technology are, in general, required to pass the entrance examinations of the Institute, or the equivalent examinations of the College Entrance Examination Board. Certificates of entrance examinations passed for admission to another college are usually accepted, provided they cover not fewer than three of the subjects required by the Institute. Persons who are considerably past the usual age who are engaged in teaching or technical pursuits, or who for satisfactory reasons desire only special courses requiring no previous training, may be admitted, at the discretion of the Faculty, without entrance examinations.

ADMISSION TO THE FIRST YEAR

The student intending to enter the Institute should bear in mind that the broader his intellectual training in any direction, and the more extensive his general acquirements, the greater will be the advantages he may expect to gain. The importance of thorough preparation in the subjects set for examination also is great; for the character and the amount of instruction given in the Institute from the outset leave little opportunity for one imperfectly fitted to make up deficiencies, and render it impossible for him to derive the full benefit from his course, or perhaps even to maintain his standing. The training given in the best high schools and academies will, in general, afford suitable preparation.

The requirements of age and scholarship specified on pages 69 to 82 are regarded as a minimum in all ordinary cases, and only exceptional circumstances will justify any relaxation. Parents and guardians are advised that it is generally for the ultimate advantage of the student not to enter under the age of eighteen years, unless for a five-year course.

Entrance Examinations of the Institute. — Examinations for admission to the first-year class will be held at the Institute buildings in Cambridge on the first Wednesday, Thursday, and Friday after June 15, 1917. A second series of examinations for admission, and for applicants conditioned at the first examinations, will be held at the Institute on the first Saturday, Monday, and Tuesday after September 11. (See Calendar, page 8.)

Applicants for admission after the September examinations will be received only when some good cause, such as illness, has prevented attendance at those examinations.

Students are advised to attend the June entrance examinations, if practicable, in order that any deficiencies then existing may be made up in September before entrance.

Entrance Examination Fee. — A fee of five dollars will be charged for admission to the entrance examinations of the Institute. This amount will, however, be credited towards the tuition fee for the first term of students who enter the Institute. A candidate dividing his examinations will pay a fee only for his first examinations. A candidate who is rejected will be required to pay a second fee if he repeats the examinations, and his original fee will not be credited to him if he is ultimately admitted. Fees may be paid to the Bursar at the time when the examinations are taken, or may be remitted in advance.

Order of the Examinations of the Institute. — The order of examinations for June, 1917, will be as follows:—

Wednesday, June 20, 1917.

8.45 to 9. A.M. . . . . *Registration of Applicants.*
9.00 A.M. to 11.00 A.M. . . . . Solid Geometry.
11.15 A.M. to 12.45 P.M. . . . . History.
2.00 P.M. to 4.00 P.M. . . . . Physics.

Thursday, June 21, 1917.

9.00 A.M. to 10.45 A.M . . . . English.
11.00 A.M. to 12.45 P.M. . . . . Plane Geometry.
2.00 P.M. to 4.00 P.M. . . . . French (Elementary).

Friday, June 22, 1917.

9.00 A.M. to 10.45 A.M. . . . . Algebra B.
11.00 A.M. to 1.00 P.M. . . . . German (Elementary).
2.15 P.M. to 4.00 P.M. . . . . Algebra A.

The order of examinations for September, 1917, will be as follows: —

Saturday, September 15, 1917.

9.00 A.M. to 11.00 A.M. . . . . Solid Geometry.
11.15 A.M. to 12.45 P.M. . . . . History.
2.00 P.M. to 4.00 P.M. . . . . Physics.

Monday, September 17, 1917.

9.00 A.M. to 10.45 A.M. . . . . English.
11.00 A.M. to 12.45 P.M. . . . . Plane Geometry.
2.00 P.M. to 4.00 P.M. . . . . French (Elementary).

Tuesday, September 18, 1917.

9.00 A.M. to 10.45 A.M. . . . . Algebra B.
11.00 A.M. to 1.00 P.M. . . . . German (Elementary).
2.15 P.M. to 4.00 P.M. . . . . Algebra A.

A schedule of the September examinations for advanced standing will be mailed on application after June 1.

Examinations at Other Points. — *Examinations are held by the Institute in its own buildings only. Candidates desiring examination at other points in June are expected to take the examinations of the College Entrance Examination Board. The conditions of application are stated below.* For further information candidates should address the Secretary of the College Entrance Examination Board, 431 West 117th St., New York, N.Y.

The entrance examinations of the College Entrance Examination Board for 1917 will be held June 18–23. A list of the places at which the examinations are to be held is published by the Board about March 1. Requests that the examinations be held at particular points, to receive proper consideration, should be transmitted to the Secretary of the Board not later than February 1.

REGULATIONS OF THE COLLEGE ENTRANCE EXAMINATION BOARD

All applications for examination must be addressed to the Secretary of the College Entrance Examination Board, 431 West 117th Street, New York, N.Y., and must be made upon a blank form to be obtained from the Secretary of the Board upon application.

If the application is received sufficiently early the examination fee will be $5.00 for candidates examined in the United States and Canada and

$15.00 for candidates examined outside of the United States and Canada. The fee should be remitted by postal order, express order, or draft on New York to the order of the College Entrance Examination Board.

The applications and fees of candidates who wish to be examined outside of the United States and Canada must reach the Secretary of the Board at least five weeks in advance of the first day of the examinations, that is, on or before Monday, May 14, 1917.

The applications and fees of candidates who wish to be examined in the United States at points west of the Mississippi River must be received at least three weeks in advance of the examinations, that is, on or before Monday, May 28, 1917.

The applications and fees of candidates who wish to be examined in the United States at points east of the Mississippi River or on the Mississippi River must be received at least two weeks in advance of the first day of the examinations, that is, on or before Monday, June 4, 1917.

When the candidate has failed to obtain the required blank form of application for examination the usual examination fee will be accepted if the fee arrive not later than the specified date accompanied by a memorandum containing the name and address of the candidate, the examination centre at which he wishes to present himself, and a list of all the subjects in which he may have occasion to take the Board's examinations.

Applications received later than the dates named will be accepted when it is possible to arrange for the admission of the candidates concerned, but only upon payment of $5.00 in addition to the usual fee.

The order of the College Board examinations in subjects required or accepted by the Institute for 1917 is as follows: —

Monday, June 18, 1917.

9.30 A.M. . . . . Mathematics A1 (Algebra to Quadratics).
Mathematics A2 (Quadratics and beyond).
Mathematics A (Elementary Algebra complete).[1]
2.00 P.M. . . . . Mathematics C (Plane Geometry).
Mathematics D (Solid Geometry).

Tuesday, June 19, 1917.

9.00 A.M. . . . . English 1 (Grammar and Composition).
English 2 (Literature).
2.00 P.M. . . . . Mathematics F (Plane Trigonometry).

Wednesday, June 20, 1917.

9.00 A.M. . . . . Latin 1 (Grammar).[2]
Latin 2 (Elementary Prose Composition).[2]
2.00 P.M. . . . . Latin 3 (Second Year Latin).[2]

[1] See footnote 2 on page 68. [2] Elective.

Thursday, June 21, 1917.

9.00 A.M. . . . . History A, C (Ancient History; English History).[1]
History B, D (Mediæval and Modern;[1] American).
2.00 P.M. . . . . French A (Elementary).
French B (Intermediate).[1]

Friday, June 22, 1917.

9.00 A.M. . . . . German A (Elementary).
German B (Intermediate).[1]
2.00 P.M. . . . . Physics; Botany;[1] Zoölogy;[1] Biology.[1]
Chemistry.[1]

Saturday, June 23, 1917.

9 A.M. . . . . Mechanical Drawing.

Each examination two hours. Candidates taking two examinations on any morning or afternoon begin the second examination at 11.10 A.M. or 4.10 P.M.

Table of Equivalents. — The following table shows for which subjects records of the College Entrance Examination Board are accepted as covering requirements for admission to the Institute:—

M. I. T. Subjects	*C. E. E. B. Subjects.*
Algebra A.	Mathematics A1 (Algebra to Quadratics).
Algebra B.	Mathematics A2 (Quadratics and beyond).[2]
English.	English 1 and 2.
French (Elementary).	French A (Elementary).
Geometry, Plane.	Mathematics C (Plane Geometry).
Geometry, Solid.	Mathematics D (Solid Geometry).
German (Elementary).	German A (Elementary).
History.	History A or D.
Physics.	Physics.
Electives.	History A or D; History B; History C; Latin 1, 2 and 3; French B; French BC; German B; German BC; Spanish; Chemistry; Botany; Zoölogy; Biology; Drawing.

Records below 60 will not be accepted.

Certificates covering fewer than three of the Institute requirements are accepted only for final candidates, but a certificate for two subjects may be accepted in connection with a satisfactory elective. Credit certificates will not remain valid for more than one year unless by special permission.

French B and German B will be accepted for advanced standing.

Trigonometry records of 70 or better will be accepted for advanced standing.

[1] Elective.

[2] Candidates are expected to take this divided examination in Algebra. Records below 70 based on a single examination in Mathematics A will be accepted only for Algebra A.

Summer Courses in Entrance Subjects. — The Institute offers summer courses corresponding to entrance requirements in Algebra, Solid Geometry, French and German.

Certificates. — The Institute accepts no certificates of preparatory schools in place of entrance examinations. The value of the opinion of previous teachers is, however, fully recognized, and great weight will be attached to statements from them. It is accordingly requested that each applicant present from the principal of the school last attended a statement of the duration and extent of his work there. For requirements in regard to elective certificates see page 75. For the required statements for preliminary applicants see page 69.

Conditions. — A candidate failing in only one or two of the examination subjects may be admitted with "conditions." A candidate incurring conditions in June must repeat in September examinations in those subjects in which he has failed. Conditions incurred in September, except in History and Physics, must be made up in January for continuance in dependent work. A condition in History incurred in September is removed by passing an examination in June or September following, or by a satisfactory record in History I (American National Development), of the second term of the first year. As no January examination is offered in Physics a September condition will be removed by passing a satisfactory examination the following June or September.

DIVISION OF ENTRANCE EXAMINATIONS

Candidates for admission are allowed at their option to divide their entrance examinations between two successive years, or between June and September of the same year. A candidate taking all his examinations at one time is termed "Complete"; a candidate taking certain examinations with a view to admission a year later, "Preliminary"; a candidate who has already passed preliminary examinations, "Final"; a candidate who is dividing examinations between June and September of the same year, "Partial."

A preliminary candidate may take examinations in June or in September, but is not entitled to repeat in September any examination in which he has failed in June. He must be at least sixteen years of age, and will be allowed the choice of any of the following

six subjects, but he will not be entitled to a record for any unless he passes at least three (or two together with an Elective). He is also required to present from his preparatory school a statement concerning his preparation in the subjects taken, blank forms for which are furnished on application by the Registrar of the Institute.

Algebra A.	**History.**
Plane Geometry.	**French** (Elementary).
Physics.	**German** (Elementary).

Preliminary candidates are advised not to offer English or the second part of Algebra (see page 71). A preliminary candidate will not be allowed to offer English unless he presents from the principal of his school a certificate that he has completed satisfactorily four years of English of high school grade. Algebra B, if passed by a preliminary candidate, will be counted with Algebra A as a single subject. Solid Geometry may be taken by a preliminary applicant, provided he presents, before entrance, evidence that he has continued mathematical study during the intervening year.

A partial candidate may make his own choice of subjects, but no credit will be given for less than three (of which one may be an elective). Algebra A and B count as one subject.

A complete or partial candidate having credit for three or more subjects may on application be credited with them for admission the following year. Credit for examinations passed will not remain valid for more than one year unless by special permission.

SUBJECTS FOR EXAMINATION

To be admitted and classified as a first-year student, the applicant must have attained the age of seventeen years, and must have passed satisfactory examinations in the following subjects: —

Algebra A.	**French** (Elementary).[1]
Algebra B.	**German** (Elementary).[1]
Plane Geometry.	**English.**
Solid Geometry.	**History.**
Physics.	

Applicants for admission must also present satisfactory evidence of preparation in **Latin,** as described on page 76, or in two of the following **Electives** (see page 75): —

[1] An applicant unable to offer one of the subjects French or German, but otherwise well prepared, may be admitted as an unclassified student.

French (Intermediate).	**Chemistry.**
German (Intermediate).	**Mechanical Drawing.**
Spanish.	**Mechanical Drawing and Mechanic Arts.**
English (Additional).	**Biology.**
History (Additional).	

A satisfactory examination record in Intermediate French or Intermediate German, obtained either in the College Entrance Examination Board examination in June or in the Technology examination in September, is accepted at present for the entire elective requirement.

The detailed requirements in the various subjects are as follows: —

Algebra. — **A.** The four fundamental operations for rational algebraic expressions; factoring, determination of highest common factor and lowest common multiple by factoring; fractions, including complex fractions; ratio and proportion; linear equations, both numerical and literal, containing one or more unknown quantities; problems depending on linear equations; radicals, including the extraction of the square root of polynomials and numbers; exponents, including the fractional and negative.

B. Quadratic equations, both numerical and literal; simple cases of equations with one or more unknown quantities, that can be solved by the methods of linear or quadratic equations; problems depending upon quadratic equations; the binomial theorem for positive integral exponents; the formulas for the nth term and the sum of the terms of arithmetic and geometric progressions, with applications. The examination in Algebra B may also include questions of a less elementary character on topics in Algebra A.

It is assumed that pupils will be required throughout the course to solve numerous problems which involve putting questions into equations. Some of these problems should be chosen from mensuration, from physics, and from commercial life. Facility in the analysis and the discussion of an algebraic expression or equation, and the use of graphical methods and illustrations in connection with the solution of equations, is also expected.

Plane Geometry. — The usual theorems and constructions of good text-books, including the general properties of plane rectilinear figures; the circle and the measurement of angles; similar polygons; areas; regular polygons and the measurement of the

circle. The solution of numerous original exercises, including loci problems. Applications to the mensuration of lines and plane surfaces.

Solid Geometry. — The usual theorems and constructions of good text-books, including the relations of planes and lines in space; the properties and measurement of prisms, pyramids, cylinders and cones; the sphere and the spherical triangle. The solution of numerous original exercises, including loci problems. Applications to the mensuration of surfaces and solids.

The above definitions are those reported by the committee of the American Mathematical Society, September, 1903.

Importance will be attached to accuracy in the numerical work of the papers in Algebra and Geometry and to satisfactory drawings in Geometry. Familiarity with the metric system is required.

The attention of teachers and applicants is particularly called to the necessity of thorough preparation in Mathematics, not merely as to the extent and amount of work done, but as to its quality. Candidates should be thoroughly grounded in fundamental principles, operations, and definitions.

It is expected that the time devoted to preparation in mathematics will be equivalent to not less than 320 periods in algebra, and the same number in plane and solid geometry. A considerable portion of the algebra should be given, if practicable, during the final year of preparation.

French (Elementary). — The requirement for Elementary French is a systematic course of four or five periods a week extending over at least two school years, each year representing not less than 120 full sixty-minute periods or the equivalent. Training in pronunciation and in the understanding of easy spoken French is regarded as an essential part of this requirement and a school certificate guaranteeing this part of the training will be required for each candidate.

The examination in French is given in two parts, which, however, may not be taken separately.

(*a*) Ability to read simple prose at sight and to translate it into clear and idiomatic English.

(*b*) Proficiency in elementary grammar, to be tested by the translation of easy English into French and by questions on the following topics: inflection of nouns and adjectives for gender and

number; pronominal adjectives; the forms and positions of pronouns, especially the personals; the partitive construction; the forms and use of numerals; the use of the subjunctive, except unusual cases; the conjugation of the regular and of the more common irregular verbs. Special attention will be given to the verbs.

An opportunity will be offered to suitably prepared applicants to pass Intermediate French in September. See page 76.

German (Elementary). — The requirement for Elementary German is a systematic course of four or five periods a week extending over at least two school years, each year representing not less than 120 full sixty-minute periods or the equivalent. Training in pronunciation and in the understanding of easy spoken German is regarded as an essential part of this requirement and a school certificate guaranteeing this part of the training will be required for each candidate.

The examination in Elementary German is given in two parts, which, however, may not be taken separately.

(*a*) Ability to read simple prose at sight and to translate it into clear and idiomatic English.

(*b*) Proficiency in elementary Grammar, to be tested by the translation of easy English into German, and by questions on the following topics: the conjugation and synopsis of the regular and of the more usual irregular verbs; declension of readily classified nouns, of adjectives, articles, pronouns; comparison of adjectives and adverbs; use of the more common prepositions; the simpler uses of the modal auxiliaries; simple cases of indirect discourse, and the rules for the order of words.

An opportunity will be offered to suitably prepared applicants to pass Intermediate German in September. See page 76.

English. — The examination in English is intended as a test of the candidate's ability to express himself clearly and simply, and of his capacity for using his past experience and reading in elementary processes of thought.

In preparation for the examination the candidate should have done a considerable amount of reading, chosen from authors of recognized worth. The books adopted by the National Conference on Uniform Entrance Requirements are taught in most secondary schools, and the candidate may, if necessary, use these in his

preparation. In any case it is expected that the aim of preparatory study will be, first, to develop in the pupil a consciousness that words, if understood, convey definite ideas; and, secondly, to form in him the habit of comparing these ideas with his own experience and his own views.

The candidate will be required to write upon subjects familiar to him, or to comment on a literary treatment of some such subject. When questions of a literary sort are asked, they are intended rather as a test of the candidate's power to read intelligently than of his knowledge of specific books.

The composition should be correct in spelling, punctuation, grammar, idiom, and the formation of paragraphs, and should be plain and natural in style. The candidate will be judged by how well he writes rather than by how much he writes.

NOTE. — It is expected that the paper in History and the translations from French and German will be written in correct and expressive English; and these papers may at any time be examined as additional evidence in determining the student's proficiency in composition.

History. — Preparation in either United States History or Ancient History may be offered. In the former subject a thorough acquaintance with the history of the Thirteen Colonies and of the United States to the present time is required, together with an elementary knowledge of the government of the United States. In the latter subject the requirement covers the history of Greece and Rome to the fall of the Roman Empire in the West.

Each of the above subjects is intended to represent one year of historical work, wherein the study is given five times per week, or two years of historical work, wherein the study is given three times per week.

The examination in History will be so framed as to require comparison and the exercise of judgment on the pupil's part, rather than of mere memorizing. The examinations will presuppose the use of good text-books, collateral reading, and practice in written work. Geographical knowledge may also be tested.

Candidates expecting to take the Course in Architecture are advised, should it be equally convenient, to prepare in Ancient History.

Physics. — The candidate will be expected to be familiar with the fundamental principles of physics. It is especially desirable that he should have a good knowledge of general mechanics and of

the mechanics of solids, liquids, and gases. A knowledge of physical hypotheses is comparatively unimportant. Text-book instruction should be supplemented by lecture-room experiments. A sufficiently extended treatment of the subject will be found in any of the principal text-books now in use in secondary schools.[1] Ability to solve simple problems will be expected. It is furthermore expected that the student will receive training in laboratory work. For the present, however, no student will be rejected because of deficiency in laboratory work, if the school from which he comes is unable to furnish such instruction, a certificate to which effect from the principal of the school will be required.

The laboratory work presented for entrance should consist of at least twenty-five well selected experiments, chosen with the view of illustrating and teaching fundamental laws and principles rather than methods of physical measurement. A satisfactory selection may be made from Experiments 1 to 55 of the College Entrance Examination Board.

The notebook should in every case contain the *original data as recorded by the student in the laboratory*, and each experiment should bear the instructor's indorsement. Great weight is attached at the Institute to the ability of the student properly to record experimental data at the time they are taken, as well as subsequently to discuss and draw logical conclusions from them; and this training should begin in the preparatory school at the very outset of the work in quantitative measurement.

Laboratory notebooks should be presented at the Registrar's office during the week preceding the examination if practicable, and must be certified by the teacher.

ELECTIVE SUBJECTS

The object of the elective requirements is to secure and to recognize greater breadth of preparatory training. The time allotment for each elective is expected to be equivalent to four or five periods per week for one year.

These requirements are to be met by the presentation of certificates made out on forms supplied by the Institute, and applicants for elective blanks are requested to specify for which subjects they are desired; but an applicant passing an examination for advanced

[1] A printed syllabus of the subject will be sent on application.

standing in Intermediate French, in Intermediate German, or in both United States History and Ancient History, need not present a certificate in the corresponding subject. Certificates are also not required of candidates passing certain College Entrance Board Examinations. (See page 68.)

Excuse from the elective requirements, or the acceptance of an equivalent may be allowed in the case of applicants considerably above the usual age, or those coming from foreign countries. Applications for the substitution of work other than that given in the list of electives will also be entertained. Examinations are in general required in the case of applicants desiring excuse from work in the Institute on the ground of electives offered at entrance. The subjects in which excuse may be granted on examination are French (L62) (Intermediate), German (L21) (Intermediate), Drawing,[1] and Mechanic Arts. Applicants offering chemistry may take a course more advanced than otherwise during their first year, and all applicants who expect to enter the Course in Chemistry or that in Chemical Engineering are advised to present chemistry as an elective subject if practicable.

Elective French (Intermediate).[2] — Translation from English into French; review of Grammar; reading of ordinary French prose. This is equivalent to the course in French L62. (See page 341.)

Elective German (Intermediate).[2] — Translation from English into German; review of Grammar; reading of ordinary German prose. This is equivalent to the course in German L21. (See page 339.)

Elective Spanish (Elementary). — Elementary Grammar, including the common irregular verbs; reading, translation from Spanish into English and from English into Spanish. This is equivalent to the course in Spanish L81. (See page 342.)

Applicants passing advanced standing examinations in Intermediate French or Intermediate German given in September may at present count these examinations for the entire elective requirement.

Elective Latin. — Satisfactory evidence should be presented that the applicant has acquired the elements of Latin Grammar, that

[1] See foot-note, page 318.

[2] In addition to the uniform requirements stated on pages 72 and 73. A certificate in these subjects does not excuse the holder from the Intermediate work in the Institute. See pages 68, 70 and 71.

he has had an elementary course in Latin Composition and has read four books of Caesar or the equivalent. A smaller amount of Latin would be of no practical advantage, therefore this is the minimum amount that can be accepted; if satisfactory, this amount will for the present be counted as equivalent to the entire elective requirement.

The study of Latin is recommended to persons who purpose to enter the Institute and who can give the subject adequate attention while preparing for the regular requirements for admission.

Elective English or History.[1] — The work of secondary schools varies so much in these branches that no definite requirement is formulated at present. Any applicant who has carried work in English or history materially beyond the requirements stated on pages 73 and 74 may present for approval as his elective a statement of the amount and kind of work done.

Elective Chemistry. — Applicants must present evidence of familiarity with the rudiments of chemistry. More importance is attached to aptitude in manipulation and in critical observation, and to a practical knowledge of the composition, methods of preparation, and reactions of the common chemical substances, than to a knowledge of theoretical conceptions, such as the determination of atomic and molecular weights, molecular structure, valence, etc.

The subject should be attempted only in schools having adequate equipment; and the laboratory work should be carried out with great care and attention to manipulation and note-writing, special emphasis being laid upon exhaustive observation and correct inference.

The applicant should also present for examination his original, uncopied notes, with any annotations which may have been made by the instructor.

For applicants who have completed the requirements of the chemistry elective a course of instruction is provided which is sufficiently advanced to take advantage of the knowledge of chemical science which they already possess, and such applicants are, in general, expected to take this course, while those who satisfy the Chemical Department, by examination or otherwise, as to their proficiency in inorganic chemistry may substitute more advanced work for the entire chemistry of the first year.

[1] In addition to the uniform requirements stated on pages 73 and 74.

Elective Mechanical Drawing. — The applicant should have had at least 160 hours of drawing, and have attained good results in penciling and inking. He should be familiar with the projection of solids, and the finding of sections and developments. Experience in reading projection drawings is regarded as important, and it is also desirable that the applicant shall have had some instruction in sketching from machine details, and in freehand lettering and dimensioning. Plates should be presented, showing the ground covered. Applicants are advised in general not to offer mechanical drawing or descriptive geometry with a view to omitting these courses at the Institute. (See foot-note, page 319.)

Elective Mechanical Drawing and Mechanic Arts. — These subjects may be offered in combination. The drawing should represent at least 60 hours work, along the above lines, or of such kind as is ordinarily given in connection with Mechanic Arts courses.

In Mechanic Arts, the applicants should be thoroughly familiar with the different tools and materials, and know when and how to use them. He should be able to adjust and to sharpen all edge-tools, and capable of executing work from working drawings. The main object of preparatory exercises should be systematic instruction in the correct use of various tools and in the fundamental operations, rather than construction.

Carpentry: The exercises should include systematic instruction in sawing; planing; chiselling, including chamfering, grooving, and plain moulding work; framing, including tenoning, mortising and fitting in braces; use of the ordinary moulding-planes and the making of simple mouldings; the making and use of the mitre-box in fitting mouldings; nailing; dovetailing; gluing; and the proper use of sand-paper.

At least seventy-five hours should be allowed, exclusive of any time that may be used in making working drawings.

Wood-turning: The applicant should have had systematic instruction and experience in the use of the wood-lathe; should understand the adjustment of speeds for the work in hand, and how to use properly the turning tools, such as gouges, turning chisels, nosing tools, right and left side tools, parting tool, calipers, and dividers. The exercises should also include systematic instruction in center and chuck turning, particular attention being paid to the production of smooth work by the cutting action of the tools, and not by the excessive use of sand-paper.

At least forty-five hours should be allowed, exclusive of any time that may be used in making drawings.

Elective Biology. — Applicants may offer either (*a*) an extended course in botany, such as that recommended by the College Entrance Examination Board, or courses of similar extent in zoölogy or in physiology; or (*b*) briefer courses in any two of the same subjects. In the latter case evidence should be given of thorough elementary knowledge of general principles and of some laboratory and field work.

ADMISSION TO ADVANCED STANDING

In the case of students passing examinations for advanced standing, in addition to obtaining *a clear record* in entrance requirements, the Faculty endeavors to facilitate the substitution of alternative work. A candidate passing with advanced standing in modern languages may arrange to complete any further language requirement of his Course during his first year. A candidate passing trigonometry or other subjects for advanced standing may, with the approval of the Faculty, substitute mechanic arts, or take additional work in English composition. A candidate who has passed off first-year Descriptive Geometry and Mechanical Drawing [1] may take second-year Descriptive Geometry. Graduates of Manual Training Schools may be excused in particular cases from the mechanic arts required in some of the engineering courses. It is in general preferred that English and mathematics be not anticipated.

To be admitted as a student in a regular Course of the second, third, or fourth year, the applicant must have attained the age of eighteen, nineteen, or twenty years, respectively, and may be required to pass satisfactorily the examination for admission to the first-year class, and examinations on all subjects given in the earlier years of the Course which he desires to enter. Applicants presenting satisfactory certificates for work done at other colleges substantially equivalent to at least that required in the first year at the Institute may be excused provisionally from taking the corresponding examinations at the Institute. The examinations for advanced standing are held at the time stated on page 8.

Graduates of colleges and scientific schools granting degrees are

[1] See foot-note, page 319.

admitted to the Institute without the usual entrance examinations, and will be permitted to enter any of the Courses at such a point as their previous range of studies will allow. If prepared to enter upon most of the studies of a certain year, they may often be afforded opportunity to make up any studies of the earlier years in which they are deficient. They will, in general, be credited with all subjects in earlier or later years in which they can show, by examination or otherwise, a standing satisfactory to the Faculty, and may be received provisionally in regular courses, subject to making up deficiencies in work of previous years within a limited time. The attention of such applicants is particularly called to the schedules of Courses on pages 85 to 131, and to the description of Subjects of Instruction, pages 171 to 352. It is highly desirable that students contemplating professional Courses after graduation from college should arrange their college electives to cover the earlier subjects of the Courses chosen, in order that the number of deficiencies to be made up may be as small as possible. *In order to enter any of the Engineering or allied Courses in the second year, it is essential that applicants have preparation in analytic geometry and the elements of the calculus, and highly desirable that they be familiar with mechanical drawing and descriptive geometry. A single year of college work will rarely suffice for admission to the second year.* For admission to third-year engineering work, they must be prepared in mathematics through the calculus, in mechanical drawing, in descriptive geometry, in physics and in that part of applied mechanics given in the second year. Summer courses of appropriate scope are offered in most of these subjects, and applicants intending to enter with advanced standing are advised to correspond with the Secretary of the Faculty in regard to their credits as early as May 1, if in doubt as to what studies, if any, should be pursued during the summer preceding entrance. (See page 135.) *Applicants desiring excuse from any portion of the physical laboratory work must present their original laboratory records. Those desiring excuse from mechanical or freehand drawing should submit examples of their work besides presenting official records.*

Graduates of technical schools not of collegiate grade will be expected to take entrance and advanced standing examinations, or in case of drawing and laboratory courses to present drawings, original note-books, etc. In certain subjects the passing of an advanced standing examination may carry credit for elementary work.

A special circular in regard to the Admission of Applicants from other Colleges and Opportunities for College Graduates will be mailed on application, and all persons desiring admission with advanced standing should correspond with the Secretary of the Faculty.

ADMISSION OF SPECIAL STUDENTS

Persons considerably past the usual age of entering students may be admitted to one or more selected subjects in one of the regular Courses except that in Architecture, *i.e.*, to a partial or special course, on giving satisfactory evidence by examination or otherwise that they are qualified to pursue with advantage the subjects chosen.

Applicants desiring admission as special students in Architecture must be college graduates, or twenty-one years of age with not less than two years of experience in an architect's office, or some equivalent and satisfactory preparation. They must give evidence of this preparation through personal conference, letters from former employers, and by the presentation of drawings covering their experience. They must pass the entrance examinations in English and Ancient History, or give other satisfactory evidence of their preparation in these subjects. (See pages 73 and 74 for the ground covered by entrance requirements.) They must take in their first year of residence courses in Descriptive Geometry and Mechanical Drawing unless these subjects have been passed at the September examinations for advanced standing, or excuse from one or both has been obtained on the basis of equivalent work accomplished elsewhere.[1] Entrance to these courses must be approved by the Department of Drawing, and satisfactory records must be obtained in order to continue architectural subjects. All special students must also register for second-year Freehand Drawing. The first week of this course will be considered a test period to determine the standing of the student. In general special students in Option 1 will be expected to take, in addition to the subjects already mentioned, courses in Design, Shades and Shadows, Perspective, Applied Perspective, Architectural History, History of European Civilization and Art, and Philosophy of Architecture, the arrangement of subjects for each student to be approved by the Department. To become eligible for the Travel-

[1] See foot-note, page 320.

ing Fellowship in Architecture a special student must obtain satisfactory records for full undergraduate requirements in all the subjects mentioned above, and a satisfactory record in graduate Design. Special students who desire to take work in Option 2, Architectural Engineering, must pass or offer equivalents for the entrance examinations in mathematics and physics, and courses in mathematics, physics, and applied mechanics required in this Option.

By means of the description of Subjects of Instruction, pages 171 to 352, the applicant may ascertain what the various subjects of study are, how, when, and by whom they are given, in what regular Courses they are included, and the preparation required for each; but admission to and continuance in special courses is dependent in all cases upon the approval of the Faculty. In general, no student will be allowed to take any subject until he has shown that he has a satisfactory knowledge of all subjects required as preparation for it.

To teachers and to persons of mature age engaged in technical pursuits, and wishing to devote some time to scientific study, the Institute desires to offer the amplest opportunities in its lecture-rooms and laboratories. Such persons may in general be admitted without formal examination, on satisfying the Faculty that they are qualified to undertake the work proposed. They will be expected after admission to attend the same exercises and examinations as other students.

Undergraduate Courses of Study

GENERAL INFORMATION

On the following pages are given the schedules of the various Undergraduate Courses of Study. Their general character and purposes are described on pages 47 to 52.

The sum of the time assigned to exercises and of that estimated as being normally necessary for the outside preparation for them in all Courses is ordinarily seven hundred and twenty hours for each term of fifteen weeks. In the following Course Schedules, the numbers in the columns at the right represent for each particular subject the total number of hours of exercise and of preparation for a term of fifteen weeks. These hours of exercise and of preparation are also given for each subject in the Alphabetical Subject Index, pages 173 to 182.

Numbers, or letters and numbers, in parentheses refer to the description of Subjects of Instruction (subjects designated by numbers only, pages 184 to 316; subjects designated by letters and numbers, pages 317 to 352), where details are given as to the methods of instruction and scope of each course, as well as to the preparation required.

During the summers between the first and second, and the second and third years all students in regular Courses are required to complete assigned courses of reading of a literary, historical, and general scientific character. (See page 133.)

In the summer following the first year, students pursuing the Course in Mining Engineering, Option 2, Chemistry, Chemical Engineering, Electrochemistry, or Engineering Administration, Option 3, are required to take Qualitative Analysis 511. In the summer following the second year, students in the Course in Civil Engineering, Mining Engineering, Options 1, 3, Sanitary Engineering, Geology, or Engineering Administration, Option 1, are required to attend the Surveying Camp at Gardner's Lake, near

East Machias, Maine. (See page 139.) Students in Engineering Administration, Option 2, are required to take courses in Surveying 100 and Mechanic Arts 107. (See page 129.)

A special course in English Composition may be required at any time after the first year of any student who shows inability to write clear and correct English. (See subject E15.)

All students bred to speak any language other than English are required, unless they pass the Entrance Examination or unless special arrangement is made to the contrary, to take special courses in English in their first and second years. (See subjects E10 and E20, pages 325, 326.)

In the third year, in addition to the other prescribed subjects, all students in regular Courses, except in Engineering Administration, are required to devote forty-five hours (exercise and preparation) in the first term and seventy-five hours in the second term to elective work in General Studies. (See page 132.)

FIRST YEAR

For description of Subjects of Instruction see pages 184 to 316 for numbered subjects, and pages 317 to 352 for subjects designated by letters and numbers.

First Term

	Hours Ex. Prep.
Mathematics (M11)	30 – 60
Plane Trigonometry (M10)	30 – 60
Inorganic Chemistry (501); Laboratory, Lectures and Recitations; Chemical Laboratory	120 – 60
Mechanical Drawing (D11) and Descriptive Geometry (D15)	90 – 0
Freehand Drawing (D31)	30 – 0
German [1] (L21)	45 – 60
Rhetoric and English Composition (E11)	30 – 30
Military Science (20)	45 – 0
Physical Training (25)	25 – 0

Second Term

Courses I, V, VIII, XI, XV1	Hours Ex. Prep.
Mathematics (M12)	60 –120
Inorganic Chemistry (502); Laboratory, Lectures and Recitations	120 – 60
Mechanical Drawing (D12) and Descriptive Geometry (D16)	90 – 0
Freehand Drawing (D32)	15 – 0
German (L21)	45 – 60
English (E12)	30 – 30
History I (H12)	30 – 30
Military Science (20)	45 – 0
Physical Training (25)	15 – 0

Course IV	
Perspective (412)	20 – 40
Mathematics (M12)	60 –120
Mechanical Drawing (D14) and Descriptive Geometry (D18)	135 – 15
Freehand Drawing (D41)	60 – 0
French (L62)	45 – 60
English (E12)	30 – 30
History I (H12)	30 – 30
Military Science (20)	45 – 0
Physical Training (25)	15 – 0

Course VII	Hours Ex. Prep.
Microscopical Laboratory (700)	30 – 30
Mathematics (M12)	60 –120
Inorganic Chemistry (502); Laboratory, Lectures and Recitations	120 – 60
Freehand Drawing (D32)	15 – 0
German (L21)	45 – 60
English (E12)	30 – 30
History I (H12)	30 – 30
Military Science (20)	45 – 0
Physical Training (25)	15 – 0

Course IX	
See page 110	

Courses II, III, VI, X, XII, XIII, XIIIb, XIV, XV2,3	
Mathematics (M12)	60 –120
Inorganic Chemistry (502); Laboratory, Lectures and Recitations	120 – 60
Mechanical Drawing (D12a) and Descriptive Geometry (D16a)	90 – 0
Freehand Drawing (D32)	15 – 0
German (L21)	45 – 60
English (E12)	30 – 30
History I (H12)	30 – 30
Military Science (20)	45 – 0
Physical Training (25)	15 – 0

Summer Reading, see page 133.

Required Summer Work: Qualitative Analysis (511) for Students in Courses III, Option 2, V, X, XIV, XV, Option 3.

[1] Students expecting to take Course IV take French (L62). For more advanced elective courses in French and German see Subjects of Instruction, pages 339 to 342.

I. — CIVIL ENGINEERING

The Course in Civil Engineering is designed to give the student sound training, both theoretical and practical, in the sciences upon which professional practice is based. Particular care is taken to enforce the application of the principles taught, and the student is made familiar with the use of engineering instruments and with the usual problems of practice.

Civil engineering is the broadest in scope of the engineering professions, being the parent stem from which have diverged all the other branches; but, even though these have become recognized as distinct professions, the field of civil engineering still remains so large that no one can become expert in its whole extent. It covers topographical engineering; the building of railroads, harbors, docks, and other works serving the purposes of commerce and transportation; municipal engineering, including the construction of sewers, waterworks, roads, and streets; structural engineering, including the construction of bridges, buildings, walls, foundations, and all fixed structures; hydraulics, the development of water power and other branches. All of these branches of engineering rest, however, upon a relatively compact body of principles, and in these principles the students are trained by practice in the class-room, the drawing-room, the field, and the testing laboratory.

In the third year the student is offered a choice of two options; one a general option which may lead in the fourth year either to the option in Hydraulic and Sanitary Engineering or to that in Railroad Engineering, and the other, an option in Highway Engineering which continues throughout the fourth year. Students desiring to pursue in greater detail the study of geodesy and topography are offered opportunity to do so by taking Course XII and advanced courses.

For information in regard to a Graduate Course in Civil Engineering see pages 143 to 148, and for a description of subjects of instruction, laboratories, equipment and other details of the Department see pages 187 to 203, 354 to 359, and 379.

I. — CIVIL ENGINEERING

First Year, page 85. Description of Subjects of Instruction, pages 184 to 352.

Second Year

FIRST TERM	Hours Ex. Prep.
Surveying and Plotting (100)	30 – 15
Descriptive Geometry (D23)	60 – 45
Mathematics (M21)	45 – 90
Spherical Trigonometry (M20)	10 – 20
Physics (801)	90 – 75
Physical Laboratory (807)	15 – 15
Mechanism (201)	30 – 60
History II (H31)	30 – 30
English (E21)	30 – 30

SECOND TERM	Hours Ex. Prep.
Surveying and Plotting (100)	30 – 0
Topographical Drawing (195)	30 – 0
Astronomy (112)	30 – 30
Applied Mechanics (215)	45 – 90
Stereotomy (D28)	45 – 10
Mathematics (M22)	45 – 90
Physics (801)	75 – 60
Physical Laboratory (807)	30 – 30
Precision of Measurements (803)	10 – 10
English (E22)	30 – 30

Summer Reading, see page 133
Summer Course in Surveying, see page 130.

Third Year

FIRST TERM	Hours Ex. Prep.
Surveying, Advanced (109)	30 – 0
Applied Mechanics (217)	60 – 90
Geology, Dynamical (1231)	45 – 30
Lithology (1211)	15 – 0
History II (H31)	30 – 30
English (E31)[1]	30 – 30
Political Economy (Ec31)	45 – 45
General Studies (see page 132)	45
Options	
Railroad Engineering (121)	30 – 60
Railroad Drafting (123)	60 – 0
1. Elements of Electrical Engineering (619)	30 – 30
2. Electrical Engineering Laboratory (681)	15 – 30
Chemistry of Road Materials (538)	120 – 30
3. Railroad Drafting (123)	45 – 0
Railroad Engineering (121)	20 – 40

SECOND TERM	Hours Ex. Prep.
Materials (143)	30 – 45
Testing Materials Laboratory (236)	30 –
Structures (140)	45 – 90
Geology, Stratigraphic (1238)	15 – 15
Geology, Structural and Field (1234)	30 – 15
Business Law (Ec60)	15 – 15
General Studies (see page 132)	75
Options	
Highway Engineering (130)	15 – 30
Railroad Engineering (121)	30 – 30
1. Railroad Drafting (123)	60 – 0
2. Geodesy (113)	30 – 30
Electrical Engineering Laboratory (682)	30 – 45
Railroad Drafting (123)	75 – 0
Highway Construction (132)	45 – 90
3. Testing Highway Materials (139)	30 – 15
Railroad Engineering (121)	20 – 20

Fourth Year

FIRST TERM	Hours Ex. Prep.
Structures (149)	45 – 90
Bridge Design (153)	90 – 0
Foundations (148)	15 – 30
Theoretical Hydraulics (162)	45 – 90
Heat Engineering (247)	45 – 90
Engineering Laboratory (263)	15 – 15
Options	
1. Hydraulic and Sanitary Engineering (175)	45 – 75
Thesis	30
2. Railroad Design (126)	45 – 0
Railroad Engineering (125)	30 – 45
Thesis	30
3. Highway Specifications (137)	45 – 60
Highway Drainage (133)	15 – 30

SECOND TERM	Hours Ex. Prep.
Structures (149), (150)	75 –150
Bridge Design (153)	90 – 0
Hydraulic Laboratory (172)	15 – 10
Heat Engineering (247)	45 – 85
Options	
Hydraulic and Sanitary Engineering (176)	45 – 75
1. Hydraulic and Sanitary Design (179)	30 – 0
Sanitary Science and Public Health (756)	15 – 0
Thesis	85
Railroad Engineering (125)	45 – 90
2. Railroad Design (126)	30 – 0
Thesis	85
Highway Design (135)	60 – 0
Highway Economics (136)	30 – 30
3. Sanitary Science and Public Health (756)	15 – 0
Thesis	115

[1] After 1916–1917

II. — MECHANICAL ENGINEERING

The Course in Mechanical Engineering aims first, to give the student a thorough training in such fundamentals as physics, mathematics, and applied mechanics; then to familiarize him by means of lectures, laboratory work and drawing-room work, with the various problems that a mechanical engineer has to deal with. He is also given a training in the mechanic arts sufficient to make him familiar with the use of shop tools, foundry practice, forging and pattern work, such knowledge being essential to the successful designer of machinery.

The work in Mechanism includes the study of linkages, cams, gear teeth, valve gears of steam engines and in the advanced courses, given in the third year, the application of mechanisms to machine tools and to automatic machinery. The course in Heat Engineering covers thermodynamics, steam engines, boilers, gas engines, gas producers and power station accessories. Courses are given in Applied Dynamics, Foundations, Factory Construction, Heating and Ventilation, Refrigeration, Industrial Management, and on Physical Metallurgy. The student is given sufficient work in electrical engineering subjects to enable him to handle the ordinary problems which may confront him. A thorough course in Theoretical Hydraulics is followed by Hydraulic Engineering, a course in which both the estimation of, and the utilization of, hydraulic power is discussed. Instruction in drawing extends to the end of the third year, the work finishing with the complete design and calculation of a boiler. The course in Machine Design, extending through both terms of the senior year and the course in Power Plant Design, afford the student an opportunity of applying many of the facts learned in preceding years. In the fourth year the student is offered the option of courses in Engine Design, Locomotive Construction, Mill Engineering and Steam Turbine Engineering.

The laboratory work in steam, hydraulics and strength of materials is planned to follow the class-room work and thereby assist the student in getting a better grasp of these subjects.

The subjects of instruction of the Department are described in detail on pages 204 to 226, and the laboratories on pages 354 to 359.

II. — MECHANICAL ENGINEERING

First Year, page 85. Description of Subjects of Instruction, pages 184 to 352.

Second Year

FIRST TERM	Hours Ex. Prep.
Mechanism (200)	45 – 90
Mechanical Engineering Drawing (206)	60 – 0
Descriptive Geometry (D21)	45 – 0
Forging (284)	30 – 0
Mathematics (M21)	45 – 90
Physics (801)	90 – 75
Physical Laboratory (807)	30 – 30
German (L35)	15 – 15
English (E21)	30 – 30

SECOND TERM	Hours Ex. Prep.
Mechanism and Valve Gears (200)	20 – 40
Mechanical Engineering Drawing (206)	45 – 0
Applied Mechanics (215)	45 – 90
Foundry (287)	45 – 0
Forging (284)	30 – 0
Mathematics (M22)	45 – 90
Physics (801)	75 – 60
Physical Laboratory (807)	30 – 25
Precision of Measurements (803)	10 – 10
English (E22)	30 – 30

Summer Reading, see page 133.

Third Year

FIRST TERM	Hours Ex. Prep.
Heat Engineering (245)	60 – 90
Applied Mechanics (216)	45 – 90
Machine Drawing (208)	30 – 0
Wood Work and Pattern Making (289)	60 – 0
Mathematics (M31)	45 – 75
Surveying (102)	30 – 0
History II (H31)	30 – 30
Political Economy (Ec31)	45 – 45
General Studies (see page 132)	45

SECOND TERM	Hours Ex. Prep.
Heat Engineering (245)	45 – 90
Applied Mechanics (225)	45 – 90
Mechanism of Machines (204)	30 – 35
Mechanical Engineering Drawing (209)	90 – 0
Boiler Design (266)	45 – 0
Engineering Laboratory (260)	20 – 5
Electrical Engineering (616)	30 – 30
Physical Metallurgy (508)	15 – 15
Vise and Bench Work (290)	30 – 0
Business Law (Ec60)	15 – 15
General Studies (see page 132)	75

Fourth Year

FIRST TERM	Hours Ex. Prep.
Machine Design (267)	60 – 0
Applied Mechanics (220)	45 – 90
Testing Materials Laboratory (235)	25 – 5
Dynamics of Machines (243)	25 – 50
Engineering Laboratory (261), (532)	50 – 25
Theoretical Hydraulics (164)	30 – 60
Electrical Engineering (617)	30 – 30
Electrical Engineering Laboratory (687)	30 – 30
Factory Construction (270)	45 – 0
Foundations (148)	15 – 30
Machine Tool Work (291)	45 – 0

SECOND TERM	Hours Ex. Prep.
Machine Design (267)	60 – 0
Power Plant Design (272)	60 – 0
General Engineering Lectures (275) or Aëronautics (1371)	15 – 15
Engineering Laboratory (261), (814)	60 – 30
Hydraulic Engineering (168)	45 – 60
Refrigeration (253)	15 – 30
Heating and Ventilation (255)	15 – 30
Industrial Management (274)	15 – 15
Machine Tool Work (291)	60 – 0
Thesis	120
Options	
1. Engine Design (277)	50 – 25
2. Locomotive Engineering (278)	30 – 45
3. Mill Engineering (279)	75 – 0
5.[1] Steam Turbine Engineering (280)	90 – 45

[1] Turbine Option omits Machine Design.

III. — MINING ENGINEERING AND METALLURGY

The demands made upon the mining and metallurgical engineer call for training in a great variety of lines. The policy of the school, accordingly, is to give him the underlying principles of mathematics, physics, chemistry, mineralogy, geology, mining engineering, and metallurgy, as well as some practical knowledge of mechanical, civil, and electrical engineering. Thus equipped, he can take up specialized work after graduation with the expectation of carrying it on successfully. The broad foundations laid in scientific and engineering subjects also give a student the general training he needs if he intends to follow technical enterprises other than mining and metallurgy.

Beginning with the second year, three optional lines of study are open to the student.

Option 1, general in character, covers the field of Mining and Metallurgy without laying stress on either subject. It aims to meet the needs of students who desire to obtain at college a broad scientific and technical training, and to defer the choice between Mining and Metallurgy to a later period.

Option 2 is arranged to fulfil the requirements of the Metallurgical Engineer. The study of metals and alloys, of metallurgical processes, and of the principles of mechanical and electrical engineering is made prominent in the course.

Option 3 is intended to train the student who desires to specialize in Mining. In the courses stress is laid upon the study of mineralogy, petrography, economic geology, mining, and ore-dressing.

Valuable opportunities are offered for observation and field work in the ample laboratories of the Institute (see page 354), and in the Summer School of Surveying (see page 139), of Mining and of Metallurgy (see page 140).

Graduate Courses of one year, which may lead to the degree of Master of Science, have been arranged for students able to devote an additional year to professional study. A description of these Courses and detailed information regarding elective subjects in advanced work may be found on pages 143 to 147, and 150.

For a description of the subjects of instruction of the Department see pages 227 to 238.

III. — MINING ENGINEERING AND METALLURGY

FOR THE CLASS OF 1917

DESCRIPTION OF SUBJECTS OF INSTRUCTION, PAGES 184 TO 352.

Third Year[1]

Option 1, Mining and Metallurgy

FIRST TERM	Hours Ex. Prep.
Mining Engineering (302)	45 – 45
Quantitative Analysis (513)	120 – 15
Mineralogy (1201)	105 – 15
Stratigraphic Geology (1237)	30 – 15
Applied Mechanics (215)	45 – 90
Physical Laboratory (808)	15 – 10
Political Economy (Ec31)	45 – 45
General Studies (see page 132)	45

SECOND TERM	Hours Ex. Prep.
Mining Engineering (302)	45 – 45
Fire Assaying (321)	75 – 15
Quantitative Analysis (514)	150 – 15
Mineralogy and Petrology (1208)	60 – 15
Elementary Economic Geology (1252)	15 – 15
Field Geology (1264)	15 – 15
Applied Mechanics (218)	45 – 90
Business Law (Ec60)	15 – 15
General Studies (see page 132)	75

Option 2, Metallurgy

FIRST TERM	Hours Ex. Prep.
Quantitative Analysis (513)	120 – 15
Mineralogy (1201)	90 – 15
Heat Engineering, Thermodynamics (245)	30 – 60
Machine Drawing (208)	60 – 0
Applied Mechanics (215)	45 – 90
Physics: Heat (802)	15 – 20
Physical Laboratory (808)	15 – 10
Political Economy (Ec31)	45 – 45
General Studies (see page 132)	45

SECOND TERM	Hours Ex. Prep.
Quantitative Analysis (514)	105 – 15
Fire Assaying (321)	75 – 15
Heat Engineering: Boilers (245)	60 –120
Engineering Laboratory (260)	15 – 15
Applied Mechanics (218)	45 – 90
Business Law (Ec60)	15 – 15
General Studies (see page 132)	75

Option 3, Mining Geology

FIRST TERM	Hours Ex. Prep.
Mining Engineering (302)	45 – 45
Quantitative Analysis (513)	120 – 15
Stratigraphic Geology (1237)	30 – 15
Mineralogy (1201)	105 – 15
Applied Mechanics (215)	45 – 90
Physics: Heat (802)	15 – 20
Physical Laboratory (808)	15 – 10
Political Economy (Ec31)	45 – 45
General Studies (see page 132)	45

SECOND TERM	Hours Ex. Prep.
Mining Engineering (302)	45 – 45
Quantitative Analysis (514)	150 – 15
Fire Assaying (321)	75 – 15
Field Geology (1264)	15 – 15
Mineralogy and Petrology (1208)	60 – 15
Elementary Economic Geology (1252)	15 – 15
Applied Mechanics (218)	45 – 90
Business Law (Ec60)	15 – 15
General Studies (see page 132)	75

SUMMER COURSE IN PRACTICAL METALLURGY OR MINING (ELECTIVE IN OPTIONS 1, 2, 3).

[1] See pages 93 to 95 for the schedules of Options 1, 2 and 3 as now given in the third year.

III. — MINING ENGINEERING AND METALLURGY

FOR THE CLASS OF 1917 ONLY

DESCRIPTION OF SUBJECTS OF INSTRUCTION, PAGES 184 TO 352.

Fourth Year

Option 1, Mining and Metallurgy

FIRST TERM	Hours Ex. Prep.
Mining Engineering: Ore-dressing (303)	45 – 30
Mining and Metallurgical Calculations (305)	15 – 15
Metallurgy (331)	45 – 45
Metallurgical Laboratory (351)	100 – 0
Metallography (334)	15 – 5
Geological Surveying (1265)	60 – 45
Economic Geology (1253)	45 – 45
Laboratory Reports (356)	15 – 0
Testing Materials Laboratory (237)	20 – 10
Heat Measurements (813)	30 – 15
Elements of Electrical Engineering (619)	30 – 30
Electrical Engineering Laboratory (687)	30 – 30

SECOND TERM	Hours Ex. Prep.
Power in Mining (259)	45 – 45
Mining and Metallurgical Calculations (305)	15 – 15
Metallurgy (331)	45 – 45
Thermochemistry and Chemical Equilibrium (568)	30 – 60
Gas Analysis (531)	20 – 10
Laboratory Reports (356)	15 – 0
Theoretical Hydraulics (163)	20 – 40
Sanitary Science and Public Health (756)	15 – 0
Forging (285)	45 – 0
Thesis	180 – 75

Option 2, Metallurgy

FIRST TERM	Hours Ex. Prep.
Mining Engineering: Ore-dressing (303)	45 – 30
Mining and Metallurgical Calculations (305)	15 – 15
Metallurgy (331)	45 – 45
Metallurgical Laboratory (351)	100 – 0
Metallography (334)	15 – 5
Laboratory Reports (356)	15 – 0
Theoretical Chemistry I (565)	45 – 90
Heat Measurements (813)	45 – 30
Testing Materials Laboratory (235)	20 – 10
Elements of Electrical Engineering (619)	30 – 30
Electrical Engineering Laboratory (687)	45 – 45

SECOND TERM	Hours Ex. Prep.
Metallurgy (331)	45 – 45
Mining and Metallurgical Calculations (305)	15 – 15
Laboratory Reports (356)	15 – 0
Theoretical Chemistry I (565)	20 – 35
Gas Analysis (531)	20 – 10
Theoretical Hydraulics (163)	20 – 40
Electric Furnaces (889)	15 – 20
Engineering Laboratory (261)	60 – 30
Sanitary Science and Public Health (756)	15 – 0
Forging (285)	45 – 0
Thesis	180 – 75

Option 3, Mining Geology

FIRST TERM	Hours Ex. Prep.
Mining Engineering: Ore-dressing (303)	45 – 30
Geological Surveying (1265)	60 – 45
Economic Geology (1253)	45 – 45
Petrography (1215)	45 – 15
Index Fossils (1273)	45 – 20
Metallurgy (331)	45 – 45
Metallurgical Laboratory (351)	100 – 0
Laboratory Reports (356)	15 – 0
Elements of Electrical Engineering (619)	30 – 30
Electrical Engineering Laboratory (687)	30 – 30

SECOND TERM	Hours Ex. Prep.
Power in Mining (259)	45 – 45
Geology of North America (1291)	60 – 30
Economic Geology (1254)	30 – 15
Petrography (1215)	45 – 15
Metallurgy (331)	45 – 45
Thermochemistry and Chemical Equilibrium (568)	30 – 60
Labgratory Reports (356)	15 – 0
Theoretical Hydraulics (163)	20 – 40
Sanitary Science and Public Health (756)	15 – 0
Thesis	150 – 15

III. — MINING ENGINEERING AND METALLURGY

FOR THE CLASS OF 1918 AND THEREAFTER

Option 1, Mining and Metallurgy

FIRST YEAR, PAGE 85. DESCRIPTION OF SUBJECTS OF INSTRUCTION, PAGES 184 TO 352.

Second Year

FIRST TERM	Hours Ex. Prep.
Qualitative Analysis (511)	120 – 15
Mineralogy (1201)	75 – 15
Dynamical Geology (1231)	45 – 30
Mathematics (M21)	45 – 90
Physics (801)	90 – 75
Physical Laboratory (807)	30 – 30
English (E21)	30 – 30

SECOND TERM	Hours Ex. Prep.
Elements of Mining Engineering (301)	15 – 10
Quantitative Analysis (512)	120 – 15
Mineralogy and Petrology (1208)	90 – 15
Stratigraphic Geology (1237)	30 – 15
Mathematics (M22)	45 – 90
Physics (801)	75 – 60
Physical Laboratory (807)	30 – 30
Precision of Measurements (803)	10 – 10
English (E22)	30 – 30

SUMMER READING, SEE PAGE 133.

SUMMER COURSES IN SURVEYING (103 AND 104), SEE PAGE 189.

Third Year

FIRST TERM	Hours Ex. Prep.
Mining Engineering (302)	45 – 45
Fire Assaying (321)	75 – 15
Quantitative Analysis (513)	120 – 15
Structural and Field Geology (1262)	45 – 30
Applied Mechanics (215)	45 – 90
English (E31)[1]	30 – 30
History II (H31)	30 – 30
Political Economy (Ec31)	45 – 45
General Studies (see page 132)	45

SECOND TERM	Hours. Ex. Prep.
Mining Engineering (302)	45 – 45
Wet Assaying (323) or Quantitative Analysis (514)	120– 15
Thermo-chemistry and Chemical Equilibrium (568)	30 – 60
Field Geology (1264)	45 – 15
Applied Mechanics (218)	45 – 90
Elements of Electrical Engineering (616)	30 – 30
Forging (285)	45 – 0
Business Law (Ec60)	15 – 15
General Studies (see page 132)	75

SUMMER COURSE IN PRACTICAL METALLURGY OR MINING (ELECTIVE).

Fourth Year

FIRST TERM	Hours Ex. Prep.
Mining Engineering: Ore-dressing (303)	45 – 45
Metallurgy (331)	60 – 60
Metallurgical Laboratory and Reports (351)	120 – 15
Geological Surveying (1265)	30 – 30
Economic Geology (1256)	45 – 45
Testing Materials Laboratory (237)	20 – 10
Heat Measurements (813)	30 – 15
Elements of Electrical Engineering (617)	30 – 30
Electrical Engineering Laboratory (687)	45 – 45

SECOND TERM	Hours Ex. Prep.
Power in Mining (259)	45 – 45
Mining and Metallurgical Calculations (305)	30 – 30
Metallurgy (331)	45 – 45
Gas Analysis (531)	20 – 10
Theoretical Hydraulics (163)	20 – 40
Sanitary Science and Public Health (756)	15 – 0
Spanish (L81) or English Composition and Literature (E34)	45 – 75
Thesis and Conference	195 – 60

[1] After 1916–1917.

III. — MINING ENGINEERING AND METALLURGY

FOR THE CLASS OF 1918 AND THEREAFTER

Option 2, Metallurgy

FIRST YEAR, PAGE 85. DESCRIPTION OF SUBJECTS OF INSTRUCTION, PAGES 184 TO 352.
SUMMER WORK: QUALITATIVE ANALYSIS (511).

Second Year

FIRST TERM	Hours Ex. Prep.
Quantitative Analysis (512)	120 – 15
Mineralogy (1201)	75 – 15
Dynamic Geology (1231)	45 – 30
Mathematics (M21)	45 – 90
Physics (801)	90 – 75
Physical Laboratory (807)	30 – 30
English (E21)	30 – 30

SECOND TERM	Hours Ex. Prep.
Quantitative Analysis (513)	120 – 15
Mineralogy and Petrology (1208)	90 – 15
Ore Deposits (1251)	30 – 40
Mathematics (M22)	45 – 90
Physics (801)	75 – 60
Physical Laboratory (807)	30 – 30
Precision of Measurements (803)	10 – 10
English (E22)	30 – 30

SUMMER READING, SEE PAGE 133.
SUMMER COURSE IN SURVEYING (104) (ELECTIVE), SEE PAGE 139.

Third Year

FIRST TERM	Hours Ex. Prep.
Fire Assaying (321)	75 – 15
Mining Engineering (306)	30 – 30
Gas Analysis (531)	20 – 10
Mechanism (201)	30 – 60
Machine Drawing (208)	60 – 0
Applied Mechanics (215)	45 – 90
English (E31)	30 – 30
History II (H31)	30 – 30
Political Economy (Ec31)	45 – 45
General Studies (see page 132)	45

SECOND TERM	Hours Ex. Prep.
General Metallurgy (335)	45 – 40
Metallurgy: Lead, Gold, Silver (337)	35 – 35
Metallurgy: Copper (339)	30 – 30
Non-ferrous Metallurgical Laboratory (355)	85 – 0
Thermochemistry and Chemical Equilibrium (568)	30 – 60
Elements of Electrical Engineering (616)	30 – 30
Applied Mechanics (218)	45 – 90
Forging (285a)	30 – 0
Business Law (Ec60)	15 – 15
General Studies (see page 132)	75

SUMMER COURSE IN PRACTICAL METALLURGY OR MINING (ELECTIVE).

Fourth Year

FIRST TERM	Hours Ex. Prep.
Metallurgy: Iron and Steel (341)	75 – 45
Metallography (333)	85 – 25
Ore-dressing (307)	40 – 15
Heat Measurements (813)	30 – 15
Heat Engineering (245)	45 – 90
Elements Electrical Engineering (617)	30 – 30
Electrical Engineering Laboratory (687)	45 – 45
Elementary Technical Electrical Measurements (668)	15 – 15
Testing Materials Laboratory (235)	20 – 10
Metal Turning (295)	45 – 0

SECOND TERM	Hours Ex. Prep.
Metallurgy: Zinc and Minor Metals (340)	30 – 30
Mining and Metallurgical Calculations (305)	30 – 30
Wet Assaying (323)	75 – 0
Electrochemistry (890)	30 – 30
Theoretical Hydraulics (163)	20 – 40
Heat Engineering (245)	45 – 60
Engineering Laboratory (260)	20 – 10
Foundry (287)	45 – 0
Thesis and Conference	195 – 30

III. — MINING ENGINEERING AND METALLURGY

FOR THE CLASS OF 1918 AND THEREAFTER

Option 3, Mining

FIRST YEAR, PAGE 85. DESCRIPTION OF SUBJECTS OF INSTRUCTION, PAGES 184 TO 352.

Second Year

FIRST TERM	Hours Ex. Prep.
Qualitative Analysis (511)	120 – 15
Mineralogy (1201)	75 – 15
Dynamical Geology (1231)	45 – 30
Mathematics (M21)	45 – 90
Physics (801)	90 – 75
Physical Laboratory (807)	30 – 30
English (E21)	30 – 30

SECOND TERM	Hours Ex. Prep.
Elements of Mining Engineering (301)	15 – 10
Quantitative Analysis (512)	120 – 15
Mineralogy and Petrology (1208)	90 – 15
Stratigraphic Geology (1237)	30 – 15
Mathematics (M22)	45 – 90
Physics (801)	75 – 60
Physical Laboratory (807)	30 – 30
Precision of Measurements (803)	10 – 10
English (E22)	30 – 30

SUMMER READING, SEE PAGE 133.
SUMMER COURSES IN SURVEYING (103 AND 104), SEE PAGE 189.

Third Year

FIRST TERM	Hours Ex. Prep.
Fire Assaying (321)	75 – 15
Metallurgy: Principles (336)	60 – 15
Mineralogy and Petrology (1209)	30 – 15
Structural and Field Geology (1262)	45 – 15
Applied Mechanics (215)	45 – 90
Elements of Electrical Engineering (619)	30 – 30
English (E31)	30 – 30
History II (H31)	30 – 30
Political Economy (Ec31)	45 – 45
General Studies (see page 132)	45

SECOND TERM	Hours Ex. Prep.
Mining: Prospecting, Exploring, Exploitation (315)	30 – 30
Metallurgy: Copper (339)	30 – 30
Quantitative Analysis (513)	120 – 15
Mineralogy and Petrology (1209)	60 – 15
Field Geology (1264)	45 – 15
Applied Mechanics (218)	45 – 90
Electrical Engineering Laboratory (687)	45 – 45
Business Law (Ec60)	15 – 15
General Studies (see page 132)	75

SUMMER WORK: MINING CAMP (372) RECOMMENDED.

Fourth Year

FIRST TERM	Hours Ex. Prep.
Metal Mining: Exploitation (316)	170 –120
Mining: Coal (317)	20 – 20
Mining Laboratory (318)	20 – 20
Metallurgy: Iron and Steel (341)	45 – 45
Geological Surveying (1265)	35 – 15
Economic Geology (1255)	75 – 45
Hydraulics (164)	30 – 60

SECOND TERM	Hours Ex. Prep.
Mining Engineering: Ore-dressing, Leaching (308)	200 – 45
Mining Plant (313)	45 – 30
Mining Laboratory (318)	90 – 45
Metallurgy: Zinc and Minor Metals (340)	30 – 30
Economic Geology (1255)	45 – 45
Thesis and Conference	115

IV. — ARCHITECTURE

Architecture is essentially a fine art which for its inspiration must continually refer to the wonderful achievements of the past, and for its fulfilment must borrow much from the sciences and from engineering. The education of the architect, therefore, which is based primarily upon the canons of art, must at the same time include historical study of civilization, painting, sculpture, and architecture, as well as some instruction in science and its engineering applications. As a profession it requires many years of earnest effort and self-sacrificing study. The architectural school can undertake to furnish only the fundamental training necessary to start the young man in his career. He must be given the proper attitude toward his profession; he must be made familiar with the underlying principles of art and science which are to become the foundation of his professional knowledge and development; he must be taught the logic of all true architecture; his taste, his power of discrimination between the good and the beautiful and the commonplace and vulgar must be developed. He must be given facility in the processes which he must use in the expression of his imagination and thought, and made acquainted with the sciences and their applications by which his creations may be transformed into reality. Such is the ideal toward which the Course in Architecture aims.

The curriculum and methods of instruction employed have been selected not merely to prepare the student for the future practice of his profession but to supply a training which shall be educational in the broadest sense.

Two Courses are offered by the Department: one in General Architecture and one in Architectural Engineering. Each includes the general fundamentals essential to the education of the architect. The Course in General Architecture lays most stress upon design and art with a minimum of engineering; while the Course in Architectural Engineering lays greatest emphasis upon structural design and engineering, with enough of general architecture and art to bring the student into full sympathy with the ideals of his profession. The intimate relation which must exist between the work of the two Courses in the practice of architecture is kept constantly before the student, and he is made to understand that

IV. — ARCHITECTURE

Option 1, General Course

First Year, page 85. Description of Subjects of Instruction, pages 184 to 352.

Second Year

FIRST TERM	Hours Ex. Prep.
Elementary Design. Elements of Architecture (471)	150 – 0
Architectural History (441)	15 – 30
Freehand Drawing (D42)	60 – 0
Shades and Shadows (411)	30 – 15
Applied Perspective (413)	30 – 0
Mathematics (M21)	45 – 90
Physics (801)	75 – 60
English (E21)	30 – 30
History II (H31)	30 – 30

SECOND TERM	Hours Ex. Prep.
Design and Theory of Architecture (471)	150 – 0
Architectural History (441)	15 – 30
Freehand Drawing (D42)	60 – 0
Applied Perspective (414)	30 – 0
Office Practice (421)	60 – 0
History of Ornament (431)	15 – 30
Applied Mechanics (215a)	45 – 90
Physics (801)	75 – 60
English (E22)	30 – 30

Summer Reading, see page 133.

Third Year

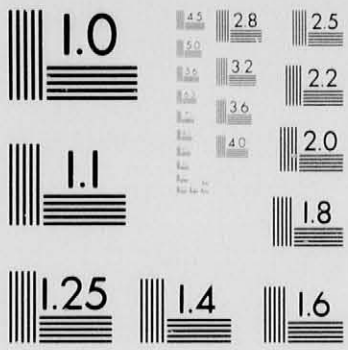
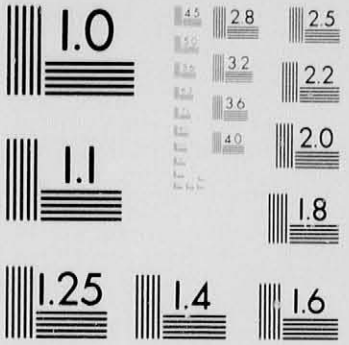
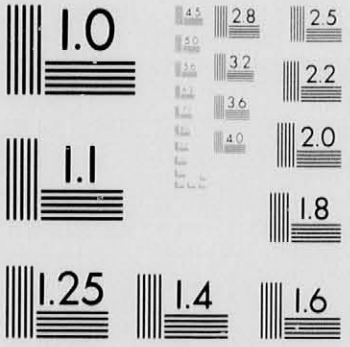
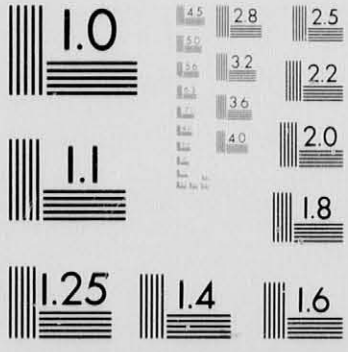
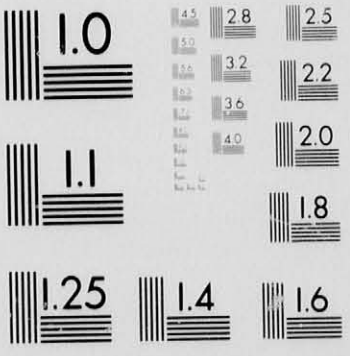
FIRST TERM	Hours Ex. Prep.
Design (472)	135 – 15
Architectural History (442)	20 – 15
European Civilization and Art (H34)	30 – 40
Freehand Drawing (D43)	60 – 0
Applied Perspective (415)	30 – 0
Water Color (453)	30 – 0
Elements of Heat Engineering (256)	45 – 45
Applied Mechanics (219)	40 – 80
Political Economy (Ec31)	45 – 45
General Studies (see page 132)	45

SECOND TERM	Hours Ex. Prep.
Design (472)	200 – 15
Architectural History (442)	20 – 25
European Civilization and Art (H34)	30 – 40
Freehand Drawing (D43)	60 – 0
Applied Perspective (415)	30 – 0
Office Practice (421)	60 – 0
Applied Mechanics (227)	45 – 90
Business Law (Ec60)	15 – 15
General Studies (see page 132)	75

Fourth Year

FIRST TERM	Hours Ex. Prep.
Design (473)	275 – 35
Constructive Design I, Elementary (481)	120 – 10
Architectural History (443)	25 – 40
European Civilization and Art (H35)	30 – 30
Life Class (D44)	90 – 0
Philosophy of Architecture (451)	15 – 15
Professional Relations (422)	15 – 0
Color (831)	5 – 5
Acoustics (829)	5 – 5

SECOND TERM	Hours Ex. Prep.
Design: Thesis (473)	375 – 75
Constructive Design II (482)	45 – 0
European Civilization and Art (H35)	30 – 30
Life Class (D44)	90 – 0
Philosophy of Architecture (451)	15 – 30
Professional Relations (422)	15 – 0
Sanitary Science and Public Health (756)	15 – 0


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IV. — ARCHITECTURE *(continued)*

the members of both Courses should be working with the same end in view, — the noblest architectural accomplishment.

The first year is to a large extent a preparatory one, including courses in drawing, history, literature, language, and science, which lead in the later years to the various phases of professional study.

The study of architectural design is begun in the second year, and in the Course in General Architecture occupies increasing periods of the student's time until in the senior year over one-half the school-hours are devoted to this subject. In the third year of the Engineering Option architectural design is replaced by applied mechanics, theory of structures, testing of materials, and structural design. Courses in architectural history and history of European civilization and art, taken by all students, form the broad, artistic, historical and technical background which is necessary for the full appreciation of any great period of architecture.

The degree of Bachelor of Science in Architecture conferred by the Institute admits the holder to candidacy for membership in the American Institute of Architects without the examination ordinarily required.

Opportunities are offered for one or two years of graduate professional work. The value of the graduate training is abundantly shown by the remarkable progress made by the students who have embraced this opportunity for a year's uninterrupted study of subjects essential to thorough preparation for their professional work. For a schedule of a Graduate Course in Architecture see page 151.

The Department will accept under certain conditions special students in Architecture who must conform to the requirements stated on page 81. Except for these requirements there is no definite course for the special student. He may select, with the approval of the Department, such courses as he desires, and for which he has the necessary preparation.

See pages 239 to 246 for detailed description of subjects of instruction.

IV. — ARCHITECTURE

Option 2. Architectural Engineering

First Year, page 85. Description of Subjects of Instruction, pages 184 to 352.

Second Year

FIRST TERM	Hours Ex. Prep.
Elementary Design. Elements of Architecture (471)	150 – 0
Architectural History (441)	15 – 30
Freehand Drawing (D42)	60 – 0
Shades and Shadows (411)	30 – 15
Surveying (102)	30 – 0
Mathematics (M21)	45 – 90
Physics (801)	75 – 60
English (E21)	30 – 30
History II (H31)	30 – 30

SECOND TERM	Hours Ex. Prep.
Design and Theory of Architecture (471)	150 – 0
Architectural History (441)	15 – 30
Office Practice (421)	60 – 0
Freehand Drawing (D42)	60 – 0
Geology of Materials of Construction (1257)	30 – 30
Sanitary Science and Public Health (756)	15 – 0
Mathematics (M22)	45 – 90
Physics (801)	75 – 60
English (E22)	30 – 30

Summer Reading, see page 133.

Third Year

FIRST TERM	Hours Ex. Prep.
Design (472)	120 – 15
Architectural History (442)	20 – 15
European Civilization and Art (H34)	30 – 40
Structural Drawing (490)	30 – 0
Applied Mechanics (220)	60 –120
Geology of Materials (1257)	15 – 30
Elements of Heat Engineering (256)	45 – 45
Political Economy (Ec31)	45 – 45
General Studies (see page 132)	45

SECOND TERM	Hours Ex. Prep.
Structural Design (491)	150 – 0
Architectural History (442)	20 – 25
European Civilization and Art (H34)	30 – 0
Theory of Structures (141)	45 – 90
Applied Mechanics (228)	60 –120
Materials (143)	30 – 45
Business Law (Ec60)	15 – 15
General Studies (see page 132)	75

Fourth Year

FIRST TERM	Hours Ex. Prep.
Structural Design (492)	215 – 0
Theory of Structures (151)	45 – 90
Applied Mechanics (230)	25 – 50
Testing Materials Laboratory (238)	30 – 15
Testing Materials Laboratory (239)	35 – 15
Architectural History (443)	25 – 40
European Civilization and Art (H35)	30 – 0
Foundations (148)	15 – 30
Electric Wiring and Lighting of Buildings (651)	15 – 15
Philosophy of Architecture (451)	15 – 0
Professional Relations (422)	15 – 0

SECOND TERM	Hours Ex. Prep.
Structural Design: Thesis (492)	440 – 0
Theory of Structures (151)	45 – 90
European Civilization and Art (H35)	30 – 0
Philosophy of Architecture (451)	15 – 0
Steam and Mechanical Appliances for Buildings (258) { Lect. / Lab.	15 – 15 / 10 – 0
Theoretical Hydraulics (163)	15 – 30
Professional Relations (422)	15 – 0

V. — CHEMISTRY

The Course in Chemistry provides fundamental training in inorganic, analytical, organic, theoretical and industrial chemistry, in both class-room and laboratory. It aims to prepare its graduates to take a responsible part in the establishment or development of industries which involve an application of chemical principles, to act as consulting chemists, to deal with problems of public welfare, to engage in research, or to become teachers. The Course includes also a considerable range of instruction in mathematics, physics, and German, all of which are essential to an intelligent grasp of modern chemical science and its rapid advances in scientific and technical fields.

The growing appreciation of the importance of chemical science, especially in its technical applications, has created a demand in widely different fields for graduates with a chemical training. To meet these conditions three series of optional subjects have been arranged in the last two years of the Course, which afford a consistently planned preparation along certain specified lines, without, however, sacrificing any fundamental subjects.

In Option 1, which may be designated as that of Research Chemistry, a large amount of time is devoted to training the individual student in the investigation of laboratory problems pertaining to the different branches of chemistry. It is intended to prepare graduates to attack the chemical problems constantly arising in the development of the industries, to act as experts, and to fill positions in technical or scientific research laboratories, or as teachers. In Option 2 a large amount of time is devoted to laboratory practice along somewhat varied lines, with reference to general analytical practice, and to the requirements for the control laboratories in chemical or metallurgical industries; while Option 3 provides the biological subjects which bear upon municipal or sanitary chemistry, together with related lines of laboratory practice.

In addition to the fundamental branches noted above, somewhat more specialized courses are offered, which include the study of water supplies, foods, oils, gas, sugars and starches, and the methods of proximate technical analysis, as indicated on the opposite page.

For further information, see pages 247 to 266, and 363.

V. — CHEMISTRY

First Year, page 85. Description of Subjects of Instruction, pages 184 to 352.
Summer Work: Qualitative Analysis (511).

Second Year

FIRST TERM	Hours Ex. Prep.
Quantitative Analysis (512)	180 – 15
Physics (801)	90 – 75
Physical Laboratory (807)	30 – 30
Mathematics (M21)	45 – 90
German (L31)	45 – 60
English (E21)	30 – 30

SECOND TERM	Hours Ex. Prep.
Quantitative Analysis (513)	195 – 15
Physics (801)	75 – 60
Physical Laboratory (807)	30 – 25
Precision of Measurements (803)	10 – 10
German (L31)	45 – 60
English (E22)	30 – 30
Options	
1. Mathematics (M22)	45 – 90
2, 3. Mineralogy (1202)	105 – 30

Summer Reading, see page 133.

Third Year

FIRST TERM		Hours Ex. Prep.
Theoretical Chemistry I (565)	Lect.	55 – 75
	Lab.	20 – 15
Gas Analysis (531)		20 – 10
History II (H31)		30 – 30
Political Economy (Ec31)		45 – 45
General Studies (see page 132)		45
Options.		
1. Quantitative Analysis (514)		120 – 30
1. Experimental Problems in Inorganic Chemistry (590)		165 – 15
2. Quantitative Analysis (514)		135 – 15
2. Experimental Problems in Inorganic Chemistry (590)		90 – 15
2. Dynamical Geology (1231)		45 – 30
3. Quantitative Analysis (514)		195 – 30
3. Optical Chemical Analysis (527)		30 – 15
3. Elements of Biology (702)		30 – 30

SECOND TERM		Hours Ex. Prep.
Theoretical Chemistry I (565)	Lect.	55 – 75
	Lab.	20 – 15
Organic Chemistry I (551)		60 – 45
Organic Chemical Laboratory (556)		150 – 10
Business Law (Ec60)		15 – 15
General studies (see page 132)		75
Options		
1. Experimental Problems in Theoretical Chemistry		165 – 20
2. Optical Chemical Analysis (527)		30 – 15
2. Heat Measurements (813)		30 – 20
2, Water Supplies and Air (520)		45 – 0
3. Food Analysis (525)		45 – 0
3. Bacteriology (731)		60 – 35

Fourth Year

FIRST TERM		Hours Ex. Prep.
Theoretical Chemistry II (566)	Lect.	30 – 45
	Lab.	18 – 12
Industrial Chemistry I (575)		45 – 45
Organic Chemistry I (551)		45 – 30
Organic Chemical Laboratory (556)		105 – 0
Journal Reports (594)		15 – 10
Options		
1. Laboratory Option [1]		90 – 15
1. Experimental Problems in Organic Chemistry (592)		180 – 30
1. Industrial Chemistry II (587)		120 – 30
2. Proximate Analysis (530)		90 – 30
2. Metallography (507)		15 – 30
2. Industrial Chemistry II (587)		90 – 15
2. Food Analysis Adv. (526)		75 – 15
3. Industrial Microbiology (735)		60 – 15
3. Bacteriology of Water and Sewage (732)		30 – 15

SECOND TERM		Hours Ex. Prep.
Theoretical Chemistry II (566)	Lect.	30 – 45
	Lab.	18 – 12
Industrial Chemistry I (575)		45 – 45
Inorganic Chemistry II (503)		30 – 30
History of Chemistry (593)		15 – 15
Recent Developments of Chemistry (597)		10 – 0
Thesis Reports (595)		15 – 15
Options		
1. Thesis		305
2. Problems in Applied Chemistry (588)		30 – 60
2. Thesis		305
3. Microscopy of Drinking Waters (706)		15 – 15
3. Sanitation in Chemical Industries (523)		30 – 30
3. Sanitary Science and Public Health (756)		15 – 0
3. Thesis		290

[1] Industrial Chemistry II, Proximate Technical Analysis, or Air, Water and Food Analysis.

VI. — ELECTRICAL ENGINEERING

As the modern development of electrical engineering has taken place largely along lines dependent on a sound theoretical knowledge, great importance is attached in Course VI to the study of mathematics, chemistry, physics and applied mechanics in the earlier years and of the theory of electricity and magnetism, beginning in the second year and continuing throughout the remainder of the Course. The electrical engineering lectures of the junior and senior years also take on a distinctly professional character, involving the applications of electricity to the various problems in railroad work, power station design, power-transmission, lighting, telephony, etc., the work of the Department being supplemented by lectures delivered by engineers not connected with the Institute.

The theoretical work runs parallel with an extended course in the laboratories, which begins with the work in chemistry and physics and extends through all of the scientific branches studied. The Electrical Testing Laboratories and the laboratories devoted to Electrical Machinery are component parts of the equipment and are in charge of professors of the Department. These laboratories are described on page 367 under the title of The Augustus Lowell Laboratories of Electrical Engineering. They are extensively equipped with apparatus adapted to the needs of undergraduate and advanced study. The laboratory work is carried on with the purpose of developing in the student habits of accurate observation, and of bringing to his consideration not only the methods and tests of fundamental importance, but questions of economy of time and precision of results.

The importance of work of the nature of scientific research is emphasized. Research laboratories are provided and meetings are held monthly at which the progress of research work being carried on is reported and discussed. The historical development of the electrical sciences and arts are discussed in monthly meetings of an electrical engineering seminar. These meetings are open to all students.

For further details see pages 267 to 276 and 367 to 370. For the schedule of Graduate Subjects in Electrical Engineering see page 153.

VI. — ELECTRICAL ENGINEERING

First Year, page 85. Description of Subjects of Instruction, pages 184 to 352.

Second Year

FIRST TERM	Hours Ex. Prep.
Physics (801)	90 – 75
Physical Laboratory (807)	30 – 30
Mechanism (200)	45 – 90
Mechanical Engineering Drawing (206)	45 – 0
Foundry Work (288); Vise and Bench Work (290b)	45 – 0
Mathematics (M21)	45 – 90
History II (H31)	30 – 30
English (E23)	30 – 45

SECOND TERM	Hours Ex. Prep.
Principles of Electrical Engineering I (601)	30 – 40
Physics (801)	75 – 60
Physical Laboratory (807)	30 – 30
Precision of Measurements (803)	10 – 10
Machine Drawing (208)	45 – 0
Applied Mechanics (215)	45 – 90
Mathematics (M22)	45 – 90
Machine-tool Work (292)	45 – 0
English (E24)	30 – 45

Summer Reading, see page 133.
Summer Course in Surveying (100), see page 140.

Third Year

FIRST TERM	Hours Ex. Prep.
Principles of Electrical Engineering Ia and IIa (609) [1]	75 – 85
Principles of Electrical Engineering II (602)	60 –100
Electrical Engineering Laboratory I (671)	60 – 50
Heat Engineering: Thermodynamics (245)	60 –120
Applied Mechanics (218)	45 – 90
Political Economy (Ec31)	45 – 45
General Studies (see page 132)	45

SECOND TERM	Hours Ex. Prep.
Principles of Electrical Engineering III (603)	60 –100
Electrical Engineering Laboratory II (672) [2]	75 – 65
Heat Engineering (245)	30 – 60
Machine Drawing (208) [1]	45 – 0
Mathematics (M35) [1]	30 – 60
Business Law (Ec60)	15 – 15
General Studies (see page 132)	75
Options	
1. Kinetics (226)	30 – 60
2. { Stationary Structures (144)	30 – 60
2. { Mathematics (M35) [2]	45 – 90

Fourth Year

FIRST TERM	Hours Ex. Prep.
Principles of Electrical Engineering IV (604)	90 –120
Electrical Engineering Laboratory III (673)	75 – 45
Theoretical Hydraulics (165)	45 – 90
Engineering Laboratory (262)	60 – 45
Economics of Corporations (Ec55)	30 – 30
Optional Studies (see page 268)	30 – 60

SECOND TERM	Hours Ex. Prep.
Principles of Electrical Engineering V (605)	85 –105
Electrical Engineering Laboratory IV (674)	60 – 45
English (E44)	30 – 30
Optional Studies (see page 268)	60 –120
Thesis	170

[1] For 1916–1917 only.

[2] After 1916–1917.

VII. — BIOLOGY AND PUBLIC HEALTH

INCLUDING BACTERIOLOGY AND SANITARY SCIENCE

Useful and inviting careers in the service of cities, states and the United States, or with public-service or private corporations, or firms or individuals, are now open to ambitious students in certain technical branches of biology and public health science, such as bacteriology, micro-biology, industrial and sanitary biology, industrial hygiene and sanitation, planktonology, serology, etc., as well as in research and investigation. For persons proficient in these subjects the demand has of late years often exceeded the supply, graduates readily obtaining positions as bacteriologists, micro-biologists, health officers, sanitary inspectors, or assistants with private manufacturers, commercial firms or public-service corporations.

To provide the equipment necessary for these positions a group of related studies covering four years has been arranged, as shown on the opposite page. These studies afford also an excellent preparation for entrance into the best medical schools or for social service positions, and graduates of this Department are immediately eligible as candidates for, and after one year of additional study may expect to obtain, the Certificate in Public Health (C. P. H.) in the School for Health Officers (see page 395).

The Course in Biology and Public Health thus furnishes certain essential elements of a well rounded education with professional training for special occupations. Some who follow it enter medical schools, — the best of which now require at least two years of college work, which must include physics, chemistry and biology. Others go immediately into professional work. Those who remain for graduate studies or investigation find ample opportunity for advanced work, including research, in the various Departmental Laboratories, or in the Sanitary Research Laboratory and Sewage Experiment Station (page 371), etc.

The arrangement of studies in a Graduate Course leading to the degree of Master of Science is described on page 154. For detailed information regarding the subjects of instruction and laboratories of the Department see pages 277 to 288, and 370.

VII. — BIOLOGY AND PUBLIC HEALTH

First Year, page 85. Description of Subjects of Instruction, pages 184 to 352.

Second Year

FIRST TERM	Hours Ex. Prep.
General Biology (701)	60 – 15
Qualitative Analysis (511)	105 – 15
Mathematics (M21)	45 – 90
Physics (801)	90 – 75
Physical Laboratory (807)	30 – 30
German, Adv. (L31)	45 – 60
English (E21)	30 – 30

SECOND TERM	Hours Ex. Prep.
Cryptogamic Botany (704)	60 – 30
Invertebrate Zoölogy (705)	45 – 25
Quantitative Analysis (512)	150 – 15
Physics (801)	75 – 60
Physical Laboratory (807)	30 – 15
Precision of Measurements (803)	10 – 10
Surveying (102)	30 – 0
German (L31)	45 – 60
English (E22)	30 – 30

Summer Reading, see page 133.

Third Year

FIRST TERM	Hours Ex. Prep.
General Bacteriology (730)	75 – 30
Vertebrate Anatomy (710)	105 – 45
Organic Chemistry (550)	30 – 30
Organic Chemical Laboratory (557)	105 – 15
Water Supplies and Air (520)	45 – 0
Food Analysis (525)	45 – 0
History II (H31)	30 – 30
Political Economy (Ec31)	45 – 45
General Studies (see page 132)	45

SECOND TERM	Hours Ex. Prep.
Embryology and Histology (711)	105 – 75
Parasitology (707)	30 – 30
Anthropology (715)	15 – 15
General Physiology (720)	90 – 60
Physiological Laboratory (725)	45 – 15
Bacteriology of Air, Water and Foods (733)	75 – 30
Biology of Infectious Diseases I (750)	15 – 15
Business Law (Ec60)	15 – 15
General Studies (see page 132)	75

Fourth Year

FIRST TERM	Hours Ex. Prep.
Industrial Microbiology (735)	60 – 30
Theoretical Biology (703)	30 – 45
Advanced Bacteriology (734)	45 – 30
Biology of Infectious Diseases (751)	30 – 30
Biology of Water and Sewage Purification (739)	15 – 30
Zymology (736)	45 – 30
Vital Statistics (190)	30 – 30
Biochemistry (524)	30 – 45
Journals (780)	30 – 15
Options	
1. { Plant Physiology (728)	15 – 15
1. { Comparative Physiology (721)	45 – 30
1. { Public Health Problems (755)	15 – 15
2. { Epidemiology (765)	15 – 15
2. { Industrial Hygiene and Sanitation (753)	30 – 30

SECOND TERM	Hours Ex. Prep.
Problems in Chemical and Industrial Biology (737)	15 – 30
Theoretical Biology (703)	30 – 45
Sanitary Science and Public Health (756)	15 – 0
Public Health Laboratory Methods (738)	45 – 15
Public Health Practice (757)	60 – 75
Personal Hygiene II (723)	30 – 30
Journals (780)	30 – 30
Options	
1. { Physiological Laboratory, Advanced (726)	60 – 30
1. { Thesis	195
2. { Public Health Problems (755)	30 – 45
2. { Thesis	180

VIII. — PHYSICS

As distinguished from the professional or technical Courses in Engineering, Architecture, etc., the Institute offers certain Courses of a distinctly scientific nature. The Course in Physics contains a series of studies adapted to the needs of those who wish to become teachers of physics, or who desire to enter upon a course in physical science either with a view to its further continuance or to prepare themselves for professional positions in which a knowledge of pure and applied physics is especially called for. Its leading features are a thorough and continuous study of the various branches of physics and a treatment of mathematics advanced considerably beyond the requirements of any of the technical Courses. Inorganic, theoretical, analytical, and organic chemistry occupy a position next in prominence to mathematics, and of hardly less importance.

Physics begins with the second year and, in lectures, readings, recitations, and laboratory exercises, extends to the close of the Course. After the completion of the lectures in General Physics the subject is taken up in detail from both the theoretical and the experimental side. The former instruction consists of a series of continuous courses, in which the subjects of analytical mechanics, electricity, light and heat are developed from a distinctly mathematical point of view. These courses form an excellent foundation for future graduate work. A large amount of experimental work is also performed, and an experimental investigation is undertaken during the fourth year in connection with the preparation of the thesis. At all times it is sought to encourage the spirit of original research, and to impart an understanding of the principles upon which scientific investigation should be conducted.

In the third and fourth years of the Course a certain amount of specialization along the lines of advanced chemistry or mathematics is provided in Options 1 and 2 respectively. A third Option recently introduced is that in Industrial Physics which virtually constitutes a distinct Course. (See pages 108, 109.)

For detailed information regarding the subjects of instruction and laboratories of the Department see pages 289 to 301, and 371. For the arrangement of graduate work see pages 143 to 147, and 155.

VIII. — PHYSICS

Options 1 and 2

First Year, page 85. Description of Subjects of Instruction, pages 184 to 352.

Second Year

FIRST TERM	Hours Ex. Prep.
Physics (801)	90 – 75
Physical Laboratory (807)	30 – 30
Acoustics (828)	15 – 15
Qualitative Analysis (511)	105 – 15
Mathematics (M21)	45 – 90
Metal Turning (295)	45 – 0
German (L31)	45 – 60
English (E21)	30 – 30

SECOND TERM	Hours Ex. Prep.
Physics (801)	75 – 60
Physical Laboratory (806, 807)	45 – 45
Precision of Measurements (803)	10 – 10
Quantitative Analysis (512)	110 – 15
Mathematics (M22)	45 – 90
Least Squares (M26)	20 – 30
German (L31)	45 – 60
English (E22)	30 – 30

Summer Reading, see page 133.

Third Year

FIRST TERM	Hours Ex. Prep.
Theoretical Physics I (841)	45 – 90
Theoretical Chemistry I (565)	45 – 75
Organic Chemistry (550)	30 – 30
History II (H31)	30 – 30
Political Economy (Ec31)	45 – 45
General Studies (see page 132)	45
Options	
1. Mathematics (M35)	45 – 75
1. Quantitative Analysis (513)	90 – 0
2. Mathematics (M36)	60 –120
2. Electrical Laboratory (822)	15 – 15

SECOND TERM	Hours Ex. Prep.
Theoretical Physics I (841)	45 – 90
Electrical Laboratory (822)	45 – 45
Heat Measurements (813)	30 – 15
Theoretical Chemistry I (565)	45 – 75
Descriptive Astronomy (833)	30 – 45
Business Law (Ec60)	15 – 15
General Studies (see page 132)	75
Options	
1. Physico-Chemical Laboratory (893)	75 – 60
1. or Experimental Problems in Theoretical Chemistry (591)	135 – 15
2. Mathematics (M39)	45 – 90

Fourth Year

FIRST TERM	Hours Ex. Prep.
Theoretical Physics II: Electrostatics (842)	45 – 90
Theoretical Physics III: Optics (843)	45 – 90
Optical Laboratory (849)	60 – 30
Physical Colloquium (855)	– 30
Electrochemistry (882)	45 – 45
Elements of Electrical Engineering (618)	30 – 30
Fourier's Series; Laplace's Coefficients (M45)	30 – 60
Options	
1. Electrical Discharges in Vacua (852)	60 – 30
2. Advanced Mathematics (M51 to M65)	30 – 60

SECOND TERM	Hours Ex. Prep.
Theoretical Physics II: Electrokinetics (842)	30 – 60
Theoretical Physics IV: Energetics and Kinetic Theory (844)	45 – 90
Physical Colloquium (855)	15 – 15
Electrical Engineering Laboratory (687)	45 – 45
Fourier's Series; Laplace's Coefficients (M45)	30 – 60
Physical Research: Thesis	195
Options	
1. Chemistry (Elective)	30 – 60
2. Advanced Mathematics (M51 to M65)	30 – 60

VIII. — PHYSICS

Option in Industrial Physics

This Course was introduced a few years since with the intention of meeting a generally recognized and increasing need in various branches of industry for men who have received a training which will particularly fit them to deal with problems whose solution involves a thorough knowledge of physical instruments and processes and of the physical properties of materials. Many industrial corporations are coming to recognize in their business the value of such expert training in physics, and there can be no reasonable doubt that in the near future this demand will increase as scientific methods come to be more fully applied to the industries.

The present Option differs from Options 1 and 2 of Course VIII in requiring a less extended study of pure and applied mathematics and a fuller consideration of applied physics, both in lecture-room and laboratory. The study of applied optics, heat measurements and electrical measurements is greatly extended. Much time is devoted to theoretical and applied chemistry. A very considerable amount of study in mechanical and electrical engineering subjects is required, and electrochemistry pure and applied, including electrical furnace work and metallography, are likewise included. There is provided an exceptional equipment of instruments and apparatus of precision, so that a large amount of accurate work can be done in the above lines of study.

The Course is so laid out that one completing it should possess such a knowledge of physical investigation and methods of dealing with physical problems as to enable him to treat intelligently questions of this character as they may arise in connection with processes in the arts.

VIII. — PHYSICS

Option 3, Industrial Physics

First Year, page 85. Description of Subjects of Instruction, pages 184 to 352.

Second Year

FIRST TERM	Hours Ex. Prep.
Physics (801)	90 – 75
Physical Laboratory (807)	30 – 30
Acoustics (828)	15 – 15
Qualitative Analysis (511)	120 – 15
Mathematics (M21)	45 – 90
Metal Turning (294)	30 – 0
German (L32)	45 – 60
English (E21)	30 – 30

SECOND TERM	Hours Ex. Prep.
Physics (801)	75 – 60
Physical Laboratory (806, 807)	45 – 45
Precision of Measurements (803)	10 – 10
Photography (861)	15 – 0
Quantitative Analysis (512)	120 – 15
Mathematics (M22)	45 – 90
Mechanism (201)	30 – 60
Metal Turning (294)	30 – 0
English (E22)	30 – 30

Summer Reading, see page 133.

Third Year

FIRST TERM	Hours Ex. Prep.
Theoretical Physics I (Mechanics) (841)	45 – 90
Electricity (821)	30 – 60
Heat Measurements (813)	45 – 15
Theoretical Chemistry I (565)	45 – 75
Mathematics (M35)	45 – 75
History II (H31)	30 – 30
Political Economy (Ec31)	45 – 45
General Studies (see page 132)	45

SECOND TERM	Hours Ex. Prep.
Theoretical Electricity (825)	45 – 90
Electrical Laboratory (822)	45 – 45
Technical Electrical Measurements Laboratory (691)	30 – 30
Advanced Heat Measurements (815)	30 – 30
Theoretical Chemistry I (565)	45 – 75
Applied Mechanics (221)	30 – 60
Testing Materials Laboratory (240)	30 – 15
Business Law (Ec60)	15 – 15
General Studies (see page 132)	75

Fourth Year

FIRST TERM	Hours Ex. Prep.
Theoretical and Applied Optics (848)	45 – 90
Optical Laboratory (849)	60 – 30
Photographic Laboratory (851)	60 – 30
Electrical Discharges in Vacua (Laboratory) (852)	45 – 30
Electrochemistry (882)	45 – 45
Organic Chemistry (550)	30 – 30
Elements of Electrical Engineering (618)	30 – 30
Heat Engineering (248)	30 – 60
Physical Colloquium (855)	– 30

SECOND TERM	Hours Ex. Prep.
Applied Electrochemistry (885)	30 – 60
Electric Furnaces (889)	45 – 15
Electrical Engineering Laboratory (687)	45 – 45
Heat Engineering (248)	30 – 60
Metallography (507)	30 – 30
Physical Colloquium (855)	15 – 15
Thesis	225

IX. — GENERAL SCIENCE

This Course, as indicated by the regulations given in the next paragraph, is largely elective above the first year, and is, accordingly, not designed to prepare students for any special branch of engineering or of science, but rather to provide a broad general training along scientific lines. The Course may well answer the needs of several classes of students. Those who have the time and inclination for extended study will be able to lay a wider and more varied foundation for subsequent intensive work than is possible in the strictly professional Courses. The Course is especially adapted to the wants of teachers of science in secondary schools, where ordinarily one is expected to give instruction in more than one branch of science, and where also it is particularly desirable for teachers to be familiar with the elements of several sciences rather than to be specialists in any one. It also gives a good scientific preparation for a business career. Furthermore, this Course makes possible the choice of a considerable amount of such non-professional subjects as English, modern languages, history and economics, on the one hand, and, on the other, mathematics, drawing and the mechanic arts. Looked at from another point of view, the Course may be regarded as affording an opportunity to secure a general education in which science predominates, but with a generous admixture of other subjects, all of which are pursued according to the methods and standards of a professional school.

The following regulations respecting the Course in General Science have been adopted by the Faculty:

1. Students of this Course shall be required to take all studies of the first term of the first year, and in the second term of the first year shall take all the studies of some one of the prescribed Courses of the Institute.

2. In the second and third years those subjects are to be taken that are required in all Courses.

3. First-year students who intend to become candidates for a degree in this Course shall, at the end of the first term of the first year, submit for the approval of the Faculty their course of study for the remainder of the four years. Those admitted to the Course later than the middle of the first year shall submit such program of studies upon entering the Course.

4. No subject shall be taken for which the student has not had the required previous preparation; and, furthermore, the choice of subjects may be restricted by tabular view limitations.

The required subjects of the second and third years are as follows:

Second year, first term: mathematics, physics, English.

Second year, second term: physics, physical laboratory, precision of measurements, English.

Third year, first term: history II, political economy, general studies.

Third year, second term: business law, general studies.

X. — CHEMICAL ENGINEERING

The efficiency of any industrial chemical process depends not only upon a knowledge of the chemical reactions forming the basis of the process, but also upon a knowledge of the mechanical principles on which depend the design, construction and maintenance of plant for carrying on these reactions. To prepare students capable of filling the demand for men competent to build and operate manufacturing industries based upon chemical principles is the purpose of this Course in Chemical Engineering.

The professional work of the course falls naturally into three groups: first, courses which provide a thorough knowledge of the fundamental principles of chemistry. Second, those courses which furnish a sound knowledge of mechanical engineering subjects, both in theory and in practice. Third, courses which deal with chemical engineering as a separate entity, and which develop a breadth of knowledge and experience not required by students in either the Course in Chemistry or the Course in Mechanical Engineering.

The Course therefore includes a training in inorganic, analytical, organic, and industrial chemistry, which is the same as that given to students in the Course in Chemistry, except in the case of some of the laboratory courses. The training in mechanism, mechanical engineering drawing, heat engineering, applied mechanics, and other important mechanical engineering subjects is given in the Department of Mechanical Engineering, and is developed with special reference to the particular needs of this Course. This is true also of the work of the Course which is given in the Electrical Engineering Department. The instruction in Chemical Engineering I and II, and Industrial Chemistry II is of a distinctly professional nature, the aim of which is described on pages 260 to 264.

A graduate year of the Course is provided in which opportunity for the development and correlation of these fundamental subjects in the field of chemical engineering is presented (see page 156). For detailed information regarding subjects of instruction and laboratories see pages 204 to 226, and 247 to 266.

For a five-year Course in Chemical Engineering and Chemical Engineering Practice see pages 114 and 115.

X. — CHEMICAL ENGINEERING

First Year, page 85. Description of Subjects of Instruction, pages 184 to 352, Summer Work: Qualitative Analysis (511).

Second Year

FIRST TERM	Hours Ex. Prep.
Quantitative Analysis (512)	185 – 30
Problems of the Chemical Engineer (586)	10 – 0
Mathematics (M21)	45 – 90
Physics (801)	90 – 75
Physical Laboratory (807)	30 – 30
German, Advanced (L33)	30 – 45
English (E21)	30 – 30

SECOND TERM	Hours Ex. Prep.
Quantitative Analysis (513)	115 – 15
Mechanism (200)	45 – 75
Mechanical Engineering Drawing (206)	60 – 0
Mathematics (M22)	45 – 90
Physics (801)	75 – 60
Physical Laboratory (807)	30 – 30
Precision of Measurements (803)	10 – 10
English (E22)	30 – 30

Summer Reading, see page 133.

Third Year

FIRST TERM	Hours Ex. Prep.
Theoretical Chemistry I(565) Lect.	55 – 75
Theoretical Chemistry I(565) Lab.	20 – 15
Heat Engineering (245)	60 – 90
Machine Drawing (208)	60
Applied Mechanics (215)	60 – 90
History II (H31)	30 – 30
Political Economy (Ec31)	45 – 45
General Studies (see page 132)	45

SECOND TERM	Hours Ex. Prep.
Chemical Engineering I (576)	30 – 60
Theoretical Chemistry I(565) Lect.	55 – 75
Theoretical Chemistry I(565) Lab.	20 – 15
Organic Chemistry I (551)	60 – 45
Organic Chemical Laboratory (556)	60 – 0
Heat Engineering (245)	30 – 45
Applied Mechanics (218)	45 – 75
Business Law (Ec60)	15 – 15
General Studies (see page 132)	75

Fourth Year

FIRST TERM	Hours Ex. Prep.
Industrial Chemistry I (575)	30 – 30
Chemical Engineering II (577)	30 – 30
Organic Chemistry I (551)	45 – 30
Organic Chem. Lab. (556)	90 – 0
Theoretical Chemistry II (566)	30 – 45
Hydraulics (163)	15 – 30
Testing Materials Lab. (237)	20 – 10
Engineering Laboratory (262)	60 – 30
Elements of Electrical Engineering (619)	30 – 30
Electrical Engineering Lab. (687)	45 – 45
Foundry (288), Vise and Bench Work (290b)	45 – 0

SECOND TERM	Hours Ex. Prep.
Industrial Chemistry I (575)	45 – 45
Industrial Chemistry II (587)	135 – 30
Chemical Engineering II (577)	30 – 60
Inorganic Chemistry II (503)	30 – 30
Thesis Reports and Memoirs (596)	30 – 15
Machine Tool Work (292)	45 – 0
Thesis	225

X A — CHEMICAL ENGINEERING *(continued)*

With Chemical Engineering Practice

The chemical industries of the United States demand more insistently each year that there be provided that training which will produce a creative chemical engineer. This is a man who has acquired a solid foundation in science, has become a keen and accurate observer, an exact and logical thinker, and who has a love for the application of this knowledge and training to the investigation and solution of the many problems which modern industry presents. While the four-year Course in Chemical Engineering described on the preceding pages is fundamental in its character, it lacks two essential elements in the development of the man who can most efficiently fill the increasing demand for technical directors in chemical manufacturing plants and leaders of industrial research. These are, first, a systematic knowledge, acquired by direct contact in the works, of the most important types of machines, structures, and processes involved in the chemical industries, and their interpretation in terms of physics, chemistry, and mechanics; and, second, an opportunity to profit by advanced courses in science and by further training in the methods of scientific research which become doubly valuable after this period of intensive practice in the applications of the principles of science to the problems of industry.

The Institute therefore now offers a five-year Course in Chemical Engineering, including a School of Chemical Engineering Practice and a year of advanced study, for the completion of which the degree of Master of Science will be awarded.

The first three years of this Course are the same as those for Course X already described. At the end of the third year students so desiring will make application for admission to the Master's Course in Chemical Engineering and will, beginning with the first term of the fourth year, pursue the course of study shown on the page opposite. The essential features are the introduction of a laboratory course of seven months' duration which is described more fully elsewhere (see School of Chemical Engineering Practice, page 142) and the provision for a full year of advanced scientific work, largely elective, after the student has acquired the self-confidence and breadth of view furnished by this practical work in the mills.

XA — CHEMICAL ENGINEERING

With Chemical Engineering Practice.

FIRST YEAR, PAGE 85.
SECOND AND THIRD YEARS, PAGE 113. SAME AS FOR COURSE X.
DESCRIPTION OF SUBJECTS OF INSTRUCTION, PAGES 184 TO 352.

Fourth Year

FIRST TERM	Hours Ex. Prep.
Chemical Engineering II (577)	30 – 60
Organic Chemistry I (551)	45 – 30
Organic Chem. Laboratory (556)	90 – 0
Testing Materials Laboratory (237)	20 – 10
Engineering Laboratory (261)	60 – 30
Elements of Electrical Engineering (610)	30 – 30
Electrical Engineering Laboratory (687)	45 – 45
Experimental Problems (590–592)	180 – 15

SECOND TERM

School of Chemical Engineering Practice.

See page 142.

Fifth Year[1]

FIRST TERM	Hours Ex. Prep.
Required	
General Chemistry (598)	30 – 60
Industrial Chemistry I (575)	30 – 30
Theoretical Chemistry II (566)	30 – 60
Thesis Reports and Memoirs (596)	15 – 15
Thesis	
Elective	
Plant Design (582)	60 – 30
Organic Chemistry II (552)	30 – 60
*Organic Chemical Laboratory (560)	135 – 30
*Industrial Chemistry II (587)	135 – 30
Applications of Thermodynamics (581)	30 – 60
*Refrigeration (254)	30 – 60
Machine Design (267)	90 – 0
Foundry (288), Vise and Bench Work (290*b*)	45 – 0
Optical Crystallography (1223)	45 – 30

SECOND TERM	Hours Ex. Prep.
Elective	
General Chemistry (598)	30 – 60
Industrial Chemistry I (575)	45 – 45
Theoretical Chemistry II (566)	30 – 60
Thesis Reports and Memoirs (596)	15 – 15
Plant Design (582)	60 – 30
Organic Chemistry II (552)	30 – 60
*Organic Chemical Laboratory (560)	135 – 30
*Industrial Chemistry II (587)	135 – 30
Materials of Construction (580)	30 – 30
History of Chemistry (593)	30 – 30
Sanitation in Chemical Industries (523)	30 – 30
*Refrigeration (254)	30 – 60
Machine Design (267)	60 – 0
Machine Tool Work (292)	45 – 0
English (E42)	30 – 30
Thesis	

* May be taken in either first or second terms.

[1] The following list is to be extended by the introduction of additional subjects in Mathematics, Physics, Engineering Administration, and English.

XI. — SANITARY ENGINEERING

The Course in Sanitary Engineering is essentially one in civil engineering. It is designed, however, for students who wish to pay particular attention to those engineering branches which are concerned with problems of the public health, and who, therefore, desire to gain a better knowledge of the subjects of chemistry, biology and public health, and of their relations to engineering problems, than can be obtained in the Course in Civil Engineering.

The line of study offered differs from the regular Course in Civil Engineering, page 86, in the following particulars.

There is a reduction in the time devoted to railroads and bridges, and an entire omission of the courses Stereotomy, Dynamo Electric Machinery, Highway Engineering; Astronomy and Geodesy, and Foundations.

The time thus gained is devoted principally to courses in chemistry, biology and public health. In these it is designed to give the students such training as shall fit them to interpret properly the results of researches in sanitary chemistry and sanitary biology, and to coöperate with chemists and biologists in professional work. Practice is given in the Chemical and Biological Laboratories, and the student is instructed in the methods of water analysis, and is taught to observe and identify the various animal and vegetable organisms present in natural waters and sewage. The Course devotes particular attention to the sanitary side of questions of water supply and drainage, and discusses, among other things, the principles of filtration and the methods of purifying water and sewage, the relation between drinking waters and disease, the methods of disposing of sewage, and other questions relating to public health. The instruction in sanitary engineering now given in the Course in Civil Engineering, which is there optional, is required in the Course in Sanitary Engineering.

For the schedule of a Graduate Course in Sanitary Engineering see page 157. For detailed descriptions of the subjects of instruction, laboratories and equipment see pages 187 to 203, 354 to 359, and 379.

XI. — SANITARY ENGINEERING

First Year, page 85. Description of Subjects of Instruction, pages 184 to 352.

Second Year

FIRST TERM	Hours Ex. Prep.
Surveying and Plotting (100)	30 – 15
Descriptive Geometry (D21)	45 – 0
Qualitative Analysis (511)	150 – 15
Mathematics (M21	45 – 90
Physics (801)	90 – 75
Physical Laboratory (807)	15 – 15
History II (H31)	30 – 30
English (E23)	30 – 45

SECOND TERM	Hours Ex. Prep.
Surveying and Plotting (100)	30 – 0
Topographical Drawing (195)	30 – 0
Quantitative Analysis (512)	90 – 15
Applied Mechanics (215)	45 – 90
Mathematics (M22)	45 – 90
Physics (801)	75 – 60
Physical Laboratory (807)	30 – 30
Precision of Measurements (803)	10 – 10
English (E22)	30 – 30

Summer Reading, see page 133.
Summer Course in Surveying, see page 139.

Third Year

FIRST TERM	Hours Ex. Prep.
Railroad Engineering (121)	20 – 40
Railroad Drafting (123)	45 – 0
Surveying, Advanced (109)	30 – 0
Applied Mechanics (217)	60 – 90
Organic Chemistry (550)	30 – 30
Organic Chemical Laboratory (558)	45 – 15
Elements of Biology (702)	30 – 0
Dynamical Geology (1231)	45 – 30
Lithology (1211)	15 – 0
History II (H31)	30 – 30
English (E31)[1]	30 – 30
Political Economy (Ec31)	45 – 45
General Studies (see page 132)	45

SECOND TERM	Hours Ex. Prep.
Railroad Engineering (121)	20 – 20
Railroad Drafting (123)	75 – 0
Theory of Structures (140)	45 – 90
Testing Materials Laboratory (236)	30 – 0
Materials (143)	30 – 45
Elements of Bacteriology (731)	60 – 0
Industrial Water Analysis (521)	30 – 0
Mechanism (201)	30 – 60
Structural and Field Geology (1234)	30 – 15
Stratigraphic Geology (1238)	15 – 15
Business Law (Ec60)	15 – 15
General Studies (see page 132)	75

Fourth Year

FIRST TERM	Hours Ex. Prep.
Theory of Structures; Bridges and Similar Structures (149)	45 – 90
Structural Design (154)	60 – 0
Theoretical Hydraulics (162)	45 – 90
Sanitary Engineering (177)	45 – 75
Bacteriology of Water and Sewage (732)	30 – 15
Water Supply and Wastes Disposal (522)	45 – 30
Heat Engineering (247)	45 – 75
Engineering Laboratory (263)	15 – 15

SECOND TERM	Hours Ex. Prep.
Theory of Structures; Bridges and Similar Structures (149)	45 – 90
Sanitary Engineering (178)	90 – 90
Hydraulic and Sanitary Design (179)	85 – 0
Hydraulic Laboratory (172)	15 – 10
Sanitary Science and Public Health (756)	15 – 0
Microscopy of Drinking Waters (706)	15 – 15
Heat Engineering (247)	45 – 85
Thesis	120

[1] After 1916–1917.

XII. — GEOLOGY

Having in view the broad character of the science of geology, and the somewhat divergent lines of training desirable for students specializing in one or more of the different lines of geologic work, no rigid schedule of studies is laid down, but schedules will be prepared under the guidance of the Geological Department to meet the needs of individual cases.

This plan is especially adapted to meeting the needs of college graduates who desire to specialize in geology and who have had the usual college courses in science including more or less geology, but not the more highly specialized courses like those in the Institute's curriculum. Such graduates may expect to take the degree of Bachelor of Science in one or two years, or the degree of Master of Science in two or three years, according to the extent and character of their previous training.

The following regulations respecting the Course in Geology have been adopted by the Faculty:

1. Students in this Course shall be required to take all the studies of the first year as in Course III.

2. In the second year the course of study shall follow closely that laid out for Options 1 and 3, of Course III, but students are advised to confer with the Geological Department regarding the substitution of German L31, General Biology 702, and Zoölogy 705 for other subjects in that schedule.

3. Surveying shall be taken as in Course III, Options 1 and 3.

4. In the third year the students shall take the subjects required of all third-year students and in addition shall take a course in French. The remainder of their third-year schedule shall be arranged in consultation with the Geological Department. The schedule as arranged should be submitted to the Faculty for approval before the close of the second year.

5. Not later than April 1st of the third year, students in this Course shall submit to the faculty for approval a course of study for the fourth year arranged after consultation with the members of the Department of Geology. The subjects chosen shall be in the main geologic in character but may give preference to one or more special lines of geologic science, such as mineralogy, petrology, stratigraphic geology and paleontology, economic geology, or physiography.

6. The third-year subjects, required of all students referred to under section 4 above, are — first term: Physics 802, Physical Laboratory 808, Political Economy Ec31 and General Studies; second term: Business Law Ec60 and General Study.

During the summer between the third and fourth years, summer work in geology is advised. This work may advantageously lead to a thesis in the fourth year.

XIII. — NAVAL ARCHITECTURE AND MARINE ENGINEERING

The Course in Naval Architecture and Marine Engineering provides instruction in the theory and methods of designing and building ships, together with a study of the properties requisite for safety and steadiness at sea. It aims to furnish a well-rounded training for those who expect to be ship-builders, ship-designers, ship-managers, or marine engine builders, or who desire to enter allied industries.

In addition to the literary, mathematical, and scientific studies requisite for a general training and for preparation for the special work of the Course, instruction is given in mechanism, thermodynamics, applied mechanics, hydraulics, heat engineering, steam turbines, and marine engineering. It is believed that a proper coördination of the design of a steamship and its propelling machinery can be attained only by a naval constructor who is familiar with both branches of his profession.

Lectures are given on theoretical naval architecture and marine engineering; treating of displacement and stability, launching, theory of waves, rolling of ships, strength of ships, propulsion of ships, steering and manoeuvering, and adjustment of compasses; and also of power, proportion and strength of marine engines, and the application of steam turbines to marine propulsion.

After preliminary instruction in ship-drawing, each student carries through the design of a ship and its machinery for a given service in a systematic manner as in good practice, giving attention both to the logical development of the design and to the requirements for registration, for insurance and governmental inspection. Drawings and all customary computations are made of the structure and arrangements of hull, engines and propellers. The student makes a model, lays out plating and draws up specifications. To explain and unify the work of design, lectures are given on the materials and methods of construction of ships of wood and of steel, and on ventilation and drainage. Further description of the subjects of instruction and of the equipment of the Department will be found on pages 310 to 316, and 380.

For description and schedule of a Graduate Course in Aëronautical Engineering see pages 154 and 155.

XIII. — NAVAL ARCHITECTURE AND MARINE ENGINEERING

First Year, page 85. Description of Subjects of Instruction, pages 184 to 352.

Second Year

FIRST TERM	Hours Ex. Prep.
Mechanism (200)	45 – 75
Mechanical Engineering Drawing (206)	75 – 0
Descriptive Geometry (D21)	45 – 0
Forging (284)	30 – 0
Mathematics (M21)	45 – 90
Physics (801)	90 – 75
Physical Laboratory (807)	30 – 30
Applied Chemistry (585)	15 – 15
English (E21)	30 – 30

SECOND TERM	Hours Ex. Prep.
Ship Construction (1331)	20 – 20
Ship Drawing (1341)	30 – 0
Mechanism (200)	20 – 40
Mechanical Engineering Drawing (206) and Surveying Instruments (101)	30 – 0
Applied Mechanics (215)	45 – 85
Forging (284)	30 – 0
Mathematics (M22)	45 – 90
Physics (801)	75 – 60
Physical Laboratory (807)	30 – 20
Precision of Measurements (803)	10 – 10
English (E22)	30 – 30

Summer Reading, see page 133.

Third Year

FIRST TERM	Hours Ex. Prep.
Naval Architecture (1301)	30 – 60
Ship Design (1342)	75 – 0
Heat Engineering: Thermodynamics (245)	30 – 60
Applied Mechanics (216)	45 – 90
Mathematics (M31)	45 – 90
History II (H31)	30 – 30
Political Economy (Ec31)	45 – 45
General Studies (see page 132)	45

SECOND TERM	Hours Ex. Prep.
Naval Architecture (1301)	30 – 55
Ship Construction (1332)	20 – 20
Ship Design (1342)	90 – 0
Heat Engineering (245)	60 –120
Engineering Laboratory (260)	20 – 5
Applied Mechanics (225)	30 – 60
Physical Metallurgy (508)	15 – 15
Foundry (287)	45 – 0
Vise and Bench Work (290)	30 – c
Business Law (Ec60)	15 – 15
General Studies (see page 132)	75

Fourth Year

FIRST TERM	Hours Ex. Prep.
Naval Architecture (1302)	30 – 60
Ship Design (1343)	80
Model Making (1395)	25 – 0
Ventilation and Drainage (1333)	30 – 30
Applied Mechanics (229)	45 – 90
Testing Materials Laboratory (237)	20 – 10
Hydraulics (163)	15 – 30
Engineering Laboratory (261, 532)	60 – 30
Elements of Electrical Engineering (619)	30 – 30
Electrical Engineering Laboratory (687)	30 – 30
Machine-tool Work (291)	45 – 0

SECOND TERM	Hours Ex. Prep.
Naval Architecture (1302)	15 – 30
Ship Design (1343)	120 – 0
Marine Engineering (1351)	30 – 60
Marine Engine Design (1352)	90 – 0
Marine Steam Turbines (1360)	30 – 60
Engineering Laboratory (261, 814)	60 – 30
Sanitary Science and Public Health (756)	15 – 0
Machine-tool Work (291)	60 – 0
Thesis	120

XIII A. — NAVAL ARCHITECTURE (*continued*)

Course for Naval Constructors

The Massachusetts Institute of Technology has been selected by the United States Department of the Navy to give professional instruction to officers designated for the Corps of Naval Constructors. For the satisfactory completion of this Course the degree of Master of Science is given.

In arranging this Course the objects sought are the addition to the training already obtained at the Naval Academy of those subjects which are peculiar to naval architecture, and such an extension and rounding out of that training as will best enable a naval constructor to meet the varied and exacting demands of his official position. The Course includes all the theoretical naval architecture of the regular four-year Course, together with lectures on advanced or special subjects relating to naval architecture and marine engineering. Other subjects selected from the regular Course are marine engineering, heat engineering, marine steam turbines, and applied mechanics. Throughout the three years instruction is given in warship design by means of lectures and drawing. The Course is broadened and strengthened by courses on sanitation, metallurgy, and theory of structures. A thorough course is given in electrical engineering, with adequate training in the Physical and Electrical Engineering Laboratories. Lectures are given in aëronautical engineering dealing with the theory and construction of aëroplanes and airships. An extended course is given in industrial management and industrial accounting as applied to navy yards.

The first and second years of the following schedule of the Course for Naval Constructors correspond respectively to the third and fourth years of Course XIII; the third year corresponds to graduate work in other departments, and leads to the degree of Master of Science.

XIII A. — NAVAL ARCHITECTURE

Course for Naval Constructors

DESCRIPTION OF SUBJECTS OF INSTRUCTION, PAGES 184 TO 352.

Junior Year [1]

FIRST TERM	Hours Ex. Prep.
Naval Architecture (1301)	30 – 60
Theory of Warship Design (1311)	30 – 30
Warship Design, preliminary work (1321)	105
Electrical Machinery (613)	45 – 90
Electrical Engineering Laboratory (684)	30 – 30
Mathematics (M36)	60 –120
Metallurgy (332)	45 – 45

SECOND TERM	Hours Ex. Prep.
Naval Architecture (1301)	30 – 60
Theory of Warship Design (1311)	30 – 30
Warship Design (1321)	120
Marine Steam Turbine (1360)	30 – 60
Electrical Machinery (614)	45 – 90
Internal Combustion Engines (251)	20 – 20
Electrical Engineering Laboratory (685)	30 – 30
Mathematics (M38)	30 – 60
Precision of Measurements (803)	10 – 10
Sanitary Science (756)	15 – 0

Senior Year [2]

FIRST TERM	Hours Ex. Prep.
Naval Architecture (1302)	30 – 60
Theory of Warship Design (1312)	30 – 30
Warship Design (1322)	90 – 0
Model Making (1395)	30 – 0
Electrical Machinery (613)	45 – 90
Electrical Engineering Laboratory (684)	30 – 30
Factory Management (H. U.)	65 – 65
Accounting, Principles of (H. U.)	45 – 90

SECOND TERM	Hours Ex. Prep.
Theory of Warship Design (1312)	30 – 30
Warship Design (1322)	105 – 0
Shipyard Practice (1314)	30 – 30
Electrical Machinery (614)	45 – 90
Electrical Engineering Laboratory (685)	30 – 30
Structures (145)	105 – 90
Accounting, Principles of (H. U.)	45 – 90

Graduate Year [2]

FIRST TERM	Hours Ex. Prep.
Theory of Warship Design (1313)	30 – 30
Warship Design (1323)	90 – 0
Marine Engineering (1355)	30 – 30
Marine Engine Design (1353)	90 – 45
Engineering Laboratory (261)	60 – 30
Alternating Current Machinery (623)	45 – 45
Electrical Engineering Laboratory (685)	45 – 45
Economics of Corporations (Ec41)	30 – 30
Public Speaking (E39)	30 – 15

SECOND TERM	Hours Ex. Prep.
Theory of Warship Design (1313)	30 – 30
Warship Design (1323)	90 – 0
Industrial Applications of Electrical Power (635)	30 – 60
Theory of Structures (145)	105 – 90
Industrial Management (274)	15 – 15
Business Law (Ec60)	15 – 15
Memoirs (1305)	15 – 35
Thesis	120

[1] The three years of this Course correspond respectively to the third, fourth, and graduate years of Course XIII.

[2] For 1916–1917 only.

XIII B. — NAVAL ARCHITECTURE *(continued)*

Course in Naval Construction

The Massachusetts Institute of Technology now offers a full five-year Course in Naval Construction open to all students. The Course is parallel to that provided for United States Naval Constructors, differing mainly in that it articulates with the first two years of the regular four-year Course in Naval Architecture and Marine Engineering. Instruction is given by the same professors and instructors and the Course is of the grade of Course XIIIA.

The Course gives a good scientific and liberal education with adequate instruction in mathematics, chemistry, physics, applied mechanics, heat engineering, and laboratory practice.

The more strictly professional work consists of naval architecture, naval construction and marine engineering (including steam turbines and internal combustion engines). Each student makes a design for a warship and its machinery; he makes supplementary calculations, such as those for launching, and makes and lays out a plating model and takes instruction in mold-loft work.

Courses are given in electrical engineering, the theory of structures and aëronautical engineering. This last subject is included both for its present importance and its relation to naval architecture.

The Department has in its possession an extensive collection of drawings, designs and other material so arranged as to facilitate instruction in the theory and practice of naval construction in the best manner.

The first two years of the Course are the same as those for Course XIII and the last three years correspond to the three years on page 123 for Course XIIIA.

XIII B. — NAVAL ARCHITECTURE

Course in Naval Construction

FIRST YEAR, PAGE 85. CHINESE AND JAPANESE STUDENTS SUBSTITUTE ENGLISH (E10) FOR GERMAN (L21).

SECOND YEAR, PAGE 121. SAME AS FOR COURSE XIII.

DESCRIPTION OF SUBJECTS OF INSTRUCTION, PAGES 184 TO 352.

Third Year

FIRST TERM	Hours Ex. Prep.
Naval Architecture (1301)	30 – 60
Theory of Warship Design (1311)	30 – 30
Warship Design (1321)	90 – 0
Heat Engineering (245)	30 – 60
Applied Mechanics (216)	45 – 90
Mathematics (M31)	45 – 90
History II (H31)	30 – 30
General Studies (see page 132)	45

SECOND TERM	Hours Ex. Prep.
Naval Architecture (1301)	30 – 55
Theory of Warship Design (1311)	30 – 30
Warship Design (1321)	120 – 0
Heat Engineering (245)	60 –120
Engineering Laboratory (260)	20 – 5
Applied Mechanics (226)	30 – 60
Foundry (287)	45 – 0
Business Law (Ec60)	15 – 15
General Studies (see page 132)	75

Fourth Year

FIRST TERM	Hours Ex. Prep.
Naval Architecture (1302)	30 – 60
Theory of Warship Design (1312)	30 – 30
Warship Design (1322)	90 – 0
Model Making (1305)	30 – 0
Ventilation and Drainage (1333)	30 – 30
Hydraulics (163)	15 – 30
Testing Materials Laboratory (237)	20 – 10
Engineering Laboratory (261, 532)	60 – 30
Applied Mechanics (229)	45 – 90
Political Economy (Ec31)	45 – 45

SECOND TERM	Hours Ex. Prep
Naval Architecture (1302)	15 – 30
Theory of Warship Design (1312)	30 – 30
Warship Design (1322)	120 – 0
Steam Turbines (1360)	30 – 60
Aëronautics (1372)	30 – 60
Internal Combustion Engines (251)	20 – 20
Engineering Laboratory (261, 814)	60 – 30
Elements of Electrical Engineering (616)	30 – 30
Metallurgy (332)	45 – 45
Vise and Bench Work (290)	30 – 0

Fifth Year

FIRST TERM	Hours Ex. Prep.
Theory of Warship Design (1313)	30 – 30
Warship Design (1323)	90
Marine Engines (1355)	30 – 60
Marine Engine Design (1353)	120 – 0
Marine Boilers	30 – 60
Hydrodynamics (M57)	20 – 40
Elements of Electrical Engineering (617)	30 – 30
Electrical Engineering Laboratory (687)	45 – 45
Machine-tool Work (291)	45 – 0

SECOND TERM	Hours Ex. Prep.
Theory of Warship Design (1313)	30 – 30
Warship Design (1323)	120
Aëronautics (1373)	30 – 60
Sanitary Science and Public Health (756)	15 – 15
Theory of Structures (145)	105 – 90
Industrial Management (274)	10 – 10
Machine-tool Work (291)	60 – 0
Thesis	120

XIV. — ELECTROCHEMISTRY

The Course in Electrochemistry aims primarily to prepare students to enter the various electrochemical and electrometallurgical industries which are being so rapidly developed at the present time. The instruction given in this Course is, however, of so broad a character that students completing it should be well prepared to undertake various lines of purely electrical and chemical work other than electrochemistry, if they so desire.

Its main features are a very thorough training in electrical and chemical subjects, which extend throughout the whole Course, and the distinctly professional work in electrochemistry, which runs through the fourth year. The electrical studies are similar to those taken by students in Electrical Engineering, and include courses in the theory of direct and alternating currents, courses in direct and alternating current generators and motors and power transmission, with practice in the Laboratories of Electrical Engineering and Electrical Testing. The instruction in chemistry is devoted chiefly to courses in analytical, theoretical, organic, and industrial chemistry. In addition to these subjects are included shorter courses in gas analysis, assaying, and metallurgical laboratory, and courses in mechanism and steam engineering.

The work in electrochemistry extends throughout the fourth year. During the first term the theory of the subject is taken up in a course of lectures which are accompanied by extended laboratory practice in electrochemical measurements. In the second term the instruction is continued by lectures on applied electrochemistry, including electro-deposition, accumulators, electric furnaces, and their products, electrolytic processes, and electrometallurgy, and by work in the Laboratory of Applied Electrochemistry. Current periodical literature is reviewed in a weekly colloquium. The thesis required is also on some electrochemical topic.

Beyond the alternative studies indicated in the Course Schedule, a certain further liberty of substitution in the fourth year may be allowed by the Faculty in the case of students who are fitting themselves for some special line of work.

XIV. — ELECTROCHEMISTRY

First Year, page 85. Description of Subjects of Instruction, pages 184 to 352.
Summer Work: Qualitative Analysis (511).

Second Year

FIRST TERM	Hours Ex. Prep.
Physics (801)	90 – 75
Physical Laboratory (807)	30 – 30
Quantitative Analysis (512)	120 – 15
Mathematics (M21)	45 – 90
Mechanical Engineering Drawing (207)	30 – 0
Metal-turning (294)	30 – 0
German (L32)	45 – 60
English (E21)	30 – 30

SECOND TERM	Hours Ex. Prep.
Physics (801)	75 – 60
Physical Laboratory (807)	30 – 30
Precision of Measurements (803)	10 – 10
Quantitative Analysis (513)	100 – 15
Gas Analysis (531)	20 – 10
Applied Mechanics (215)	45 – 90
Mathematics (M22)	45 – 90
Metal-turning (294)	30 – 0
English (E22)	30 – 30

Summer Reading, see page 133.

Third Year

FIRST TERM	Hours Ex. Prep.
Principles of Electrical Engineering Ia, IIa (609)	75 –115
Electrical Engineering Laboratory I (671)	60 – 50
Theoretical Chemistry I (565)	45 – 75
Organic Chemistry (550)	30 – 30
Fire Assaying (322)	30 – 15
Political Economy (Ec31)	45 – 45
History II (H31)	30 – 30
General Studies (see page 132)	45

SECOND TERM	Hours Ex. Prep.
Principles of Electrical Engineering III (603)	60 – 75
Electrical Engineering Laboratory II (678)	30 – 30
Theoretical Chemistry I (565)	45 – 75
Organic Chemical Laboratory (557)	75 – 0
Heat Measurements (813)	30 – 15
Mechanism (201)	30 – 60
Mathematics (M32)	30 – 60
Business Law (Ec60)	15 – 15
General Studies (see page 132)	75

Fourth Year

FIRST TERM	Hours Ex. Prep.
Electrochemistry (882)	45 – 45
Electrochemical Laboratory (886)	105 – 15
Alternating Current Machinery (623)	45 – 45
Electrical Engineering Laboratory (679)	70 – 40
Electric Transmission and Distribution of Power (633)	30 – 45
Heat Engineering (248)	30 – 60
Industrial Chemistry I (575)	45 – 45
Metallurgical Laboratory and Reports (352, 356)	30 – 0
Colloquium (855)	25

SECOND TERM	Hours Ex. Prep.
Applied Electrochemistry (885)	30 – 60
Electrochemical Laboratory (887)	45 – 30
Physical Metallurgy (508)	15 – 15
Heat Engineering (248)	30 – 60
Industrial Chemistry I (575)	45 – 45
Colloquium (855)	15 – 15
Thesis.	
Options	
1. Electrical Engineering Laboratory (680)	35 – 30
2. Industrial Chemistry II (587)	45 – 45

XV. — ENGINEERING ADMINISTRATION

The Course in Engineering Administration provides a training for men who expect to enter positions concerned with the management or administration of manufacturing, construction, and transportation enterprises which demand a knowledge of scientific and engineering principles. It combines with instruction in general engineering studies in the methods, economics, and law of business. The course includes (1) the instruction common to all Courses, in literature, language, and history, and in chemistry, physics, and mathematics; (2) a choice of engineering studies classified under three options: Civil Engineering, Mechanical and Electrical Engineering, Chemical Engineering; and (3) a selected group of subjects in business and economics. While the amount of time assigned to engineering subjects is less than that prescribed in the other Courses of the Institute, the fundamental subjects have been retained which will enable graduates to fill many of the positions open to engineers.

Approximately one fourth of the total time of the curriculum is given to business subjects which are primarily chosen so as to train students to analyze commercial and industrial problems. In this group special emphasis is placed upon accounting, business law, the industrial organization of society, and business management. The course in Accounting is designed to be of service to administrative officers in the analysis of accounts and financial reports, rather than to make bookkeepers, auditors, or accountants in a technical sense. Business Law treats of contracts, agency, negotiable instruments, sales, and patents. The two extended subjects of Industrial Organization and Business Management deal with the financial operations of corporations and the conduct of business from the standpoint of the individual employer. Among other subjects included in the group of business studies are banking, statistics, report writing, transportation, and securities and investments.

Civil Engineering Option. The Civil Engineering Option is intended to meet the needs of students expecting to enter upon administrative positions in organizations engaged in transportation or the construction of works pertaining thereto, or in the development and distribution of hydraulic power. The Course

XV. — ENGINEERING ADMINISTRATION

First Year, page 85. Description of Subjects of Instruction, pages 184 to 352.
Option 3. Summer Course in Qualitative Analysis (511).

Second Year

FIRST TERM	Hours Ex. Prep.
Mathematics (M21)	45 – 90
Physics (801)	90 – 75
Physical Laboratory (807)	30 – 30
Political Economy (Ec32)	45 – 45
German [1] (L33)	30 – 45
English (E21)	30 – 30
Options	
1. Mechanism (201)	30 – 60
1. Descriptive Geometry (D21)	45 – 0
2. Mechanism (201)	30 – 60
2. Descriptive Geometry (D21)	45 – 0
3. Quantitative Analysis (512)	120 – 15

SECOND TERM	Hours Ex. Prep.
Accounting (Ec50)	45 – 45
Banking (Ec37)	45 – 60
Physics (801)	75 – 60
English (E22)	30 – 30
Options	
1. Applied Mechanics (215)	45 – 90
1. Surveying (102)	30 – 0
1. Mathematics (M22)	45 – 90
1. Physical Laboratory (807)	5 – 5
1. Precision of Measurements (803)	10 – 10
2. Applied Mechanics (215)	45 – 90
2. Mathematics (M22)	45 – 90
2. Physical Laboratory (807)	20 – 20
2. Precision of Measurements (803)	10 – 10
3. Quantitative Analysis (513)	120 – 15
3. Mechanism (201)	30 – 60
3. Foundry Work (287)	45 – 0
3. Physical Laboratory (807)	20 – 20
3. Precision of Measurements (803)	10 – 10

Summer Reading, see page 133.
Option 1. Summer Course in Surveying at Camp, see page 139.
Option 2. Summer Courses in Surveying (100) and Mechanic Arts (297).

Third Year

FIRST TERM	Hours Ex. Prep.
Industrial Organization (Ec56)	30 – 60
Statistics (Ec65)	60 – 0
Report Writing (E33)	30 – 30
Heat Engineering (247)	45 – 90
History II (H31)	30 – 30
Options	
1. Applied Mechanics (217)	60 – 90
1. Railroad Engineering (121)	20 – 40
1. Elements of Electrical Engineering (619)	30 – 30
1. Electrical Engineering Laboratory (681)	15 – 30
2. Applied Mechanics (216)	45 – 90
2. Elements of Electrical Engineering (615)	45 – 75
2. Machine Drawing (208)	60 – 0
2. Theoretical Chemistry I (565) Lect.	55 – 75
2. Theoretical Chemistry I (565) Lab.	20 – 15
3. Organic Chemistry (550)	30 – 30
3. Mechanical Engineering Drawing (207)	45 – 0
3. Metal Turning (295)	45 – 0

SECOND TERM	Hours Ex. Prep.
Industrial Organization (Ec56)	45 – 45
Transportation (Ec35)	30 – 45
Securities and Investments (Ec38)	45 – 45
Heat Engineering (247)	45 – 60
English (E34)	45 – 75
Options	
1. Structures (140)	45 – 90
1. Railroad Engineering (121)	20 – 20
1. Materials (143)	30 – 35
2. Applied Mechanics (225)	45 – 90
2. Mechanical Engineering Drawing (209)	105 – 0
2. Theoretical Chemistry I (565) Lect.	55 – 75
2. Theoretical Chemistry I (565) Lab.	20 – 15
3. Organic Chemistry Laboratory (557)	75 – 0

[1] Students taking Civil Engineering Option may substitute one year of Spanish for German.

differs from the regular Civil Engineering Course by the substitution of business subjects for some of the more descriptive optional subjects of the fourth year and for the following subjects of earlier years: astronomy, geodesy, geology, highway engineering, railroad drawing, stereotomy, and topographical drawing. The graduates of this option are, however, well trained in the fundamental principles and professional subjects upon which the practice of civil engineering depends.

Mechanical and Electrical Engineering Option. The Option in Mechanical and Electrical Engineering is planned to give a training in a sufficient number of the fundamental engineering subjects to make its graduates competent to deal with engineering affairs other than the direct design and construction of plants. It includes many of the important subjects given in the regular Course in Mechanical Engineering, omitting, however, certain of the more specialized subjects. The option differs from the Course in Electrical Engineering in that less attention is given to design and to the more theoretical parts of electrical engineering, the aim being to give the students a general knowledge, which, together with the laboratory practice, should make them capable of employment in the operating or in directing the operating of electrical plants.

Chemical Engineering Option. The Chemical Engineering Option affords instruction in the more important branches of chemistry and in the fundamental principles of mechanical engineering. The time devoted in this option to organic chemistry is much less, and that devoted to the other branches of chemistry is somewhat less than in the Chemical Engineering Course. The training is, however, adequate to fit capable students to take many of the positions open to graduates of Courses V and X. The instruction in mechanical and electrical engineering is also less extended than that in the Chemical Engineering Course. The primary purpose of the option is to give the information and training necessary to prepare men to deal with the economic administration rather than with the scientific development and control of the processes involved in the industries devoted to the manufacture of materials, such as textiles, paper, leather, rubber, fertilizers, iron and steel, foods, and chemicals.

XV. — ENGINEERING ADMINISTRATION *(continued)*

DESCRIPTION OF SUBJECTS OF INSTRUCTION, PAGES 184 TO 352.

Fourth Year

Option 1, Civil Engineering

FIRST TERM	Hours Ex. Prep.
Cost Accounting (Ec51)	45 – 45
Business Management (Ec58)	45 – 75
Business Law (Ec61)	30 – 60
Taxation (Ec70)	15 – 15
Structures (149)	45 – 90
Railroad Engineering (125)	30 – 60
Theoretical Hydraulics (164)	30 – 60
Testing Materials Laboratory (236)	30 – 0
Foundations (148)	15 – 30

SECOND TERM	Hours Ex. Prep.
Business Management (Ec58)	60 –110
Business Law (Ec61)	30 – 60
Structures (149)	45 – 90
Structural Design (155)	75 – 0
Hydraulic Engineering (169)	30 – 60
Hydraulic Laboratory (172)	15 – 5
Sanitary Science (756)	15 – 0
Thesis	125

Option 2, Mechanical and Electrical Engineering

FIRST TERM	Hours Ex. Prep.
Cost Accounting (Ec51)	45 – 45
Business Management (Ec58)	45 – 75
Business Law (Ec61)	30 – 60
Taxation (Ec70)	15 – 15
Machine Design (267a)	90 – 0
Theoretical Hydraulics (164)	30 – 60
Testing Materials Laboratory (235)	30 – 0
Electric Transmission and Distribution of Power (633)	30 – 60
Electrical Engineering Laboratory (687)	45 – 45

SECOND TERM	Hours. Ex. Prep.
Business Management (Ec58)	60 –110
Business Law (Ec61)	30 – 60
Machine Design (267a)	60 – 0
Hydraulic Engineering (169)	30 – 60
Engineering Laboratory (262)	60 – 30
Central Stations (638)	30 – 60
Thesis	130

Option 3, Chemical Engineering

FIRST TERM	Hours Ex. Prep.
Cost Accounting (Ec51)	45 – 45
Business Management (Ec58)	45 – 75
Business Law (Ec61)	30 – 60
Taxation (Ec70)	15 – 15
Industrial Chemistry I (575)	45 – 90
Applied Mechanics (215)	60 –105
Engineering Laboratory (262)	60 – 30

SECOND TERM	Hours Ex. Prep.
Business Management (Ec58)	60 –110
Business Law (Ec61)	30 – 60
Industrial Chemistry II (587)	105 – 15
Elements of Electrical Engineering (618)	30 – 30
Electrical Engineering Laboratory (687)	45 – 45
Thesis	190

OPTIONS IN GENERAL STUDIES

All students in regular Courses in the third year, except in Course XV, are required to devote forty-five hours during the first term and seventy-five hours during the second term to elective work in general studies. The division of this time between exercises and preparation varies for the different subjects. The choice of subjects is to be made from the following list of options:

Economics

FIRST TERM	Hours Ex. Prep.	SECOND TERM	Hours Ex. Prep.
Economic History (Ec33)	15 - 30	Railroad Economics (Ec34)	45 - 30
		Banking and Finance (Ec36)	45 - 30
		Labor Problems (Ec45)	45 - 30

English

Public Speaking (E57)	30 - 15	English Literature of the Nineteenth Century (E52)	45 - 30
Shakespeare's Plays (E51)	30 - 15		
The English Bible (E53)	30 - 15	English Composition Advanced (E56)	30 - 45
		Argumentation and Debate (E58)	45 - 30

Modern Languages

	Hours Ex. Prep.		Hours Ex. Prep.
German (L41)	15 - 30	German (L41)	30 - 45
German (L42)	15 - 30	German (L42)	30 - 45
German (L43)	30 - 15	German (L44)	30 - 0
French (L71)	15 - 30	German (L45)	30 - 45
French (L72)	15 - 30	German (L46)	30 - 45
French (L73)	30 - 15	German (L47)	15 - 30
		French (L71)	15 - 30
		French (L72)	15 - 30
		French (L74)	30 - 0

History and Science

Current Public Problems (H37)	15 - 30	History of Science (790)	30 - 45
History of Science (790)	15 - 30	General Geology (1233)	45 - 30

The object of these options is to promote breadth of intellecual interest. Most of the student's time beyond the second

year is devoted directly, or indirectly, to increasing his future professional efficiency. Even in the earlier years this has been the underlying purpose of most of the work.

Without attempting any discrimination between general and professional, or liberal and technical studies, the Faculty has aimed to include in the list of third-year options subjects so far removed from the professional field that the student shall acquire in some measure new points of view and a wider mental horizon. Even subjects which have an implied relationship to the professional fields are presented with such emphasis on their broader general aspects as to serve the purpose indicated.

Students are allowed to exercise entire freedom of choice among these subjects, except that General Geology is not counted as an option in Courses I, III, Option 1 and 3, V, Option 2, VII, XI, XII.

Students will be expected to choose their general study option for the following term in May and in December. Subject to the approval of the heads of their Departments, fourth-year students also will be admitted to these options in general studies without requirement as to examination.

SUMMER READING

All students who are candidates for the Bachelor's degree of the Institute are required by the Faculty to complete prescribed courses of reading of a non-professional character during the summers following the first and the second school-years. A statement of the works read during the summer is required at the beginning of the next school-year. The first-year reading is advantageous as preparation for the course in English of the second year.

The purposes of these courses are to increase the acquaintance of the student with literature, history, and general science, to develop in him a taste for such reading, and to impress him with the importance of general culture, not only as a source of individual enjoyment, but as a practical aid to professional men in their social and business relations.

A circular on Summer Reading is issued each year, containing

a list of the required reading, and a supplementary list in which additional books are recommended to the attention of students. The books in both lists are selected for their value from the point of view of general training, and the attempt is made to include only readable and attractive works.

Summer Courses

The Institute offers courses of instruction during the months of June, July, August, and September, supplementing the work of the regular school year. The requirements for admission, and in general the work performed and the final examinations are expected to correspond to those of the regular school year, and similar records and reports will be given. In case such a final record is based on an examination, no student taking the examination for the purpose of making up a condition will be entitled to admission also to the September examination in the same subject.

Summer Courses are undertaken primarily for the benefit of two classes of students: first, for those who wish to prolong their stay in summer, in order to distribute their work over a large portion of the year, or to gain more time for advanced work in their regular courses — time especially valuable in the fourth year, when original investigations and the examination of professional problems form an important part of their occupations; and second, for those who, through illness or for other causes, have deficiencies to make up. The continuity of effort and freedom from interruption made possible by summer work are of particular value in many of the laboratory courses.

The Summer Courses are open also to persons not students in the Institute, if they possess the necessary qualifications. They are of particular advantage to persons planning to enter the Institute, whether with or without advanced standing. Applicants for admission to the first year may take French or German. College graduates or others desiring to enter the second or third year will find it greatly to their advantage to make up deficiencies in Mathematics, Drawing, etc., in this way, and they are advised to communicate as early as possible with the Secretary of the Faculty with reference to plans of study.

SCHEDULE OF SUMMER COURSES

Offered in 1916

Architecture.

(*a*) Shades and Shadows (411)
(*b*) Design I (471)
(*c*) Design II (472)

Biology and Public Health.

(*a*) General Bacteriology
(*b*) Microscopy and General Biology
(*c*) Hygiene and Sanitation
(*d*) Municipal Sanitation
(*e*) Principles of Sanitation
(*f*) Microscopy of Drinking Water and Limnology

Chemistry.

(*a*) Qualitative Analysis (511) (Required Summer Course)
(*b*) Inorganic Chemistry (501, 502)
(*c*) Qualitative Analysis (511)
(*d*) Quantitative Analysis (512)
(*e*) Quantitative Analysis (513)
(*f*) Organic Chemistry (556, 557)
(*g*) Industrial Chemistry II (587)

Civil Engineering.

(*a*) Surveying (100)
(*b*) Structures (140)
(*c*) Theoretical Hydraulics (162)
(*d*) Summer Surveying Camp (Required Summer Course)

Drawing.

(*a*) Mechanical Drawing and Descriptive Geometry

Electrical Engineering.

(*a*) Principles of Electrical Engineering (612)
(*b*) Electrical Engineering Laboratory

English.

(*a*) English I (Composition)
(*b*) English II (English Literature through Milton)
(*c*) English III (English Literature since Milton)

Mathematics.

(*a*) Mathematics (Solid Geometry)
(*b*) Mathematics (Entrance Algebra B)
(*c*) Mathematics (M12)
(*d*) Mathematics (M21)
(*e*) Mathematics (M22)
(*f*) Mathematics (M35) and (M31)

Mechanical Engineering.

(*a*) Mechanism (200, 201)
(*b*) Mechanical Engineering Drawing (206, 207, 208, 209)

Mechanic Arts.

(*a*) Woodwork and Pattern Making (289)
(*b*) Forging (284)
(*c*) Vise and Bench Work (290)
(*d*) Machine-Tool Work (291)
(*e*) Metal Turning (294)

Mechanics.

(*a*) Applied Mechanics (215)

Modern Languages.

(*a*) German (Elementary) (L11)
(*b*) German (Intermediate) (L21)
(*c*) German (Advanced)
(*d*) French (Elementary)
(*e*) French (Intermediate) (L62)

Physics.

(*a*) Mechanics, Optics, Electricity and Heat (801)
(*b*) Precision of Measurements (803)
(*c*) Physical Laboratory (Mechanics, Light and Heat) (807, 808)
(*d*) Physical Laboratory; Recitations (806)

Persons desiring instruction in subjects not included in the foregoing schedule may make application to the Secretary of the Faculty. Courses likely to be of special value to persons desiring admission with advanced standing will not begin, as a rule, until July, and in other cases arrangements for delayed admission will be made if practicable.

Requirements for Admission. — The requirements for admission to the various courses are the same as those stated for the corresponding courses in the Subjects of Instruction, pages 171 to 352, except that Chemistry (b) is open only to students who have had lecture-room instruction of college grade. Applicants not already connected with the Institute should correspond with the Secretary of the Faculty in regard to their qualifications.

Applications for admission to any of the courses should be made to the Registrar, at a date as early as possible before the beginning of the course. In general, courses will not be given unless at least six applications have been received before June 10.

Registration and Fees. — Each student will be required to register in advance at the Registrar's office for every course he

desires to attend. Admission will be contingent upon approval of attendance cards.

A fee of $25 for each course (with certain exceptions noted in the special circular) will be collected by the Bursar at the time fixed for beginning the course. For one-half or any smaller portion of a course the fee will be three-fifths that of the full course, and for any fraction of a course greater than one-half the full fee will be charged. For the courses in the Chemical or Mining Laboratories a deposit of $20 will be required, to cover the cost of gas, water, and chemicals, as well as a charge for apparatus damaged or destroyed; and in the Mechanical Laboratories additional charges will be made for materials, power, and service. Attendance at the Summer Surveying Camp is required of all students in Courses I, III, Options 1, 3, XI, XII, and XV, Option 1. For information concerning tuition see page 140.

A special circular (issued in April) giving full details in regard to dates and subjects will be sent on application. A circular describing the Summer Surveying Camp may also be obtained on application.

Professional Summer Schools

To bring the students into closer relations with the practical side of their professions, professional summer schools are held in the Departments of Civil Engineering, Mining Engineering and Metallurgy, Chemistry, and Geology. The students, accompanied by instructors, give their time to field-work or visit and report on mines or industrial establishments.

Summer School of Civil Engineering. — With the exception of brief courses in the manipulation and use of the tape, compass, transit and level, the entire field-work in surveying and railroad engineering is given at the Technology Summer Camp on the shore of Gardner's Lake near the village of East Machias, Maine. This locality is well adapted for the carrying out of all the operations involved in the various problems of plane surveying; for performing the field-work necessary for the making of large and small scale topographic maps; and for the making of railroad location surveys. Gardner's Lake is specially favorable for carrying on the field-work necessary to hydrographic surveying. The Machias and East Machias Rivers are available for stream gaging, by means of floats and by the various types of meters. Some of the smaller streams afford opportunity for weir measurements.

The camp property comprises about eight hundred and fifty acres of rolling land in the form of a strip varying in width from one-fourth to one mile with a shore line of five miles on the lake. The principal structure consists of a central administration building, connected by covered passageways with two other buildings. The central building contains class-rooms, offices, a few sleeping rooms, and a general reading and assembly room. On either side of the central building are one-story wings, one of which contains a drafting-room furnishing accommodations for seventy-two students, and the other a dining-room with seating space for one hundred and sixty-eight, kitchen, lavatory and other necessary service rooms. The sleeping accommodations consist of a group of tents

with raised wooden floors, each furnished with two cots and other necessary equipment for camp life. Sanitary accommodations of the most approved type, and a wholesome water supply are provided. A physician is in constant attendance throughout the camp session.

The camp is primarily intended for students of Courses I, III, Options, 1, 3, XI, XII, and XV, Option 1, who are required to attend during the months of August and September following their sophomore year. A limited number of students from other courses having the requisite preparation may be admitted by petition.

No additional charge for tuition will be made to Institute students. Others, not connected with the Institute, may be admitted with the approval of the Faculty upon payment of a tuition fee of $50 which will be remitted in case of later registration as Institute students and payment of full tuition for two years. The cost of camp operation and maintenance is shared equally by those in attendance.

Summer School of Surveying. — Students in Courses VI and XV, Option 2, are required to take the course in Surveying 100 during the two weeks immediately following their second year. The instruction is given in Boston and vicinity. No fee is charged.

Summer School of Chemistry. — The course in Qualitative Analysis 511 as given in Courses III, Option 2, V, X, XIV, and XV, Option 3, is given in the summer, and attendance is required of all students in these Courses. The summer work begins immediately after the close of the first year, and lasts for six weeks. The instruction includes both class-room and laboratory work and is given under conditions which permit of a greater concentration of thought and energy, and a greater freedom from interruption than is possible during the two regular terms. No extra charge for tuition is made in the case of Institute students intending to enter the second year of Courses III, Option 2, V, X, XIV, or XV, Option 3, and the course is open only to such students. The usual deposit with the Bursar to cover chemical breakage is required.

Summer Schools of Mining and Metallurgy. — In order to bring the students of mining and metallurgy into closer touch with practice, there are organized traveling Summer Schools for the study of geological fields, mines, mills and smelting works, and a

Summer Camp of Mining. Opportunities are also offered to students for practical work in mines during the summer holidays.

The mining and metallurgical Summer Schools take place in alternate years; it is customary to include some metallurgical study in the school devoted to mining and vice versa. For the Summer School of Mines a section of the country is selected where the students with their instructors may make a systematic study of mining, geology, and surveying in one or more representative mines. At the Summer School of Metallurgy, the party visits a locality where various smelting and refining operations are conducted, and makes a systematic study of the different operations, writing up the notes from day to day.

These traveling Summer Schools, lasting about three weeks, usually cover one of the following districts: Nova Scotia; Eastern New Jersey, Eastern Pennsylvania and Maryland; Western New Jersey and Western Pennsylvania; Northern New York and Ohio; Lake Superior and Southern Ontario. Occasionally longer excursions are made into the Western parts of the country. In visiting works the students receive a systematic training in observing facts and taking notes; the individual notes are assembled and worked out in evening sessions.

The Summer Camp is located at the Elizabeth Mine, near the village of South Strafford, Vermont. Under the charge of an instructor, students spend two weeks at the mine to become familiar with underground conditions; the course of instruction includes hand and machine-drilling, blasting, timbering, track laying, and the like.

Summer instruction will not be given to less than six students.

Practical work for the summer can usually be obtained for students desiring to gain experience by working regular shifts at the prevailing rate of wages.

Summer School of Industrial Chemistry. — As frequently as practicable parties of students are formed to visit typical chemical and metallurgical plants, starting soon after the close of the regular school year in June. These parties are made up of students in Chemistry, Chemical Engineering and Electrochemistry and are necessarily limited to such a number as is deemed advisable by those in charge, usually about eighteen. The party is accompanied by two members of the instructing staff, and frequent evening conferences are held at which notes are compared and discussed and details of processes explained. The trips usually occupy ten to

fourteen days. A small tuition fee is charged to reimburse the Institute for the expenses involved, and the students participating pay their own traveling expenses.

In 1915 the party visited manufacturing plants in Brooklyn and New York City, N.Y.; Babbitt, Bayonne, Edgewater, Millville, Newark and Trenton, N.J.; Conshohocken, Ivy Rock, Northampton and Philadelphia, Penn. Altogether some fourteen plants were inspected during this trip of nine days.

On account of unusual industrial conditions no summer trip was arranged for 1916.

A School of Chemical Engineering Practice is provided by the Institute for the following purposes: First, in order that students in Chemical Engineering may have opportunity to obtain a systematic knowledge of the mechanical appliances of chemical industries by direct personal contact with them, and to study the factors upon which the efficient performance of these machines depend. Second, that they may have as adequate a training in the application of the principles of science to the problems of industrial practice as possible. Third, that they may get a general idea of the modern methods of factory control and management, and obtain some familiarity with the difficulties incident to the human element in industry. Fourth, that they may acquire some degree of self-confidence in handling industrial processes and attacking industrial problems.

To this end five stations for instruction have been located in selected plants of five representative industries, each station being in charge of a member of the Faculty and fitted with the necessary analytical laboratories, testing and measuring apparatus, and drawing-room facilities. Each student will remain in each station for a period of six weeks, thus occupying the thirty weeks from the beginning of February to the following September. A descriptive circular giving further details of the School and the scope of the work may be obtained by addressing the Secretary of the Faculty.

Summer Schools of Geology, Paleontology, and Mineralogy. — With the view of emphasizing the practical character of the instruction in Geology, provision is made for field-work during the summer vacation in districts remote from Boston. Advanced students may sometimes secure field experience in connection with the professional work of the instructors.

Graduate Study and Research

GENERAL STATEMENT

THE Institute offers opportunities for graduate study and research leading to the degrees of Master of Science, Doctor of Philosophy, or Doctor of Engineering. These degrees are awarded solely for resident work, under the conditions specified in the following pages. Advanced study or investigation may also be pursued by students having the necessary preparation, without reference to candidacy for a degree. This may, for example, be advantageous for those who desire either to devote their time almost wholly to a definite line of investigation or to specialize in some limited field of science or technology.

In addition to the facilities for investigation offered in connection with all the departments of the Institute, there have been established laboratories devoted to research in physical chemistry, in applied chemistry, in electrical engineering, and in sanitary science, public health and sewage experimentation, which offer unusual opportunities to those wishing to pursue such work. The organization and equipment of these laboratories and the character of the work pursued are described on pages 166 to 170, 353, 370, and 371.

REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE

The degree of Master of Science is awarded upon the satisfactory completion of a resident course of study in science or engineering extending over not less than one year. The candidate for this degree must, except in cases of unusual attainments, have taken his first degree in some scientific school, college, or university of good standing; and his preparation must be substantially equivalent to that of a graduate of the Institute, except as specially provided below in the case of college graduates taking two or three years at the Institute. Only those applicants will

be accepted as candidates whose attainments, as shown by their previous record of scholarship or by other information, are of such a character as to indicate that their proposed course of advanced study and research can be creditably pursued.

The applicant must file with the Secretary of the Faculty, on a form provided for this purpose, preferably before May 1st,[1] a statement of his proposed course of study. A specific Course in Aëronautical Engineering is offered which in general should be taken entire. If not a graduate of the Institute, he will be expected to include also on a special blank a full statement of his previous work, showing how far it corresponds to the requirements for the Bachelor's degree of the Institute. Candidates are expected to enter upon their work at the beginning of the school year.

College students intending to enter the Institute for fourth-year or graduate work will find it advantageous to make their selection of college electives correspond as nearly as possible to the first three or four years of undergraduate work at the Institute. If in doubt in regard to any courses of study, they should correspond with the Secretary of the Faculty or with the professor in charge of the Department. A special circular on "Opportunities for College Graduates" will be mailed on application to the Secretary.

COURSES FOR THE DEGREE OF MASTER OF SCIENCE

1. For Graduates in Scientific Courses. — The course of study leading to the degree of Master of Science consists mainly of advanced study and research in the branch of science or engineering in which the student has already completed an undergraduate course substantially equivalent to one of those given at the Institute.[2] The candidate must pursue his course of study continuously, under the direction and oversight of the Faculty, for not less than one full school year after filing his application, exhibiting during that time ability to conduct original investigations. He must pass creditable examinations at such times and on such subjects as may be designated, and finally must present an acceptable thesis.

[1] In case financial aid is asked for, application for it and for candidacy for the higher degree should be presented by March 1st.

[2] For preparation for the Graduate Course in Aëronautical Engineering, see page 160.

This graduate course serves to supplement the undergraduate work in the same field by more thorough instruction in underlying principles and their mathematical development, by a more specialized study of important branches of the profession, and especially by training in the investigation of scientific and technical problems. The great recent development of pure and applied science has made it very difficult for the student to acquire an adequate professional education from an undergraduate course of four years, especially since much of this time needs to be given to preparatory and general educational studies. If his circumstances permit, it is therefore highly desirable for the student to devote at least one additional year to graduate work. The character of such work and the conditions under which it is carried on are so different from those in the undergraduate courses that the fifth year is almost sure to give, not merely more additional professional knowledge, but a new and valuable kind of training. The closer individual contact with the instructors, the general use of original articles and scientific monographs rather than text-books, and especially the large amount of time devoted to research, develop originality and independent power, and inculcate the principles and spirit of the investigator, which are necessary to success not less in technological than in scientific pursuits.

2. For College Graduates. — The number of college graduates who come to the Institute each year to prepare themselves for the engineering profession continues to increase. Many of these students so elect their college program that they are able to enter as students in the third-year courses of the Institute. To encourage such students to pursue advanced work and thereby to get the utmost value from their professional Course, the Faculty has voted to give to such students, when they have completed (in general with not less than one year's residence) substantially all requirements in any Course up to the beginning of the fourth year, the option of becoming a candidate for the Master of Science degree without previously taking the Bachelor of Science degree, on the basis of two years of additional work, or of becoming candidates for the Bachelor's degree on the basis of one year's additional work in case it is felt that a longer period cannot be devoted to study. Under this arrangement a student by properly electing his course of study in college may in three years after

taking his Bachelor's degree take the Master's degree at the Institute in any desired branch of engineering.

The requirements for this two-year course include the subjects in the fourth year of the regular Course and subjects chosen from the list of studies offered as electives for graduate study, together with the preparation of a thesis. The choice and distribution of studies constituting the schedules of both years should be made in consultation with the professor in charge of the Department (it being understood that the work of the first year would consist mainly of the work of the regular fourth year) and the schedules should be submitted to the Faculty for approval.

ELECTIVE SUBJECTS FOR GRADUATE COURSES

Since the choice of the most advantageous subjects for a graduate course depends much upon individual conditions, the Faculty has not prescribed definite schedules for the higher degrees except in Aëronautical Engineering. But in order to indicate the opportunities for advanced work offered by the Institute, and in order to aid candidates for such degrees in laying out their courses of study, there have been brought together upon the following pages the names of such elective subjects as are considered to be especially appropriate for this purpose. A detailed description of these subjects will be found in the later section of this Catalogue entitled "Description of Subjects of Instruction," to which the numbers in parentheses attached to the separate topics refer. These subjects have been grouped under headings corresponding to the various Undergraduate Courses of the Institute, so as to indicate the lines of advanced work most suitable for a graduate of any of these Courses or for a graduate from another institution who has had an equivalent preparation. It should be understood, however, that the choice of subjects is not necessarily restricted to those offered in any one department; but it is in general essential that the applicant for admission to any elective subject shall have had the preparation indicated as being required for it in the description given under Subjects of Instruction. The necessary preparation may in many cases be obtained by taking subjects offered in the Summer School or by pursuing such courses of special reading during the previous summer as may be recommended by the professor in charge.

The subjects in each Course are classified as follows: [1] —

A. Principal Subjects, consisting of professional studies more advanced in character and scope than the corresponding work for the degree of Bachelor of Science. The principal part of the candidate's work must be selected from subjects in this group.

B. Subordinate Subjects, consisting of studies selected from the fourth-year schedules of other Undergraduate Courses or Options in the same Course, and in exceptional instances certain third-year subjects which form with the advanced work a logical general program. The time devoted to subjects in this group must be less than that required for the principal work.

The candidate's research and his other principal subjects are to be selected with due reference to each other in consultation with the professor in charge of the Department, and the proposed course of study must be submitted to the Faculty for approval.

[1] This classification does not apply to the Course in Aëronautical Engineering.

CIVIL ENGINEERING

A. Principal Subjects

First Term

	Hours Ex. Prep.
Thesis	
Structures of Metal, Wood and Masonry (156)	45 – 90
Railroad Engineering (127)	30 – 60
Railroad Design (128)	45 – 0
Hydraulic Laboratory Research (171)	120–
Waterpower Engineering (173)	45 – 90
Waterpower Design (182)	90 – 0
Engineering of Water and Sewage Purification (181)	120–
Sanitary Design (183)	90 – 0
Highway Engineering Research (134)	45 –135
Structural Design, Advanced (156a)	90 – 0
Valuation of Public Service and other Corporations (129)	45 – 90

Second Term

Thesis	
Structures of Metal, Wood and Masonry (156)	45 – 90
Railroad Engineering (127)	30 – 60
Railroad Design (128)	45 – 0
Waterpower Design (182)	90 – 0
Waterpower Engineering (173)	45 – 90
Sanitary Design (183)	90 – 0
Highway Engineering Research (134)	45 –135
Structural Design, Advanced (156a)	90 – 0
Reinforced Concrete Research (159)	
Specifications and Contracts (199)	30 – 60

B. Subordinate Subjects

Railroad Engineering (125), Railroad Design (126), Hydraulic and Sanitary Engineering (175), Hydraulic and Sanitary Engineering (176), Sanitary Engineering (177), Sanitary Engineering (178), Hydraulic and Sanitary Designing (179), Reinforced Concrete Design (158), Vital Statistics (190).

Industrial Hygiene and Sanitation (753), Public Health Problems (755).

Chemistry of Road Materials (538), Highway Construction (132), Highway Design (135), Highway Economics (136), Highway Specifications (137).

Mathematics (M36), Mathematics (M39), Theory of Probability and Method of Least Squares (M26).

History of European Civilization and Art (H33), Economics of Corporations (Ec55).

MECHANICAL ENGINEERING

A. Principal Subjects

First Term

	Hours Ex. Prep.
Research	
Heat Engineering, Advanced (250)*	100–200
Heat Transmission (257)	15 – 30
Machine Design, Advanced (268)*	100–200
Theory of Elasticity, Advanced (231)*	100–200
Analytical Mechanics (M65)	30 – 60

Second Term

Research	
Heat Engineering, Advanced (250)*	100–200
Machine Design, Advanced (268)*	100–200
Theory of Elasticity, Advanced (231)*	100–200
Analytical Mechanics (M65)	30 – 60

B. Subordinate Subjects

Engine Design (277), Locomotive Construction (278), Mill Engineering (279), Heating and Ventilating (255), Hygiene of Heating and Ventilation (760), Power Plant Design (272), Refrigeration (253), Industrial Management (274).

Principles of Electrical Engineering (604, 605),[1] Electrical Engineering Laboratory.[2]

Mathematics (M36), Mathematics (M38), Fourier's Series (M45).

[1] Students who have not had the equivalent of the third-year electrical work in Course VI, but have had an amount of Electrical Engineering corresponding to that required in Course II, should confer with Professor Jackson as to preparation to be made during the summer for this course.

[2] Special Course offered to two or more applicants.

* May be given in either first or second terms.

MINING ENGINEERING AND METALLURGY

A. Principal Subjects [1]

First Term

	Hours Ex. Prep.
Research	
Mining Engineering, Advanced (311)	45 – 90
Problems in Dressing and Milling of Ores (309)	120–
Ore-Dressing, Advanced (312)	45 – 90
Leaching Gold and Silver Ores (338)	120– 60
Metallurgy and Physics of Metals (360)	120 to 480
Mechanical Treatment of Metals, Lectures and Laboratory (361)	30 – 30
Economics of Metallurgical Plants (362)	15 – 15
Development of Metallurgical Processes (363)	30 – 30
Mineral Lands, Acquisition, Tenure (314)	90 –

Second Term

Research	
Mining Engineering, Advanced (311)	200–
Ore-Dressing, Advanced (312)	200–
Mining Projects and Design (319)	150–
Mine Examination and Reports (320)	200–
Metallurgical Plant Design (349)	100–
Metallurgy and Physics of Metals (360)	120 to 480
Metallurgy of Copper, Advanced (364)	30 – 30
Machine Design (269)	60 –
Heat Measurements (816)	45 –

B. Subordinate Subjects

These subjects can be chosen from studies given in Course III as well as in other Courses, especially Courses II, XII and XV (see page 147).

[1] Geological studies which may form part of the Principal Subjects for students in Options 1 and 3 are given on page 303.

ARCHITECTURE

A. Principal Subjects

First Term

	Hours Ex. Prep.
Architectural Design, Advanced (474)	370
Constructive Design, Advanced (483)	120
Life Class and Decorative Design, Advanced (D45)	90
European Civilization and Art: Special Topics (H36)	30
Architecture, Theory and Practice (454)	15

Second Term

Architectural Design, Advanced (474)	465
Life Class and Decorative Design, Advanced (D45)	90
Architectural Problems, Advanced (452) [1]	
History and Archæology (444) [1]	
Architecture, Theory and Practice (454)	15

B. Subordinate Subjects

With the approval of the Head of the Department certain fourth-year subjects given in other Courses, and optional subjects in Course IV, and in exceptional instances third-year subjects which form with the advanced work a logical general program, may be elected.

[1] Owing to the large amount of study required in this Course it will be given only through special arrangement of individual students with Professor Cram.

CHEMISTRY

A. Principal Subjects

First Term

	Hours Ex. Prep.
Chemical Research	
Research Reports	15
Inorganic Chemistry III (504)	15 – 60
Qualitative Analysis of Rare Metals (515)	165–
Organic Qualitative Analysis (516)	135–
Organic Chemistry II (552)	30 – 60
Biochemistry (524)	30 – 45
Optical Crystallography and Applications (1223)	45 – 30
Polarized Light and its Applications (864) or Radiation (868) (given in alternate years)*	15 – 30
Mathematics (M56)	30 – 60

Second Term

	Hours Ex. Prep.
Chemical Research	
Research Reports	15
Inorganic Chemistry III (504)	15 – 60
Qualitative Analysis of Rare Metals (515)	165–
Organic Chemistry II (552)	30 – 60
Polarized Light and its Applications (864) or Radiation (868) (given in alternate years)	15 – 30
Geology of Coal and Petroleum (1260)	30 – 30
Mathematics (M56)	30 – 60

B. Subordinate Subjects

Proximate Technical Analysis (530), Advanced Food Analysis (526), Water and Air Analysis (520), Sugar Analysis (527).

Theoretical Physics IV (844), Theoretical Physics III (843), Descriptive Astronomy (833), Electrical Measurements (813), Electrochemistry, lect. and lab. (882), (886), Applied Electrochemistry, lect. and lab. (883), (887).

Bacteriology of Water and Sewage (732), Industrial Biology (735), Sanitary Science and Public Health (756), Zymology (736), Problems in Chemical and Industrial Biology (737), Vital Statistics (190), Public Health Laboratory Methods (738).

Metallurgy (332).

Mathematics (M36), Mathematics (M39), Least Squares (M26).

European Civilization and Art (H33).

Economics of Corporations (Ec55).

* May be given in either first or second terms.

ELECTRICAL ENGINEERING

A. Principal Subjects

First Term

	Hours Ex. Prep.
Research [1]	
Alternating Currents (627)	135
Alternating Current Machinery, Advanced (625)	75
Electrical Engineering Laboratory (675)	75 to 150
Power Stations and Distribution Systems (639)	75 to 150
Electric Railways (643)	135
Electrical Testing (676)	75 to 150
Electrical Engineering Seminar (629)	75
Waterpower Design (182)	90
Organization and Administration of Public Service Companies (634)	135 to 180
Advanced Mathematics	90 to 180

Second Term

Research [1]	
Alternating Currents (627)	135
Electrical Engineering Laboratory (675)	75 to 150
Dynamo Design (646)	75 to 150
Power Stations and Distribution Systems (639)	75 to 150
Electric Railways (643)	135
Electrical Engineering Seminar (629)	75
Waterpower Design (182)	90
Organization and Administration of Public Service Companies (634)	135 to 180
Advanced Mathematics	90 to 120

B. Subordinate Subjects

Structures (149),[2] Railroad Engineering (125),[3] Valuation of Public Service and other Corporations (190).

Machine Design (267),[4] Mill Engineering (279).[4]

Electrostatics and Electrokinetics (842), Electrochemistry, lectures and laboratory [5] (882), (886), Applied Electrochemistry, lectures and laboratory (883), (887).

European Civilization and Art (H33).

[1] Graduate students are expected to attend the meetings of the Research Committee which are scheduled for the first Wednesday afternoon in each month. Each graduate student is expected to report on his work at such a meeting at least once during the year.

[2] The student must have taken third-year Structures or the course given in Course VI, fourth year.

[3] Students who have not pursued courses equivalent to Railroad Engineering 121 should arrange a course of summer preparation designated by the Professor of Railroad Engineering.

[4] References to be studied prior to admission to these courses will be furnished by Professor Park to applicants who have not had courses equivalent to those given in Course II in Mechanical Engineering, Drawing, Steam Engineering, Applied Mechanics and Dynamics of Machines. For Mill Engineering, Cotton Machinery is also required.

[5] Students who have not studied Theoretical Chemistry should arrange a course of summer reading with Professor Goodwin.

BIOLOGY AND PUBLIC HEALTH

A. Principal Subjects

First Term

	Hours Ex. Prep.
Research	90 – 60
Control of City Milk Supplies (743)	60 – 90
Bacteriology of Fermentation Industries (740)	30 – 60
Personal Hygiene, I (760)	15 – 45
Sanitation of Houses and Public Buildings (762)	15 – 30
Public Health Field Work (770)	90 – 60

Second Term

Research	30 – 60
Microbiology of Soils and Plant Diseases (741)	30 – 45
Bacteriology in Relation to Refrigeration, Canning and Food Preserving (742)	30 – 45
Sanitary Law (772)	15 – 15
Public Health Administration (773)	15 – 30

B. Subordinate Subjects

Biology of Infectious Diseases (750, 751), Industrial Hygiene and Sanitation (753), Public Health Laboratory Methods (738), Public Health Problems (755).

Vital Statistics (190).

Hydraulic Measurements (170), Sanitary and Hydraulic Engineering (175).[1]

Water Analysis and Water Supplies (522), Sanitation in Chemical Industries (523).

[1] Courses in Applied Mechanics and Theoretical Hydraulics must be taken prior to admission

PHYSICS

A. Principal Subjects

First Term

	Hours Ex. Prep.
Physical Research	
Radiation (868) [1]	15 – 60
Theory of Radiation (869) [2]	15 – 60
Microscope Theory and Photomicrography (867)*	60 – 30
Polarized Light and its Applications (864) [2]	15 – †
Optical Crystallography and Applications (1223)	45 – 30
Theoretical Chemistry II (566)	30 – 60
Mathematics (M56), (M69)	30 – 60
Electrical Discharges in Vacua (852)	60 – 30

Second Term

Physical Research	
Microscope Theory and Photomicrography (1867)*	60 – 30
Electrical Discharge in Gases; Radioactivity (862) [1]	15 – †
Hertz Waves; Radio-Telegraphy (863) [2]	15 – †
Theory of Radiation [2] (869)	15 – 60
Radioactive Measurements (872)	30 – 15
Constitution of Matter in the Light of Recent Discovery (871)	15 – 60
Theoretical Chemistry II (566)	30 – 60
Mathematics (M56), (M69)	30 – 60

B. Subordinate Subjects

Electrochemical Laboratory (886), Applied Electrochemistry, lectures and laboratory (883), (887).

Alternating Current Machinery (623), Electrical Engineering Laboratory.[3]

History of Chemistry (591), Organic Chemistry Laboratory (557).

Mathematics (M36), Analytical Mechanics (M65).

European Civilization and Art (M33).

[1] Offered in 1916–1917.
[2] Not given in 1916–1917.
[3] Special course given to two or more students.
* Offered in either the first or second term.
† Assigned reading and an examination will be required.

CHEMICAL ENGINEERING

A. Principal Subjects

First Term

	Hours Ex. Prep.
Research	
Research Reports	
Chemical Engineering of Special Industries (579)	30 – 60
Chemical Engineering Laboratory (583)*	30 –
Industrial Applications of Chemical Principles (584)	15 – 15
Applications of Thermodynamics (581)	30 – 60
Plant Design (582)	60 – 30
Refrigeration (254)*	30 – 60
Inorganic Chemistry III (504)	15 – 60
Qualitative Analysis of Rare Metals (515)*	165–
Biochemistry (524)	30 – 45
Organic Qualitative Analysis (516)	135–
Organic Chemistry II (552)	15 – 60
Optical Crystallography and Applications (1223)	45 – 30

Second Term

Research	
Research Reports	
Chemical Engineering Laboratory (583)*	30 –
Materials of Construction (580)	30 – 30
Plant Design (582)	60 – 60
Refrigeration (254)*	30 – 60
Inorganic Chemistry III (504)	15 – 60
Qualitative Analysis of Rare Metals (515)*	165–
Organic Chemistry II (552)	15 – 60
Theoretical Chemistry II (566)	30 – 60

B. Subordinate Subjects

Air and Water Analysis (part) (520), Proximate Technical Analysis (530).

History of Chemistry (591).

Electrochemistry, lectures and laboratory (882), (886), Applied Electrochemistry, lectures and laboratory (883), (887), Heat Measurements (813).

Machine Design (267),[1] Mill Engineering (279),[1] Industrial Management (274).

Industrial Applications of Electric Power (635), Electrical Engineering, Laboratory,[2] Technical Electrical Measurements Laboratory (691).

Mathematics (M36), Mathematics (M38).

Economics of Corporations (Ec55), European Civilization and Art (H33).

[1] References to be studied prior to entrance to these courses will be furnished by Professor Park to applicants who have not had courses equivalent to those given in Course II in Mechanical Engineering, Drawing, Steam Engineering, Applied Mechanics, and Dynamics of Machines. For Mill Engineering, Cotton Machinery is also required.

[2] Special Course given to two or more students having adequate preparation.

* May be given in either the first or second terms.

SANITARY ENGINEERING

A. Principal Subjects

First Term

	Hours Ex. Prep.
Thesis	
Reinforced Concrete Design (158)	45 – 90
Structures of Metal, Wood and Masonry (156)	45 – 90
Structural Design (156a)	90 – 0
Hydraulic Laboratory Research (171)	120–
Engineering of Water and Sewage Purification (181)	120–
Sanitary Design (183)	90 – 0
Biology of Water and Sewage Purification (739)	15 – 30
Sanitation of Houses and Public Buildings (762)	15 – 15
Vital Statistics (190)	30 – 30

Second Term

Thesis	
Structures of Metal, Wood and Masonry (156)	45 – 90
Structural Design (156a)	90 – 0
Sanitary Design (183)	90 – 0
Reinforced Concrete Research (159)	
Chemistry of Road Materials (537)	45 – 0
Specifications and Contracts (199)	30 – 60

B. Subordinate Subjects

First Term. Foundations (148), Epidemiology (765), Hygiene of Heating and Ventilation (760), Industrial Hygiene and Sanitation (753), Biology of Infectious Diseases (751), Mathematics (M36), Economics of Corporations (Ec55).

First and Second Terms. Railroad Engineering (125), Railroad Design (126), Bridge Design (153), Public Health Problems (755), Journals (780), History of European Civilization and Art (H33).

Second Term. Advanced Structures (150), Personal Hygiene [1] (723), Mathematics (M39), Theory of Probability and Method of Least Squares (M26), Heating and Ventilation (255).

[1] Previous preparation in General Physiology (720) required for admission.

GEOLOGY

A. Principal Subjects

First Term

	Hours Ex. Prep.
Research	
Petrography, Advanced (1225)	90 – 45
Economic Geology, Advanced (1259)	90 –
Field Geology, Advanced (1267)	90 –
Geology of Europe (1294)	30 – 60
Introductory Paleontology (1271)	60 – 30
Index Fossils (1273)	90 – 30

Second Term

Research	
Chemical Mineralogy and Petrology (1226)	45 – 90
Petrography, Advanced (1225)	90 – 45
Economic Geology, Advanced (1259)	90 –
Geology of North America (1291)	60 – 30
Geology of Coal and Petroleum (1260)	30 – 30
Field Geology, Advanced (1267)	90 –
Introductory Paleontology (1271)	60 – 30
Organic Evolution (1275)	30 – 60

B. Subordinate Subjects

First Term. Metallography (334), Advanced Surveying (109), Heat Measurements (813), Descriptive Astronomy (833).

First and Second Terms. Mining Engineering (302), Ore-Dressing (303), Theoretical Chemistry I (565).

Second Term. General Metallurgy (341), General Metallurgy (342), Fire Assaying (321).

ELECTROCHEMISTRY

A. Principal Subjects

First Term

	Hours Ex. Prep.
Research	
Electrochemical Seminar (896)	15 – 60
Alternating Currents, Advanced (627)	135
Electrical Engineering Laboratory (675)	75 to 150
Applied Thermodynamics (581)	30 – 60
Chemical Engineering Laboratory (583)*	30 – 0
Radiation (868) [1]	15 – 60
Electrical Discharges in Vacua (852)	60 – 30
Industrial Application of Chemical Principles (584)	15 – 15
Inorganic Chemistry III (504)	15 – 60
Theoretical Chemistry II (566)	30 – 60

Second Term

Research	
Applied Electrochemistry Seminar (897)	15 – 60
Plant Design (582)	60 – 30
Alternating Currents, Advanced (627)	135–
Electrical Engineering Laboratory (675)	75 to 150
Chemical Engineering Laboratory (583)*	30 – 0
Radio-active Measurements (872)	30 – 15
Constitution of Matter in the Light of Recent Discovery (871)	15 – 60
Inorganic Chemistry III (504)	15 – 60
Theoretical Chemistry II (566)	30 – 60
Materials of Construction (580)	30 – 30

B. Subordinate Subjects

Industrial Chemistry II (587), Problems in Applied Chemistry (588), History of Chemistry (591).

Metallurgy (331), Metallography (334), Mining Engineering, lectures and laboratory (303), (351).

Principles of Electrical Engineering (604, 605).

Theoretical Hydraulics (164) and Hydraulic Laboratory (172), Engineering Laboratory (260) or (261) (selected work).

Economics of Corporations (Ec55), European Civilization and Art (H33).

[1] Offered in 1916–1917.

* May be given in either the first or second terms.

AËRONAUTICAL ENGINEERING

The Graduate Course in Aëronautical Engineering is open to graduates of the Institute in Mechanical Engineering, Electrical Engineering or Naval Architecture and to graduates from other technical schools and colleges who have preparation essentially equivalent to that required for the Bachelor's Degree in one of these Courses. In general, graduates from non-technical colleges, even though prepared in mathematics and theoretical mechanics, will find it necessary to take at least one year of work in general engineering before applying for the Course.

Prospective applicants for the Course should be well grounded in applied mechanics and mathematics, including differential equations, and they are advised to make special preparation when necessary.

The Course in general consists of theoretical dynamics of rigid bodies and fluids, of the general theory of aëroplanes and airships, and of the design of both types of aircraft.

An aërodynamic laboratory with a four foot wind tunnel gives opportunity for research in connection with the preparation of a design and the graduation thesis. Facilities are available for study and experiments with aëronautical engines and propellers.

Any of the Aëronautical Engineering courses are open to persons who may not be candidates for a degree, provided they are qualified to undertake the work required.

AËRONAUTICAL ENGINEERING

First Term

	Hours Ex. Prep.
Dynamics of Rigid Bodies (M66)	45 – 90
Fluid Dynamics, Theoretical (M59)	30 – 60
Fluid Dynamics, Experimental (1374)	30 – 30
Theory of Aëroplane Design (1375)	45 – 90
Aëroplane Design (1376)	90 –
Aërial Propellers (1379)	10 – 40
Aëro Engines (251a)	30 – 30
Aërodynamic Laboratory (1380)	60 – 30

Second Term

Dynamics of Rigid Bodies (M66)	45 – 90
Fluid Dynamics, Theoretical (M59)	30 – 60
Aëroplane Design (1376)	90 –
Theory of Airship Design (1377)	45 – 90
Airship Design (1378)	90 –
Meteorology (1381)	20 – 20
Thesis	150

MATHEMATICS

Special provision will be made for graduates of scientific schools or colleges who may desire to prepare themselves for the teaching of mathematics, or to pursue advanced mathematical work in connection with other sciences. The courses available for election include Curve Tracing, Advanced Calculus, Fourier's Series, Hydrodynamics, Thermodynamics, Analytical Mechanics, Mathematics of Wireless Telegraphy, the Potential Function, Elements of the Theory of Functions of a Complex Variable, Partial Differential Equations, Statistical Methods in Theoretical Physics, and a course on the Teaching of Elementary Mathematics. Brief descriptions of these courses may be found on pages 344 to 352, and the professor in charge of the Department may be consulted in regard to arrangements of work or possible additions to the list. College graduates may find it practicable in two years to combine with the requirements for the Master's degree in Mathematics a valuable amount of undergraduate work in some one of the professional departments.

REQUIREMENTS FOR THE DEGREE OF DOCTOR OF ENGINEERING OR DOCTOR OF PHILOSOPHY

The study and research leading to the Doctor's degrees are especially valuable to those who wish to engage in original investigation or in teaching in higher institutions. Moreover the increasing demand for men having not only engineering training, but the attitude of mind impelling them to attack new problems renders such work valuable for men who are preparing themselves as thoroughly as possible for the practice of engineering.

The degree of Doctor of Engineering or Doctor of Philosophy certifies to the creditable completion of a program of advanced studies, and to the performance of an investigation of high grade. The degree of Doctor of Engineering is given when the course of study consists principally of engineering subjects, and the investigation deals with scientific problems having a technological bearing; that of Doctor of Philosophy is given when the work has been mainly study and research in science. These degrees will be conferred only upon candidates who have not only breadth of scientific attainment, but have also shown the power of dealing with new problems in an independent and efficient manner. As a rule the study and research must be pursued under the direction of the Faculty for three years. Candidates of exceptional ability or those who have had exceptional preparation may be able to complete the requirements in less time. The required time of residence may be somewhat reduced in the case of candidates who satisfy the Faculty that they have successfully accomplished at another institution advanced work of a grade equal to that required at the Institute. It will often be advisable for a candidate to qualify himself for the Master's degree as a part of his preparation for the Doctor's degree.

The candidate for the degree of Doctor of Engineering, or Doctor of Philosophy must have taken his first degree in some scientific school, college or university of good standing; and his preparation must be substantially equivalent to that of a graduate of the Institute. Only those applicants will be accepted as candidates whose attainments and capacity are believed to be such as to indicate that the requirements for these degrees can be creditably met. The candidate must file with the Secretary of the Faculty on a form provided for this purpose a statement of his proposed

plan of study and of his investigation. The work for the degree is expected to consist mainly of scientific research and of the preparation of a thesis describing it. This must be supplemented, however, by systematic studies of an advanced character in some branch of science or engineering, which will be termed the *major* subject of the candidate. Thus, chemistry, physics, geology, biology, or civil, mechanical, electrical, chemical, mining or sanitary engineering may be chosen as the major subject. In addition as *minor* subject or subjects, studies such as will give a fundamental knowledge must be pursued in one other or in two other of these branches of science or engineering or in mathematics. Candidates for the degree of Doctor of Engineering will be required to prepare themselves in two minor subjects outside the branch of engineering chosen as major subject, e.g., with electrical engineering as a major, minors may be chosen in other branches of engineering such as structural engineering, hydraulics or machine design, or mathematics, physics and electrochemistry.

Candidates for the degree of Doctor of Philosophy will be required to prepare themselves in but one minor, it being understood, however, that the *major* subject in this case shall include the main branches of the science, e.g., a major in chemistry shall include inorganic, organic and theoretical chemistry. Proficiency in the major and minor subjects, which includes the power to use them effectively, will be tested by examinations, which may be written or oral or both, at the discretion of the Department concerned. It is desirable that the work in minor subjects be completed at least one year before the candidate intends to come up for his degree in order that the latter part of his period of study may be devoted without interruption to the prosecution of his thesis, and to advanced study in his major subject in preparation for his final examination.

Each candidate for a Doctor's degree is required at some time within a half year of final examinations for the degree to present in person before representatives of the Faculty a carefully prepared account of his research work, including a discussion of its bearing on the development of the branch of science to which it relates, and of its relations to previous work in the same field, a summary of the results and conclusions reached by himself, and suggestions as to desirable extensions of the same general line of investigation. Before receiving his diploma each candidate for the degree of

Doctor of Philosophy, or Doctor of Engineering, must deposit with the Secretary of the Faculty, in addition to his typewritten thesis, 200 printed copies of an abstract of his thesis in form and substance suitable for publication in a journal devoted to the science to which the thesis pertains. This abstract will be printed with the coöperation of the candidate under the direction of the Committee on Publications at the expense of the Institute.

In planning his course of study, the candidate should consult the section of the Catalogue or Programme entitled "Elective Subjects for Graduate Courses," on page 146, and the section entitled "Opportunities for Research," on pages 166 to 170. More specific information in regard to all requirements will be furnished on application to the Secretary of the Faculty Committee on Advanced Degrees.

Each candidate for the Doctor's degree will at the time of his acceptance be placed in charge of a Faculty committee which will exercise general oversight of his work.

Opportunities for Research

IN DEPARTMENTAL LABORATORIES

OPPORTUNITIES for research are afforded in all the departmental laboratories devoted to the more advanced branches of instruction, as well as in the separately organized research laboratories described below.

In structural engineering researches may be pursued in the higher theory of structures, such as the investigations of arches, domes, movable bridges, suspension bridges, reinforced concrete structures, and other similar subjects, accompanied by original work in structural design. Students may also carry on investigations upon engineering materials in the testing laboratories.

In hydraulic engineering researches may be made upon problems relating to the flow of water and the use of hydraulic motors; also upon the design of water power plants and other hydraulic works.

In mechanical engineering researches may be conducted upon subjects connected with the strength of materials, the theory of elasticity, and upon the theory of thermodynamics and its various applications in the field of steam and gas engineering, refrigeration, heat transmission and the generation and flow of compressed air, etc. For the equipment of the Engineering Laboratories see page 354.

In mining engineering and metallurgy researches are carried on mainly along the four lines represented by investigations of mining subjects, problems in ore-dressing, processes for the extraction of metals from their ores, and the thermal treatment of metals and alloys and their microscopic examination.

In electrical engineering opportunities for research are offered in such subjects as transmission-line problems, the effect of wave form on the performance of the various types of alternating current motors, electrical measuring instruments, condenser losses, the various properties, magnetic and other, of the materials used in

electrical construction; the effect of high voltage currents on insulation; the energy transformations in rotary converters, and the numerous obscure phenomena related to the flow of electric currents.

In electrochemistry students may take up investigations on either the scientific or applied side, the work being done either in the Laboratory of Electrochemical Measurements upon problems involving refined measurements of conductance, decomposition-voltage, polarization and allied quantities; or in the Laboratory of Applied Electrochemistry upon investigations requiring the use of heavy alternating or direct currents, electric furnaces, pyrometers, etc.

In the Laboratory of Heat Measurements provision is made for researches relating to accurate thermometry, high temperature measurements, the calorific power of fuels, heat insulating and fire retarding materials.

In the Optical Laboratory modern instruments are provided for studies in photometry, spectroscopy, interference, and polarization, and for researches in photography and micro-photography.

In chemistry facilities for research are afforded in each of its important branches. Investigations in physical chemistry and in applied chemistry are carried on mainly in the special research laboratories devoted to those subjects (see page 168). In organic chemistry investigations of scientific interest as well as those involving applications to the arts may be pursued. An assistant professor of organic chemical research has been appointed who gives nearly his entire time to the direction of such researches. In inorganic and analytical chemistry and in the chemistry of foods and chemistry of sanitation there is also especial opportunity for the study of original problems.

In geology special opportunity for research in the Geological Department is provided in the following subjects now occupying the attention of teachers in the Department as matters of investigation: dynamical geology with special reference to volcanoes; geology of the igneous rocks; chemical mineralogy and petrography; stratigraphy and paleontology.

RESEARCH LABORATORY OF PHYSICAL CHEMISTRY

This laboratory, which was established in 1903, is devoted to research work and advanced instruction in physical chemistry. It consists of a group of small laboratories, accommodating in all eighteen research workers. It is equipped with every convenience for physico-chemical investigations. A fuller description may be found on page 367.

The researches are carried on in part by a staff of Research Assistants and Associates working under the direction of those professors of the Institute who are connected with the subjects of theoretical or physical chemistry. The Laboratory offers also to candidates for higher degrees excellent opportunities for conducting investigations in physical chemistry. During every year since its establishment from ten to sixteen men have been engaged upon physico-chemical researches in the laboratory.

RESEARCH LABORATORY OF APPLIED CHEMISTRY

In order that opportunity may be provided for the study of some of the general problems of a chemical nature constantly confronting the manufacturing public, that there may be offered to the individual manufacturer facilities for the investigation of his special problems, and that the Institute may be brought more intimately into connection with the industries of the country, there has been established a Research Laboratory of Applied Chemistry.

Members of the Research Laboratory Staff offer a number of advanced lecture courses and weekly seminars upon topics of general interest in this field. The laboratory work is carried on for the most part by a corps of Research Associates and Assistants, but opportunity is offered for properly prepared students to pursue advanced study and investigation of a character leading to the degrees of Master of Science and Doctor of Engineering.

RESEARCH LABORATORY OF ELECTRICAL ENGINEERING

In connection with the Department of Electrical Engineering, there has been established a Research Laboratory for the study of problems, both of a technical and economic nature, which bear directly on electrical engineering practice. Two classes of investi-

gations are undertaken in this laboratory: (1) those which lie on the border line between pure physics and electrical engineering, the direct bearing of which on engineering practice depends more or less upon future advancement of the art, and (2) those which are of immediate commercial interest.

The work in this laboratory is carried on for the most part by a corps of Research Associates and Assistants under the immediate supervision of the more experienced members of the Department. Opportunity is also offered for properly qualified students to carry out investigations in this laboratory as theses for the degrees of Master of Science and Doctor of Engineering. Undergraduate students are given the opportunity of acting as special observers from time to time. The Vail Collection of Electrical Engineering Books is available in connection with the work of the laboratory.

SANITARY RESEARCH LABORATORY AND SEWAGE EXPERIMENT STATION

By the generosity of an anonymous donor the Institute has since 1902 maintained a Sanitary Research Laboratory and Sewage Experiment Station for the investigation of problems relating particularly to the purification of the sewage of large cities, for the demonstration of sanitary methods and appliances, and for the advancement of popular education in public health subjects. For a description of the laboratory see page 371.

Investigations are carried on by a regular staff of biologists and chemists. Students or others who, having had the necessary preparation in chemistry, bacteriology, or sanitary engineering, desire to attack problems relating to sanitary science or the public health, or who desire to become familiar with the methods and processes employed in sanitary research and public health science, especially as related to the purification of air, milk, sewage and water, may be received at any time.

HAWAIIAN VOLCANO OBSERVATORY

By a gift from the estate of Edward and Caroline Rogers Whitney in 1909, special research in seismology and other branches of geophysics was provided for. On January 1, 1912, the Hawaiian Volcano Research Association coöperated with the Institute to

establish an observatory and laboratory at the volcano Kilauea. Work was begun at once and a suitable building has been constructed with laboratories, a seismograph cellar, water supply, and facilities for physico-chemical investigation of volcanic process.

Investigations are carried on by a resident staff, and properly qualified investigators will be received at the Observatory for special studies. For further information see page 377.

Subjects of Instruction

INSTRUCTION is given by lectures and recitations, and by practical exercises in the field, the laboratories, and the drawing-rooms. A high value is set upon the educational effect of these exercises, and they form the foundation of each of the fifteen Courses. Text-books are used in many subjects, but not in all. In many branches the instruction given differs widely from available text-books; and, in such cases, notes on the lectures and laboratory work have been printed, either privately or by the Institute, and are furnished to the students at cost. Besides oral examinations in connection with the ordinary exercises, written examinations are held from time to time. Near the close of the months of January and May general examinations are held.

In the following pages will be found a more or less detailed statement of the scope as well as the method of instruction of every subject offered in the various departments of the Institute. The subjects are classified according to the departments in which they are given, related studies being arranged in sequence. Owing to the intimate relations existing between the work of the various departments of the Institute, it not infrequently appears in the following classification of subjects that the same instructor gives courses in several divisions other than his own.

The subjects are numbered, or lettered and numbered, for convenience of reference in consulting the various Course Schedules, pages 85 to 131, and the Alphabetical Subject Index, pages 173 to 182. Subjects designated by numbers alone will be found on pages 184 to 316; subjects designated by letters and numbers on pages 317 to 352. As the total number of hours per term devoted to a subject often varies in different Courses, these hours are not in every case given in connection with the following descriptions. Thus Quantitative Analysis (subject 512) is taken 120 hours in Course III, Option 2, 180 hours in Course V, 135 hours in Course X, etc. In the above mentioned Course Schedules, however, the

number of hours of exercise and of preparation in each subject is given, and in the Subject Index, pages 173 to 182, both the hours of exercise and the hours of preparation are also indicated.

The requisites for preparation include not merely the subjects specified by number, but also those required as preparation for them. Thus, for instance, the requirements for course 215 (Applied Mechanics) are M21 and 801; that for M21 is M12; that for M12 is M10 and M11; those for M10 and M11 are 1, 2 and 5 (Algebra, Plane Geometry and Solid Geometry required for admission, page 183); the requirement for 801 is M12. So that to take up 215, Applied Mechanics, the applicant must be prepared to pass, or must have passed, examinations in M10, M11, M12, M21, 801 and in 1, 2 and 5. The reason for this is that in order to properly carry on the work in subject 215, the student must have had suitable training in all of the subjects indicated.

By careful consideration of the Course Schedules, in connection with the following Description of Subjects, the applicant for a special Course may select for the earlier part of that Course such subjects as will enable him to pursue later those more advanced subjects which he may particularly desire. He may also ascertain what preparatory training is requisite for admission to any special work at the Institute.

Applications for exception for sufficient causes from the required preparation as stated in connection with each subject described below will always be considered by the Faculty.

The topics included in the list which follows are subject to change at any time by action of the Faculty; and the list of studies for which any student applies is always subject to the approval of the Faculty.

ALPHABETICAL SUBJECT INDEX

First Term

Numbers, or letters and numbers, in parentheses immediately following the subjects refer to the Subjects of Instruction, pages 183 to 352. Numbered subjects, pages 183 to 316. Lettered and numbered subjects, pages 317 to 352.

Numbers following those in parentheses indicate the year in which the subject is given. g, Graduate. e, Elective.

For many fourth-year subjects division of time between exercises and preparation is varied at the discretion of the instructor.

The hours of exercise and preparation indicated are for a term of fifteen weeks.

Subject	Hours Ex.	Hours Prep.
Acoustics (828) 2	15	15
Acoustics (829) 4	5	5
Aërial Propellers (1379) g	10	20
Aërodynamic Laboratory (1380) g	60	30
Aëronautics (1372) 4	45	45
Aëro Engines (251a) g	30	30
Aëroplane Design, Theory of (1375) g	45	90
Aëroplane Design (1376) g	90	0
Air and Water Anal. (520) 3	45	0
Alternating Currents, Advanced (627) g		
Alternating Current Mach. (623) 4, g — Recitations	30	45
Alternating Current Mach. (623) 4, g — Problems	15	0
Alternating Current Machinery, Advanced (625) g		
Analytical Mechanics (M65) e	30	60
Applications of Chemical Thermodynamics (581) e	30	60
Applied Chemistry (585) 2, 4	15	15
Applied Mechanics (215) — 3 III	45	90
Applied Mechanics (215) — 3 X	60	90
Applied Mechanics (216) 3 II, XIII XIIIA, XIIIB, XV[2]	45	90
Applied Mechanics (217) 3 I, XI, XV[1]	60	90
Applied Mechanics (218) 3 VI	45	90
Applied Mechanics (219) 3 IV[1]	40	80
Applied Mechanics (220) 3 — IV[2]	60	120
Applied Mechanics (220) 3 — 4 XV[3]	60	105
Applied Mechanics (229) 4 II, XIII, XIIIB	45	90
Applied Mechanics (229a) 4	45	90
Applied Mechanics (230) 3 IV[2]	25	50
Architectural History (441) 2	15	30
Architectural History (442) 3	20	15
Architectural History (443) 4. Lect. 20 Ex. 5	25	40
Architecture, Theory and Practice (454) g	15	0
Assaying, Fire (322) 3 — V	30	5
Assaying, Fire (322) 3 — XIV	30	15
Bacteriology (730) 3	75	30
Bacteriology, Advanced (734) 4	45	30
Bacteriology of Fermentation Industries (740) g	30	60
Bacteriology of Water and Sewage (732) 4	30	15
Biochemistry (524) 4, g	30	45
Biology, General (701)2	60	15
Biology, Elements of (702) 3	30	30
XI	30	0
Biology of Infectious Diseases II (751) 4	30	30
Biology, Theoretical (703) 4	30	45
Biology of Water and Sewage Purification (739) 4	15	30
Bridge Design (153) 4	90	0
Business Law (Ec61) 4	30	60
Business Management (Ec58) 4	45	75
Calculating Machines (860) e	7	
Carpentry (289a) and Wood Turning (289b) e	60	0
Central Stations (637) 4, e	30	60
Chemical Engineering II (577)	30	30
XA	30	60
Chemical Engineering Laboratory (583)	30	
Chemical Engineering of Special Industries (579) g	30	60
Chemistry, Inorganic I (501) 1 — Laboratory 60, Lectures 30, Recitations 30	120	60
Chemistry, Anal. & Tech. (534) 3	45	45
Chemistry of Road Materials (538) 3	120	30
Coal Mining (317) 4	20	20
Color (831) 4	5	5
Comparative Physiology (721) 4	45	30
Constructive Design I (481) 4	120	10
Constructive Design III (483) g	120	0
Control of Milk Supplies (743) g	60	90
Cost Accounting (Ec51) 4	45	45
Crystallography, Optical, and Applications of (1223) g	45	30
Crystallography, Physical and Chemical (1221) g	45	
Current Public Problems (H37) 3, e	15	30
Descriptive Geometry (D15) 1	45	0
Descriptive Geometry (D21) 2	45	0
Descriptive Geometry (D23) 2	60	45
Descriptive Geom. — College Class	75	60
Descriptive Geom. — I	85	80
Design I (471) 2	150	0
Design II (472) 3 — IV[1]	135	15
Design II (472) 3 — IV[2]	120	15

First Term

Subject	Hours	Ex.	Prep.
Design III (473) 4	275	–	35
Design (Architectural, Advanced) (474) g	370	–	0
Design of Stations and Distribution Systems (639) g			
Differential Equations, Applications (M61–M63) e	30	–	90
Differential Equations, Partial (M69) e	30	–	60
Discrete Systems (M61) e	30	–	60
Dynamical Geology (1231) 2, 3	45	–	30
Dynamics of Machines (243) 4	25	–	50
Dynamics of Rigid Bodies (M66) g	45	–	90
Dynamo Design (645) 4, e	60	–	30
Economic Geology (1253) 4	45	–	45
XII	60	–	30
Economic Geology (1255) 4	75	–	45
Economic Geology (1256) 4	45	–	45
Economic Geology, Advanced (1259) g	90	–	0
Economic History (Ec33) 3, e	15	–	30
Economics of Corporations (Ec55) 4	30	–	30
Electric Furnaces (888) 4, g	35	–	15
Electric Transmission and Distribution of Power (633) 4	30	–	60
Electric Railways, Advanced (643) g			
Electric Wiring and Lighting of Buildings (651) 4	15	–	15
Electrical Discharges in Vacua (852) 4	45	–	30
VIII[1]	60	–	30
Electrical Engineering, Elements of (615) 3	35	–	75
Electrical Engineering, Elements of (617) 4, 5	30	–	30
Electrical Engineering, Elements of (618, 619) 3, 4	30	–	30
Electrical Engineering Laboratory (687) 4 — II	30	–	30
Electrical Engineering Laboratory (687) 4 — III[1, 2]	30	–	30
Electrical Engineering Laboratory (687) 4 — III[2], X, XV[2]	45	–	45
Electrical Engineering Laboratory (687) 4 — XA, XIIIB	45	–	45
Electrical Engineering Laboratory (687) 4 — XIII	30	–	30
Electrical Engineering Laboratory and Reports (671) 3 VI, XIV,	60	–	50
Electrical Engineering Laboratory (684) 3	30	–	30
Electrical Engineering Laboratory (673) 4	75	–	45
Electrical Engineering Laboratory (679) 4	70	–	40
Electrical Engineering Laboratory (681) 3	15	–	30
Electrical Engineering Laboratory (675) g			
Electrical Engineering, Principles of (602)3	60	–	100
Electrical Engineering, Principles of (604) 4	90	–	120
Electrical Engineering, Principles of (609) 3	75	–	85
Electrical Engineering Seminar (629) g			
Electrical Laboratory (822) 3	15	–	15
Electrical Machinery (613)	45	–	90
Electrical Testing, Advanced (676) g			
Electricity (821) 3	30	–	30

Subject	Hours	Ex.	Prep.
Electrochemical Lab. (886) 4	105	–	15
Electrochemical Seminar (896) g	15	–	60
Electrochemistry (882) 4	45	–	45
Electrochemistry, Elements of (881) e	30	–	30
Engineering of Water and Sewage Purification (181) g	120	–	
Engineering Laboratory (261, 532) 4, g — II	50	–	25
Engineering Laboratory (261, 532) 4, g — XIII, XIIIA, XIIIB	60	–	30
Engineering Laboratory (262) 4	60	–	30
Engineering Laboratory (263) 4	15	–	15
English (E10) 1	30	–	30
English (E11) 1	30	–	30
English (E20) 2	30	–	30
English (E21) 2	30	–	30
English (E23) 2	30	–	45
English (E31) 3	30	–	30
English (E41) 4	15	–	15
English Bible (E53) 3, e	30	–	15
Epidemiology (765) e	15	–	15
European Civilization and Art I (H33) 2	45	–	45
European Civilization and Art II (H34) 3	30	–	40
European Civilization and Art III (H35) 4			
European Civilization and Art (H36) g	30	–	75
IV[1]	30	–	30
IV[2]	30	–	0
Factory Construction (270)	45	–	0
Field Geology, Advanced (1267) g	90	–	
Fire Assaying (321)	75	–	15
Fire Assaying (322) — V	30	–	5
Fire Assaying (322) — XIV	30	–	15
Fluid Dynamics (1374) g	30	–	60
Fluid Dynamics, Theoretical (M59) g	30	–	60
Food Analysis (525) 3	45	–	0
Food Analysis, Adv. (526) 4	75	–	15
Forging (284) 2	30	–	0
Forging (284a) e	45	–	0
Foundations (148) 4	15	–	30
Foundry Work (288) 2, 4	33	–	0
Fourier's Series (M45) 4	30	–	60
Freehand Drawing (D31) 1	30	–	0
Freehand Drawing (D42) 2	60	–	0
Freehand Drawing (D43) 3	60	–	0
French (Elementary) (L61) e	45	–	90
French (Intermediate) (L62) 1	45	–	90
French (L71) 3, e	15	–	30
French (L72) 3, e	15	–	30
French (L73) 3, e	30	–	15
Gas Analysis (531)	20	–	10
Gas and Fuel Analysis (532) 4	8	–	
Geological Seminar (1290) 4	30	–	75
Geological Surveying (1265) 3, 4 — III[1, 3] 4	60	–	45
Geological Surveying (1265) 3, 4 — XII[1] 3	55	–	0
Geological Surveying (1265) 3, 4 — XII[2] 3	30	–	15
Geological Surveying (1265) 3, 4 — XII[2] 4	60	–	30
Geology, Dynamical (1231) 2, 3	45	–	30

First Term

Subject		Hours Ex.	Prep.
Geology, Economic (1253) 4		45–	45
	XII	60–	30
Geology, Economic (1255) 4		75–	45
Geology, Economic, Advanced (1259) g		90–	0
Geology, General (1232) 2	III[1,3]	45–	30
	XII	45–	30
Geology, Historical (1240) 4		90–	90
Geology of Europe (1294) g		30–	60
Geology of Materials of Construction (1257) 3, e		15–	30
Geology, Structural and Field (1262)	III[1]	45–	30
	III[3]	45–	15
German (Elementary) (L11) e		45–	90
German (Intermediate) (L21) 1		45–	90
German (L31) 2		45–	60
German (L32) 2		45–	60
German (L33) 2		30–	45
	XI	30–	45
German (L35) 2		15–	15
German (L41) 3, e		15–	30
German (L42) 3, e		15–	30
German (L43) 3, e		30	–15
Glass Blowing (898) 4, e		12–	0
Heat Engineering (245) 3, 4	VI, XIII	30–	60
	II, X	60–	90
Heat Engineering (247) 3, 4		45–	90
	XI	45–	75
Heat Engineering (248) 4		30–	60
Heat Engineering, Elements of (256) 3		45–	45
Heat Measurements (813) 4	III[1]	30–	10
	III[2]	45–	35
	V[2,3]	30–	30
Heat Transmission (257) e		15–	
Heating and Ventilation (256) 3	IV	45–	45
Heating and Ventilation Design (257) 3		30–	0
Highway Drainage (133) 4		15–	30
Highway Engineering Research, Advanced (134) g		45–	135
Highway Specifications (137) 4		45–	60
History II (H31) 2, 3		30–	30
History of Science (790) 3, e		15–	30
Hydraulic and Sanitary Engineering (175) 4		45–	75
Hydraulic Laboratory Research (171) g		120–	
Hydraulics, Theoretical (162) 4	I, XI	45–	90
Hydraulics, Theoretical (163) 4	III[1,2]	20–	40
	X, XIII, XIIIB	15–	30
Hydraulics, Theoretical (164) 4	II, XV[1,2]	30–	60
Hydraulics, Theoretical (165) 4		45–	90
Hydrodynamics (M57)		20–	40
Hygiene, Personal, I (760)		15–	45
Illumination and Photometry (655) 4, e		30–	60
Index Fossils (1273) 4		60–	30
	III[3]	45–	20
Industrial Applications of Chemical Principles (584) g		15–	15
Industrial Microbiology (735) 4		60–	30
Industrial Chemistry II (587) 4		90–	15
	V[2]	120–	30
	V, XIV	45–	45
Industrial Chemistry I (575) 4	X	30–	30
	XIV	45–	45
Industrial Hygiene and Sanitation (753) 4		30–	30
Industrial Organization (Ec56) 3		30–	60
Inorganic Chemistry, Exp. Problems in (590) 3	V[1]	165–	15
	V[2]	90–	15
	XA	180–	15
Inorganic Chemistry III (504) g		15–	60
Internal Combustion Engines (252) e		15–	
International Law (H39) 3, e		15–	30
Italian (L91) e		30–	45
Journal Reports (594) 4		15–	10
Journals (780) 4		30–	15
Laboratory Reports (356) 4		15–	0
Leaching Gold and Silver Ores (338) g		120–	60
Life Class (D44) 4		90–	0
Life Class and Decorative Design (D45) g		90–	0
Lithology (1211) 3		15–	0
Machine Design (267) 4		90–	0
Machine Design (267a) 4		90–	0
Machine Design (268) g			
Machine Drawing (208) 3	II	30–	0
	III[2]	60–	0
	X, XV[2]	60–	0
Machine Tool Work (291) II, XIII, XIIIB		45–	0
Machine Tool Work (291a) e		75–	0
Marine Engine Design (1353) g		120–	0
Marine Engineering (1355)		30–	30
Marine Engines (1351) g	XIIIA	30–	30
Mathematical Laboratory (M54) e		30–	
Mathematics (M11) 1		30–	60
Mathematics (M21) 2		45–	90
Mathematics (M31) 3		45–	90
Mathematics (M32) 3		30–	60
Mathematics (M35) 3		45–	75
Mathematics (M36) 3		60–	12
Mathematics, Advanced (M51–M65)		30–	60
Mechanical Applications of Electric Power, (635) g, e		40–	30
Mechanical Draw. (D11) 1		45–	0
Mech. Eng. Draw. (206) 2		60–	0
	VI	45–	0
	XIII	75–	0
Mechanical Eng. Drawing (207) 2, 3		30–	0
	XV[2]	45–	0
Mechanical Treatment of Metals (361) g		30–	30
Mechanism (200) 2	II, VI	45–	90
	XIII, XIIIB	45–	70
Mechanism (201) 2, 3		30–	65
Metal Mining (316) 4		170–	120
Metallography (507) 4		15–	30

First Term

Subject	Hours Ex.	Prep.
Metal Turning (294) 2	30–	0
Metal Turning (295) 2, 3, 4	45–	0
X	30–	0
Metallography (333) 4	85–	25
Metallography (334) 4	15–	5
Metallurgical Calculations (347) g		
Metallurgical Laboratory (351) 4	100–	0
Metallurgical Laboratory and Reports (352, 356) 4	30–	0
Metallurgical Plants, Economics of (362) g	15–	15
Metallurgical Processes, Development of (363) g	30–	30
Metallurgy (331) 4	45–	45
Metallurgy and Physics of Metals (360) g	120 to	480
Metallurgy of Engineering Materials (332) 3, 4	45–	45
Metallurgy of Iron and Steel (341) 4 — III$_2$	75–	45
Metallurgy of Iron and Steel (341) 4 — III$_3$	45–	45
Metallurgy, Principles of (336) 3	60–	15
Military Science (20, 21) 1 — A	45–	0
Military Science (20, 21) 1 — B	30–	15
Mineral Lands: Acquisition, Tenure (314) g	90–	0
Mineralogy (1201) 2	75–	10
Mineralogy and Petrology (1209) 3	30–	15
XII	60–	15
Mining and Metallurgical Calculations (305) 4	15–	15
Mining Engineering (302) 3	45–	45
Mining Engineering (303) 4	45–	30
Mining Engineering (306) 3	30–	30
Mining Engineering, Advanced (311) g	45–	90
Mining Laboratory (318) 4	20–	20
Model Making (1395) 4	30–	0
XIII	25–	0
Naval Architecture (1301) 3	30–	60
XIII$_A$	15–	20
Naval Architecture (1302) 4	30–	60
Oil Testing (536) 4, e	25–	5
Optical Laboratory (849) 4	60–	30
Optical Methods in Chemical Analysis (527) 3	30–	15
Ore-Dressing (307) 4	40–	15
Ore-dressing (312) g	45–	90
Organic Chemistry (550) 3	30–	30
Organic Chemistry I (551) 4	45–	30
Organic Chemistry II (552) g	30–	60
Organic Chemical Laboratory (558)	45–	15
Org. Chemical Laboratory (557) 3, 4 VII	105–	15
Organic Chemical Laboratory (556)	105–	0
X	90–	0
Organic Chemistry, Exp. Problems in (592) 4	80–	30
Organic Laboratory, Advanced (560) e		
Organic Qualitative Analysis (516) g	135–	0
Organization and Administration of Public Service Companies (695) g		

Subject	Hours Ex.	Prep.
Paleontology (1277) g		
Paleontology, Introductory (1271) 3, g	60–	30
Personal Hygiene I ( )	15–	45
Perspective, Applied (413) 2	30–	0
Perspective, Applied (415) 3	30–	0
Petrography (1215) 4	60–	15
III^3	45–	15
Petrography (1225) g		
Philosophy of Architecture (451) 4	15–	15
IV^2	15–	0
Photographic Laboratory (851) 4	60–	30
Physical Colloquium (855) 4 — XIV	30– 25–	
Physical Laboratory (807) 2	30–	30
I, XI	15–	15
Physical Measurements, General (866) g	60–	15
Physical Training (25) 1	25–	0
Physicochemical Research Reports and Reviews g		
Physics (801) 2 — Lectures 45, Recitations 45	90–	75
IV, Lect. 45, Rec. 30	75–	60
Plant Design (582) e	60–	30
Plant Physiology (728) 4	15–	15
Plotting. See Surveying (100)		
Polarized Light (864) e	15–	
Political Economy (Ec31) 3	45–	45
Political Economy (Ec32) 2	45–	45
Potential Function, Theory of (M52) e	30	–60
Power Stations and Distribution Systems (639) g		
Problems in the Dressing and Milling of Ores (309) g	120–	0
Problems of the Chemical Engineer (586) 2	10–	0
Professional Relations (422) 4	15–	0
Proximate Technical Analysis (530) 4	90–	30
Public Health Problems (755) 4	15–	15
Public Speaking (E57) 3, e	30–	15
Qualitative Analysis (511) 2 — III^{1,3}	120–	15
Qualitative Analysis (511) 2 — VII	105–	15
Qualitative Analysis (511) 2 — VIII^{1,2}	105–	15
Qualitative Analysis (511) 2 — VIII^3	120–	15
Qualitative Analysis (511) 2 — XI	150–	15
Qualitative Analysis (511) 2 — XII	105–	15
Qualitative Analysis of Rare Metals (515) g	165–	
Quantitative Analysis (512) 2 — III^2	120–	15
Quantitative Analysis (512) 2 — V	180–	15
Quantitative Analysis (512) 2 — X	185–	30
Quantitative Analysis (512) 2 — XIV	120–	15
Quantitative Analysis (512) 2 — XV^2	120–	15
Quantitative Analysis (513) 3 — III	120–	15
Quantitative Analysis (513) 3 — VIII^1	90–	
Quantitative Analysis (514) 3 — V^1	120–	30
Quantitative Analysis (514) 3 — V^2	135	–15
Quantitative Analysis (514) 3 — V^3	195–	30
Radiation (868) g	15–	60

First Term

Subject	Hours Ex.	Prep.
Radiation, Theory of (869) g	15–	60
Railroad Design (126) 4	45–	0
Railroad Design (128) g	45–	0
R. R. Drafting (123) 3 { $I^{1,2}$	60–	0
R. R. Drafting (123) 3 { I^3, XI	45–	0
Railroad Engineering (121) 3 { $I^{1,2}$	30–	60
Railroad Engineering (121) 3 { I^3, XI, XV^1	20–	40
Railroad Engineering (125) 4	30–	45
XV^1	30–	60
Railroad Engineering (127) g	30–	60
Refrigeration (254) g	30–	60
Reinforced Concrete Design (158) g	45–	90
Reinforced Concrete Theory (157) 4	30–	60
Report Writing (E33) 3	30–	30
Research Conferences (598) g	30–	
Sanitary Design (183) g	90–	0
Sanitary Engineering (177) 4	45–	75
Sanitation of Houses and Public Buildings (762) g	15–	15
Shades and Shadows (411) 2	30–	15
Shakespeare's Plays (E51) 3, e	30–	15
Ship Design (1342) 3	75–	0
Ship Design (1343) 4	80–	
Spanish (L81) e	30–	45
Standardizing Laboratory (667) 4	30–	30
Statistical Methods in Theoretical Physics (M67) g	15–	
Statistics (Ec65) 3	60–	0
Storage Batteries and their Applications (653) 4	15–	15
Structural and Field Geology (1262) 3 { III^1	45–	30
Structural and Field Geology (1262) 3 { III^3	45–	15
Structural Design (492) 4	215–	0
Structural Design (154) 4	60–	0
Structural Design, Advanced (156a) e	90–	0
Structural Drawing (490) 3	30–	0
Structures (149) 4	45–	90
Structures (151) 4, IV^2	45–	90
Structures of Metal, Wood and Masonry (156) e	45–	90
Surveying (102) 2, 3	30–	0
Surveying and Plotting (100) 2	30–	15
Surveying, Advanced (109) 3	30–	0
Taxation (Ec70) 4	15–	15
Teaching of Elementary Mathematics (M71) e	15–	30
Technical Electrical Measurements (662) 4	10–	10
Technical Electrical Measurements, Elementary (668) 4	15–	15
Technical Electrical Measurements Laboratory (664) 3	15–	15
Technical Electrical Measurements Laboratory (665) 4	30–	30
Testing Materials Laboratory (235) 4* { II	25–	5
Testing Materials Laboratory (235) 4* { $III^{1,2}$, X, XIII, XIIIA	20–	10
Testing Materials Laboratory (235) 4* { $XV^{1,2}$	30–	0
Testing Materials Laboratory (237) 3	20–	0
Testing Materials Laboratory (238) 4	30–	15
Testing Materials Laboratory (239) 4	35–	15
Theoretical and Applied Optics (848) 4	45–	90
Theoretical Biology (703) 4	30–	45
Theoretical Chemistry I (565) 3, 4		
III^2	45–	90
V, X, XV^3	75–	90
VIII, XIV	45–	75
Theoretical Chemistry II (566) 4 V	48–	57
X	30–	45
Theoretical Chemistry III (567) g	15–	30
Theoretical Physics I (841) 3	45–	90
Theoretical Physics II (842) 4	45–	90
Theoretical Physics III (843) 4	45–	90
Theory of Elasticity (231) g		
Theory of Functions (M56) e	30–	60
Theory of Warship Design (1311) 3	30–	30
Theory of Warship Design (1312) 4	30–	30
Theory of Warship Design (1313) g	30–	30
Thermodynamics (M53) e	30–	60
Trigonometry, Plane (M10) 1	30–	60
Trigonometry, Spherical (M20) 2, 3	10–	20
Valuation of Public Service and other Corporations (129) e	45–	90
Ventilation and Drainage (1333) 4	30–	30
Vertebrate Anatomy (710) 3	105–	45
Vise and Bench Work (290b) 4	12–	0
Vital Statistics (190) 4	30–	30
Warship Design (1321) 3	105–	
Warship Design (1322) 4	90–	
Warship Design (1323) g	90–	
Water Supplies and Air (520) 3	45–	0
Water and Sewage, Purification of (760) g	30–	60
Water Color (453) 3	30–	0
Waterpower Design (182) g	90–	0
Water Supply and Wastes Disposal (522) 4	45–	30
Waterpower Engineering (173) g	45–	90
Wood Turning (289b). See Carpentry.		
Woodwork and Pattern Making (289) 3	60–	0
Zymology (736) 4	45–	30

ALPHABETICAL SUBJECT INDEX

Second Term

Numbers, or letters and numbers, in parentheses immediately following the subjects refer to the Subjects of Instruction, pages 183 to 352. Numbered subjects, pages 183 to 316. Lettered and numbered subjects, pages 317–352.

Numbers following those in parentheses indicate the year in which the subject is given. g, Graduate, e, Elective.

For many fourth-year subjects division of time between exercises and preparation is varied at the discretion of the instructor.

The hours of exercise and preparation indicated are for a term of fifteen weeks.

Subject	Hours Ex.	Hours Prep.
Accounting (Ec50) 2	45–	45
Aëronautics (1372) 4 — XIIIA	45–	45
Aëronautics (1372) 4 — XIIIB	30–	60
Aëronautics (1373) g	30–	60
Aëroplane Design (1376) g	90–	0
Airship Design, Theory of (1377) g	45–	90
Airship Design (1378) g	90–	0
Alternating Currents, Advanced (627) g		
Alt. Cur. Machinery (622) 4, g — Lectures	5–	0
Alt. Cur. Machinery (622) 4, g — Recitations	15–	15
Alt. Cur. Machinery (622) 4, g — Problems	15–	0
Analytical Mechanics (M65) e	30–	60
Anthropology (715) 3	15–	15
Applied Electrochemistry (885) 4	30–	60
Applied Electrochemistry (897) g	15–	60
Applied Mechanics (215) 2 — I, II, VI, XI, XIV, XV[1,2]	45–	90
Applied Mechanics (215) 2 — XIII	45–	85
Applied Mechanics (215a) 2	45–	90
Applied Mechanics (218) 3 — III	45–	90
Applied Mechanics (218) 3 — X	45–	75
Applied Mechanics (221) 3 — VIII[3]	30–	60
Applied Mechanics (225) 3 — II, XV[2]	45–	90
Applied Mechanics (226) 3 — XIII		
Applied Mechanics (226) 3 — XIIIB	30–	60
Applied Mechanics (227) 3 — IV[1]	45–	90
Applied Mechanics (228) 3 — IV[2]	60–	120
Architectural History (441) 2	15–	30
Architectural History (442) 3	20–	25
Architectural History: Special Research (443) g		
Architectural Problems, Advanced (452) g		
Architecture, Theory and Practice (454) g	15–	0
Argumentation and Debate (E58) e, 3	45–	30
Assaying, Fire (321) 3 — III	75–	15
Assaying, Wet (323) 3, 4 — III[1]	120–	15
Assaying, Wet (323) 3, 4 — III[2]	75–	0
Astronomy (112) 2	30–	30
Astronomy, Descriptive (833)	30–	45
Bacteriology, Elements of (731) 3 — V	60–	30
Bacteriology, Elements of (731) 3 — XI	60–	0
Bacteriology in Relation to Refrigeration, Canning and Food Preserving (742) g.	30–	30
Bacteriology of Air, Water and Foods (733) 3	75–	30
Bacteriology of Water and Sewage (732) 3	45–	30
Banking (Ec37) 2	45–	60
Banking and Finance (Ec36) 3, e	45–	30
Biology of Infectious Diseases I (750) 3	15–	15
Boiler Design (266) 3	45–	0
Botany, Cryptogamic (704) 2	60–	30
Bridge Design (153) 4	90–	0
Business Law (Ec60) 3	15–	15
Business Law (Ec61) 4	30–	60
Business Management (Ec58) 4	60–	110
Business Relations (422) 4	15–	0
Central Stations (637) 4, e	45–	45
Central Stations (638) 4 — XV[2]	30–	60
Chemical Engineering I (576) 3	30–	60
Chemical Engineering II (577) 4	30–	60
Chemical Engineering Laboratory (583)	30–	0
Chemical Mineralogy and Petrology (1226)	45–	90
Chemistry, Inorganic (502) — Laboratory 60, Lectures 30, Recitations 30	120–	60
Chemistry, Analytical and Technical (534) 3	90–	0
Chemistry of Road Materials (537) g	45–	
Chipping and Filing (290a) e	45–	0
Civil Engineering Drawing (107). See Surveying and Plotting 100, 107		
Constitution of Matter (871) g	15–	60
Constructive Design (482) 4	45–	0
Continuous Media (M62) e	30–	65
Crystallography, Elementary (1220) e	15–	
Curve Tracing (M51) e	30–	60
Descriptive Geometry (D16) 1	45–	0
Descriptive Geometry (D16a) 1	70–	0
Descriptive Geometry (D18) 1	90–	15
Design I (Architectural) (471) 2	150–	0
Design II (Architectural) (472) 3	210–	15
Design III (Architectural) (473) 4	375–	75
Design (Architectural, Advanced) (474) g		
Designs of Stations and Distribution Systems (639) g		
Differential Equations, Applications (M61–M63) e	30–	60
Dynamics of Rigid Bodies (M66) g	45–	90
Dynamo Design (646) 4, g	60–	30
Economic Geology (1254) 4 — XII	30–	15
Economic Geology (1259) g	60–	15
Electric Furnaces (889) 4 — III[2]	90–	0
Electric Furnaces (889) 4 — VIII[2]	15–	20
Electric Railways (642) 4, e	45–	15
	30–	60

Second Term

Subject	Hours Ex. Prep.
Electric Railways, Advanced (643) g	
Electric Transmission Equipment (632)	30– 60
Electrical Discharge in Gases (862) e	15– 0
Electrical Engineering, Elements of (616) 3, 4	30– 30
Electrical Engineering, Elements of (619) 4	30– 30
Electrical Engineering, Principles of (601) 2	30– 40
Electrical Engineering, Principles of, III (603) 3 — VI	60–100
Electrical Engineering, Principles of, III (603) 3 — XIV	60– 60
Electrical Engineering, Principles of (605) 4	85–105
Electrical Engineering Laboratory (672) 3	75– 65
Electrical Engineering Laboratory (674) 4	60– 45
Electrical Engineering Laboratory (678) 3	30– 30
Electrical Engineering Laboratory (680) 4	35– 30
Electrical Engineering Laboratory (682) 3	30– 45
Electrical Engineering Laboratory (685) 4	30– 30
Electrical Engineering Laboratory (687) 3, 4	45– 45
Electrical Engineering Seminar (629) g	
Electrical Laboratory (822) 3	45– 45
Electrical Machinery (614) 4	45– 90
Electrical Measurements (821) 3, 4	30– 30
Electrochemical Laboratory (887) 4	45– 30
Electrochemistry (890) 4	30– 30
Embryology and Histology (711) 3	105– 75
Engine Design (277) 4	50– 25
Engineering Laboratory (260) 3, 4	20– 5
III[2]	20– 10
VI	20– 0
Engineering Laboratory (261, 814) 4	60– 30
VI	45– 25
XV[2]	90– 0
Engineering Laboratory (262) 4	60– 30
Engineering Lectures, General (275) 4	15– 15
English (E10) 1	30– 30
English (E12) 1	30– 30
English (E20) 2	30– 30
English (E22) 2	30– 30
English (E24) 2	30– 45
English (E34) 3	45– 75
English (E42) 4	15– 15
English (E44) 4	30– 30
English Composition, Advanced (E56) 3, e	30– 45
English Literature of the Nineteenth Century (E52) 3, e	45– 30
European Civilization and Art I (H33) 2	30– 40
European Civilization and Art II	
(H34) 3 — IV[1]	30– 40
(H34) 3 — IV[2]	30– 0
European Civilization and Art III (H35) 4	
IV[1]	30– 30
IV[2]	30– 0
Experimental Problems in Theoretical Chemistry (591) 3 — V[1]	165– 20
VIII	135– 15
Fluid Dynamics, Theoretical (M59) g	30– 60
Food Analysis (525) 3, 4	45– 0
Forging (284) 2	30– 0
Forging (284a) e	60– 0
Forging (285) 3, 4	45– 0
Forging (285a) 3	30– 0
Foundry Work (287) 2, 3, 4	45– 0
Fourier's Series (M45) 4	30– 60
Freehand Drawing (D32) 1	15– 0
Freehand Drawing (D41) 1	60– 0
Freehand Drawing (D42) 2	60– 0
Freehand Drawing (D43) 3	60– 0
French (Elementary) (L61) e	45– 90
French (Intermediate) (L62) 1	45– 60
French (L71) 3, e	15– 30
French (L72) 3, e	15– 30
French (L74) 3, e	30– 0
Gas Analysis (531) 2, 3, 4	20– 10
Geodesy (113) 3	30– 30
Geological Seminar (1290) 4	30– 75
Geological Surveying (1265) 3 — XII[1]	90– 0
Geological Surveying (1265) 3 — XII[2]	120– 15
Geology, Economic (1254) 4	30– 15
Geology, Economic (1255) 4	45– 45
Geology, Economic (1259) g	90– 0
Geology, Field (1264) 3	45– 15
Geology, Field, Advanced (1267) 4	90–
Geology, General (1233) 3	45– 30
Geology of Coal and Petroleum (1260) g	30– 30
Geology of Materials of Construction (1257) 2	30– 30
Geology of North America (1291) 4	60– 30
Geology, Stratigraphic (1237) 2	30– 15
Geology, Stratigraphic (1238) 3	15– 15
Geology, Structural and Field (1234) 3	30– 15
Geometry, Advanced (M58) e	30– 60
German (Elementary) (L11) e	45– 90
German (Intermediate) (L21) 1	45– 60
German (L31) 2	45– 60
German (L41) 3, e	30– 40
German (L42) 3, e	30– 45
German (L44) 3, e	30– 5
German (L45) 3, e	30– 45
German (L46) 3, e	30– 45
German (L47) 3, e	15– 30
Heat Engineering (245) 3, 4 — II	45– 95
Heat Engineering (245) 3, 4 — VI, XIII	60–120
Heat Engineering (245) 3, 4 — X	30– 45
Heat Engineering (245) 3, 4 — XIV	30– 60
Heat Engineering (247) 3, 4	45– 90
I, XI	45– 85
III[2], XV	45– 60
Heat Engineering (248) 4	30– 60
Heat Engineering (250) g	
Heat Measurements (813) 3	30– 15
XII	30– 30
Heat Measurements (814) 4	8– 0
Heat Measurements, Advanced (815) 3	30– 30
Heat Measurements (816) g	45–
Heating and Ventilation (255) 4	15– 30
Hertz Waves; Radio Telegraphy (863) e	15– 0
Highway Construction (132) 3	45– 90
4	45– 60
Highway Design (135) 4	60– 0
Highway Economics (136) 4	30– 30
Highway Engineering (130) 3	15– 30
Highway Engineering Research, Advanced (314) g	45–135
Highway Specifications (137) 3	30– 60
History I (H12) 1	30– 30
History and Archeology (444) g	– 30

Second Term

Subject	Hours	Ex.	Prep.
History of Chemistry (593) 4	15–	15	
History of Ornament (431) 2	15–	30	
History of Science (790) 3, e	30–	45	
Hydraulic and Sanitary Design (179) 4 — I	30–	0	
Hydraulic and Sanitary Design (179) 4 — XI	85–	0	
Hydraulic and Sanitary Engineering (176) 4	45–	75	
Hydraulic Engineering (169) 4	XV[1,2]	30–	60
Hydraulic Engineering (168) 4	II	45–	60
Hydraulic Laboratory (172) 4	I, XI	15–	10
	XV[1]	15–	5
Hydraulics (163) 4	20–	40	
	IV	15–	30
Hydrodynamics (M57) 4	20–	40	
Industrial Applications of Electrical Power (635) 4	30–	60	
Industrial Chemistry I (575) 4	45–	45	
Industrial Chemistry II (587) 4	X	135–	30
	XIV	45–	45
	XV[3]	105–	15
Industrial Management (274) 4	15–	15	
Industrial Organization (Ec56) 3	45–	45	
Industrial Water Analysis (521) 3	30–	0	
Inorganic Chemistry II (503) 4	30–	30	
	X	30–	30
Inorganic Chemistry III (504) g	15–	60	
Internal Combustion Engines (251) 4	20–	20	
Italian (L91) e	30–	45	
Journal Meetings (691) 4	30–	0	
Journals (780) 4	30–	30	
Labor Problems (Ec45) 3	30–	45	
Laboratory Reports (356) 4	15–	0	
Least Squares, Method of (M26) 2, 3, 4	20–	30	
Life Class (D44) 4	90–	0	
Life Class and Decorative Design (D45) g	90–	0	
Locomotive Engineering (278) 4	30–	45	
Machine Design (267) 4	60–	0	
Machine Design (267a)	60–	0	
Machine Design (269) g	60–		
Machine Design (270) g			
Machine Drawing (208) 3	VI	60–	0
Machine-tool Work (291) 4	II, XIII		
	XIII[B]	60–	0
Machine-tool Work (291a) e	75–	0	
Machine-tool Work (292) 4	45–	0	
Marine Engine Drawing (1352) 4	90–		
Marine Engineering (1351) 4	30–	60	
Marine Steam Turbines (1360) 4	30–	60	
Materials (143) 3	30–	45	
	IV[2]	30–	45
	XV[1]	30–	35
Materials of Construction (580) e	30–	30	
Mathematical Laboratory (M54) e	30–		
Mathematics (M12) 1	60–120		
Mathematics (M22) 2	45– 90		
Mathematics (M35) 3	45– 75		
Mathematics, Advanced (M51–M65)	30– 60		
Mathematics of Wireless Telegraphy (M63) e	30– 60		
Mechanic Arts (297) 2	75–	0	
Mechanical Applications of Electric Power (635) 4, e	30–	45	
	XIII[A]	30–	60
Mechanical Drawing (D12) 1	45–	0	

Subject	Hours	Ex.	Prep.
Mechanical Drawing (D12a) 1	20–	0	
Mechanical Drawing (D14) 1	45–	0	
Mech. Eng. Drawing (206) 2 — II	45–	0	
Mech. Eng. Drawing (206) 2 — VI	20–	0	
Mech. Eng. Drawing (206) 2 — X	60–	0	
Mech. Eng. Drawing (206) 2 — XIII	30–	0	
Mech. Eng. Drawing (209) 3	II	90–	0
	XV[2]	105–	0
Mechanism (200) 2 — II, VI, XIII, XIII[B]	20–	40	
Mechanism (200) 2 — X	45–	75	
Mechanism (201) 2, 3	30–	60	
Mechanism of Machines (204) 3	30–	35	
Memoirs (1305) g	15–	35	
Metal Turning (294) 2	30–	0	
Metallography (507) 4	30–	30	
Metallurgical Laboratory (355) 3	85–	0	
Metallurgical Plant Design (349) g	100–	0	
Metallurgy (331) 4	45–	45	
Metallurgy and Physics of Metals (360) g	120 to	480	
Metallurgy, Copper (339) 3	30–	30	
Metallurgy, General (335) 3	45–	40	
Metallurgy, General (341) g			
Metallurgy, General (342) g			
Metallurgy, Lead, Gold, Silver (337) 3	35–	35	
Metallurgy of Copper, Advanced (364) g	30–	30	
Metallurgy, Zinc and Minor Metals (340) 4	30–	30	
Meteorology (1381) g	20–	20	
Microbiology of Soils and Plant Diseases (741) g	30–	30	
Microscopical Laboratory (700) 1	30–	30	
Microscopy of Drinking Waters (706) 4	15–	15	
Military Science 1 — (20) A	45–	0	
Military Science 1 — (21) B	30–	15	
Mill Engineering and Drawing (279) 4	75–	0	
Mine Examination and Reports (320) g	200–	0	
Mineralogy (1201) 2	60–	15	
Mineralogy (1202) 2	105–	30	
Mineralogy and Petrology (1208) 2	90–	15	
Mineralogy and Petrology (1209) 3	60–	15	
	XII	90–	30
Mining and Metallurgical Calculations (305) 4	15–	15	
Mining Engineering (302) 3	45–	45	
Mining Engineering (308) 4	200–	45	
Mining Engineering, Advanced (311) g	200–	0	
Mining Engineering, Elements of (301) 2	15–	10	
Mining Laboratory (318) 4	90–	45	
Mining Plant (313) 4	45–	30	
Mining Projects and Design (319) g	150–	0	
Mining: Prospecting, Exploring, Exploitation (315) 3	30–	30	
Mold Loft Work (1391) e			
Municipal Government (H38) 3, e	30–	45	
Naval Architecture (1301) 3	30–	55	
	XIII[A]	30–	60
Naval Architecture (1302) 4	15–	30	
Office Practice (421) 2, 3	60–	0	
Optical Methods in Sugar Analysis (527) 3	30–	15	
Ore Deposits (1251) 2	30–	40	
Ore-dressing, Advanced (312) g	200–	0	
Organic Chemical Laboratory (557) 3	75–	0	
	XV[3]	90–	0
Organic Chemical Laboratory (556)	150–	10	
	X	60–	0

Second Term

Subject	Hours Ex.	Prep.
Organic Chemistry I (551) 3	60–	45
Organic Chemistry II (552) g	30–	60
Organic Evolution (1275) e	30–	60
Organic Laboratory, Advanced (560) e		
Organization and Administration of Public Service Companies (634) g		
Paleontology (1277) g		
Paleontology, Introductory (1271) 3, g	60–	30
Parasitology (707) 3	30–	30
Pattern Work (289c) e	30–	0
Personal Hygiene (723) 4	30–	30
Perspective (412) 1	20–	40
Perspective, Applied (414) 2	30–	0
Perspective, Applied (415) 3	30–	0
Petrography (1215) 4	45–	15
Petrography (1225) g		
Philosophy of Architecture (451) 4	15–	30
IV[2]	15–	0
Photography (861) 2, e	15–	0
Physical Colloquium (855) 4	15–	15
Physical Laboratory (807) 2 — I, III, VI, VIII, X, XI, XIII, XIV	30–	30
Physical Laboratory (807) 2 — II, V	30–	25
Physical Laboratory (807) 2 — VII	30–	15
Physical Laboratory (807) 2 — XV[1]	5–	5
Physical Laboratory (807) 2 — XV[2,3]	20–	20
Physical Laboratory Recitations (806) 2	15–	15
Physical Metallurgy (508) 3, 4	15–	15
Physical Training (25) 1	15–	0
Physico-chemical Laboratory (893) 3	75–	60
Physico-chemical Research Reports and Reviews g		
Physics (801) 2 — Lectures 45, Recitations 30	75–	60
Physiography (1235) e	45–	30
Physiological Laboratory (725) e	45–	15
Physiological Laboratory, Advanced (726)	60–	30
Physiology, General (720)	90–	60
Plant Design (582) g	60–	60
Plotting (107). See Surveying (100)		
Polarized Light (864) e	30–	
Power in Mining (259) 4	45–	45
Power Plant Design (272) 4	60–	0
Power Stations and Distribution Systems (639) 9		
Precision of Measurements (80)	10–	10
Principles and Applications of Electrolysis (865) e	6–	0
Problems in Applied Chemistry (588) 4	30–	60
Problems in Chemical and Industrial Biology (737) 4	15–	15
Professional Relations (422) 4	15–	0
Proximate Technical Analysis (530) 4	90–	30
Public Health Administration (773) g	15–	0
Public Health Laboratory Problems (741) g	90–	15
Public Health Laboratory Methods (738) 4	45–	30
Public Health Practice (757) 4	60–	75
Public Health Problems (755) 4	30–	45
Quantitative Analysis (512) 2 — III[1,3]	120–	15
Quantitative Analysis (512) 2 — VII	150–	15
Quantitative Analysis (512) 2 — VIII[1,2]	110–	15
Quantitative Analysis (512) 2 — VIII[3]	120–	15
Quantitative Analysis (512) 2 — XI	90–	15
Quantitative Analysis (512) 2 — XII	135–	15
Quantitative Analysis (513) 2, 3 — III[2,3]	120–	15
Quantitative Analysis (513) 2, 3 — V[2]	195–	15
Quantitative Analysis (513) 2, 3 — X	115–	15
Quantitative Analysis (513) 2, 3 — XIV	100–	15
Quantitative Analysis (513) 2, 3 — XV[3]	120–	15
Quantitative Analysis (514) 3	165–	15
Quantitative Analysis (514) 3 — III	120–	15
Radiation, Theory of 869) g	15–	60
Radioactive Measurements (872)	30–	15
Railroad Design (126) 4	30–	0
Railroad Design (128) g	45–	0
Railroad Drafting (123) 3 — I[1],	60–	0
Railroad Drafting (123) 3 — I[3], XI	75–	0
Railroad Economics (Ec34) 3, e	45–	30
Railroad Engineering (121) 3 — I[1,2]	30–	30
Railroad Engineering (121) 3 — I[3], XI, XV[1]	20–	20
Railroad Engineering (125) 4	45–	90
Railroad Engineering (127) g	30–	60
Recent Developments in Chemistry (597) 4	10–	0
Recent Developments in Organic Chemistry (563) e	15–	
Refrigeration (253)	15–	30
Refrigeration (254) g	30–	60
Reinforced Concrete Research (159) g		
Research Conferences (598) g	30–	
Sanitary Science and Public Health (756) 2, 4	15–	0
Sanitary Design (183) g	90–	0
Sanitary Engineering (178) 4	90–	90
Sanitary Law (772) g	15–	0
Sanitation in Chemical Industries (523) 4	30–	30
Sanitation of Houses and Public Buildings (758) g	15–	15
Sanitation of Ships (761) 4	15–	15
Scientific Investigation, Principles of 4		45
Securities and Investments (Ec38) 3	45–	45
Ship Construction (1331) 2	20–	20
Ship Construction (1332) 3	20–	20
Ship Design (1343) 4	120–	0
Ship Design (1342) 3	90–	0
Ship Drawing (1341)	30–	0
Shipyard Practice (1314) 4	30–	30
Spanish (L81) 3, e	30–	45
Spanish (L81) 3, e — III[1]	45–	70
Specifications and Contracts (199) g	30–	60
Statistical Methods in Theoretical Physics (M07) g	15–	
Stationary Structures (144) 3	30–	60
Steam and Mechanical Appliances for Buildings (258) 4 — Lect.	15–	15
Steam and Mechanical Appliances for Buildings (258) 4 — Lab.	10–	0
Steam Turbine Engineering (280) 4	90–	45
Stereotomy (D28) 2	45–	10
Structural Design (155) 4	75–	0
Structural Design (491) 3	150–	0
Structural Design (492) 4	440–	0
Structural Design, Advanced (156a)	90–	0
Structures of Metal, Wood, and Masonry (156) e	45–	90
Structures, Stationary (144) 3	30–	60
Structures, Theory of (140) 3, I[1,2]	45–	90
Structures, Theory of (140) 3, I[3], XI, XV[1]	45–	90
Structures, Theory of (141) 3 — IV	45–	90
Structures, Theory of (145) g	105–	90
Structures, Theory of (149) 4	45–	90
Structures, Theory of, Advanced (150) 4	30–	60

Second Term

Subject	Hours	Ex.	Prep.
Structures, Theory of (151) 4. . . . IV	45–	90	
Surveying and Plotting (100) 2	30–	0	
Surveying (102)	30–	0	
Surveying Instruments (101) 2 . . XIII			
Teaching of Elementary Mathematics (M71) e	15–	30	
Technical Electrical Measurements Laboratory (691) 3	30–	30	
Telephone Engineering (658) 4, e	30–	60	
Testing Highway Materials (139) 3 . . .	30–	15	
V	45–	30	
X	27–	18	
Testing Materials, Laboratory (236) 3 I, XI	30–	0	
Theoretical Biology (703) 4	30–	45	
Theoretical Chemistry I (565) 3, 4 . . .			
III[2]	20–	35	
V, X, XV[3]	75–	90	
VIII, XIV	45–	75	
Theoretical Chemistry II (566) 4, g . . .	30–	60	
V	48–	57	
Theoretical Chemistry III (567) g. . .	15–	30	
Theoretical Chemistry, Experimental Problems in (591).	135–	15	
Theoretical Electricity (825) 3	45–	90	
Theoretical Physics I (841) 3.	45–	90	
Theoretical Physics II (842) 4	30–	60	
Theoretical Physics IV (844) 4	45–	90	
Theory of Elasticity (231) g			
Theory of Functions (M56) g.	30–	90	
Thermochemistry and Chemical Equilibrium (568) 3, 4	30–	60	
Thesis Reports (595) 4	15–	15	
Thesis Reports and Memoirs (596) 4 . .	30–	15	
Topographical Drawing (195) 2, 3. . . .	30–	0	
Transportation (Ec35) 4.	30–	45	
Volcanology and Seismology (1296) 4, g .	45–	90	
Vise and Bench Work (290) 3	30–	0	
Warship Design (1321) 3.	120–		
Warship Design (1322) 4. . . . XIIIA	90–	0	
XIIIB	120–	0	
Warship Design (1323) g.	90–		
Warship Design, Theory of (1311) 3. . .	30–	30	
Warship Design, Theory of (1312) 4. . .	30–	30	
Warship Design, Theory of (1313) g. . .	30–	30	
Water Supplies and Air (520) 3, 4. . . .	45–	0	
Water and Sewage, Purification of (739) g	30–	60	
Water Power Design (182) g	90–	0	
Water Power Engineering (173) g. . . .	45–	90	
Zoölogy, Invertebrate (705) 2, 3	30–	30	
XII	45–	25	

Required Summer Courses

Summer Surveying Camp

Surveying (100) VI, XV[2].	60–	15	
Surveying, Plane (107)	100–	0	
Surveying, Geodetic and Topographic (108)	100–	0	
Surveying, Hydrographic (160)	50–	25	
Railroad Field-Work (120).	80–	15	

Chemistry

Qualitative Analysis (511)	210–	30	

Mining

Surveying (103)	240–	0	
Surveying (104)	120–		
Mining Camp (372) e	300–		

Mechanic Arts

Mechanic Arts (297)	75–	0	

ENTRANCE REQUIREMENTS

THE requirements for admission to the Institute are described in detail on pages 64 to 82.

Applicants for admission as students in the first year must show by examination evidence of suitable preparation in the subjects included in the following list. Applicants for admission as special students in the first year must similarly show evidence of suitable preparation in such subjects of the list as are required for admission to the courses of study that they desire to pursue.

1. ALGEBRA. (*See page* 71.)

2. PLANE GEOMETRY. (*See page* 71.)

3. ENGLISH. (*See page* 73.)

4. HISTORY. (*See page* 74.)

5. SOLID GEOMETRY. (*See page* 72.)

6. FRENCH (Elementary). (*See page* 72.)

7. GERMAN (Elementary). (*See page* 73.)

8. PHYSICS. (*See page* 74.)

DEPARTMENT OF MILITARY SCIENCE AND TACTICS

EDWIN T. COLE, MAJOR, U. S. ARMY.
Professor of Military Science.

FREDERICK B. DOWNING, CAPTAIN, U. S. ARMY.
Assistant Professor of Military Science.

Assistant

LEICESTER F. HAMILTON, S. B.

IN conformity with the requirements of the Acts[1] of Congress of July 2, 1862, and August 30, 1890, and Section 1225 of the Revised Statutes of the United States, as amended by Act of Congress approved November 3, 1893, and the Acts of the General Court of Massachusetts in furtherance thereof, the Institute provides instruction in military science and tactics.[2]

Attendance at military exercises is required of all male students who take a majority of their studies in the first year, except aliens, college graduates, students who were twenty-one years of age at the beginning of the term in question, or who have passed an examination on the military course, or presented records for equivalent work at other colleges.

For these exercises they are required to provide themselves with uniforms, which are made from measure and by contract, in order to secure uniformity of material and manufacture, as well as cheapness. The whole cost to each student does not exceed sixteen dollars. A student presenting to the Faculty a certificate of physical disability from the Institute Medical Adviser (see page 57) may be excused from the prescribed drill exercises and in lieu thereof will be required to attend a course of theoretical studies in military science (course B). But all such certificates must be presented *within ten days after entrance* and no student

[1] "For the endowment, support and maintenance of at least one college where the leading object shall be without excluding other scientific and classical studies, and including military tactics, to teach such branches of learning as are related to agriculture and the mechanic arts, in such manner as the Legislatures of the States may respectively prescribe, in order to promote the liberal and practical education of the industrial classes in the several pursuits and professions in life."

[2] An officer of the regular army, with the rank of Professor, has the work in charge. On the graduation of every class he is required by statute to obtain from the President and report to the adjutant-general of the army the *names of such students belonging to the class as have shown special aptitude for military service*, and to furnish a copy of this report to the adjutant-general of the State.

to whom the military requirement applies may omit military exercises unless he has appeared before the committee of the Faculty and received his excuse in writing from the Secretary.

In the permanent organization of the regiment, cadet officers are appointed by the Professor of Military Science, subject to the approval of the Faculty.

20. Military Science. A. — Professor COLE.

First and Second Terms, First Year, three hours per week. This course consists of two hours drill per week and one hour per week theoretical instruction by lectures and demonstrations in the various branches of military science and the military history and policy of the United States. An examination based on the theoretical instruction will be held at the end of each term.

REQUIRED IN ALL COURSES.

21. Military Science. B. — Professor COLE.

This course in military theory may be the same as course 20 or may be extended to two hours per week with subjects assigned for study in addition to the lectures at the option of the Professor of Military Science.

22. Target Practice. — Professor COLE.

This course is elective and open to students of all classes so far as time and the facilities available will admit.

ELECTIVE.

DEPARTMENT OF PHYSICAL TRAINING

ALFRED E. BURTON, S.B., Sc.D.
Dean.

FRANK M. KANALY.
Instructor in Physical Training.

JOHN W. KILDUFF.
Assistant in Physical Training.

The Gymnasium of the Institute is located on the third floor of the Walker Memorial Building fronting on the Esplanade, east of the educational buildings. This gymnasium affords ample accommodation for the training of classes in gymnastics and indoor games.

The gymnasium is open to all students free of charge, and the instruction is especially arranged to fit individual needs. Bronze medals, known as the Cabot Medals for Improvement in Physical Development, are awarded to the five or six men showing the greatest physical improvement for the year. These medals are the gift of the late Samuel Cabot, for many years a member of the Corporation of the Institute.

The Athletic Field gives an opportunity for track-team contests and inter-class games. This field is provided with a quarter-mile running track, straight-away tracks for 100-yard and 220-yard dashes, tennis courts, etc. It is under the direction of an Advisory Council on Athletics, composed of alumni and undergraduate students.

25. Physical Training. — Mr. KANALY and assistant.

First and Second Terms, First Year, forty-five hours. Four lectures on the relation of exercise to health and on personal hygiene are given to the first-year class at the beginning of the school year, and all first-year men take a physical examination during the first month from which anthropometric charts are plotted. The class is then divided into four sections for gymnastic exercise, each section having two hours a week of work for twenty weeks under the direction of the instructor. All students not specifically excused, a majority of whose work is in the first year, are required to take these lectures and exercises.

REQUIRED IN ALL COURSES.

DEPARTMENT OF CIVIL AND SANITARY ENGINEERING

CHARLES M. SPOFFORD, S.B.
Hayward Professor of Civil Engineering.
GEORGE F. SWAIN, S.B., LL.D. (Absent)
Gordon McKay Professor of Civil Engineering.
DWIGHT PORTER, PH.B.
Professor of Hydraulic and Sanitary Engineering.
ALFRED E. BURTON, S.B., SC.D.
Professor of Topographical Engineering.
LEWIS J. JOHNSON, A.B., C.E.
Professor of Civil Engineering.
ARTHUR G. ROBBINS, S.B.
Professor of Topographical Engineering.
GEORGE C. WHIPPLE, S.B.
Gordon McKay Professor of Sanitary Engineering.
CHARLES B. BREED, S.B.
Professor of Railroad Engineering.
HECTOR J. HUGHES, A.B., S.B.
Professor of Civil Engineering.
HAROLD K. BARROWS, S.B.
Associate Professor of Hydraulic Engineering.
GEORGE E. RUSSELL, S.B.
Associate Professor of Hydraulic Engineering.
GEORGE L. HOSMER,
Associate Professor of Topographical Engineering.
JOHN W. HOWARD, S.B.
Assistant Professor of Topographical Engineering.
JAMES M. BARKER, S.B.
Assistant Professor of Structural Engineering.

Instructors

HOWARD B. LUTHER, S.B., Dipl. Ing. JOHN B. BABCOCK, 3D, S.B.
HALE SUTHERLAND, A.B., S.B.

Research Assistant

WILLIAM H. SANDLAS, B.S.

Assistants

EDWARD H. CLARKSON, JR., S.B. CHESTER F. LEWIS, S.B.
CHARLES L. CROSIER, S.B. WILLIAM A. LIDDELL, S.B.
HOWARD L. FOSTER, S.B. CHARLES J. MCCARTHY, S.B.
JAMES H. MURDOUGH, S.B.

THE instruction in civil engineering is given by means of lectures and recitations, and by practice in the field, the drafting-room, and the laboratory. The professional work begins in the second year, with practice in the use of surveying instruments, accom-

panied by drafting-room work consisting of computations and the preparation and interpretation of maps and profiles. This work is preliminary to an extensive summer course in which thorough training is given in surveying and railroad field-work. The study of mechanics is also begun in this year, and the course in Mechaism is given. Descriptive geometry is completed, and followed by the course in Stereotomy.

In the third year the professional work includes the courses in Railroad Engineering, Highway Engineering, Advanced Surveying, Geodesy, Materials, and the Elements of Structures, in which the student is shown the application of surveying, descriptive geometry, mechanics, and other branches. In the fourth year the work is almost entirely professional, and leads the student into the details of the various branches of engineering.

In all this work, the object is to enable the student to apply intelligently to practical problems the principles that he has studied; to give power, to avoid rule-of-thumb methods, and to train the student to have courage and self-reliance in solving the problems that the engineer has to meet.

100. Surveying and Plotting. — Professors ROBBINS, HOSMER, HOWARD, and assistants.

PREPARATION: M10; M12; D12, D16 or D12a; D16a.

First and Second Terms, Second Year, two hours per week, lectures, recitations, field-work and drafting. The field-work is confined to the manipulation and use of the tape, compass, transit, and level in order to familiarize the student with these instruments before beginning the extensive surveying field-work required at the Summer Camp. The work in the drafting-room consists in making computations which arise in the work of the surveyor, in making scale drawings, profiles, and contour maps, and studying their application to the solution of engineering problems. *Text-book, Breed and Hosmer, The Principles and Practice of Surveying, Vol. I.*

REQUIRED IN I, XI, (VI, XV_2, IN SUMMER).

101. Surveying Instruments. — Professors ROBBINS, HOSMER, HOWARD, and assistants.

PREPARATION: M10; D11; D15.

Second Term, Second Year, two hours per week for last six weeks, lectures and field-work. This very brief course illustrates the use of some of the common forms of surveying instruments.

REQUIRED IN XIII.

102. Surveying. — Professors ROBBINS, HOSMER, HOWARD, and assistants.

PREPARATION: M10; D11; D15.

First Term, Third Year, two hours per week (for II); Second Term, Second Year, two hours per week (first term for IV$_2$); lectures, problems and field-work. The methods of using the compass and chain, the transit and tape, and the level in making plane surveys are explained by lectures and by field exercises. In the drafting-room the computations and drawings necessary to interpret surveying field notes are made.

REQUIRED IN II, IV$_2$, VII, XV$_1$.

103. Surveying. — Professor HOWARD, and assistants.

PREPARATION: M21; 301.

At Camp Technology, East Machias, Maine, summer between Second and Third Years, five weeks, lectures, recitations, drafting and field-work. The field-work consists of plane, topographic and elementary railroad surveying. Plans and maps will be made in the drafting-room from notes taken in the field. *Text-book, Breed and Hosmer, Principles and Practice of Surveying, Vol. I.*

REQUIRED IN III$_{1,3}$ XII.

104. Underground Surveying. — Professor HOWARD, and assistants.

PREPARATION: 103.

Summer between Second and Third Years, two weeks, lectures, recitations, field-work and drafting. This course immediately follows 103 and will be given at some mine. The field-work consists of mine surveying. The drafting-room work includes computations from original field notes and the drafting of mine plans. *Text-book, Breed and Hosmer, Principles and Practice of Surveying, Vol. I.*

REQUIRED IN III$_{1,3}$ and XII.

107. Plane Surveying. — Professors ROBBINS, HOSMER, HOWARD, and assistants.

PREPARATION: 100; M21.

At Camp Technology, East Machias, Maine, summer between Second and Third Years, one hundred hours, lectures, field-work, and drafting. The field-work consists in making surveys with the compass and chain and with the transit and tape, the running of profiles and cross-sectioning with the level, and in the astronomical determination of a meridian. The work in the drafting-room consists of making computations which arise in surveying operations and of making scale drawings, profiles, and contour maps from the field notes. *Text-book, Breed and Hosmer, The Principles and Practice of Surveying, Vol. I.*

REQUIRED IN I, XI, XV$_1$.

108. Geodetic and Topographic Surveying. — Professors ROBBINS, HOSMER, HOWARD, and assistants.

PREPARATION: 801; 107 simultaneously.

At Camp Technology, East Machias, Maine, summer between Second and Third Years, one hundred hours, lectures, field-work, and drafting. The field-

work consists of the measurement of a base line, triangulation, and the determination of position astronomically; the making of topographic surveys with the transit; the making of large and small scale maps with the plane table; the use of the sextant in hydrographic surveys; the traverse plane table in making road traverses for small scale maps. The course also includes trigonometric and barometric leveling. The work in the drafting-room consists of making the computations and drawings necessary to interpret the results of the field observations. *Text-book, Breed and Hosmer, The Principles and Practice of Surveying, Vol. II; Hosmer, Practical Astronomy.*

REQUIRED IN I, XI, XV_1.

109. Advanced Surveying. — Professors ROBBINS, HOSMER, HOWARD, and assistants.

PREPARATION: 108.

First Term, Third Year, two hours per week, lectures, computations and drafting. This course is devoted to the construction of stadia diagrams, the completion of the computations and map work of course 108 taken during the summer, and in the making of topographic maps from surveys made with the camera.

REQUIRED IN I, XI.

112. Astronomy. — Professors HOSMER, HOWARD.

PREPARATION: M20; 100 simultaneously.

Second Term, Second Year, two hours per week, lectures, recitations and observations. Special attention is given to those astronomical observations which may be needed in the practice of the surveyor. Observations with the engineer's transit for latitude, longitude, time and azimuth are a required part of the work. The text-book used is *Hosmer, Practical Astronomy.*

REQUIRED IN I.

113. Geodesy. — Professors HOSMER, HOWARD.

PREPARATION: 112.

Second Term, Third Year, two hours per week, lectures and recitations. The methods of conducting a geodetic survey are discussed in detail, and the more important methods of determining the figure of the earth, both by arc measurements and by pendulum observations, are briefly considered. *Text-book, Crandall's Geodesy.*

REQUIRED IN $I_{1, 2}$.

120. Railroad Field Work. — Professor BREED; Mr. BABCOCK and assistants.

PREPARATION: 100; 107 simultaneously.

At Camp Technology, East Machias, Maine, summer between Second and Third Years, class-room and field work. A survey is made for a railroad about two miles in length. A reconnoissance is first made, followed by a complete preliminary survey with transit and level and the location of

contours as a basis for fixing the location; the location survey is then executed. There is also a systematic drill in the laying out of curves by various methods, including the A. R. E. A. spirals, and in staking out earthwork. Sufficient class work of an elementary character is given at the Camp to supplement the field-work. *Text-books, Allen's Railroad Curves and Earthwork, and Field and Office Tables.*

REQUIRED IN I, XI, XV_1.

121. Railroad Engineering. — Professor BREED; Mr. BABCOCK.

PREPARATION: M22; 100; 120.

First and Second Terms, Third Year, two hours per week for I_1, I_2; two hours per week for first ten weeks for I_3, XI, XV_1, recitations. This course consists of a thorough study of curves and earthwork. The first term is devoted to the mathematics of curves, with applications to the location of railroads, highways, sewers, pipe lines, etc. The second term is devoted principally to the methods of staking out and computing earthwork, and to Y and connecting tracks. Recitation work predominates, particularly in the first term, and many problems are assigned for solution outside and in the class-room. The applications of this course are further developed by 120 and 123. So much of this course as relates specifically to railroads (twenty hours in all) is omitted by students in Courses I_3, XI, XV_1.

REQUIRED IN I, XI, XV_1.

123. Railroad Drafting. — Professor BREED; Mr. BABCOCK and assistants.

PREPARATION: 100; 120; 121 simultaneously.

First Term, Third Year, four hours per week for I_1, I_2; three hours per week for I_3 and XI; Second Term, Third Year, four hours per week for I_1, I_2; five hours per week, for I_3 and XI, computations and drafting. This course supplements the class work of 121 and the field-work of 120. From notes taken in the field at the Summer Camp, a map and a profile of the preliminary survey for a railroad are plotted and finished. Another problem consists of a careful study in the adjustment of a line of railroad location upon a contour map, involving computation of the earthwork, and the preparation of a "mass diagram" for the determination of "haul" and of "borrow and waste." The detailed design of a standard turnout is also required in I, options 1 and 2; the location of a reservoir site, including an estimate of the quantities involved, is required in XI. A problem in highway location is given to I, option 3 under the direction of Professor Hughes.

REQUIRED IN I, XI.

125. Railroad Engineering. — Professor BREED.

PREPARATION: 120; 121; 236.

First Term, Fourth Year, two hours per week for I_2, XV_1; Second Term, Fourth Year, three hours per week for I_2, lectures and recitations. The subjects treated include the following: maintenance of way; the economics

of railroad location, with a critical study of train resistance and the influence of grade, distance, curvature, and rise and fall; tractive effort of locomotives; rolling stock and mechanics and operation of brakes; interlocking and block signals; elimination of grade crossings; yards and stations. The object is to give the student a comprehensive knowledge of Railroad Engineering. The solution of problems on economics, tractive effort, brakes and signals is required. *Text-books, Willard's Maintenance of Way and Structures; Wellington's Economics of Railroad Location; neostyled notes on Signals and on Railroad Engineering and Economics of Location.*

REQUIRED IN I_2, XV_1.

126. Railroad Design. — Professor BREED; Mr. BABCOCK.

PREPARATION: 125 simultaneously.

First Term, Fourth Year, three hours per week; Second Term, Fourth Year, two hours per week, computations and drafting. A course in the drafting-room, including problems in railroad location; the proportioning of culverts and water ways; the complete computation and detailed design of a division yard, including a locomotive terminal; interlocking signals and other practical railroad problems involving the application of the principles taught in courses 121 and 125. Each student is given a different problem to solve, and the work is critically corrected and discussed in detail.

REQUIRED IN I_2.

127. Railroad Engineering. — Professor BREED.

PREPARATION: 125; 126; 128 simultaneously.

First and Second Terms, Graduate Year, two hours per week, class-room exercises with much outside reading. This course is a continuation of the courses required for preparation. Special attention is given to freight and passenger yards and terminals and to their operation; locomotive terminals; coal handling; railroad economics; railroad electrification; investigations and report writing. The object of this course is to give the student a broad training in the larger railroad problems involving traffic conditions and economics. *Text-books, Droege, Freight Terminals and Trains; Byers' Economics of Railway Operation; Reports of the American Railway Engineering Association,* and various other reports and periodicals.

ELECTIVE IN I, GRADUATE YEAR.

128. Railroad Design. — Professor BREED.

PREPARATION: 126; 127 simultaneously.

First and Second Terms, Graduate Year, three hours per week, computations and drafting. This course is a continuation of Railroad Design 126, including design of freight, passenger and locomotive terminals; grade crossing elimination; estimate of cost of and reports on railroad structures and equipment.

ELECTIVE IN I, GRADUATE YEAR.

129. Valuation of Public Service and other Corporations. — Professor SPOFFORD, Messrs. SHEPHERD, WALKER.

First Term, Graduate Year, three hours per week, class-room exercises with much outside reading. This course consists of the study of the economic and engineering principles underlying the valuation of railroad and other corporate properties, and of the court decisions on the various phases of the subject; together with the details of the methods of making a valuation.

ELECTIVE IN I, VI, GRADUATE YEAR.

130. Highway Engineering. — Professor HUGHES.

PREPARATION: 121 simultaneously.

Second Term, Third Year, one hour per week, lectures. This course includes an outline of the principles governing the location, construction, and maintenance of roads, and the construction and maintenance of pavements for city streets. *Text-book, Blanchard's Elements of Highway Engineering.*

REQUIRED IN $I_{1,2}$.

132. Highway Construction. — Professor HUGHES.

PREPARATION: 121; 123 simultaneously.

Second Term, Third Year, three hours per week, recitations and visits of inspection. This course is devoted to the study of modern highway construction and maintenance, including city pavements and sidewalks; inspections of roads under construction, and critical examinations of pavements in use to determine the effect of traffic and other factors on the wear of street surfaces. *Text-book, Blanchard and Drowne's Text-book on Highway Engineering.*

REQUIRED IN I_3.

133. Highway Drainage. — Professor PORTER.

PREPARATION: 162 simultaneously.

First Term, Fourth Year, last seven weeks, class-room exercises. This course is devoted to the study of surface and sub-surface drainage, run-off, and design of culverts.

REQUIRED IN I_3.

134. Highway Engineering Research Advanced. — Professors HUGHES, GILL.

PREPARATION: 135; 136; 538.

First and Second Terms, Graduate Year, three hours of conference, and not less than nine hours of preparation per week. The work of the course will consist of individual problems of investigation and research in highway construction and maintenance, and the physical and chemical properties of road-making materials.

ELECTIVE IN I, GRADUATE YEAR.

135. Highway Design. — Professor HUGHES.

PREPARATION: 137.

Second Term, Fourth Year, four hours per week, computations and drafting. A course in the design of streets and pavements, including finished plans, and estimates of cost of construction.

REQUIRED IN I_3.

136. Highway Economics. — Professors HUGHES.

PREPARATION: 133; 137.

Second Term, Fourth Year, two hours per week, recitations. A course in the methods of financing the construction and maintenance of highways and pavements, and upon the relative merits of different pavements with reference to wear, and the cost of construction and maintenance.

REQUIRED IN I_3.

137. Highway Specifications. — Professor HUGHES.

PREPARATION: Ec60; 132; 139.

First Term, Fourth Year, three hours per week, lectures and recitations. A course treating of the principles of contracts and specifications with special applications to highway construction, and practice in writing highway specifications. *Text-book, Mead's Contracts, Specifications and Engineering Relations.*

REQUIRED IN I_3.

139. Testing Highway Materials. — Professors HUGHES, HAYWARD; MR. COWDREY.

PREPARATION: 217; 132 simultaneously.

Second Term, Third Year, six hours per week for last five weeks, lectures and laboratory exercises. A course in which physical tests of various kinds of materials used in highway construction are made.

REQUIRED IN I_3.

140. Theory of Structures. — Professor BARKER; Messrs. LUTHER AND SUTHERLAND.

PREPARATION: 217.

Second Term, Third Year, three hours per week. This course is devoted to a study of loads, reactions, shears, and moments in their relation to structures of various kinds, principally bridges and roofs. The practical designing of beams and girders is also taken up. *Text-book, Spofford's Theory of Structures.*

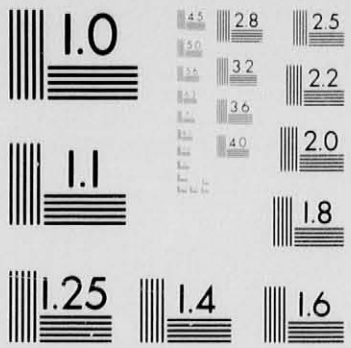
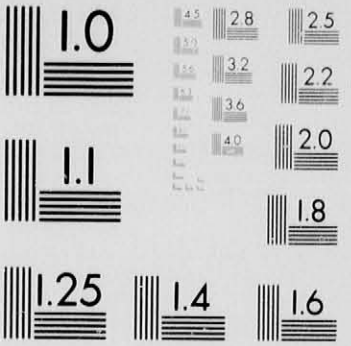
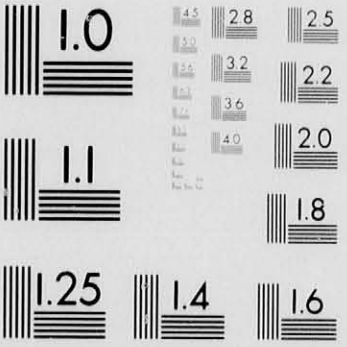
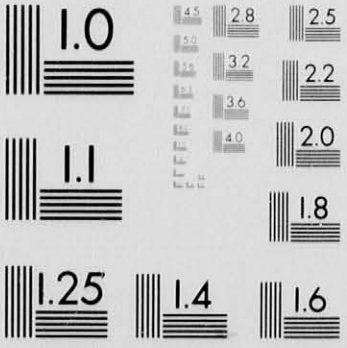
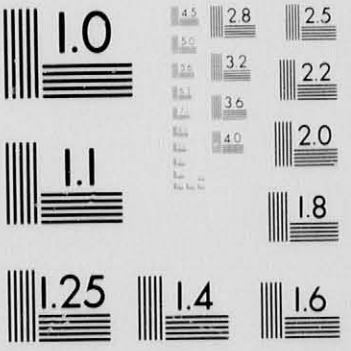
REQUIRED IN I, XI, XV_1.

141. Theory of Structures. — Mr. SUTHERLAND.

PREPARATION: 228 simultaneously.

Second Term, Third Year, three hours per week, recitations. This course is essentially identical with course 140, except that less time is given to problems relating to steel bridge design. *Text-book, Spofford's Theory of Structures.*

REQUIRED IN IV_2.


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143. Materials. — Professor JOHNSON; Mr. O'NEILL, and special lecturers.

PREPARATION: 217 OR 220; 140 OR 141 simultaneously.

Second Term, Third Year, two hours per week, lectures and recitations. This course is designed to acquaint the student with the properties of the various materials used by the engineer, such as stone, brick, cement, concrete, wood, iron, and steel. *Text-book, Mills' Materials of Construction.*

REQUIRED IN I, XI, IV_2, XV_1. XV_1 omits ten hours of preparation.

144. Stationary Structures. — Professor BARKER.

PREPARATION: 218.

Second Term, Third Year, two hours per week, recitations. This course is designed to give students in electrical engineering a knowledge of the fundamentals of the theory of structures. *Text-book, Spofford's Theory of Structures.*

OPTIONAL IN VI.

145. Theory of Structures. — Professor BARKER.

PREPARATION: 229.

Second Term, Graduate Year, three hours per week class-room exercises, four hours per week drafting. This course is specially arranged for naval constructors. It is intended to give an outline of the methods of computing and designing structures, with the object of enabling the students to meet the simpler structural problems arising in the design of ships. *Text-book, Spofford's Theory of Structures.*

REQUIRED IN XIIIA, XIIIB.

148. Foundations. — Mr. GOW.

PREPARATION: 140 OR 141 OR 225.

First Term, Fourth Year, two hours per week for last seven and one half weeks, lectures. A course devoted to the study of the methods of constructing foundations for bridges, buildings, and other structures. *Text-book, Jacoby and Davis' Foundations.*

REQUIRED IN I, II, IV_2, XV_1.

149. Theory of Structures; Bridges and Similar Structures. — Professors SPOFFORD, JOHNSON; Mr. SUTHERLAND.

PREPARATION: 140 OR 141; 143.

First Term, Fourth Year, three hours per week; Second Term, Fourth Year, five hours per week for first nine weeks, recitations and occasional lectures. This is an extended course in continuation of 140. It treats of the computation and design of structures of wood, steel, and masonry, by analytical and by graphical methods. The subjects considered are: roof and bridge trusses of various forms, trestles, earth pressure, retaining walls, masonry dams, arches of metal stone, and concrete, and the theory

of reinforced concrete design. The object is to train the student thoroughly in the application of the principles of mechanics to the design of the more common engineering structures. *Text-book, Spofford's Theory of Structures.*

REQUIRED IN I, XI, XV_1.

150. Advanced Structures. — Professor SPOFFORD.

PREPARATION: 149.

Second Term, Fourth Year, five hours per week for last six weeks, lectures and recitations. This course is a continuation of course 149. It treats of the deflections of framed structures, continuous girders, swing bridges and certain other subjects. *Text-book, Spofford's Theory of Structures.*

REQUIRED IN I.

151. Theory of Structures. — Professor JOHNSON.

PREPARATION: 141; 143.

First Term, Fourth Year, three hours per week; Second Term, Fourth Year, five hours per week for first nine weeks, recitations and occasional lectures. This is similar to course 149, except that it is more specifically adapted for students in architectural engineering. *Text-book, Spofford's Theory of Structures.*

REQUIRED IN IV_2.

153. Bridge Design. — Professor BARKER; Mr. SUTHERLAND.

PREPARATION: 149 simultaneously.

First and Second Terms, Fourth Year, six hours per week, drafting and lectures. This course aims to show the student the relations of the theory of structures to engineering practice through the preparation of designs and working drawings for a plate girder railway bridge, a wooden roof truss, a reinforced concrete structure and a steel truss highway bridge. Emphasis is laid on the cultivation of careful, systematic and practical habits of computation.

REQUIRED IN I.

154. Structural Design. — Professor JOHNSON.

PREPARATION: 149 simultaneously.

First Term, Fourth Year, four hours per week, drafting. This is a course similar in character to course 153, but much shorter, and intended to give only an outline of the subject.

REQUIRED IN XI.

155. Structural Design. — Professor JOHNSON.

PREPARATION: 149 simultaneously.

Second Term, Fourth Year, five hours per week, drafting and lectures. This course is similar in character to Structural Design 154.

REQUIRED IN XV_1

156. Structures of Metal, Wood and Masonry. — Professor SPOFFORD; Mr. LUTHER.

PREPARATION: 150; 153 OR 492.

First and Second Terms, Graduate Year, three hours per week, class-room exercises. This is a continuation of course 150, and requires a large amount of preparation, involving the solution of problems and investigation of references. Among the subjects which may be considered are the computation and design of steel frames for bridges, buildings, towers, standpipes, etc.; structures of concrete and reinforced concrete, such as dams, standpipes, subways, tunnels, buildings and reservoirs; steel and reinforced concrete arches, suspension bridges, and the general study of indeterminate structures by various methods.

ELECTIVE IN I, IV$_2$, XI, GRADUATE YEAR. Open to Undergraduates only by Petition.

156a. Structural Design, Advanced. — Professor SPOFFORD; Mr. LUTHER.

PREPARATION: 150; 153 OR 492; 156 simultaneously.

First and Second Terms, Graduate Year, six hours per week, computations and drafting. The problems selected will be adapted to the individual needs of the student.

ELECTIVE TO GRADUATE STUDENTS IN I, IV$_2$, XI.

157. Reinforced Concrete Theory. — Mr. SUTHERLAND.

PREPARATION: 140.

First Term, Fourth Year, two hours per week, recitations. An elective course of thirty class-room exercises in the first term of the fourth year in which a study is made of the theory of reinforced concrete construction.

ELECTIVE FOR UNDERGRADUATE STUDENTS. Admission only by Petition.

158. Reinforced Concrete Design. — Mr. SUTHERLAND.

PREPARATION: 149.

First Term, Graduate Year, three hours per week, recitations. Instruction is given in the theoretical and practical principles involved in the design of structures of reinforced concrete. The problems considered are chiefly those arising in the construction of buildings, but some attention is given to retaining walls and beam bridges.

ELECTIVE IN I, IV$_2$, XI.

159. Reinforced Concrete Research. — Professor JOHNSON, Mr. SUTHERLAND.

PREPARATION: 149; 158.

Second Term, Graduate Year, not less than six hours per week, conference, laboratory work, etc. This course includes conferences, reading, computing, laboratory investigation, and may include visits to work under construction, preparation of reports, designs, estimates, and technical papers, participation in technical discussions, or anything likely to advance knowl-

edge of the subject. In this course ability to read German and French is of great assistance. The work of each student will, as far as possible, be arranged to meet his individual needs or preferences.

ELECTIVE IN I, IV_2, XI, GRADUATE YEAR.

160. Hydrographic Surveying. — Professor RUSSELL; Mr. LUTHER and assistants.

PREPARATION: 107; 108 simultaneously.

At Camp Technology, East Machias, Maine, summer between Second and Third years, lectures, field work, computations and drafting.

(a) *Stream Gaging.* — A course designed to instruct the students in the principles underlying the art of measuring the flow of water in open channels. The equipment of the Camp includes a complete gaging station on a nearby stream where each student is given opportunity to make several complete measurements and is instructed in the use of various current meters.

(b) *Soundings.* — On Gardner's Lake, the student is instructed in the method of making soundings and practices the use of the sextant and the transit in locating them. In the drafting-room a portion of the data thus secured is plotted. *Text-book (for Stream Gaging only), Porter's Notes on Stream Gagings.*

REQUIRED IN I, XI.

162. Theoretical Hydraulics. — Professors PORTER, HUGHES, RUSSELL.

PREPARATION: 215.

First Term, Fourth Year, three hours per week, recitations. A course covering the principles of hydrostatic and hydrodynamic pressure, the flow of water through orifices and nozzles, over weirs, and through pipes and open channels, and the losses from friction and other sources. *Text-book, Russell's Hydraulics.*

REQUIRED IN I, XI.

163. Theoretical Hydraulics. — Mr. LUTHER.

PREPARATION: 215.

First or Second Term, Fourth Year, hours vary in the different courses. A brief course taking up selected portions of the work given in course 162. *Text-book, Russell's Hydraulics.*

REQUIRED IN $III_{1,2}$, IV_2, X, XIII, XIIIB.

164. Theoretical Hydraulics. — Professor RUSSELL; Messrs. LUTHER, SUTHERLAND.

PREPARATION: 215.

First Term, Fourth Year, two hours per week, recitations. A course dealing with selected portions of the work given in course 162, especially with flow through pipes. *Text-book, Russell's Hydraulics.*

REQUIRED IN II, III_3 $XV_{1,2}$.

165. Theoretical Hydraulics. — Professor BARROWS; Mr. LUTHER.

PREPARATION: 215.

First Term, Fourth Year, three hours per week, recitations. A course covering the principles of hydrostatics; of the measurement of flowing water by orifices, nozzles, and weirs; of flow through pipes and open channels and of the theory of hydraulic turbines and impulse wheels. *Text-books, Russell's Hydraulics; Daugherty's Hydraulic Turbines.*

REQUIRED IN VI.

168. Hydraulic Engineering. — Professor RUSSELL.

PREPARATION: 164.

Second Term, Fourth Year, three hours per week, recitations and lectures. A course devoted largely to a study of the hydraulic principles underlying the proper design and operation of impulse and reaction turbines; and, in part, to problems of stream flow, storage and the general arrangement of water power plants.

REQUIRED IN II.

169. Hydraulic Engineering. — Professor BARROWS.

PREPARATION: 164 OR 165.

Second Term, Fourth Year, two hours per week, recitations. This is essentially a course in water power engineering, including a study of practice in regard to the construction and selection of hydraulic turbines and impulse wheels, the study of hydrology, effect of storage and pondage, estimates of available power, the important features of hydro-electric developments and their general arrangement. *Text-books, Daugherty's Hydraulic Turbines; Barrows' Notes on Water Power Engineering.*

OPTIONAL IN VI.

REQUIRED IN $XV_{1,2}$.

171. Hydraulic Laboratory Research. — Professor RUSSELL and assistants.

PREPARATION: 162, 165 OR 164.

First Term, Graduate Year, eight hours per week including preparation, conferences, laboratory work, and discussion and arrangement of data. The aim of this course is to offer training in hydraulic laboratory research to certain specially fitted students. The many unsolved problems relating to the flow of water through large orifices, over weirs and dams of various types, through pipes and their common fittings, the calibration and development of measuring devices, and problems arising in turbine design, furnish ample fields for interesting and important investigations. The work is carried on under the close supervision of the professor, who engages co-operatively in each problem.

ELECTIVE FOR A LIMITED NUMBER OF PROPERLY QUALIFIED GRADUATE STUDENTS IN I, II, VI, XI, $XV_{1,2}$.

172. Hydraulic Laboratory. — Professors RUSSELL, TAFT and assistants.

PREPARATION: 162 OR 164.

Second Term, Fourth Year, eight two-hour exercises, one per week, after seven weeks. The time is devoted to testing pumps, pulsometers, a hydraulic ram, etc.; to measuring water by means of weirs, meters, nozzles and orifices; and to making efficiency tests of water wheels.

REQUIRED IN I, XI, XV_1.

173. Water Power Engineering. — Professor BARROWS.

PREPARATION: 144 OR 149; 165 OR 169 OR 176; 182 simultaneously.

First and Second Terms, Graduate Year, three hours per week, conferences and recitations. This course is a continuation of courses 165, 169, 176, and includes detailed studies of hydrology, storage and available power with particular reference to some water power project, the designs for which are made in 182 (taken simultaneously with 173).

Studies and reports upon details of water power development are also made, as well as of the comparative economy and valuation of water power. One or more visits are made each year to water power plants in New England and reports made upon important features. *Mead's Water Power Engineering is used for reference.*

ELECTIVE IN I, VI.

175. Hydraulic and Sanitary Engineering. — Professor PORTER.

PREPARATION: 162 simultaneously.

First Term, Fourth Year, three hours per week, recitations. This course deals mainly with works for the sewerage of cities and towns and for the treatment and disposal of sewage; but includes a study of irrigation in which are studied diversion weirs, canals, distributaries, drops, regulators, and other special works. The work of the course is supplemented by course 179. *Text-books, Folwell's Sewerage; Swan and Horton's Hydraulic Diagrams; Newell and Murphy's Principles of Irrigation Engineering.*

REQUIRED IN I_1.

176. Hydraulic and Sanitary Engineering. — Professor PORTER.

PREPARATION: 175.

Second Term, Fourth Year, three hours per week, recitations. This course is a continuation of course 175, and includes the study of the quantity of water required for city and town supplies, estimation of the yield from drainage basins, stream flow and ground water flow, computations to determine the necessary storage to insure a given supply, the proportioning of standpipes, conduits, and distribution systems, conditions affecting the quality of water, and sedimentation and filtration works for improving the quality. The subject of water power is also studied with attention to the considerations governing the location and development of water-power plants, modes of estimating the power capacity of given water privileges, the elementary principles involved in impulse wheels and

turbines, and commercial tests of turbines. *Text-books, Turneaure and Russell's Public Water Supplies; Daugherty's Hydraulic Turbines.*

REQUIRED IN I_1.

177. Sanitary Engineering. — Professor WHIPPLE.

PREPARATION: 162 simultaneously.

First Term, Fourth Year, three hours per week, lectures and recitations. This course and course 178 form a continuous series of exercises extending throughout the fourth year. The course treats comprehensively the general principles of sanitary engineering and includes such matters as city planning, housing, fire prevention, street cleaning, refuse disposal, sewerage and sewage disposal. The class-room work is supplemented by many problems and so arranged as to be in harmony with course 179. The reading of assigned references forms an important part of the work.

REQUIRED IN XI.

178. Sanitary Engineering. — Professor WHIPPLE.

PREPARATION: 177.

Second Term, Fourth Year, six hours per week, lectures, recitations and drafting. This course is a continuation of course 177. A large part of the time is devoted to the subject of public water supplies, in the study of which the following matters are taken up; quantity of water required for city supplies, estimation of yields of catchment areas, ground water supplies, storage computations, quality of water and methods of water purification. Reference is made to public health administration and a sufficient number of exercises devoted to vital statistics. *Text-books, Turneaure and Russell's Public Water Supplies; Williams and Hazen's Hydraulic Tables.*

REQUIRED IN XI.

179. Hydraulic and Sanitary Design. — Professors PORTER, RUSSELL.

PREPARATION: 175 OR 177; 149, and 176 OR 178 simultaneously.

Second Term, Fourth Year, six hours per week (two hours for I), computations and drafting. In this course typical subjects for design are assigned, the data seldom being the same for any two students, and are worked out in detail in the drafting-room, subject to the criticism and suggestions of the instructor in charge. Problems commonly taken up are: a preliminary design for a system of sewers for a small town; a design for a cross-section of a large sewer to be built in ground of specified character and to conform to given requirements as to carrying capacity; a design for a high masonry dam.

REQUIRED IN I_1, XI.

181. Engineering of Water and Sewage Purification. — Professor PORTER.

PREPARATION: 149; 176 OR 178; 183 simultaneously.

First Term, Graduate Year, eight hours per week, conferences and problems. A course dealing with the engineering features of existing works for the

disposal and treatment of sewage and the purification of public water supplies, such as sewer outfalls, sewage reservoirs, screens, grit chambers, sedimentation basins, septic tanks, slow sand and mechanical filters.

ELECTIVE IN I, XI.

182. Water Power Design. — Professor BARROWS.

PREPARATION: 173 simultaneously.

First and Second Terms, Graduate Year, six hours per week, computations and drafting. This course supplements course 173, and is devoted to the design of works connected with water power development.

ELECTIVE IN I, VI.

183. Sanitary Design. — Professor PORTER.

PREPARATION: 181 simultaneously.

First and Second Terms, Graduate Year, six hours per week, conferences, computations and drafting. This course supplements course 181, and is devoted to the design of works connected with the purification of water and sewage.

ELECTIVE IN I, XI.

190. Vital Statistics. — Professor WHIPPLE.

First Term, Fourth Year, two hours per week, lectures. The work includes a general consideration of the statistical method, the collection of statistics, the consideration of errors, and preparation and critical analyses of morbidity and mortality rates. Special attention is given to the use of vital statistics in connection with the work of departments of public health.

REQUIRED IN VII. Elective to properly qualified graduate students, and to undergraduates other than those in VII by petition only.

195. Topographical Drawing. — Professors BURTON, HOSMER, HOWARD, and assistants.

PREPARATION: D11 AND D15; D32.

Second Term, Second Year, two hours per week, drawing. This course is devoted to the study of the different conventional signs employed in making topographical maps. Each student is required to make a number of plates, and to become reasonably proficient in the preparation of such maps. Particular attention is given to the study of contour maps, and the solution of problems relating thereto.

REQUIRED IN I, XI.

199. Specifications and Contracts. — Professor SPOFFORD; Mr. SAVILLE.

PREPARATION: Ec60.

Second Term, Graduate Year, two hours per week, conferences and lectures. A course discussing the law of contracts, and the writing of specifications. The course involves a detailed study of the provisions commonly found in engineering specifications from the legal as well as from the engineering point of view. *Text-book, Tucker's Contracts in Engineering.*

ELECTIVE IN I, XI. Open to undergraduates only by petition.

SPECIAL LECTURES

In addition to the above regular courses of instruction, occasional lectures are given by prominent engineers, in active practice in their profession, upon subjects with which they are especially familiar. Students also have the opportunity to hear many lectures by practising engineers at the meeting of the Society of Arts, and of the Civil Engineering Society.

DEPARTMENT OF MECHANICAL ENGINEERING, APPLIED MECHANICS AND MECHANIC ARTS

EDWARD F. MILLER, S.B.
Professor of Steam Engineering.

ALLYNE L. MERRILL, S.B.
Professor of Mechanism.

LIONEL S. MARKS, S.B., M.M.E.
Professor of Mechanical Engineering.

CHARLES E. FULLER, S.B.
Professor of Theoretical and Applied Mechanics.

WILLIAM A. JOHNSTON, S.B.
Professor of Theoretical and Applied Mechanics.

CHARLES F. PARK, S.B.
Professor of Mechanism.

GEORGE B. HAVEN, S.B.
Professor of Machine Design.

JOSEPH C. RILEY, S.B.
Associate Professor of Heat Engineering.

CHARLES W. BERRY, S.B.
Associate Professor of Heat Engineering.

HARRISON W. HAYWARD, S.B.
Associate Professor of Theoretical and Applied Mechanics.

ARTHUR E. NORTON, PH.B.
Assistant Professor of Engineering Drawing.

THEODORE H. TAFT, S.B.
Assistant Professor of Mechanical Engineering.

WALTER H. JAMES, S.B.
Assistant Professor of Mechanical Engineering Drawing.

LAWRENCE S. SMITH, S.B.
Assistant Professor of Theoretical and Applied Mechanics.

GEORGE W. SWETT, S.B.
Assistant Professor of Machine Design.

Instructors

JAMES R. LAMBIRTH.
ROBERT H. SMITH.
CHARLES E. LITTLEFIELD.
ROY G. BURNHAM, S.B.
MYRON W. DOLE, S.B.
ADDISON F. HOLMES, S.B.
WALTER HUMPHREYS, S.B.
IRVING H. COWDREY, S.B.
MALCOLM C. MACKENZIE.
JEREMIAH F. O'NEILL.
JESSE J. EAMES, S.B.
WILLIAM H. JONES, S.B.
FRANCIS A. BROWN.
DEAN PEABODY, JR., S.B. (*Absent*)
WILLIAM H. WENGERT, B.S., S.B.
RALPH G. ADAMS, S.B.
KENNETH C. ROBINSON, S.B.
ARTHUR L. BROWN, S.B.
STEPHEN R. BARTLETT, A.B., S.B.
ALPHEUS A. PACKARD, S.B.
FRANCIS W. ROYS, S.B.

Assistants

ARTHUR B. ENGLISH. HORATIO W. BROWN, S.B.
JAMES T. SHORROCK. WILLIAM J. BARRETT, S.B.
HARRY G. DAVIES. CARUTHERS A. COLEMAN, S.B.
HARRY M. MOSHER. DEAN A. FALES, S.B.
ARCHIBALD S. MORRISON, S.B.

MANY of the subjects taught by the Mechanical Engineering Department are fundamentals in nearly all of the different branches of engineering; consequently instruction is given not only to the students in Mechanical Engineering but also to those taking Civil, Sanitary, Electrical, Chemical, Naval Architecture and Marine Engineering; to students in Architecture, Electrochemistry and to those taking the Metallurgical Option in Mining Engineering. To meet the requirements of the various departments, courses of different lengths are given in a number of subjects.

The instruction which is given by means of lectures, recitations, drawing-room and laboratory work, is planned to develop in the mind of the student the power of thinking for himself and to cultivate in him the ability to apply to the solution of practical problems sound theoretical knowledge.

The instruction in applied mechanics is given in the second, third and fourth years. The fundamental principles of statics, kinetics and the strength of materials are developed in an extended series of lectures and recitations. The work is so planned as to impart to the student a thorough knowledge of such principles as will be of practical use in his profession.

Particular attention is given to the solution of problems which involve the application of these principles in engineering practice and which test the student's ability to apply what he has learned.

The instruction is followed by a series of lectures and recitations intended to familiarize the student with such data upon the strength of materials as have been obtained by means of experiments. In connection with this portion of the work and in illustration of it, a series of laboratory exercises is given in which the student is taught to make tests on the strength and resisting properties of materials, especial emphasis being laid upon tests made upon full-sized pieces under the conditions of practice. The theory of friction, of continuous girders, of stone and iron arches and the

theory of elasticity and its applications are also treated at considerable length.

The instruction in mechanic arts aims to give a systematic training in the typical operations to be performed with the different tools and appliances used in the foundry, in the forge shop, in the machine shop and in wood working.

The student is taught how to sharpen and to adjust all edge tools used, also the proper speeds, cutting angles and feeds for the various materials worked.

In order to make a student familiar in as short a time as possible with the different operations and with the different methods used in any branch of the work, every problem given him is so chosen as to bring in each time one or more new operations.

The instruction is mainly by lecture, each new operation being described and discussed just before the work is to be undertaken; notes and text-books are also used. Supplementary illustrated lectures are given in connection with many of the courses descriptive of industrial appliances and methods of production used in large establishments. Excursions are taken with the instructor to the various forge shops, machine shops and foundries near Boston.

200. Mechanism. — Professors MERRILL, PARK, JAMES, NORTON; Messrs. DOLE, MACKENZIE.

PREPARATION: M12, D12 OR D12a, D16 OR D16a.

First and Second Terms, Second Year, sixty-five lectures and recitations (forty-five in Second Term only for X). This course includes a systematic study, not only of the motions and forms of the various mechanisms occurring in machines, and the manner of supporting and guiding the parts, independently of their strength, but also of the design of gear-teeth and the theory and practice of designing valve gears for steam engines, including the plain slide-valve, link motions, radial valve-gears, double valves, and drop cut-off valves.

REQUIRED IN II, VI, X, XIII, XIIIB.

201. Mechanism. — Professor MERRILL; Messrs. DOLE, HUMPHREYS, MACKENZIE, ADAMS.

PREPARATION: M10; M11, D11, D15 simultaneously.

First or Second Term, Second or Third Year, two hours per week. A brief course, omitting valve-gears.

REQUIRED IN I, III_2, $VIII_3$, XI, XIV, XV.

204. Mechanism of Machines. — Professor SWETT; Mr. WENGERT.

PREPARATION: 200, 206.

Second Term, Third Year, two hours per week, lectures and recitations. A course supplemental to the work in kinematics discussing the application of mechanisms to process machinery, machine tools, etc.

REQUIRED IN II.

206. Mechanical Engineering Drawing. — Professor JAMES; Messrs. MACKENZIE DOLE, and assistants.

PREPARATION: D12a, D16a: For II and VI, 200 simultaneously; For XIII, second term, 200 simultaneously.

First and Second Terms, Second Year (Second Term, Second Year for X), lectures and drawing-room exercises. Hours vary in the different Courses. This course is intended to give a general understanding of working drawings of machinery and some familiarity with the methods of representation and dimensioning. In addition (with the exception of Course X) some training is given in the solution of practical problems supplementary to the course in Mechanism, such as problems in belting, the design of cams, gear-teeth, etc.

REQUIRED IN II, VI, X, XIII.

207. Mechanical Engineering Drawing. — Professor JAMES; Mr. MACKENZIE and assistant.

PREPARATION: D12a, D16a.

First Term, Second Year (thirty hours for XIV), First Term, Third Year (forty-five hours for XV_3), lectures and drawing-room exercises. A course devoted to the making of dimensioned working drawings of simple machines from measurements.

REQUIRED IN XIV, XV_3.

208. Machine Drawing. — Professor JAMES; Messrs. BURNHAM, MACKENZIE, DOLE, ADAMS, and assistants.

PREPARATION: D12a, D16a. For II and VI, 206.

First Term, Third Year, sixty hours (thirty hours for II); Second Term, Third Year, forty-five hours. A course giving thorough instruction in making and using working drawings of machinery, both detail and assembly drawings. Considerable attention is given to the study of modern drafting-room systems.

REQUIRED IN II, III_2, V, X, XV_2.

209. Mechanical Engineering Drawing. — Professor JAMES; Messrs. BURNHAM AND ADAMS.

PREPARATION: 200, 208, 215. FOR II, 208, 215.

Second Term, Third Year, ninety hours. (One hundred and five hours for XV_2.) A course giving advanced work of the same nature as course 208. In addition, a certain amount of time is devoted to the study of problems

in mechanism design such as would be met in designing a machine or in investigating the action of an existing machine.

REQUIRED IN II, XV_2.

215. Applied Mechanics (Statics, Stresses in Frames, Kinetics). — Professors JOHNSTON, FULLER, HAYWARD, SMITH; Messrs. HOLMES, COWDREY, ROYS.

PREPARATION: M21; 801 first term.

First or Second Term, Second, Third or Fourth Years, three hours per week (four hours per week for X). The course comprises a study of statics, consisting of the general methods and applications of statics, including the determination of reactions, stresses in frames; of distributed forces, center of gravity; of moment of inertia, radius of gyration of plane areas and solids including principal axes and principal moments of inertia; of kinematics and kinetics including the equations for uniform and varying rectilinear and curvilinear motion, centrifugal force, unresisted projectile, pendulum, harmonic motion, rotation, combined rotation and translation, momentum and angular momentum, center of percussion, impact, work, power and kinetic energy.

REQUIRED IN I, II, III, VI, X, XI, XIII, XIV, $XV_{1,2}$.

215a. Applied Mechanics (Statics, Stresses in Frames, Strength of Materials). — Professors JOHNSTON, FULLER, HAYWARD; Mr. HOLMES.

PREPARATION: M21, 801 first term.

Second Term, Second Year, three hours per week. The course comprises the study of statics, with applications; of center of gravity and moment of inertia of plane surfaces; also the strength of materials, mathematically treated, including the stresses and deformations in bodies subjected to tension, to compression and to shearing; also the theory of beams with thorough discussion of the distribution of the stresses, shearing forces, bending moments and longitudinal shear, slopes and deflections; stresses in hooks, in columns and in beams subjected to tension or compression as well as bending.

REQUIRED IN IV_1.

216. Applied Mechanics (Strength of Materials). — Professors JOHNSTON FULLER, HAYWARD, SMITH; Mr. HOLMES.

PREPARATION: M22, 215, 801.

First Term, Third Year, three hours per week. This course comprises a study of the strength of materials, including the stresses and deformations in bodies subjected to tension, to compression, to shearing; common theory of beams with thorough discussion of the distribution of stresses, shearing forces, bending moments, longitudinal shear, slopes, and deflections; stresses in hooks, in columns, and in beams subjected to tension or compression as well as bending; torsional stresses and stresses in springs.

REQUIRED IN II, XIII, XIIIB, XV_2.

217. Applied Mechanics (Strength of Materials). — Professors JOHNSTON, FULLER, HAYWARD, SMITH; Mr. HOLMES.

PREPARATION: M22, 215, 801.

First Term, Third Year, four hours per week. The course comprises a study of the strength of materials as described in course 216 with additional applications to simple frames subjected to bending stresses; also a brief study of strains and the relations of the stresses on different planes.

REQUIRED IN I, XI, XV_1.

218. Applied Mechanics (Strength of Materials). — Professors JOHNSTON, FULLER, HAYWARD, SMITH; Mr. HOLMES.

PREPARATION: M22, 215, 801.

Second Term (First Term for VI), Third Year, three hours per week. This course comprises a study of the strength of materials as described in course 216. Also a brief study of the experimental data on the strength of materials.

REQUIRED IN III, VI, AND X.

219. Applied Mechanics (Statics, Stresses in Frames, Strength of Materials). — Professors JOHNSTON, FULLER, HAYWARD; Mr. HOLMES.

PREPARATION: M22, 801.

First Term, Third Year, three hours per week. The course comprises the study of statics, with applications; of center of gravity and moments of inertia of plane surfaces; also the strength of materials, mathematically treated, including the stresses and deformations in bodies subjected to tension, to compression, to shearing; also the common theory of beams with thorough discussion of the distribution of the stresses, shearing forces, bending moments, and longitudinal shear.

REQUIRED IN IV_1. For 1916–1917 only.

220. Applied Mechanics (Statics, Stresses in Frames, Strength of Materials). — Professors JOHNSTON, FULLER, HAYWARD, SMITH.

PREPARATION: M22, 801.

First Term, Third or Fourth Year, four hours per week. The course includes a study of statics, with applications; of center of gravity and moment of inertia of plane surfaces; of kinetics; of the strength of materials. The work given is similar to part of that described in courses 215 and 216.

REQUIRED IN IV_2, XV_3.

221. Applied Mechanics (Strength of Materials). — Professor JOHNSTON; Mr. HOLMES.

PREPARATION: M22, 801.

Second Term, Third Year, two hours per week. This course comprises a study of the strength of materials including the common theories of bending, of torsion and of columns; covering a part of the work given in course 216.

REQUIRED IN $VIII_3$.

225. Applied Mechanics (Dynamics, Strength of Materials, Graphic Statics). — Professors FULLER, JOHNSTON, SMITH.

PREPARATION: 216.

Second Term, Third Year, three hours per week, lectures or recitations. The course includes the study of the methods of the design of riveted joints; a mathematical treatment of the continuous girder, planned to apply to parts of machinery and structures where continuity exists. The student is required to solve a considerable number of problems illustrating the application of the fundamental principles dealt with in this portion of the work. The course also includes a study of the general methods of graphic statics with applications to the determination of stresses in roof trusses and other framed structures, and to the determination of the stability of masonry arches and abutments. A number of problems illustrating these principles are worked out by the student on the drawing board during this part of the course.

The last part of the course comprises a study of the application of the principles of dynamics in the determination of stresses due to the inertia of moving parts of machines, the theories of friction, as applied to the distribution of friction on journals and pivots and the transmission of power by belting and ropes.

REQUIRED IN II, XIII, XV_2.

226. Applied Mechanics (Kinetics). — Professor FULLER.

PREPARATION: 218.

Second Term, Third Year, two hours per week. This course is a continuation of the earlier courses in applied mechanics and includes a study of the application of the principles of kinetics in problems involving the determination of the forces acting upon, and the stresses within moving parts of machines, the problems chosen being such as are commonly met with in engineering practice. In some cases the solutions involve also the application of the principles of work and energy as well as the fundamentals of kinematics. Both analytical and graphical methods are used.

ELECTIVE IN VI.

227. Applied Mechanics (Strength of Materials Graphic Statics). — Professors FULLER, JOHNSTON, HAYWARD.

PREPARATION: 219.

Second Term, Third Year, three hours per week, lectures or recitations. The course comprises a study of the strength of materials, mathematically treated, including slopes and deflections in beams, the stresses in hooks, columns, and in beams subjected to tension or compression as well as bending; torsional stresses; also the study of data on the strength of materials which have been obtained by means of experiments on full size pieces under practical conditions; a study of the tests required in the standard specifications to determine the quality of materials: also the study of

the general methods of graphic statics with applications to the determination of stresses in roof trusses and other frame structures.

REQUIRED IN IV_1.

228. Applied Mechanics (Graphic Statics, Strength of Materials). — Professors FULLER, JOHNSTON, HAYWARD.

PREPARATION: 200.

Second Term, Third Year, four hours per week, lectures or recitations. The course comprises a more extended study of the strength of materials and of experimental data than is given in course 227; also a more complete application of the methods of graphic statics to the determination of stresses in roof trusses, arches and other frames and the stability of masonry arches and abutments.

REQUIRED IN IV_2.

229. Applied Mechanics (Stability of Structures, Strength of Materials). — Professors FULLER, JOHNSTON.

PREPARATION: 225.

First Term, Fourth Year, three hours per week, lectures or recitations. The course comprises a study of experimental data on the strength of materials with especial reference to tests on full sized beams, columns, shafting and other pieces under practical conditions; of experiments to determine the effect on physical properties of different materials of varying conditions of stress.

The course also includes a study of the methods of treatment of non-homogeneous beams, particularly of the theories underlying the design of reinforced concrete structures; of the construction of simple forms of roof trusses, girders, and arches; the stresses in suspension cords; the theory of curved beams and applications; and the derivation and use of the formulas for the stresses and strains in shafting subjected to combined bending and torsion, thick cylinders and spheres, and flat plates. A considerable number of problems, illustrating applications of these principles in practice, are solved by the students in this course.

REQUIRED IN II, XIII, XIIIB.

229a. Applied Mechanics (Strength of Materials, Graphic Statics). — Professors FULLER and JOHNSTON.

PREPARATION: 225.

First Term, Fourth Year, three hours per week, lectures or recitations, This course comprises study of the mathematical treatment of the continuous girder, the arch, the stresses in suspension cords, the theory of curved beams and applications, and the study of the mathematical theory of elasticity with applications in the deviation of formulas for stresses in shafting, cylinders, spheres and flat plates.

REQUIRED IN XIII AFTER 1916–1917.

230. Applied Mechanics (Theory of Reinforced Concrete Beams and Columns, Continuous Girders, Elastic Arch). — Professors FULLER, JOHNSTON.

PREPARATION: 228.

First Term, Fourth Year, three hours per week, for first eight weeks. The course comprises a study of the methods of treatment of non-homogeneous beams with particular reference to the theories underlying the design of concrete structures; also a mathematical treatment of the continuous girder with applications to problems involving the determination of stresses and deflections in cases of beams which are continuous over more than two supports; and the theory of the elastic arch.

REQUIRED IN IV_2.

231. Theory of Elasticity, Advanced. — Professors FULLER, JOHNSTON.

First or Second Terms, Graduate Year. This course is open to graduates of Course II, and begins with a detailed study of those portions of the general theory that have not been treated in the undergraduate course. Subsequently, the work will be planned to suit the special needs of the student, one important consideration being the nature of his research work.

ELECTIVE IN II, GRADUATE YEAR.

Analytical Mechanics.

First and Second Terms, Graduate Year, two hours per week. A more detailed description may be found under course M65.

ELECTIVE IN II, VIII, GRADUATE YEAR.

235. Testing Materials Laboratory. — Professor HAYWARD; Messrs HOLMES, COWDREY, ROYS, and assistants.

PREPARATION: 225.

First Term, Fourth Year, thirty hours, lectures, laboratory exercises. This course is devoted to the study of the behavior of materials under stress, the heat treatment of steel and tests of cement, sand and concrete.

REQUIRED IN II, XV_2.

236. Testing Materials Laboratory. — Professor HAYWARD; Messrs HOLMES, COWDREY, ROYS, and assistants.

PREPARATION: 217.

Second Term, Third Year (First Term, Fourth Year for XV_1), thirty hours, lectures, laboratory exercises. This course is similar to course 235.

REQUIRED IN I, XI, XV_1.

237. Testing Materials Laboratory. — Professor HAYWARD; Messrs COWDREY, ROYS, and assistants.

PREPARATION: 218 OR 226.

First Term, Fourth Year, twenty hours, lectures, laboratory exercises. This course is similar to course 235.

REQUIRED IN $III_{1,2}$, X, XA, XIII, XIIIB.

238. Testing Materials Laboratory. — Professor HAYWARD; Messrs. COWDREY, ROYS, and assistants.

PREPARATION: 228.

First Term, Fourth Year, thirty hours, lectures, laboratory exercises. This course is devoted to the study of the behavior of materials under stress and is especially adapted to the needs of students in Architectural Engineering.

REQUIRED IN IV_2.

239. Testing Materials Laboratory. — Professor HAYWARD.

PREPARATION: any one of the following: 217, 218, 225, 228.

First Term, Fourth Year, thirty-five hours, lectures, laboratory exercises. This course is devoted to the study of the materials used in concrete, both plain and reinforced; the selection of a proper aggregate from materials that may be available, their treatment for various purposes and proper methods of placing. This course is also open to a limited number of students of other Courses during both First and Second Terms.

REQUIRED IN IV_2.

240. Testing Materials Laboratory. — Professor HAYWARD; Messrs. COWDREY AND ROYS.

PREPARATION: 221, which must be taken simultaneously.

Second Term, Third Year, thirty hours, lectures, laboratory exercises. This course is similar to course 238 but is especially adapted to the needs of students in Industrial Physics.

REQUIRED IN $VIII_3$.

243. Dynamics of Machines. — Professor RILEY.

PREPARATION: 225 OR 226; 245 OR 246.

First Term, Fourth Year, twenty-five hours, lectures and drawing-room exercises. The greater part of this course is devoted to a study of the forces due to inertia of the moving parts of machinery, including crank-and-connecting-rod mechanisms, cams, governors, fly-wheels, etc. Both analytical and graphical methods of differentiation and integration are applied to determine the relations between motions and the forces associated with them. A study of the measurement of power by means of torsion meters and absorption dynamometers is also included in this course.

REQUIRED IN II.

245. Heat Engineering. — Professors MILLER, MARKS, RILEY, BERRY, TAFT; Messrs. EAMES, JONES, MACKENZIE.

PREPARATION: M22, 200, 206; 216 OR 218, 801.

First Term, Third Year, four hours per week (two hours for XIII); Second Term, Third Year, three hours per week (two hours for III_2, VI and X, four hours for XIII), lectures and recitations. This course includes a detailed

study of the principles of thermodynamics; a discussion of the properties of gases, saturated and superheated vapors, especially of air and steam; of the flow of fluids through orifices, nozzles, pipes and meters, a discussion of the action of the steam injector; a study of the various cycles of the hot air, internal combustion, and steam engines, of the turbine, air compressor, and refrigeration systems. These engineering applications are treated from the physical, analytical and graphical points of view, so as to give the student a good foundation in the principles of thermodynamics, not only as applied to the discussion of ideal cases, but also in the solution of actual heat engineering problems. The course also includes a study of the simple, compound and multiple expansion steam engine, of the different types of gas engines, of the gas producer, of compressed air and refrigerating machines, and the methods of testing such machines. A careful study of the mechanical and various thermal efficiencies is made from data based upon reliable tests made on steam engines and turbines, gas engines, compressors and refrigerating systems. The mastery of principles and the discussion of data are much simplified by an extensive use of both the pressure volume and the temperature entropy diagrams. The theoretical work of the course is paralleled by a suitably graded set of drill and engineering problems to be solved independently by the student. The subjects of steam boilers and gas engines are treated at considerable length. Several lectures are given on condensers, air pumps, and the various accessories of a steam plant. The amount and arrangement of the work are varied for the different professional courses.

REQUIRED IN II, III_2, VI, X, XIII.

247. Heat Engineering. — Professor MILLER.

PREPARATION: M22, 201, 801.

First and Second Terms, Fourth Year (Third Year for XV), three hours per week, lectures and recitations. The course includes a study of valve-gears, steam engines, steam boilers, power station accessories, and thermodynamics.

REQUIRED IN I, XI, XV.

248. Heat Engineering. — Professor BERRY.

PREPARATION: M22, 201, 801.

First and Second Terms, Fourth Year, two hours per week, lectures and recitations. This course includes a study of the principles of thermodynamics and their application to the solution of various heat engineering problems. Less time is devoted to the description of purely mechanical features than in course 245.

REQUIRED IN $VIII_2$, XIV.

250. Heat Engineering, Advanced. — Professors MILLER, MARKS, RILEY, BERRY.

PREPARATION: 245.

A course of study and reading in advanced engineering thermodynamics will be outlined to meet the needs of each student especial attention

being given to the literature bearing on the subject matter of his research work. The distribution of time between study and experimentation will differ with the character of the investigation undertaken by each student.

ELECTIVE IN II, GRADUATE YEAR.

251. Internal Combustion Engines. — Professor RILEY.

PREPARATION: 246.

Second Term, Third Year (Fourth Year for XIIIB), twenty lectures and laboratory exercises. This course is devoted mainly to oil and gasoline engines, including the types applied to marine and aërial propulsion. Several text-books are used for reference, and reading is assigned from current articles in the technical press and transactions of engineering societies.

REQUIRED IN XIIIA, XIIIB.

251a. Aëro-Engines. — Professor RILEY.

First Term, Graduate Year, two hours per week. A course of lectures, the subject matter being confined to gasoline engines for aëroplanes and airships. A study is made of theoretical principles which may be applied in the design of light-weight, high-speed motors, including methods of balancing the reciprocating parts and obtaining satisfactorily uniform torque. The mechanical arrangements of the principal aëro-engines in present use are studied in detail.

REQUIRED IN GRADUATE COURSE IN AËRONAUTICAL ENGINEERING.

252. Internal Combustion Engines. — Professor RILEY.

PREPARATION: 245, 246, 247 OR 248.

First Term, two hours per week for the last eight weeks. A course of lectures in extension of the work given in Heat Engineering and including gas, gasoline and oil engines.

ELECTIVE.

253. Refrigeration. — Professor BERRY.

PREPARATION: 245, 246, 247 OR 248.

Second Term, Fourth Year, two hours per week for first half of term, lectures. The course includes a study of the principles underlying the mechanical production of heat, the physical properties of different refrigerants, a description of standard types of refrigerating machines and systems, and a discussion of actual refrigeration problems such as ice-making, warehouse construction, operative difficulties, etc. Brief mention is made of low temperature production by liquefaction of gases and the use of the power-absorbing thermodynamic cycle as a warming engine.

REQUIRED IN II.

254. Refrigeration. — Professor BERRY.

PREPARATION: 245.

First or Second Term, Graduate Year, two hours per week, lectures and recitations. This course includes all of course 253, with additional time

spent upon the various applications of refrigeration to the arts and sciences, and the solution of problems.

ELECTIVE IN X, GRADUATE YEAR.

255. Heating and Ventilation. — Professors MILLER, PARK; Mr. SNOW.

PREPARATION: 245, 247 OR 248 OR 255.

Second Term, Fourth Year, two hours per week last half of term, lectures. The aim of the course is to give a working acquaintance with the essential engineering principles underlying a correct practice of heating and ventilating work.

REQUIRED IN II.

256. Elements of Heat Engineering. — Professor MILLER.

PREPARATION: 801.

First Term, Third Year, three hours per week, lectures and recitations. This course gives the student a training in the thermodynamics of gases, saturated and superheated steam, sufficient to enable him to take Heating and Ventilation (255).

REQUIRED IN IV_2.

257. Heat Transmission. — Professor BERRY.

PREPARATION: 245; 247 OR 248.

First Term, Fourth Year, one hour per week, lectures and recitations. This course discusses the transmission of heat by radiation, conduction and convection as illustrated in steam condensers, feed water heaters, brine coolers, interchangers of absorption machines, radiators, atmospheric condensers, steam boilers, evaporators, cold storage insulation, condensation and evaporation in engine cylinders, cooling of hot bodies, such as castings, freezing of ice, etc.

ELECTIVE.

258. Steam and Mechanical Appliances for Buildings. — Mr. ROBINSON.

Second Term, Fourth Year, one hour per week, lectures; eight hours laboratory work. This course discusses the various steam and mechanical appliances used in connection with the equipment of buildings.

REQUIRED IN IV_2.

259. Power in Mining. — Professor TAFT.

PREPARATION: 218, 302, 801.

Second Term, Fourth Year, three hours per week, lectures and recitations. The work in this course covers the principles and types of machines used as sources of power and motors in mining work. It includes the elements of perfect gases, saturated and superheated vapors and the flow of fluids; a study of the principles of different types of boilers and steam engines,

simple and compound; a short study of valve-gears, of steam turbines, internal combustion engines, air compressors and power plant accessories.

REQUIRED IN $III_{1,3}$. OPTION I ONLY AFTER 1916–1917.

260. Engineering Laboratory. — Professor TAFT; Messrs. EAMES, JONES, ROBINSON, PACKARD, and assistants.

PREPARATION: 245 simultaneously.

Second Term, Third Year, one two-hour exercise per week for ten weeks. The work in this course is devoted to elementary experiments which are preparatory to those of course 261. These include the use of the indicator, the horse power and steam consumption of a simple engine; the setting of plain slide, piston and Corliss valves; the calibration of pressure and vacuum gages; the testing of different types of calorimeters; the measurement of the flow of steam and air; the determination of the clearance of an engine, etc.

REQUIRED IN II, III_2, XIII, XIIIB.

261. Engineering Laboratory. — Professor TAFT; Messrs. EAMES, JONES, ROBINSON, PACKARD, and assistants.

PREPARATION: 245 OR 246, 260, 163 OR 164 simultaneously.

First and Second Terms, Fourth Year, two two-hour exercises per week. This course is a continuation of course 260 and includes course 532 in the first term and course 814 in the second term. It is designed to make the student familiar with the standard methods of testing for ordinary steam and hydraulic machinery, to teach him to think systematically and accurately on such matters and to accustom him to the assumption of engineering responsibility.

Three or four students work together under the direction of an instructor, one of the students, however, being in direct charge of the group. As far as is possible, the men are left to themselves in the matter of practical preparation, running of the machinery, etc. Each student writes a complete report of the test, giving required results, arrangement of apparatus, method of testing and details of computation.

REQUIRED IN II; XA, FIRST TERM; XIII, XIIIA, XIIIB, AND IN III_2, FOR SECOND TERM ONLY.

262. Engineering Laboratory. — Professor TAFT; Messrs. EAMES, JONES, ROBINSON, PACKARD and assistants.

PREPARATION: 245 OR 247: 163 OR 164, except for XV_3.

First or Second Term, Fourth Year, two two-hour exercises per week. This course is intended for those men who are allowed only one term of Engineering Laboratory. It is purposed to cover in a much briefer way the work of courses 260 and 261. The elementary experiments are emphasized and enough of the more advanced work taken to exemplify the methods of testing the more common steam and hydraulic machinery.

REQUIRED IN VI, X, $XV_{2,3}$.

263. Engineering Laboratory. — Professor TAFT; Messrs. EAMES, JONES, ROBINSON, PACKARD, and assistants.

PREPARATION: 262, 247 simultaneously.

First Term, Fourth Year, seven two-hour exercises, one per week, after eight weeks. The time is devoted to steam engine testing, including steam consumption, the use of the indicator and valve setting; the measurement of the flow of air and steam; testing air compressors, gas engines, etc.

REQUIRED IN I, XI.

266. Boiler Design. — Professors HAVEN, SWETT; Mr. WENGERT.

PREPARATION: 208; 225 AND 245 simultaneously.

Second Term, Third Year, one hour per week lectures, two hours per week drawing. This course is devoted to the practical design of four types of boilers and various other pressure vessels.

REQUIRED IN II.

267. Machine Design. — Professors HAVEN, SWETT; Mr. WENGERT.

PREPARATION: 266; 229 AND 243 simultaneously.

First and Second Terms, Fourth Year, four hours per week, lectures and drawing-room exercises. This course includes a systematic application of the principles of Applied Mechanics to the design of machines.

REQUIRED IN II.

267a. Machine Design. — Professors HAVEN, SWETT; Mr. WENGERT.

PREPARATION: 209; 225; 235, simultaneously.

First Term, Fourth Year, six hours per week, Second Term, Fourth Year, four hours per week, lectures and drawing-room exercises. The subject matter of this course includes the rational design of machine elements and simple machines as viewed from the standpoint of economy in manufacture and ease of duplication.

REQUIRED IN XV_2.

268. Advanced Machine Design. — Professors HAVEN, SWETT.

PREPARATION: 267.

First or Second Terms, Graduate Year, one hundred and fifty to three hundred hours per term. This subject embraces an application of the fundamental principles of design extended to machines involving complex stresses and motions.

ELECTIVE IN II, GRADUATE YEAR.

269. Machine Design. — Professors HAVEN, SWETT.

PREPARATION: 208; 218.

Second Term, Graduate Year, four hours per week. A study of the underlying principles of design as applied to mining machinery.

ELECTIVE IN III, GRADUATE YEAR.

270. Factory Construction. — Professors HAVEN, FULLER, HAYWARD.

PREPARATION: 225; 229 simultaneously.

First Term, Fourth Year, three hours per week, lectures, calculation and drawing-room exercises. A study of structures used for industrial purposes together with the necessary calculations and drawings for the design of a factory or machine shop.

REQUIRED IN II.

272. Power Plant Design. — Professors MILLER, RILEY; Mr. BARTLETT.

PREPARATION: 225; 245 OR 247 OR 248.

Second Term, Fourth Year, four hours per week, lectures and drawing-room exercises. The work of the course consists in making the working drawings necessary to show the location of boilers, engines, auxiliaries, piping, coal pockets, etc., for a power house, and also drawings and calculations of some of the details.

REQUIRED IN II.

274. Industrial Management. — Professor PARK.

PREPARATION: 275 OR 1371 simultaneously.

Second Term, Fourth Year (Graduate Year for XIIIa), one hour per week. The course includes a study of the organization and relations of the various departments of an industrial establishment, the location, arrangement, construction and equipment of industrial works for efficiency and economy in manufacturing, efficacious conditions for labor, process mapping or routing, scheduling of work, classification of metal working plants and the machine shop problem, the office and engineering department, forms of industrial organization and differentiation of responsibility, reports, methods of superintendence, employment and cost of labor, systems of compensating labor, and a discussion of the effect on cost of different systems of distributing indirect expenses, and current methods of "efficiency engineering."

REQUIRED IN II, XIIIa.

275. General Engineering Lectures. — INSTRUCTING STAFF AND OUTSIDE ENGINEERS.

Second Term, Fourth Year, one hour per week, lectures. This course covers such matters of general engineering interest as resistance and propulsion of ships, recent development in locomotive construction, power station economics, relations of employer and employee regarding patents, etc.

REQUIRED IN II. ELECTIVE TO FOURTH-YEAR AND GRADUATE STUDENTS.

277. Engine Design. — Professor RILEY.

PREPARATION: 243 AND FIRST TERM OF 267.

Second Term, Fourth Year, three hours per week (fifty hours), lectures and drawing exercises. The option in Engine Design begins with a detailed

study of reciprocating steam engines. Typical engines are discussed with reference to special requirements of the services in which they operate, and to shop methods of construction, as well as to the way in which the thermodynamic and mechanical problems are worked out. In the drawing-room the student makes a partial design of an engine, applying the scientific principles of heat engineering to determine the best steam distribution and the size and strength of the essential parts. This course follows soon after the instruction in Dynamics of Machines, and is taken together with the second term work in Machine Design, both of which courses are directly applied.

REQUIRED IN II_1.

278. Locomotive Engineering. — Professor FULLER.

PREPARATION: 229; 243.

Second Term, Fourth Year, three hours per week first seven weeks, two hours per week last eight weeks. The option in Locomotive Engineering begins with a study of the form and proportions of the details of the more usual types of locomotives. Sets of complete detail drawings of modern locomotives, both simple and compound, are used for this purpose, a considerable number of such drawings having been furnished to the department by different locomotive builders. The students make calculations of the stresses to which the various parts are subjected, and thus learn to determine the strength of the different members, modern locomotives being used for this purpose. A study is made, also, in some detail, of the compound locomotive, of train-resistance, of air-brakes, of the modes of conducting locomotive tests, of the economy and performance of both simple and compound locomotives, as shown by tests, etc.

REQUIRED IN II_2.

279. Mill Engineering. — Professors HAVEN, SWETT; Mr. WENGERT.

PREPARATION: 229; 267 simultaneously.

Second Term, Fourth Year, seventy-five hours, lectures and drawing-room exercises. A course of study relating to the distribution of power and the organization and routing of material in manufacturing processes. Cotton manufacture is used as an illustration.

REQUIRED IN II_3.

280. Steam Turbine Engineering. — Professor PEABODY.

PREPARATION: 163, 229, 243.

Second Term, Fourth Year, one hundred and thirty-five hours, lectures, recitations and drawing-room exercises. The option in Steam Turbine Engineering gives a discussion of the arrangement and construction of various types of steam-turbine and methods of determining sizes and proportions required for the development and distribution of power and to secure sufficient strength and favorable conditions for operation.

REQUIRED IN II_4.

284. Forging. — Messrs. Lambirth and Brown.

Preparation: D11 or D15.

First Term, Second Year, two hours per week; Second Term, four hours per week for eight weeks. This course includes systematic instruction in the use of each tool as it is taken up, the study of each material worked, with an explanation of its various grades and of the proper methods of treatment for each, and the discussion of methods of making large forgings. The ground covered includes instruction in the building and care of fires, heating, drawing, forming, bending and twisting, upsetting, upsetting while bending, upsetting for square corners, punching, bolt making, welding (including careful instruction in scarfing for the various welds), chain making, and the construction of hooks and ring bolts. The work in steel includes drawing, forming, welding, refining and tempering, and spring and tool making. Training is given in the use of the power hammer and drop forging is also included.

Required in II, XIII, XIIIb.

284a. Forging. — Messrs. Lambirth and Brown.

Preparation: D11, D15.

First Term, three hours per week; Second Term, four hours per week. This course is similar to course 284 but of greater length. The increase in time allows more thoroughness and the introduction of additional work.

Elective.

285. Forging. — Messrs. Lambirth and Brown.

Preparation: D11, D15.

Second Term, Fourth Year, three hours per week. This course covers nearly the same ground as that of course 284, but in a less thorough manner. This course will be taken in the third year for III_1, for the class of 1918 and thereafter.

Required in $III_{1,2}$.

285a. Forging. — Messrs. Lambirth and Brown.

Preparation: D11, D15.

Second Term, Third Year, two hours per week. This course is similar to course 285, but with certain abbreviations.

Required in III_2.

287. Foundry Work. — Mr. O'Neill, and assistant.

Preparation: D11, D15.

Second Term, Second Year (Third Year for XIII, XIIIB), Fourth Year for III_2, three hours per week. This is a course in the foundry. Instruction is first given in cutting over and tempering sand and the use of mould-

er's tools, making two, and three part green sand moulds and making, baking, and testing cores. Ramming, venting, facing, spruing, use of risers, the clamping and weighting of moulds, stopping off, bedding, loose-piece moulding, and use of chills are considered in proper order. Following this come exercises in multiple and duplicate production by use of snap flasks, slip jackets and machines, such as the power squeezer, hinged turn-over, and jarring stripping plate moulding machines. Here the mounting and gating of wood and metal patterns on plates, the use of follow boards, and making of sand and plaster matches is described and illustrated by examples. Floor and sweep moulding are taken up by means of selected typical examples. Castings are first made in white metal for practice, then in brass and in cast iron, when the students are taught pouring, and the running of metal furnaces.

The laboratory work is supplemented by illustrated lectures on loam, large floor and sweep moulding, steel and aluminum casting, foundry appliances and modern methods of production.

REQUIRED IN II, III_2, AFTER 1916–1917, XIII, XIIIB, XV_3.

288. Foundry Work. — Mr. O'NEILL and assistant.

PREPARATION: D11, D15.

First Term, Second Year (Fourth Year for X), three hours per week for eleven weeks. This course covers nearly the same ground as that of course 287, but with certain abbreviations.

REQUIRED IN VI, X.

289. Wood-work and Pattern-making. — Mr. O'NEILL and assistant.

PREPARATION: 287 OR 288.

First Term, Third Year, four hours per week. This course is a combination of Courses 289a, 289b, and 289c with certain abbreviations. The course begins with the elements of Joinery and Wood-Turning and leads to the work in Pattern-Making. The exercises include sawing, planing, chiseling, boring, etc.; laying out work; jig, band and circular sawing; and lathe work, including center, chuck, and face plate turning. Thorough training is given in the adjustment, use, sharpening and care of wood-working tools, machines and appliances.

In the making of patterns and core boxes, the principles of moulding are carefully considered. The projects include patterns of pipe-fittings, valves, pulleys, gears, hangers, machine parts, etc. The laboratory work is supplemented by illustrated lectures on the construction and foundry application of solid, split and loose-piece patterns; large complete, part and skeleton patterns for floor, loam and sweep work; master and metal patterns; mounting of patterns on plates and their preparation for use on moulding machines.

REQUIRED IN II.

289a. Carpentry and
289b. Wood-turning. — Mr. O'Neill and assistant.

Preparation: D11, D15.

First Term, four hours per week. The object of the work is a thorough training in the adjustment, use, and sharpening of the ordinary wood-working tools. The exercises in Carpentry include instruction in sawing; planing; chiseling, including chamfering, grooving, and plain moulding work; framing, including tenoning, splicing, mortising and fitting braces; use of the ordinary moulding planes and making mouldings; making and use of the mitre box in fitting mouldings; nailing; dovetailing; gluing; and the proper use of sandpaper. The exercises in Wood-Turning include systematic instruction and experience in the use of the wood lathe in center and chuck turning, the discussion of the proper adjustment of cutting speeds for various materials and conditions, and careful training in the use of turning tools such as gouges, turning chisels, nosing tools, right and left side tools, parting tool, calipers, and dividers. Particular attention is given to the production of smooth work by the cutting action of the tools. The course includes also the making of simple patterns.

Elective.

289c. Pattern-work. — Mr. O'Neill and assistant.

Preparation: 287 or 288; 289a; 289b.

Second Term, two or four hours per week. This course includes a discussion of the principles of moulding in connection with the making of patterns and core-boxes, and the methods of building up patterns. The projects in this course include patterns of pipe-fittings, valves, pulleys, gears, hangers, machine parts, etc. The laboratory work is supplemented by illustrated lectures on the construction and foundry application of solid, split and loose-piece patterns; large complete, part and skeleton patterns; for floor, loam and sweep work; master and metal patterns; mounting of patterns on plates and their preparation for use on moulding machines.

Elective.

290. Vise and Bench Work. — Messrs. Smith, Littlefield, and assistant.

Preparation: D11, D15.

Second Term, Third Year (Fourth Year for XIIIB), two hours per week. A course in mechanical processes where the tools are guided principally by hand. The instruction is given by lectures and demonstration at the beginning of each period, supplemented by the text-book. The course is arranged to advance the students in a logical, systematic and progressive manner, and in the shortest time. Each student is required to do problems which involve the application of the following principles and processes: — laying out work, angles of cutting tools, grinding tools, chipping cast iron,

chipping key-ways, pneumatic chipping and drilling, classification of files and methods of operating, filing cast iron, filing and fitting steel and wrought iron, alignment and babbitting of bearings, scraping bronze and babbit bearings, steam pipe fitting, autogeneous welding, and measuring the hardness of common metals and hardened, tempered and heat-treated steels with the scleroscope.

REQUIRED IN II, XIII, XIIIB.

290a. Chipping and Filing. — Messrs. SMITH, LITTLEFIELD, and assistant.

PREPARATION: D11, D15.

Second Term, three hours per week. This course is similar to course 290, but of greater length, more extended training being given in certain portions of the work. The exercises in Chipping begin with a study of the tools used, with reasons for their shapes, sizes, and cutting angles. The work includes chipping chamfers, flat, concave, and convex surfaces, and "chipping to shoulder." The instruction covers methods of holding work, cross filing, draw filing, free-hand filing, production of flat surfaces, surfaces at right angles, parallel surfaces, chamfering, filing to template, use of hacksaw, fitting, including parallel, drive, and slide fits, finishing and polishing, the construction, care, and use of scraping tools, and the production of flat surfaces, each student making a pair of small surface plates.

ELECTIVE.

290b. Vise and Bench Work. — Messrs. SMITH, LITTLEFIELD, and assistant.

PREPARATION: D12 OR D12a; D32.

First Term, Second Year (Fourth Year for X), three hours per week for last four weeks. This course is similar to course 290 but of much shorter length. It includes laying out work, grinding tools, hand and pneumatic chipping, filing, alignment and babbitting of bearings, belt lacing, pipe fitting, and measuring the hardness of metals with the scleroscope.

REQUIRED IN VI, X.

291. Machine-tool Work. — Mr. SMITH, and assistants.

PREPARATION: 290.

First and Second Terms, Fourth Year (Fifth Year for XIIIB), three hours per week in First Term, four hours per week in Second Term. Instruction is given, when necessary, in the mechanism of the machine-tools used and careful attention is paid to the various adjustments for the work in hand. The different measuring tools and devices, with the advantages, methods of use, and limits of accuracy of each are considered. As each cutting tool is taken up, its cutting angles and general adjustments are discussed, together with the "feeds" and cutting speeds suitable for each

material worked and for each machine. The course includes instruction in centering, squaring, straight and taper turning and fitting, outside and inside screw cutting, chucking, reaming, finishing and polishing, drilling, tapping, mandrel making, grinding and lapping, boring, brass turning and finishing, ornamental turning, planing flat and V surfaces, fitting, the use of the milling machine, gear-cutting, tool-making, including taps, drills, reamers, milling cutters, and cylindrical gages.

REQUIRED IN II, XIII, XIIIB.

291a. Machine-tool Work. — Mr. SMITH, and assistants.

PREPARATION: 290 OR 290a.

First and Second Terms, five hours per week. This course is similar to course 291 but is of greater length, additional projects being included.

ELECTIVE.

292. Machine-tool Work. — Mr. SMITH, and assistants.

PREPARATION: 290b.

Second Term, Second Year (Fourth Year for Course X), three hours per week. Instruction is given in general machine-tool work, consisting of centering, straight and taper turning and fitting, screw cutting, chucking, finishing, accurate drilling, tapping, cylindrical grinding, shaping and planing, plain and index milling and gear cutting.

REQUIRED IN VI, X.

294. Metal Turning. — Messrs. SMITH, LITTLEFIELD, and assistants.

PREPARATION: D11, D15.

First and Second Terms, Second Year, two hours per week. A brief course in Chipping, Filing and Scraping precedes a course in Machine-tool work, special attention being given to brass work. The course includes lathe work, drilling and milling, the object being to give students a training sufficient to enable them to construct experimental apparatus.

REQUIRED IN $VIII_3$, XIV.

295. Metal Turning. — Mr. SMITH, and assistants.

PREPARATION: D11 simultaneously.

First Term, Second Year, Third Year for XV_3, Fourth Year for III_2, three hours per week. The course begins with exercises in elementary chipping and filing, which are followed by instruction in lathe work, covering, centering, straight turning, screw cutting, chucking, finishing, drilling, and tapping.

REQUIRED IN III_2, AFTER 1916–1917 $VIII_{1,2}$, XV_3.

297. Mechanic Arts. — Messrs. SMITH, LITTLEFIELD, O'NEILL.

PREPARATION: D12; D32.

Summer Course, seventy-five hours. This course is a combination of the courses in Vise and Bench Work 290b and in Machine Tool Work 292 with certain changes and with the addition of some foundry work. It is intended to give training in the use of hand tools and in general machine tool work and also instruction in foundry practice.

REQUIRED IN XV_2.

SPECIAL LECTURES

Besides the teaching by the regular corps of instructors, lectures upon special subjects are given by gentlemen actively engaged in the profession.

DEPARTMENT OF MINING ENGINEERING AND METALLURGY

HEINRICH O. HOFMAN, E.M., MET.E., PH.D.
Professor of Metallurgy.

HENRY L. SMYTH, A.B., C.E.
Professor of Mining and Metallurgy.

ALBERT SAUVEUR, S.B.
Professor of Metallurgy and Metallography.

EDWARD D. PETERS, M.D., DR. ING.
Gordon McKay Professor of Metallurgy.

CHARLES H. WHITE, S.B., A.M.
Professor of Mining and Metallurgy.

GEORGE S. RAYMER, A.B., E.M.
Assistant Professor of Mining.

CHARLES E. LOCKE, S.B.
Assistant Professor of Mining Engineering and Metallurgy.

EDWARD E. BUGBEE, S.B.
Assistant Professor of Mining Engineering and Metallurgy.

CARLE R. HAYWARD, S.B.
Assistant Professor of Mining Engineering and Metallurgy.

Instructor

RUFUS C. REED, S.B.

Assistants

FRED C. LANGENBERG, S.M., ELMER E. HARRINGTON, S.B.

THE study of Mining and Metallurgy covers such a large field of technical endeavor that the courses given cannot follow the details of the several branches. The aim of all instruction is to ground the student in the fundamental principles of the professional studies, and to train his mind and hand that he may be a close observer, a good reasoner, and a conscientious worker.

Instruction is given by lectures and recitations, by laboratory work, and by summer schools. Work in the Department covers studies in mining, ore-dressing, metallurgy, metallography, and assaying. With these are interwoven auxiliary courses in physics, chemistry, mineralogy, geology, and in civil, mechanical, and electrical engineering. The manner in which these studies are taken by students pursuing three different Options is given on

pages 91–95; descriptions of the subjects are to be found as indicated by the accompanying numbers. All students in the Department follow the same studies for the first year; in the second year there are some differences in the Options; they become very marked in the third and fourth years.

301. Elements of Mining Engineering. — Professor LOCKE.

PREPARATION: D11; 501.

Second Term, Second Year, one hour per week, lectures. The time is devoted to mechanics and machinery in general, from the viewpoint of the mining engineer, with the object of preparing the student so that he may readily understand special machinery considered later in the courses in Mining Engineering 302, 303, etc.

REQUIRED IN $III_{1,3}$.

302. Mining Engineering. — Professor LOCKE.

PREPARATION: 104, 301, 801, 1201; 215 simultaneously.

First and Second Terms, Third Year, three hours per week, lectures. In the first term are discussed the tools of mining, methods of prospecting, and the opening up of deposits, including the sinking of shafts and slopes, the driving of levels, and the working of stopes or rooms for ore or coal, timbering and hydraulicking.

In the second term the subjects considered are tramming, hoisting ore, coal, and men, pumping, ventilating, lighting, explosions, fires, mining law, underground surveying, accounting and the handling of men. *Text-book, Richards' Mining Notes.*

REQUIRED IN III_1.

303. Mining Engineering: Ore Dressing. — Professor LOCKE.

PREPARATION: 218, 302, 321.

First Term, Fourth Year, three hours per week, lectures. This course is a continuation of Mining Engineering 302. The greater part of the time is devoted to wet concentration, including crushing machinery, screens, classifiers, jigs, vanners and tables. Magnetic, flotation, pneumatic, electrostatic and other minor processes are also discussed. It is aimed to correlate the lectures with the ore-dressing laboratory work of course 351. *Text-book, Richards' Text-Book of Ore-Dressing.*

REQUIRED IN III. After 1916–1917, in III_1 only.

305. Mining and Metallurgical Calculations. — Professors LOCKE, HAYWARD.

PREPARATION: 303 OR 307, AND EITHER 331, FIRST TERM, OR 335.

Second Term, Fourth Year, two hours per week, Class of 1917, one hour per week during the whole of the fourth year. A course devoted to the solu-

tion of problems relating to the efficiency of processes and apparatus in metallurgy and in ore-dressing. The metallurgical work deals chiefly with thermal lines. The ore-dressing work is devoted to the calculation and interpretation of results of operations, and to a discussion of typical examples of smelter schedules. *Reference book, J. W. Richards' Metallurgical Calculations.*

REQUIRED IN $III_{1,2}$.

306. Mining Engineering. — Professor RAYMER.

PREPARATION: 513, 1208, 1251.

First Term, Third Year, two hours per week, lectures. A course covering the principles of Metal and Coal Mining.

REQUIRED IN III_2.

307. Ore-Dressing. — Professor LOCKE.

PREPARATION: 218, 306, 321.

First Term, Fourth Year, one hour per week, lectures, twenty-four hours, laboratory. The ground covered in the lectures embodies the principles of ordinary wet gravity concentration, flotation, and magnetic separation. The most important crushing and concentration machines of interest to the metallurgist are treated briefly. The laboratory work covers three seven-hour periods for three weeks and three seminars of one hour; the work is identical with part of the ore-dressing of course 351. *Text-book, Richards' Text-book of Ore-Dressing.*

REQUIRED IN III_2. Not given until 1917–1918.[1]

308. Mining Engineering: Ore-Dressing, Leaching. — Professor RAYMER.

PREPARATION: 218, 321, 1201.

Second Term, Fourth Year, two hundred hours. A course of lectures, nine hours per week, lasting from February 3 to April 22, and of laboratory work, nine hours per week, extending through the term. The principles of amalgamation, concentration, dressing, and leaching of ores are fully discussed.

REQUIRED IN III_3. Not given until 1917–1918.[1]

309. Problems in Dressing and Milling of Ores. — Professor RAYMER.

PREPARATION: 308.

First Term, Graduate Year, eight hours per week. This course consists of laboratory work and a report; it has for its object the determination of the best method of treatment for an ore, and the design of a plant.

ELECTIVE IN III, GRADUATE YEAR.

[1] See note on page 238.

311. Mining Engineering, Advanced. — Professor LOCKE.

PREPARATION: 302.

First Term, Graduate Year, nine hours per week, Second Term, Graduate Year, two hundred hours. The first term is devoted mainly to lectures, conferences, and assigned readings, being supplementary to course 302, and covering details of subjects and calculation of problems omitted in the earlier course on account of lack of time. The second term is devoted to the design of a mine plant starting with certain assumed conditions.

ELECTIVE IN III, GRADUATE YEAR.

312. Ore-Dressing, Advanced. — Professor LOCKE.

PREPARATION: 303.

First and Second Terms, Graduate Year. A course of one hundred and thirty-five hours in the first term devoted to lectures, conferences and readings, covering ground omitted in course 303; and two hundred hours in the second term devoted to the design of a mill under certain assumed conditions.

ELECTIVE IN III, GRADUATE YEAR.

313. Mining Plant. — Professor RAYMER.

PREPARATION: 315, 316, 317.

Second Term, Fourth Year, nine hours per week from April 22–May 27, lectures. A course on the hoisting, haulage, drainage, and ventilation equipment of mines.

REQUIRED IN III_3. Not given until 1917–1918.[1]

314. Mineral Lands: Acquisition, Tenure. — Professor RAYMER.

PREPARATION: 313, 316, 317.

First Term, Graduate Year, six hours per week, lectures. This course deals with the methods of acquiring and holding lode and placer claims; with laws and regulations covering the location and patenting of lode claims, placers, and mills sites, conflicts, extralateral rights, tunnel rights, and a study of court decisions in the important cases.

ELECTIVE IN III, GRADUATE YEAR.

315. Mining: Prospecting, Exploring, Exploitation. — Professor SMYTH.

PREPARATION: 1208, 1237, 1264.

Second Term, Third Year, two hours per week, lectures. The subjects discussed are property in minerals, prospecting, or search for mineral deposits on the surface, exploring, including stripping, trenching, test-pitting and drilling, breaking ground, and the principles of exploitation.

REQUIRED IN III_3.

[1] See note on page 238.

316. Metal Mining: Exploitation. — Professor SMYTH.

PREPARATION: 218, 315; 317, 318 simultaneously.

First Term, Fourth Year. The course consists of six lectures, one hour of conference, and six hours in the draughting room per week, for the first thirteen weeks of the term. The lectures deal in detail with shaft-sinking, drifting, raising, methods of mining, operating routine, organization and costs. The required work includes two problems a week, and one project.

REQUIRED IN III_3. Not given until 1917–1918.[1]

317. Coal Mining. — Mr. NORRIS.

PREPARATION: 315, 316 simultaneously.

First Term, Fourth Year, ten hours per week for the last two weeks. A course of lectures covering as completely as possible the development, mining, preparation and marketing of coal.

REQUIRED IN III_3. Not given until 1917–1918.[1]

318. Mining Laboratory. —

PREPARATION: 218, 315; 316 simultaneously.

First and Second Terms, Fourth Year. A course of fifty conferences and sixty laboratory hours, in the last three weeks of the first term and the first eight weeks of the second term of the fourth year. The course deals with the construction, testing and selection of mining machinery and supplies.

REQUIRED IN III_3. Not given until 1917–1918.[1]

319. Mining Projects and Design. — Professors SMYTH, RAYMER.

PREPARATION: 313, 316; 317.

Second Term, Graduate Year. This course of one hundred and fifty hours consists in the working-out in considerable detail of a mining project. It is given in the first seven weeks of the second term.

ELECTIVE IN III, GRADUATE YEAR.

320. Mine Examination and Reports. — Professor SMYTH.

PREPARATION: 308, 316, 317.

Second Term, Graduate Year. This course of two hundred hours is given in the last eight weeks of the term. It includes lectures and conferences on mine valuation, examination, and reports; and the examination of a mine and the preparation of a report.

ELECTIVE IN III, GRADUATE YEAR.

21. Fire Assaying. — Professor BUGBEE; Mr. REED.

PREPARATION: 512, 1201.

First Term, Third Year, five hours per week, lectures and laboratory. This course consists of one lecture and one four-hour laboratory exercise a week.

[1] See note on page 238.

The work includes the crushing and sampling of ores, the assay of ores for gold, silver and lead and also of bullions, solutions, mattes and miscellaneous furnace products. The fire assay of copper, tin and mercury is discussed in the lecture, but not undertaken in the laboratory. Particular attention is given to the chemical and metallurgical principles involved, and great stress is laid on the accuracy, care and neatness of the work and the notes. *Text-book, Bugbee's Fire Assaying.*

REQUIRED IN III.

322. Fire Assaying. — Professor BUGBEE; Mr. KEED.

PREPARATION: 512.

First Term, Third Year. This is a short course of ten lectures and ten two-hour laboratory exercises which covers only the assay of ores for silver, gold, and lead. *Text-book, Bugbee's Fire Assaying.*

REQUIRED IN XIV.

323. Wet Assaying. — Professor WHITE.

PREPARATION: 513.

Second Term, Third Year, eight hours per week (for III); Second Term, Fourth Year, five hours per week (for III_2), lectures, laboratory. The lectures given to Option 1 treat of the methods of sampling and analyzing metallurgical materials and products. The methods described are those found best adapted to present-day practice, and include the exact processes demanded by the umpire as well as the shorter methods required for the control of metallurgical operations. The laboratory work may be varied to meet the requirements of the individual student, and is chosen from the following subjects: the analysis of ores for their essential metallic elements and important impurities; of steel, including the special steels; of bullion; brass; bronze; and other alloys; of fluxes and fuels, including oil and gas; of mattes; slags; boiler water; and refractories.

The lectures given to Option 2 describe the mine and smelter methods of analysis required in the production of the metals. The laboratory work consists chiefly in the application of those methods which have been found most useful in connection with the production of the non-ferrous metals. It consists in the analysis of bullion, mattes, slags, fuels, fluxes, and refractories.

REQUIRED IN $III_{1,2}$.

331. Metallurgy. — Professors HOFMAN, BUGBEE, HAYWARD.

PREPARATION: 513, 321, 801; 351 simultaneously.

First and Second Terms, Fourth Year, three hours per week, lectures. The first term is given to a detailed discussion of the metallurgy of lead, copper, silver and gold; special attention is given to the properties of metals, the constitution and properties of alloys, the principles on which are based the operations sampling, drying, roasting, smelting, amalgamating, leach-

[1] See note on page 238.

ing and electro-depositing. The work in Metallurgical Laboratory 351 is so arranged as to run parallel with that in the class-room. In the forty-five lectures of the second term are treated in detail, the metallurgy of zinc and aluminum, of iron and steel, and of fuels and refractory materials. General metallurgy is confined to a full treatment of the subjects of fuels and refractories, as the necessary general discussions of metallurgical apparatus, products, etc., have been given in connection with the several metals. For the Class of 1918 and thereafter this course will occupy sixty hours in the first term and forty-five hours in the second term. *Text-books, Hofman's General Metallurgy, Copper; Thomsen's Stamp Milling and Cyaniding; and Stoughton's Iron and Steel.*

REQUIRED IN III. After 1916–1917 in III_1 only.

332. Metallurgy of Engineering Materials. — Professors HOFMAN, HAYWARD.

PREPARATION: 502.

First Term, Third or Fourth Year, three hours per week, lectures and laboratory. The aim of this course is to make the engineer familiar with the industrial use of fuels, with the production of the metals and alloys used in construction, and the effects foreign constituents have upon them. The instruction is given by lectures and laboratory demonstrations, the latter being confined to the heat-treatment and microscopical examination of some of the leading metals and alloys.

REQUIRED IN XIIIA, XIIIB.

333. Metallography. — Professor SAUVEUR.

PREPARATION: 335, 513, 567; 813 simultaneously.

First Term, Fourth Year, lectures, laboratory. A course of twenty-five lectures including the study of the micro-structure of iron and steel, of non-ferrous metals, and of several commercial alloys; the influence of thermal and mechanical treatments on these structures; the study of equilibrium diagrams, and of the phase rule applied to alloys.

The laboratory work consists of sixty hours devoted to the preparation for microscopical examination of various grades of iron and steel variously treated and of some alloys, and to the taking of photo-micrographs of their structures; it includes the construction of the equilibrium diagrams of iron-carbon and other alloys. *Text-book, Sauveur's The Metallography of Iron and Steel. Reference books, Desch's Metallography, and Rosenhain's Physical Metallurgy.*

REQUIRED IN III_2. Not given until 1917–1918.[1]

334. Metallography. — Professor HAYWARD.

PREPARATION: 801; 813 simultaneously.

First Term, Fourth Year, lectures, and laboratory. A course of eight lectures, descriptive of the constitution and micro-structure of metals and alloys and of the relations between their properties, chemical and me-

[1] See note on page 238.

chanical treatment and structure. The application of the microscope to the study of alloys is covered by seven hours in the laboratory.

REQUIRED IN $III_{1,2}$. For Class of 1917 only.

335. General Metallurgy. — Professor HOFMAN.

PREPARATION: 321, 513, 1208; 355 simultaneously.

Second Term, Third Year, three hours per week, lectures. This course covers in a general manner the properties of metals and metallic compounds, treats in detail fuels and refractories, discusses the principles which govern pyro-, hydro-, and electro-metallurgical processes, and considers some typical apparatus used in these processes.

REQUIRED IN III_2.

336. Principles of Metallurgy. — Professors SAUVEUR, PETERS.

PREPARATION: 512, 1201.

First Term, Third Year, four hours per week, lectures and laboratory. A course of forty-five lectures devoted to a general study of metallurgical materials, operations and products, and of the physical and chemical principles upon which the art of metallurgy is based.

The laboratory work consists of fifteen hours devoted to simple experiments dealing with the calorific power of fuels, melting points of metals, pyrometry, reduction of some metallic oxides, etc.

REQUIRED IN III_3.

37. Metallurgy: Lead, Gold and Silver. — Professors HOFMAN, BUGBEE.

PREPARATION: 321, 513, 1208; 355 simultaneously.

Second Term, Third Year, thirty-five lectures. In this course fifteen lectures are devoted to lead, and twenty to gold and silver. Under the heading of lead are discussed the theory and practice of the smelting of lead ores and the desilverization of lead bullion. The extraction of gold and silver from ores by means of amalgamation and lixiviation forms the second division. In this the larger part of the allotted time is devoted to a study of the cyanide process. Besides the chemical side, due emphasis is laid upon modern methods of handling, classifying, and filtering sands and slimes. The course concludes with a brief discussion of the parting of gold and silver. *Text-books, Hoffman's Lead; Thomson Stamp Milling and Cyaniding.*

REQUIRED IN III_2.

338. Leaching Gold and Silver Ores. — Professor WHITE.

PREPARATION: 308.

First Term, Graduate Year, one hundred and twenty hours, lectures and laboratory. The lectures include a description of the chemical and physical properties of gold and silver and of such of their compounds as are of importance in connection with the leaching processes, and a description of those processes which have been applied commercially for the extraction of gold and silver by solution, the greater emphasis, by far, being placed upon the process of cyanidation and its problems. The students consult

the literature of the subject for the study of the best modern plants and report upon the methods by which the more important problems have been solved with various ores under the conditions existing in the principal gold and silver districts of the world.

For laboratory work, the student is given an ore with which he is not familiar upon which he operates in a logical and systematic way to develop the most profitable method of treatment, the results of which are embodied in a detailed report at the end of the course.

ELECTIVE IN III, GRADUATE YEAR.

339. Metallurgy : Copper. — Professor PETERS.

PREPARATION: 336; or 335 simultaneously.

Second Term, Third Year, two hours per week, lectures. A course of thirty lectures devoted mainly to the dry metallurgy of copper, and including a brief study of the more important wet methods, and of the electrolytic process. The construction of metallurgical furnaces and the handling of smelter fumes are also considered. *Text-books, Hofman's Metallurgy of Copper; Peter's Principles of Copper Smelting.*

REQUIRED IN $III_{2,3}$.

340. Metallurgy: Zinc and Minor Metals. — Professors HOFMAN, PETERS.

PREPARATION: 339.

Second Term, Fourth Year, two lectures per week. A course which treats of the metallurgy of zinc, aluminum, mercury, nickel, cobalt, tin, arsenic, antimony, bismuth, and platinum.

REQUIRED IN $III_{2,3}$. Not given until 1917–1918.[1]

341. Metallurgy: Iron and Steel. — Professor SAUVEUR.

PREPARATION: 335, 355, 568.

First Term, Fourth Year, three hours lectures, two hours laboratory per week. The lectures include a description of the methods used for the production of cast iron, steel and wrought iron, raw materials, mechanical appliances and mechanical operations being duly considered, but special emphasis being laid on the chemical and physical principles upon which the art is based; the study of the treatments, both mechanical and thermal, by which iron and steel after their manufacture, are converted into finished implements; the study of the properties of iron and steel and of the relations existing between those properties and the chemical compositions, treatments and structures of the metals considered.

The laboratory work consists of thirty hours devoted to a practical demonstration for the rationale of the heat treatment of iron and steel such as annealing, hardening and tempering; it includes the determination of the thermal critical points of iron and steel and the determination of the strength, elastic limit, ductility, hardness, magnetic properties, etc., of various grades of these metals after various mechanical and heat treatments. *Text-book, Sauveur and Boylston's Laboratory Experiments in Metallurgy.*

REQUIRED IN III_2. Not given until 1917–1918.[1]

[1] See note on page 238.

349. Metallurgical Plant Design. — Professors HOFMAN, BUGBEE, HAYWARD.

PREPARATION: 305, 339, 340, 341.

Second Term, Graduate Year, one hundred hours. This course aims to make the student conversant with some construction details of metallurgical plants. It involves the fundamental calculations for a given problem, and the study of detail in working drawings, to be followed by the preparation of drawings of a plant as a whole and of some of the apparatus in detail.

ELECTIVE IN III, GRADUATE YEAR.

351. Metallurgical Laboratory. — Professors HOFMAN, LOCKE, BUGBEE, HAYWARD; Mr. REED.

PREPARATION: 303, 331, 356 simultaneously.

First Term, Fourth Year, eight hours per week for twelve and one half weeks. A course of laboratory work in which the students make a practical study of the working of the machines, furnaces, etc., used in the processes of ore-dressing and metallurgy. Ores are crushed by means of breakers, rolls, and stamps. They are then sized and sorted with screens and classifiers, and finally concentrated with jigs, revolving and Wilfley tables, Frue and Embrey vanners, and magnetic machines. In metallurgical work, copper, lead, silver, and gold ores are tested and the processes used include roasting, smelting, amalgamating, leaching and electrolytic treatment. This course will be changed in 1917 to include Metallography 334, and Laboratory Reports 356.

REQUIRED IN III. After 1916–1917 in III_1 only.

352. Metallurgical Laboratory. — Professors HOFMAN, HAYWARD.

PREPARATION: 322, 513; 356 simultaneously.

First Term, Fourth Year, eight hours per week for three weeks. In this course the work is identical with the purely metallurgical work of course 351.

REQUIRED IN XIV.

355. Metallurgical Laboratory: Non-ferrous. — Professors HOFMAN, BUGBEE, HAYWARD.

PREPARATION: 321, 1208.

Second Term, Third Year, eighty-five hours. This course of eight hours of laboratory work with weekly conferences is given during the first ten weeks of the term. It is taken simultaneously with class-room work in metallurgy, and aims to render the student familiar with the leading metallurgical operations. The exercises deal with roasting, smelting, leaching, and electro-deposition. The work is similar to the metallurgical part of course 351.

REQUIRED IN III_2.

356. Laboratory Reports. — Professors HOFMAN, LOCKE, BUGBEE, HAYWARD; Mr. REED.

PREPARATION: 351 or 352 simultaneously.

First Term, Fourth Year, one hour per week. A seminar accompanying courses 351 and 352, in which the students and instructors meet and discuss the various points brought out by the week's work. Students in Course XIV attend three seminars, which are connected with the work of course 352. This course is continued for Course III, throughout the second term in connection with thesis work. In 1917 this course will be included in Metallurgical Laboratory 351.

REQUIRED IN III, XIV.

360. Metallurgy and the Physics of Metals. — Professor SAUVEUR.

PREPARATION: 334, 341.

Graduate Year. This is essentially a research course devoted to the investigation of problems dealing with the treatment and properties of metals. It may be taken in the first or second term, or in both, the time required varying between two hundred and forty and nine hundred and sixty hours according to the nature of the investigation and the time the student is able to devote to it.

ELECTIVE IN III, GRADUATE YEAR.

361. Mechanical Treatment of Metals. — Professors HOFMAN, HAYWARD.

PREPARATION: 334, 339, 341.

First Term, Graduate Year, two hours per week. This course of ten lectures and twenty laboratory exercises deals in the class room with the principles governing the mechanical treatment of metals and studies in the laboratory microscopically and otherwise the physical changes metals and alloys undergo when subjected to mechanical deformation by rolling, drawing, and punching. Not given in 1916–1917.

ELECTIVE IN III, GRADUATE YEAR.

362. Economics of Metallurgical Plants. — Professor PETERS.

PREPARATION: 339, 340, 341.

First Term, Graduate Year, one hour per week, lectures. This course treats mainly of the application of modern business principles and methods to the locating, erecting, and managing of metallurgical plants. While much that is given in this course will be applicable to metallurgical operations in general, special attention will be devoted to copper. Smelter fumes will be discussed briefly.

ELECTIVE IN III, GRADUATE YEAR.

363. Development of Metallurgical Processes. — Professor PETERS.

PREPARATION: 339, 340, 341.

First Term, Graduate Year, two hours per week, lectures. A course devoted to the historical development of the metallurgical processes used in the

production of the more important non-ferrous metals. Especial attention is given to the developments of the past few years. Amalgamation and cyaniding are not discussed.

ELECTIVE IN III, GRADUATE YEAR.

364. Metallurgy of Copper, Advanced. — Professor PETERS.

PREPARATION: 339, 363.

Second Term, Graduate Year, two hours per week, lectures. A course intended to supplement and elaborate the regular undergraduate lectures on the metallurgy of copper. The furnace processes are studied with considerable minuteness, and the principles underlying the more important operations are analyzed and discussed. Matte, slag, smelter fumes, and other products and educts are studied.

ELECTIVE IN III, GRADUATE YEAR.

372. Mining Camp.

PREPARATION: 104, 302 or 315.

Summer Course, Third Year, six weeks. This course is given at the Elizabeth Mine, near South Strafford, Vermont, in June and July. The subjects studied are underground surveying, drilling, blasting, timbering, tracklaying, blacksmith work, etc.

ELECTIVE IN III_3.

Note: Subjects marked (1) become parts of the regular Courses in Mining Engineering and Metallurgy at the times specified. They may be given, however, before the dates assigned if applied for by a sufficient number of students.

DEPARTMENT OF ARCHITECTURE

Ralph Adams Cram, Litt.D.
Professor of Architecture.

H. Langford Warren, A.M.
Professor of Architecture at Harvard University.
Lecturer on Architectural History.

William H. Lawrence, S.B.
Professor of Architectural Engineering.

John O. Sumner, A.B.
Professor of History.

Harry W. Gardner, S.B.
Associate Professor of Architecture.

W. Felton Brown,
Associate Professor of Freehand Drawing.

Stephen Codman, A.B.
Associate Professor of Architecture.

Charles Everett, A.D., P.G.
Assistant Professor of Architecture.

Instructors

C. Howard Walker.
Clarence E. Morrow, S.B.
Israel P. Lord.
Alexander S. Jenney.
Russell W. Porter, S.B.
Edwin C. Holbrook, S.B.

Assistant

Ida D. Loring.

The courses offered by the Department naturally divide themselves into three groups: (1) those courses that are considered essential for all students in Architecture who are working for the degree; (2) those developed especially for the students in the General Option; (3) those developed for the students in Architectural Engineering.

The two Options run very nearly parallel for the first two years, a small difference occurring in the second year. At the beginning of the third year the line of demarcation between the professional work of the Options becomes more marked, and in the fourth year it is very sharply defined; but the general subjects, common to both Options, which continue through the four years emphasize the close relation between the two and the interdependence of one upon the other in a complete architectural equipment.

The students of both Options mingle in a common drawing-room so that the ideas and work of each may be influenced by

those of the other. They thus learn to feel that one Option is but the complement of the other, and to realize their responsibility not alone to their particular department of study but to the whole profession. Thus is accomplished in the engineering student a flexibility, and in the student of design a sincerity, that can scarcely be brought about in any other way.

In all professional work the methods of instruction are, so far as possible, individual. Even in such courses as Architectural History and European Civilization and Art, which must be presented in the lecture room, written exercises and required personal conferences keep the instructor in touch with the progress of each student. In the courses in Design and Freehand Drawing individual criticism and correction form to a very large extent the basis of instruction.

As we believe that the function of the architectural school is to give training in fundamentals, our efforts are concentrated upon imparting to the student a very clear understanding of the general principles of the subject, and upon training his powers of analysis and application. It is believed undesirable, in fact dangerous, to spend much time upon the hampering limitations of ordinary practice before the student has acquired sufficient knowledge of the subject to discriminate between the general and the special case.

Daily progress and attention to work is insisted upon, and the results of class exercises during the term are considered quite as trustworthy a measure of a student's development and power as are the formal examinations.

The student is strongly advised to spend a part of the summer vacation in an office. The experience that he gets there of practical problems and conditions will be a great aid to him in a clearer understanding of the value of his school work.

411. Shades and Shadows. — Professor GARDNER.

PREPARATION: D14, D15; D41 simultaneously.

First Term, Third Year, four hours per week for seven and one half weeks. The work is done in the drawing-room and each of the two-hour exercises is in the nature of an examination, and requires one hour of preparation. This course attempts to give the student an understanding of the principles of descriptive geometry methods in casting the conventional shadows used in architectural rendering. These methods are supplemented by shorter ones often useful in actual practice.

REQUIRED IN IV.

412. Perspective. — Professor LAWRENCE.

PREPARATION: D14, D18 simultaneously.

Second Term, First Year, two hours per week for ten weeks. A series of exercises in the last weeks of the term, consisting of lectures, recitations, and class-room work. Each hour of exercise is supplemented by two hours of drawing or preparation. The subjects considered are the general theory of conical projection and its application to perspective drawing, methods of direct division, direct measurement, relations between lines and points in the perspective projection, method of cubes, method of perspective plan, curves, shadows, and apparent distortion. *Text-book, Lawrence's Principles of Architectural Perspective.*

REQUIRED IN IV.

413. Applied Perspective. — Professor GARDNER.

PREPARATION: 412.

First Term, Second Year, two hours per week; Second Term, Second Year, two hours per week. A series of two-hour drawing-room exercises, intended to give the student facility in studying the actual appearance of objects represented in orthographic projection, and in translating into orthographic projection objects represented in perspective.

REQUIRED IN IV.

414. Applied Perspective. — Professor GARDNER.

PREPARATION: 413; 471 or 472, which must be taken simultaneously.

A course in which perspective studies of some of the problems in Design will be made.

REQUIRED IN IV.

415. Applied Perspective. — Mr. LORD.

PREPARATION: 414; 472 or 473 which must be taken simultaneously.

First and Second Terms, Third Year, two hours per week. A course similar in nature to course 414, given in connection with the problems in design.

REQUIRED IN IV.

421. Office Practice. — Mr. JENNEY.

PREPARATION: D11, D15, D18.

Second Term, Third Year (Second Year for IV$_2$), four hours per week. A course divided between conferences in the class-room, visits to shops and to buildings in the course of erection, and drawing-room exercises. The principles governing the making of architectural working-drawings and details will be discussed in the class-room, plans of the work of some eminent architects will be examined and discussed. Wherever possible visits will be made to the buildings erected from these plans. The study of building materials and their influence upon architectural designing will be an important part of this course.

REQUIRED IN IV.

422. Professional Relations, Contracts, etc. — Mr. JENNEY.

PREPARATION: 421.

First and Second Terms, Fourth Year, one hour per week. A course dealing with the relations between the architect and his client, the practitioners of the allied arts and crafts, the contractors, the American Institute of Architects and other professional organizations, and with the general public. This series of conferences will be conducted by Mr. Jenney in the class room, but from time to time men who are eminent in their respective callings will be asked to speak upon the topics under discussion.

REQUIRED IN IV.

431. History of Ornament. — Mr. WALKER; Professor GARDNER.

PREPARATION: D42 simultaneously.

Second Term, Second Year, one hour per week. The course explains the historical development of ornament, and teaches facility in the general treatment of color in decoration. Acquaintance is also made with the characteristics of different styles. Instruction is given by lectures, and to the students of Option 1 by problems in design which are criticised before the class.

REQUIRED IN IV.

441. Architectural History. — Professor WARREN.

First and Second Terms, Second Year, one hour per week. The course is given with the aid of the stereopticon and is devoted to Assyrian, Persian, Greek, Roman and Byzantine architecture.

REQUIRED IN IV.

442. Architectural History. — Professor WARREN.

PREPARATION: 441.

First Term, Third Year, one hour per week; Second Term, Third Year, one hour per week for ten weeks, lectures. A course given with the aid of the stereopticon which deals mainly with Romanesque and Gothic architecture. Five additional hours in each term are devoted to written exercises.

REQUIRED IN IV.

443. Architectural History. — Professor WARREN.

PREPARATION: 442.

First Term, Fourth Year, two hours per week for ten weeks. A course devoted mainly to the Renaissance in Italy, with a brief consideration of the Renaissance in France and England. Five additional hours are devoted to written exercises.

REQUIRED IN IV.

444. History and Archæology; Special Research. — Professor CRAM.

PREPARATION: 443, H35.

Graduate Year. Opportunities are given in the Graduate Course for the study of chosen periods in architectural history, for which the large collections of the Department, as well as those freely opened to students by the Museum of Fine Arts and the Public Library, offer complete facilities. Owing to the large amount of study required in this course, it will be given only through special arrangement of individual students with Professor Cram.

ELECTIVE IN IV, GRADUATE YEAR.

451. Philosophy of Architecture. — Professor CRAM.

PREPARATION: 442, 472.

First and Second Terms, Fourth Year, one hour per week. A series of conferences in which architecture is considered from a theoretical rather than a historical point of view. The course serves to supplement the drawing-room instruction in design in furnishing a résumé of the fundamental principles of architecture and its relationship to civilization and the other arts allied with architecture.

REQUIRED IN IV.

452. Architectural Problems, Advanced. — Professor CRAM.

PREPARATION: 474, FIRST TERM.

Second Term, Graduate Year. A course consisting of a design problem chosen by each student in consultation with a member of the Department Faculty, together with historical research, collateral reading, and a written dissertation covering the historical, theoretical, and practical aspects of the problem. It is intended that the student should, as far as practicable, choose the subject and stylistic treatment in which he is most interested. The instruction will be individual.

ELECTIVE IN IV, GRADUATE YEAR.

453. Water Color. — Professor BROWN.

PREPARATION: D42 simultaneously.

First Term, Third Year, one two-hour exercise per week. The purpose of this course is to impress the student with the importance of combining good drawing, values, and color as applied to architectural subjects. Color-principles and color-harmony will be studied so as to give the student a practical and artistic base upon which to build. Sketching out-of-doors will be undertaken in three simple values from the point of view that landscape is the proper background for architecture. With this end in view twelve sketches from nature will be required from each Option I student as vacation work, to be submitted in the fall for criticism.

REQUIRED IN IV.

454. Architecture, Theory and Practice. — Professor CRAM.

PREPARATION: 473.

First and Second Terms, Graduate Year, one hour per week. A series of conferences, demonstrating the adaptation of theory to practical problems through consideration of sketches, working drawings, and photographs of buildings actually constructed.

ELECTIVE IN GRADUATE YEAR.

471. Design I. — Professor GARDNER.

PREPARATION: D41; D18, 411 simultaneously.

First and Second Terms, Second Year, ten hours per week. This course lays the foundation for the æsthetic training of the student. He is made to study and analyze the elements of the best examples of classical architecture, in order to cultivate his taste and sense of proportion. The fundamental principles of architecture are inculcated, and the influences governing design are explained and discussed. By means of problems in design the student is taught the methods of study, the principles of academic rendering, and obtains the necessary training of the hand and the eye. The course is given by means of individual instruction in the class-room, and by criticism of the students' work before the class.

REQUIRED IN IV.

472. Design II. — Mr. LORD.

PREPARATION: 412, 471, D42.

First Term, Third Year, ten hours per week for Option 1, nine hours per week for Option 2; Second Term, Third Year, fourteen hours per week for Option 1. A continuation of course 471.

REQUIRED IN IV.

473. Design III. — Professor EVERETT.

PREPARATION: 413, 472, D43.

First Term, Fourth Year, twenty-seven hours per week; Second Term, thirty hours per week. A course forming a continuation of the preceding course, 472. The second term is devoted largely to the preparation of the graduating theses.

REQUIRED IN IV_1.

474. Advanced Architectural Design. — Professors CODMAN, EVERETT.

PREPARATION: 473.

First and Second Terms, Graduate Year. This course is a continuation of course 473. It aims to give the student training in design through the study of buildings of monumental character, special attention being given to the analysis of the conditions of the problem. Sketch-problems of a day's duration are given at intervals throughout the year.

ELECTIVE IN IV, GRADUATE YEAR.

481. Constructive Design I. — Professor LAWRENCE; Messrs. MORROW, HOLBROOK.

PREPARATION: 227.

First Term, Fourth Year, eight hours per week. A course in elementary architectural construction. The subjects treated are: the theory of construction, loads, reactions, the design of beams, wooden and cast-iron columns, slow burning construction, and a simple wooden roof truss. Instruction is given by lectures and problems in design and one exercise in the testing laboratory.

REQUIRED IN IV.

482. Constructive Design II. — Professor LAWRENCE; Mr. MORROW.

PREPARATION: 227.

Second Term, Fourth Year, three hours per week. A short course given as a continuation of course 481.

REQUIRED IN IV.

483. Constructive Design III. — Professor LAWRENCE.

PREPARATION: 481.

First Term, Graduate Year, eight hours per week. This course is a continuation of the course in Constructive Design, 481. It consists of a series of lectures and problems in practical design. The subjects studied are the theory and design of the plate and box girder, steel columns, simple steel roof trusses, and general framing.

ELECTIVE IN IV, GRADUATE YEAR.

490. Structural Drawing. — Messrs. MORROW, HOLBROOK.

PREPARATION: D14; D18.

First Term, Third Year, two hours per week. A course intended to supply information required by the structural designer and a certain amount of practice in drawing. The student will be made familiar with methods of the template and fabrication shops by lectures and by visits to structural works and buildings in process of erection. Measured drawings will be made of structural details including a full set of drawings for a plate girder. This course will not touch upon the manufacture of material or the computation of stresses.

REQUIRED IN IV_2.

491. Structural Design. — Professor LAWRENCE; Messrs. MORROW, HOLBROOK.

PREPARATION: 490; 239; 228 simultaneously.

Second Term, Third Year, ten hours per week. A course in which are considered fundamental principles underlying structural design. Its main object is to give the student power to analyze such problems as are

found in practice, and to adapt and apply to the solution of these problems principles already acquired in the study of Mathematics and Applied Mechanics. Elementary forms in wood, cast iron, and steel are studied.

REQUIRED IN IV_2.

492. Structural Design. — Professor LAWRENCE; Mr. ROCKWOOD.

PREPARATION: 491; 151 simultaneously.

First Term, Fourth Year, fourteen hours per week; Second Term, twenty-nine hours per week. This course is a continuation of course 491. Practical problems in architectural construction are given, including general framing in steel, plate and box girders, and riveted and pin trusses, and structures in reinforced concrete. Great importance is placed upon the study of the details of design, and in each problem carefully worked out and dimensioned drawings are made. A part of the time during the second term is devoted to thesis work.

REQUIRED IN IV_2.

DEPARTMENT OF CHEMISTRY AND CHEMICAL ENGINEERING

HENRY P. TALBOT, PH.D.
Professor of Inorganic Chemistry.

ARTHUR A. NOYES, PH.D., LL.D., SC.D.
Professor of Theoretical Chemistry.

WILLIAM H. WALKER, PH.D., ENG.D.
Professor of Chemical Engineering.

HENRY FAY, PH.D., SC.D.
Professor of Analytical Chemistry.

AUGUSTUS H. GILL, PH.D.
Professor of Technical Chemical Analysis.

F. JEWETT MOORE, PH.D.
Professor of Organic Chemistry.

WARREN K. LEWIS, PH.D.
Professor of Chemical Engineering.

JAMES F. NORRIS, PH.D.
Professor of General Chemistry.

WILLIS R. WHITNEY, PH.D.
Non-resident Professor of Chemical Research.

SAMUEL P. MULLIKEN, PH.D.
Associate Professor of Organic Chemical Research.

MILES S. SHERRILL, PH.D.
Associate Professor of Theoretical Chemistry.

ALPHEUS G. WOODMAN, S.B.
Associate Professor of Chemistry of Foods.

ARTHUR A. BLANCHARD, PH.D.
Associate Professor of Inorganic Chemistry.

ELLWOOD B. SPEAR, PH.D.
Associate Professor of Inorganic Chemistry.

WILLIAM T. HALL, S.B.
Assistant Professor of Analytical Chemistry.

ROBERT S. WILLIAMS, PH.D.
Assistant Professor of Analytical Chemistry.

EDWARD MUELLER, PH.D.
Assistant Professor of Inorganic Chemistry.

JOSEPH W. PHELAN, S.B.
Assistant Professor of Inorganic Chemistry.

JOHN F. NORTON, PH.D.
Assistant Professor of Chemistry of Sanitation.

EARL B. MILLARD, PH.D.
Assistant Professor of Theoretical Chemistry.

Instructors

FREDERICK R. KNEELAND, S.B. — CLARK S. ROBINSON, S.M.
LEICESTER F. HAMILTON, S.B. — CLARENCE K. REIMAN, Sc.D.
FREDERIC H. SMYTH, A.M., PH.D.

Research Associate

RUTH THOMAS, S.B.

Research Assistant

HELEN VINCENT, A.B.

Assistants

DONALD BELCHER, S.B.
CLIFTON N. JACOBS, S.B.
WILLARD R. CRANDALL, S.B.
RALPH V. DAVIES, S.B.
PERCIVAL P. GOODING, S.B.
GEORGE M. MAVERICK, S.B.
MARSHALL S. WELLINGTON, S.B.
JOHN M. HOOD, S.B.
JOSEPH V. MEIGS, S.B.
STEPHEN G. SIMPSON, S.B.
EARL P. STEVENSON, S.B.
HSIEN WU, S.B.

Purchasing Agent

ARTHUR C. MELCHER, S.B.

INSTRUCTION in general Inorganic Chemistry is given to all students in regular courses during the first term of their first year, and to all except students of the Course in Architecture in the second term of that year. The course is designed not only to impart a knowledge of the principles of the science and of the descriptive chemistry of the metallic and non-metallic elements, but to constitute an introduction to scientific methods of experimentation, observation, and reasoning. Special effort is, therefore, made to impress upon the student the importance of neatness, accuracy, and thoughtfulness in connection with his laboratory practice, and to point out the value in later professional work in all courses of intelligent observation and ability to interpret the meaning of observed phenomena.

The instruction in chemical subjects is continued in the courses in Chemistry, Physics, Biology and Public Health and Geology, and in those of Mining, Sanitary, and Chemical Engineering, and includes Analytical, Theoretical, Organic, and Industrial Chemistry, as well as opportunity for elective courses in such specialized lines as Gas, Oil, Air, Water, Food, Sugar, and Proximate Technical Analysis. In all of these subjects class-room instruction is combined with laboratory work. Students in the Courses in Chemistry and Chemical Engineering devote, as a rule, more time

to these subjects than students in other courses, and their work is, accordingly, somewhat more advanced.

The opportunities for research work under the direction of the instructors in the various branches enumerated above are unusually extensive, and the general and special laboratories are well equipped for advanced work of this character. A description of these laboratories will be found on pages 363 to 367 and in the circular describing the Research Laboratory of Physical Chemistry.

The aim throughout all the courses of chemical instruction is to teach the student self-reliance, to inculcate habits of accurate thought and work, and to afford such a training as will fit him to cope successfully with scientific and technical problems.

501. Inorganic Chemistry I. — Professors TALBOT, BLANCHARD, SPEAR, MUELLER, PHELAN; Messrs. ROBINSON, SMYTH, REIMAN, and assistants.

PREPARATION: 1; 3; 8.

First Term, First Year, two lectures, two recitations, four laboratory exercises per week. In this course the fundamental principles of the science are taught in connection with the descriptive chemistry of the non-metallic elements. The lectures are designed to precede the work of the laboratory, in which the student is expected to verify and illustrate the principles and facts which have been discussed in the lecture room. Careful manipulation, thoroughness in observation, accuracy in arriving at conclusions, and neatness in note-taking are required of each student, and the training afforded by this course is considered of value to all students of the Institute, whatever Course they may later select; for students of the Courses in Chemistry and Chemical Engineering it lays the necessary foundation for subsequent chemical study.

No previous study of Chemistry is required for admission to this course, but the instruction is so arranged that students who have already spent considerable time upon chemical work in secondary schools are admitted to lectures and laboratory work of a somewhat advanced character, in which the knowledge which they have already acquired is utilized. *Textbooks, Smith, General Chemistry for Colleges; Talbot and Blanchard, Electrolytic Dissociation Theory.*

REQUIRED IN ALL COURSES.

502. Inorganic Chemistry I. — Professors TALBOT, BLANCHARD, SPEAR, MUELLER, PHELAN; Messrs. ROBINSON, SMYTH, REIMAN, and assistants.

PREPARATION: 501.

Second Term, First Year, two lectures, two recitations, four laboratory exercises per week. This course is a continuation of the preceding and deals with the chemistry of the metallic elements. The laboratory in-

struction includes practice in the methods of synthetic inorganic chemistry in the case of those students who continue chemical subjects in the later years, while the students in the other Engineering Courses devote the time to the study of certain applications of Chemistry to engineering practice. *Text-books, Blanchard's Synthetic Inorganic Chemistry; Spear, Laboratory Notes.*

REQUIRED IN ALL COURSES EXCEPT IV.

503. Inorganic Chemistry II. — Professor TALBOT.

PREPARATION: 801, 513.

Second Term, Fourth Year, two hours per week. This course is designed to strengthen and broaden the student's knowledge of inorganic chemistry. The outside preparation consists in the reading of assigned portions of a standard text-book and the class-room exercises are intended to assist the student in correlating his knowledge in such a way as to increase its utility, and to assist him in logical deduction and reasoning.

REQUIRED IN V, X.

504. Inorganic Chemistry III. — Professor TALBOT.

PREPARATION: 513; 575, 802.

First and Second Terms, Graduate Year, one hour per week. This course includes the preparation and discussion of memoirs on selected topics in inorganic chemistry, in connection with which the student is expected to make extensive use of the library facilities, and to present the results of his reading in concise, orderly form, with due attention to proper sequence and to a discrimination between the important and the unimportant material collected.

ELECTIVE IN V, X, GRADUATE YEAR.

507. Metallography. — Professors FAY, WILLIAMS.

PREPARATION: 565.

First Term, Fourth Year, fifteen exercises (Second Term, thirty exercises for VIII$_3$). In this course the general methods used in the study of alloys, the construction and interpretation of equilibrium diagrams and the relations between the constitution of alloys and their physical properties will be considered. The iron-carbon diagram will be studied in detail with its application to the heat treatment and the use of steel.

REQUIRED IN V$_2$, VIII$_3$.

508. Physical Metallurgy. — Professor FAY.

PREPARATION: 502, 801.

Second Term, Third Year, two hours per week, last eight weeks of term, lectures. The object of the course is to present to the student the relationships which exist between the constitution of alloys and their physical

properties. Equilibrium diagrams of binary alloys will be discussed briefly and the iron-carbon diagram will be discussed in detail, with special reference to the microstructure, and the relationship between structure, heat treatment and mechanical properties.

REQUIRED IN II, XIII, XIV.

511. Qualitative Analysis. — Professors FAY, HALL, WILLIAMS; Mr. HAMILTON and assistants.

PREPARATION: 502.

First Term, Second Year, or Summer School, recitations, laboratory practice and individual conferences. Time varies in the different Courses. This course is intended to emphasize the principles involved in chemical analysis, to broaden the student's knowledge of inorganic chemistry, to develop deductive reasoning power and to give practice in manipulation. After a series of preliminary experiments illustrating principles and giving practice in writing equations, the student is required to analyze unknown industrial products such as minerals, pigments, slags, and alloys. The student reports not only upon his qualitative results but also upon the proximate amounts of each element present. Not only is the educational value of the course broad, but it serves as a necessary introduction to the study of quantitative analysis. It is given in the Summer following the first year to Courses III, Option 2, V, X, XIV, and XV, Option 3, and in the first term of the second year to other Courses. *Text-books, Noyes, Qualitative Chemical Analysis; Treadwell-Hall, Analytical Chemistry, Vol. I.*

REQUIRED IN III, V, VII, VIII, X, XI, XII, XIV, XV_3.

512. Quantitative Analysis. — Professors FAY, WILLIAMS; Mr. HAMILTON and assistants.

PREPARATION: 511.

First or Second Terms, Second Year, recitations, laboratory practice and individual conferences. Time varies in different Courses. In this course one half of the term is devoted to volumetric analysis, the other to gravimetric analysis. This work is regarded as a preliminary training for the more advanced work of the third year, and the time is spent upon simple quantitative analyses which are typical of the sub-divisions of the subject; such, for example, as the gravimetric determinations of chlorine; of sulphuric, phosphoric, and carbonic acids, of iron, calcium, and magnesium, the volumetric determinations involving the use of acid and alkali, and such oxidizing agents as potassium bichromate and permanganate, and iodine, as well as the processes of chlorimetry. The calibration of flasks and burettes is included in this course. Great stress is here laid upon the accuracy, care and integrity necessary for successful quantitative work; and, as in the instruction in Qualitative Analysis, the chief endeavor is to promote thoughtful and intelligent workmanship. Special attention is given to Stoichiometry and the modern theories of solutions

as applied to Quantitative Analysis. *Text-books, Talbot, Quantitative Chemical Analysis; Treadwell-Hall, Analytical Chemistry, Vol. II.*

REQUIRED IN III, V, VII, VIII, X, XI, XII, XIV, XV_3.

513. Quantitative Analysis. —Professors FAY, HALL, WILLIAMS, and assistants.

PREPARATION: 512; L21.

Second Term, Second Year, or First Term, Third Year, one lecture and one recitation per week. Laboratory work varies in the different Courses. In this course the principles involved in the methods of analysis are discussed and the applications of these principles to problems other than those being carried out by the student in the laboratory are also considered.

The laboratory work of this course includes the analysis of silicates, minerals, ores, and industrial products. The instruction of this term is intended primarily to fit the student to judge intelligently of the adaptability and accuracy of the processes employed, rather than to furnish detailed directions for specific analyses, although the latter phase is not overlooked. The course is given in the second term of the second year to Courses III, option 2, V, X, XIV and XV, option 3 and in the first term of the third year to other courses. The assignment and arrangement of work are adapted to the special needs of the student. See pages 176 and 181 for the hours of laboratory work in the various courses.

REQUIRED IN III, V, $VIII_1$, X, XIV, XV_3.

514. Quantitative Analysis. — Professors FAY, HALL, and assistants.

PREPARATION: 513.

First or Second Term, Third Year, lectures, recitations and laboratory work. In the lectures are discussed not only the principles underlying the methods used in the analysis of the commercially important alloys, especially irons and steels, but the effect of various elements upon the chemical and physical properties, and the adaptability of various alloys for particular industrial purposes.

The laboratory work of this course is devoted largely to a study and comparison of rapid, typical methods of iron and steel analysis. It is not given with the idea of producing specialists along this line, but is used as an example of the development of rapid, accurate processes for the control of commercial products.

REQUIRED IN III_1, V.

515. Qualitative Analysis of Rare Metals. — Professor NOYES.

PREPARATION: 513.

First or Second Term, Graduate Year, one hundred and sixty-five hours, laboratory work. A course for advanced students, the work of which includes the testing of recently developed methods and the investigation of new procedures for the separation and detection of the rarer metals.

ELECTIVE IN V, GRADUATE YEAR.

516. Organic Qualitative Analysis. — Professor MULLIKEN.

PREPARATION: 551; 556.

First Term, Graduate Year, nine hours per week, laboratory exercises. A course for advanced students in systematic methods for the identification of organic compounds.

ELECTIVE IN V, GRADUATE YEAR.

520. Water Supplies and Air. — Professor NORTON, and assistant.

PREPARATION: 512.

First or Second Term, Third Year, forty-five hours lectures and laboratory practice. This course consists of thirty-eight hours of laboratory practice in the chemical examination of potable waters, of sewages and of air; and of seven lectures in which the methods of analysis and the sanitary significance of the results are discussed.

REQUIRED IN $V_{2, 3}$, VII.

521. Industrial Water Analysis. — Professor NORTON, and assistant.

PREPARATION: 512.

Second Term, Third Year, five lectures, twenty-five hours laboratory work. This course consists of a study of methods of selection and treatment of water for industrial purposes.

REQUIRED IN XI.

522. Water Supplies and Wastes Disposal. — Professor NORTON, and assistant.

PREPARATION: 521.

First Term, Fourth Year, fifteen lectures or conferences, thirty hours laboratory work. A course dealing with the chemical problems involved in modern methods of selection and treatment of potable waters and the disposal and purification of wastes. Several trips are taken to inspect examples of the various methods of treatment. *Text-book, Woodman and Norton, Air, Water and Food.*

REQUIRED IN XI.

523. Sanitation in Chemical Industries. — Professor NORTON.

PREPARATION: 512, 550 OR 551.

Second Term, Fourth Year, thirty class-room exercises. A course for the discussion of problems of sanitation important to the chemist. This includes water supply and purification for factory purposes, wastes disposal, disinfection, ventilation and occupational diseases. Reports will be required from the students on specially assigned topics.

REQUIRED IN COURSE V_3.

524. Biochemistry. — Professor NORTON.

PREPARATION: 730, 512, AND 550 OR 551.

First Term, Fourth or Graduate Years, two conferences per week. This course consists of conferences and assigned reading, on the more important phases of biological chemistry. The chemistry of the general classes of substances composing animal and plant life and the chemistry of metabolic processes are discussed. Respiration is given attention from a chemical standpoint. Physico-chemical topics important to the biologist, such as osmotic pressure, adsorption, diffusion and colloidal chemistry are treated. Recent work on bacterial metabolism is outlined. Finally, the chemistry of immunity is discussed. This would include such subjects as toxins, ptomains and chemotherapy. The conferences are, as far as possible, illustrated with experiments. When taken as a graduate course further assigned work will be required. *Text-book, Mathews, Physiological Chemistry.*

REQUIRED IN VII; ELECTIVE IN V, X, GRADUATE YEAR.

525. Food Analysis. — Professor WOODMAN and assistant.

PREPARATION: 512.

First Term, Third Year (for VII), Second Term (for $V_{2, 3}$), seven lectures, thirty-eight hours laboratory exercises. A course designed to introduce the student to the methods generally employed in determining the character, purity and nutritive value of common food materials. The extent, character and legal status of food adulteration is discussed, and analyses made of typical food products.

REQUIRED IN $V_{2, 3}$, VII.

526. Food Analysis, Advanced. — Professor WOODMAN and assistant.

PREPARATION: 525.

First Term, Fourth Year, seventy-five hours, laboratory work and classroom exercises. A course designed to illustrate the manner of attacking the chemical problems arising in connection with state and municipal food control. In addition to the laboratory practice, each student is expected to present in conference a detailed written report concerning some particular food material, its forms of adulteration and the most rapid as well as systematic method of detecting them, accompanied by actual figures obtained in the laboratory. Some attention is devoted also to the system of food inspection and to a critical study of methods of food analysis.

REQUIRED IN V_3.

527. Optical Methods in Chemical Analysis. — Professor WOODMAN and assistant.

PREPARATION: 512, 801.

First or Second Term, Third Year, two hours per week laboratory exercises. This course comprises standardization of saccharimeters by

quartz-plate readings; determinations of specific rotary powers, double polarization, the quotient of purity; and practice in the calculations of optical analysis, with special reference to the use of the polariscope, refractometer and microscope, as applied to sugars, starches, essential oils, and the like. About five hours of the time allotted to the course is devoted to class-room discussion of methods.

REQUIRED IN $V_{2, 3}$.

530. Proximate Technical Analysis. — Professor GILL and assistant.

PREPARATION: 121; 512; 550 OR 551, 575 simultaneously.

First Term, Fourth Year, fifteen six-hour exercises conference and laboratory work. A course upon the methods in common use for the analysis of alkaloids, asphalt, oils, paints, paper, rubber, soaps, and tanning materials. The student is required to consult current literature for methods of analysis, and to present the results of his reading before the entire class for criticism and suggestion before a method is finally adopted.

REQUIRED IN V_2.

531. Gas Analysis. — Professor GILL and assistant.

PREPARATION: 512.

First or Second Term, Third Year or Second Term, Fourth Year, eight lectures, fifteen hours laboratory work. A course embracing the qualitative and quantitative analysis of the various gases, the technical analysis of commonly occurring gaseous mixtures, such as illuminating and fuel gas, gases from acid chambers, and chimney gas, and the consideration of the losses due to waste gases. *Text-book, Gill, Gas and Fuel Analysis for Engineers.*

REQUIRED IN $III_{1, 2}$, V, XIV.

532. Gas and Fuel Analysis. — Professor GILL and assistant.

PREPARATION: 502; 802.

First Term, Fourth Year, lectures and laboratory work. A course discussing the origin, manufacture, properties, uses, and analysis of the various fuels; also smokeless combustion, and the considerations involved in the economical application of fuel. Given in connection with Engineering Laboratory 261.

REQUIRED IN II, VI, XIII, XIIIB.

534. Analytical and Technical Chemistry. — Mr. KNEELAND and assistants.

PREPARATION: 502.

First Term, Third Year, forty-five hours, lectures; Second Term, ninety hours, laboratory work. This course covers the principles of organic, analytical and technical chemistry, with particular reference to the needs of naval constructors.

REQUIRED IN XIIIA.

536. Testing of Oils. — Professor GILL and assistants.

PREPARATION: 512; 550.

First Term, Fourth Year, twenty exercises, lectures and laboratory work. A course covering the mechanical and chemical testing of the mineral, animal, and vegetable oils, with the purpose of detecting adulteration, and of determining their applicability, and their safety, from the point of view of the manufacturer and of the insurance underwriter. *Text-book, Gill, Handbook of Oil Analysis.*

ELECTIVE.

537. Chemistry of Road Materials (Brief Course). — Professor GILL.

PREPARATION: 502.

Second Term, Graduate Year, fifteen lectures, thirty hours, laboratory work. This course is intended for civil engineers and deals with the applications and tests of bitumens, tars, oils, paints and chemicals used in the preservation of roads and road structures.

ELECTIVE IN I, GRADUATE YEAR.

538. Chemistry of Road Materials. — Professor GILL and assistant.

PREPARATION: 502.

First Term, Third Year, thirty hours, lectures and conferences, ninety hours, laboratory work. In this course is considered the source, preparation, application and tests of cements, bitumens, tars, binders, oils and preservative agents used in connection with road making.

REQUIRED IN I_3.

550. Organic Chemistry (Brief Course). — Professor MOORE.

PREPARATION: 502.

First Term, Third Year, thirty exercises. This course is designed for students who will not pursue the study of organic chemistry further, and includes a general discussion of the most important facts in the chemistry of the compounds of carbon. The typical methods of preparation and the chemical and physical properties of the various classes of compounds are presented, and a brief account is given of the source and technical preparation of the simpler substances of commercial importance.

REQUIRED IN VII, VIII, XI, XIV, XV_3.

551. Organic Chemistry I. — Professor MOORE.

PREPARATION: 512, 801.

Second Term, Third Year, sixty hours; First Term, Fourth Year, forty-five hours, lectures and recitations. A course in which the general principles and theories of organic chemistry, the method of preparation, and the characteristic reactions of organic compounds are treated in great detail, including all specific compounds which are of technical or theoretical importance. The lectures are fully illustrated by experiments.

REQUIRED IN V, X, XA.

552. Organic Chemistry II. — Professor MULLIKEN.

PREPARATION: 551 and 556, or equivalents.

First and Second Terms, Graduate Year; two exercises per week. This subject is a continuation of Organic Chemistry I 551. Its object is to give the advanced student having this fundamental preparation that broader and more intimate acquaintance with the theories, principles, and practical applications of Organic Chemistry that should be possessed by the industrial organic chemist as well as by teachers and research workers in Organic Chemistry. In this course groups of important topics, varying from year to year, are thoroughly studied by assigned reading and discussion of monographs and current publications in a seminar accompanied by lectures.

ELECTIVE IN V, X, GRADUATE YEAR.

553. Recent Developments in Organic Chemistry. — Professor MOORE.

Second Term, Graduate Year, one hour per week, lectures. This course is designed for those graduate students and members of the instructing staff whose regular work is in other departments of the science, but who yet desire to keep in touch with what is being done in the organic field. The newer views of the valence of carbon and of oxygen, the relation of color and flourescence to chemical constitution, and other topics of general chemical interest will be discussed.

ELECTIVE IN GRADUATE YEAR.

556. Organic Chemical Laboratory. — Professor MOORE; Mr. KNEELAND and assistants.

PREPARATION: 513; 551 simultaneously.

Second Term, Third Year, ten hours per week; First Term, Fourth Year, seven hours per week (four and six hours for X). In this course the student becomes familiar with the operations and apparatus involved in organic work, such as fractional distillation, extraction, crystallization, steam distillation, determinations of melting and boiling points, and the like; and with various general methods of preparation, such as etherification, saponification, nitration, sulphonation, reduction, and oxidation, diazotization, etc. He prepares in all from twenty to thirty compounds, including nitro-benzene, aniline, ethers, phenol, dyestuffs, and other products of synthetic and commercial interest. The work is supplemented by regular conferences with individual students in which the application of the theories of the science to the work in hand is constantly emphasized.

In connection with the foregoing the student makes a systematic study of the characteristic reactions of organic compounds, with special reference to their analytical significance. An important part of the work consists in the identification of unknown compounds and the separation of mixtures through an application of the knowledge gained from experiments with known substances. The instruction in this course also includes qualita-

tive tests for all the important elements occurring in organic compounds, and quantitative determinations of carbon, hydrogen, nitrogen, and the halogens.

REQUIRED IN V, X, XA.

557. Organic Chemical Laboratory. — Professor MOORE; Mr. KNEELAND and assistants.

PREPARATION: 512; 550.

First or Second Term, Third Year, one hundred and five hours (seventy-five for XIV, ninety for XV$_3$). This course includes a portion of the instruction described under course 556, the time devoted to the work varying somewhat with the professional Course.

REQUIRED IN VII, XIV, XV$_3$.

558. Organic Chemical Laboratory. — Professor MOORE; Mr. KNEELAND and assistants.

PREPARATION: 512; 550.

First Term, Third Year, one three-hour exercise per week. In this course the student performs experiments designed to illustrate the principles discussed in course 550.

REQUIRED IN XI.

560. Organic Laboratory, Advanced. — Professors MOORE, MULLIKEN.

PREPARATION: 551 and 556 or equivalent.

The facilities of the well-equipped Organic Laboratory of the Institute are open to properly qualified students for either research, or work in the preparation and reactions of special classes of organic compounds. The kind and amount of work may be varied to meet individual requirements.

ELECTIVE.

565. Theoretical Chemistry I. — Professors SHERRILL, MILLARD, and assistants.

PREPARATION: M21; 801; 807; 512.

First and Second Terms, Third Year, three hours per week, recitations; one hour per week for ten weeks, lectures; eight two and a half-hour laboratory exercises (except in III$_2$, VIII, and XIV). In this subject only the more important general principles of chemistry are considered; but these are treated with great thoroughness, and are illustrated by applying them to a variety of problems, which the students are required to solve. These problems are discussed in detail, the aim being to develop power to use the principles, rather than merely to impart a knowledge of the phenomena. The topics considered in the course are the pressure-volume relations of gases, the properties of solutions related to molal composition, the conduction of electricity in solutions, the ionic theory, the mass-action law applied to the rate and equilibrium of chemical changes, heterogeneous

equilibrium from the phase-rule standpoint, and thermo-chemistry. The laboratory course serves to emphasize the principles of the subject, rather than to teach physico-chemical methods of measurement; and for this reason it is closely correlated with the class-room work. The principles are, however, illustrated by the determination of physico-chemical constants; for example, of vapor-density and molecular-weight of vapor-pressure, boiling-point, and freezing-point, of transference-numbers, conductivity, and ionization, of rates of reaction, of the equilibrium-constants of gaseous, dissolved, and solid substances, and of thermo-chemical constants. *Text-book, Noyes and Sherrill's General Principles of Chemistry.*

REQUIRED IN III_2, V, VIII, X, XIV, XV_3.

566. Theoretical Chemistry II. — Professors NOYES, SHERRILL.

PREPARATION: 565.

First and Second Terms, Fourth Year, two hours per week, lectures and recitations; six three-hour laboratory exercises per term (except in X). This subject is a continuation of subject 565, and is presented in the same way. In the first term are considered the principles of electrochemistry and thermodynamic chemistry — the latter consisting of a discussion of the effect of temperature and pressure on equilibrium from the free-energy-standpoint. The second term is devoted to a consideration of surface-effects in their chemical relations (especially in their bearing upon adsorption and catalysis) and to the chemistry of colloidal substances. *Text-book, Noyes and Sherrill's General Principles of Chemistry.*

REQUIRED IN V; X, FIRST TERM; Xa.

567. Theoretical Chemistry III. — Professor KEYES.

PREPARATION: 566, M22.

First and Second Terms, Graduate Year, one hour per week. In this course the theories will be developed which seek to account for the properties of substances from a kinetic viewpoint. The methods of mathematical analysis which apply to this particular field of inquiry will first be considered. Then the kinetic theory as applied to perfect gases will be taken up. Van der Waals' equation and later developments of it accounting for the properties of compressed gases and the continuity of the gaseous and liquid states will next receive detailed attention. An extension of the kinetic theory will be presented, whereby, by ascribing an electronic structure to the atom and molecule, it is possible to accurately account for the gas, liquid, and solid phases of substances; and the deductions from this theory will be compared with all the data available for a number of representative substances. In a later part of the course, the electrical properties of gases as accounted for by the recent development of the electron theory will be considered. This discussion will include the consideration of electrical conduction in metals, of the photo-electric effect, and of theories of magnetism and of radiation.

ELECTIVE IN V, GRADUATE YEAR.

568. Thermo-chemistry and Chemical Equilibrium. — Professor MUELLER.

PREPARATION: 502; 801.

Second Term, Third Year, two hours per week. This subject is devoted to the fundamental principles of thermochemistry and chemical equilibrium. These principles are illustrated and emphasized by numerous problems which are solved independently by the students and afterwards discussed in the class-room.

REQUIRED IN $III_{1,2}$.

575. Industrial Chemistry I. — Professor NORRIS; Mr. WILSON.

PREPARATION: 502; 550 OR 551, 565 simultaneously.

First and Second Terms, Fourth Year (Fifth Year for XA), forty-five hours per term, First Term, thirty hours for X and XA, lectures and recitations. In this course the more important industrial chemical processes, including metallurgy, are studied from the point of view of both the chemical reactions forming the basis of the process, and the plant necessary to carry on these reactions. In this way the interrelationship of the different industries as to raw material, sources of energy, and standard types of apparatus is developed and a general survey of the field obtained.

REQUIRED IN V, X, XA, XIV, XV_3.

576. Chemical Engineering I. — Professor LEWIS.

PREPARATION: 218, 565 simultaneously.

Second Term, Third Year, thirty hours, lectures and recitations. The intelligent, effective and economical control of a modern industrial process requires on the part of the operating engineer not only a clear, qualitative appreciation of the factors involved, but in addition the power quantitatively to analyze the exact influence of each of these factors upon the results attained. The attempt of this and the following course is to develop with reference to the field of chemical engineering this power in the student. In this course are considered the principles on which the more important mechanical operations involved in the chemical manufacturing industries depend, together with a study of the types of apparatus available for such operations, and the kind of work for which each is best adapted.

REQUIRED IN X.

577. Chemical Engineering II. — Professor LEWIS.

PREPARATION: 576; 575 simultaneously.

First and Second Terms, (First Term only in XA), Fourth Year, thirty hours per term. During the first term of this course the time is devoted to a systematic and comprehensive analysis of both the qualitative and quantitative applications under industrial conditions of the principles presented in the previous course. The attempt is made to develop familiarity and mastery of these principles both by detailed discussion in the class-room and by the solution of typical problems. It is, however, highly undesirable that the work should be limited to such instruction as it tends

to emphasize the method and point of view of the instructor, rather than to develop in the student that individuality necessary for the successful attack of his future problems. Therefore, during the second term the work is restricted to the quantitative solution of a relatively small number of problems so chosen as to require careful analysis. Furthermore, in order to develop in the student originality of method, these problems are so far as possible of such a nature that neither previous instruction nor study of the literature will directly reveal a simple method of attack. Moreover, to avoid stereotyping the instruction, the subject matter is widely varied from year to year. While problems are chosen from any suitable branch of chemical industry, especial attention is paid to the processes of sedimentation, lixiviation, crystallization, evaporation, air drying, and electrolysis.

REQUIRED IN X, XA.

579. Chemical Engineering of Special Industries. — Professor LEWIS.

PREPARATION: 565, 575.

First Term, Graduate Year, thirty hours, lectures and conferences. A course intended to familiarize the student with the principles of chemical engineering by developing the technique of their application in a single industry. No attempt is made to give factory details and routine except in those cases where general chemical and engineering methods are well illustrated. Each year one of the following topics is studied as typical of important subdivisions of engineering practice: —

a. *Manufacture of leather.* This industry offers exceptional opportunities for the quantitative study of the applications of lixiviation, osmosis, hydrolysis, electrolytic dissociation, diffusion, precipitation of colloids, washing of solids, and air drying, as well as the utility of the methods of proximate analysis in the control of commercial processes.

b. *Evaporation.* The applications of the principles of heat engineering and of the properties of solutions are illustrated in the problems of air and vacuum drying, open and closed pan evaporation, and the design and operation of multiple effect systems.

c. *Fractional Distillation.* The applications of the general principles of chemistry to the separation of mixtures of volatile substances are studied in commercially important cases, and the engineering methods involved are analyzed in the light of the best modern practice.

ELECTIVE IN XA.

580. Materials of Construction. — Professor LEWIS.

PREPARATION: 565, 575; 576; 587.

Second Term, Graduate Year, thirty hours, lectures and conferences. This course treats of the mechanical properties and chemical resistance of the commercial materials of construction. Especial attention is given to the study of plastics, from the point of view of the engineer in the light of colloidal chemistry.

ELECTIVE IN XA.

581. Applications of Chemical Thermodynamics. — Professor LEWIS.

PREPARATION: 565; 576.

First Term, Graduate Year, thirty hours, lectures and conferences. A course intended to present thermochemistry from a point of view most helpful to the chemical engineer. The previous training in the subject is used as a foundation upon which to build a familiarity and appreciation which shall render the subject matter more readily available in technical work.

ELECTIVE IN XA.

582. Plant Design. — Professor LEWIS.

PREPARATION: 581 simultaneously.

First and Second Terms, Graduate Year, sixty hours per term, conferences and drawing-room work. A course planned to familiarize the student with the more important methods of chemical engineering design, to develop original power in the solution of problems, to give experience in the selection, criticism, interpretation, and use of material available in the literature, and to emphasize the technique of the laboratory methods of obtaining needed data. Especial attention is paid to graphical methods. The subject matter of the course will vary from year to year, and will be selected from any suitable branch of applied chemistry.

ELECTIVE IN XA.

583. Chemical Engineering Laboratory. — Professors WALKER, LEWIS, and assistant.

PREPARATION: 582 simultaneously.

First or Second Terms, Graduate Year, fifteen two-hour exercises. This course is intended to familiarize the student with the principles underlying the operations of chemical industry by quantitative experimentation with typical forms of apparatus in the laboratory. This includes experimental work with the filter press, open and closed pan evaporators, rectifying column, ball mill, crushers and grinders, stirrers, sedimentation tanks, crystallization, gas and electric furnaces of the various types, as well as the possibility of utilizing such of the special equipment of the laboratory as may be of especial value to the individual student. In all cases emphasis is laid upon capacity and efficiency as the controlling factors in operation.

ELECTIVE IN X, GRADUATE YEAR.

584. Industrial Applications of Chemical Principles. — Professor BLANCHARD. PREPARATION: 565, 575.

First Term, Graduate Year, fifteen hours, seminar. A course in which a few of the important industrial processes will be studied from the standpoint of general chemistry. Particular attention will be directed to determine the theoretical maximum efficiency in each case and methods of attaining it. Not offered in 1916–1917.

ELECTIVE IN V, X, XIV, GRADUATE YEAR.

585. Applied Chemistry. — Professor GILL.

PREPARATION: 502.

First Term, Second Year, fifteen exercises. This course deals with the properties, testing, and applications of paints, oils, varnishes, lubricants and wood preservatives. Alloys, bearing metals, boiler scale and corrosion of metals are also discussed.

REQUIRED IN XIII, XIIIB.

586. Problems of the Chemical Engineer. — Professor LEWIS.

PREPARATION: 501, 502.

First Term, Second Year, ten lectures. A descriptive course in which is developed the field of activity of the chemical engineer and the preparation along both chemical and engineering lines which the practice of the profession requires.

REQUIRED IN X.

587. Industrial Chemistry II. — Professor LEWIS and assistants.

PREPARATION: 513; 565; 575 simultaneously.

First or Second Term, Fourth Year, laboratory practice. Hours vary in the different Courses. In this course no attempt is made to prepare a large number of chemical products, on the one hand, nor to ape factory methods or scale of operations on the other. The work consists rather in instruction in the evolution of a chemical process from the idea as formulated in the class-room through the successive stages of laboratory development to the design and equipment of the necessary plant.

The process is first examined in the light of available literature, and is analyzed as to the probable factors which enter into its successful operation. Commencing with the preparation of the raw material it is next carried out in a quantitative manner in the laboratory on as large a scale as is consistent with reasonable accuracy and despatch. In this way the knowledge necessary to an intelligent opinion as to the commercial practicability of the process is obtained, and the data required for the design and equipment of a plant for carrying on the process are accumulated. Each chemical operation is analytically controlled, rapid methods of the requisite accuracy being employed. The physical properties of the solutions, precipitates, and final products are critically observed and the choice of the apparatus to be recommended is based upon quantitative experimentation carried out in the Laboratory of Chemical Engineering. Finally, each student submits a technical report upon the process and plant, complete with blue prints of the layout and estimate of costs. In this report especial attention is devoted to the use of clear, concise English, and to the general appearance of the finished copy. Questions of labor, depreciation, interest and insurance are discussed in the class, and so far as is possible are involved in the students' reports.

REQUIRED IN $V_{2,3}$, X, XV_3; OPTIONAL IN XA, XIV.

588. Problems in Applied Chemistry. — Professor LEWIS; Mr. WILSON.

PREPARATION: 565; 575 simultaneously.

Second Term, Fourth Year, thirty hours, recitations and conferences. A course involving the discussion and solution of problems illustrating the quantitative application of chemical principles in various industries. The aim of the work is to train the student in the interpretation and use of data in such a way as to secure from them the most information concerning the operation and economy of the processes of applied chemistry. A careful analysis is made of a few specific industries, the outlines of which are already familiar from previous courses.

REQUIRED IN V_2.

590. Experimental Problems in Inorganic Chemistry. — Professors FAY, NORRIS.

591. Experimental Problems in Theoretical Chemistry. — Professors NOYES, NORRIS.

592. Experimental Problems in Organic Chemistry. — Professors MOORE, NORRIS, MULLIKEN.

PREPARATION: For 590: 514 simultaneously; For 591: 590, 565 simultaneously; For 592: 551, 556 simultaneously.

These courses include the solution of problems of the nature of minor researches, in the respective fields indicated above, which are intended to give the student an opportunity to test his ability to do work of an original character. In connection with this work carefully written reports are required upon the journal literature relating to the topics in hand, and a formal record of results obtained in the laboratory must be presented for acceptance. The problems in inorganic chemistry include also those of analytical chemistry.

REQUIRED IN V_1, XA; V_2 TAKES 590 only.

593. History of Chemistry. — Professor MOORE.

PREPARATION: 550 OR 551; 565.

Second Term, Fourth Year, fifteen exercises. In this course historical development of the important theories of Chemistry is considered. The treatment of the subject is essentially biographical, special attention being given to the life and work of the men who have materially advanced the science by their investigations or theories. In connection with the instruction in this subject each student is required to complete an extended course of reading, which includes a study of one or more of the classical memoirs in Chemistry, and to prepare an essay based on the study of some important period in the history of Chemistry.

REQUIRED IN V, XA.

594. Journal Reports. — Professor FAY.

PREPARATION: 551.

First Term, Fourth Year, fifteen exercises. A series of exercises in which topics are assigned to individual students for report and discussion before the class. The topics are chosen largely from the current journal literature in English, French and German, with the purpose, in part, of familiarizing the student with the use of such journals as a means of self-education.

REQUIRED IN V.

595. Thesis Reports. — Professor TALBOT and members of the Instructing Staff.

Second Term, Fourth Year, one hour per week. A series of class-room exercises at which the students are required to report upon the progress of the investigations upon which their theses are to be based. These reports are subject to criticism and suggestion from members of the class, and of the instructing staff.

REQUIRED IN V.

596. Thesis Reports and Memoirs. — Professor NORRIS and members of the Instructing Staff.

Second Term, Fourth Year, thirty exercises. A series of exercises, a part of which are of the same nature as course 595. In addition, each student is assigned several topics in applied chemistry upon which memoirs are prepared and presented for discussion before the class and members of the instructing staff. In these papers the student is required to present the subjects as completely and critically as is practicable, and to supplement them by experiments, drawings, or tabulated statistics.

REQUIRED IN X, XA.

597. Recent Developments in Chemistry. — Professor TALBOT and members of the Instructing Staff.

PREPARATION: 502, 550 OR 551.

Second Term, Fourth Year, ten hours. During the most of the second term, weekly meetings are held at which reports and reviews of topics of current interest are presented by members of the instructing staff or graduate students.

REQUIRED IN V, ELECTIVE IN X.

598. Research Conferences in Physical Chemistry. — Professors NOYES, KEYES.

PREPARATION: 565, 566 simultaneously.

First and Second Terms, Graduate Year, two hours per week, conferences. The researches in progress in the Research Laboratory of Physical Chemistry are discussed by those who are at work upon them.

ELECTIVE IN V.

599. General Chemistry. — Professor NORRIS.

This course will not be definitely arranged and given until 1917–1918.

REQUIRED IN XA.

SPECIAL LECTURES

During this year, in addition to the regular courses, it is planned to have special lectures given by the persons named below:

Mr. James W. Loveland, superintendent with B. T. Babbitt, upon the Manufacture of Soap and Glycerine; Mr. S. W. Wilder, Jr., General Manager of the Merrimac Chemical Company, upon Alumina and Alumina Compounds.

DEPARTMENT OF ELECTRICAL ENGINEERING

DUGALD C. JACKSON, C.E.
Professor of Electrical Engineering.

ARTHUR E. KENNELLY, A.M., S.D.
Professor of Electrical Engineering.

HARRY E. CLIFFORD, S.B.
Gordon McKay Professor of Electrical Engineering.

COMFORT A. ADAMS, S.B., E.E.
Abbott and James Lawrence Professor of Engineering.

FRANK A. LAWS, S.B.
Professor of Electrical Engineering.

RALPH R. LAWRENCE, S.B.
Associate Professor of Electrical Engineering.

WILLIAM E. WICKENDEN, B.S.
Associate Professor of Electrical Engineering.

CHARLES W. GREEN, B.S.
Assistant Professor of Electrical Engineering.

WALDO V. LYON, S.B.
Assistant Professor of Electrical Engineering.

RALPH G. HUDSON, S.B.
Assistant Professor of Electrical Engineering.

Instructors

F. GARDINER PERRY, S.B.
NATHANIEL S. MARSTON, S.B.
O. ROBERT SCHURIG, A.B., S.B.
CHESTER L. DAWES, S.B.
CLAIRE W. RICKER, S.B., S.M., M.E.E.
HAROLD B. RICHMOND, S.B.
RUDOLPH F. ZECHA, S.B.

Research Associates

HARRISON W. SMITH, A.B., S.B.
O. ROBERT SCHURIG, A.B., S.B.

Research Assistants

ERNEST W. CHAPIN, A.B.
ROBERT J. WISEMAN, S.B., ENG.D.
PHILIP L. ALGER, S.B.
GEORGE Y. ALLEN, S.B.
ROBERT S. BURNAP, S.B.
RUSSELL N. HUNTER, B.S.
JOHN B. PETERSON, S.B.
CHARLES W. WHITALL, S.B., S.M.
WALTER E. WYNNE, S.B.

Assistants

HILDING N. CARLSON, S.B.
HAROLD F. DODGE, S.B.
GEORGE W. WYMAN, S.B.
PAUL H. BURKHART, B.S.
WILLIAM T. HAINES, B.S.
WALTER B. LITTLEFIELD, A.B., S.B.

THE instruction in Electrical Engineering aims to give a foundation in those general principles of electricity and magnetism upon which the development and advancement of the electrical art, in all its various phases, have been shown to rest. Coördinated with this instruction in the theory of electricity and magnetism and enforcing it, are courses on the larger problems of engineering, together with the work in the laboratories, embracing a detailed study of the instruments, methods, and plant used in modern electrical engineering practice, special emphasis being laid throughout on a study of sources of error, economy of time, and precision of results.

The unusually extensive equipment of the Augustus Lowell Laboratory of Electrical Engineering makes it possible to familiarize the undergraduate student with the various types of apparatus and the engineering methods with which he will be brought into contact in his later professional work, and also affords opportunity for graduate students to carry out original investigations. The latter opportunities are enhanced by the great libraries of the Department.

Excursions to important industrial works with which the vicinity of Boston abounds keep the students in touch with present practice in electrical engineering.

Fourth Year Options. — Fourth year students are expected to select their optional studies from the following: Mathematics, Central Stations (637), Dynamo Design (645), Electrochemistry (881), Illumination (655), for the first term; and Central Stations (637), Industrial Applications of Electric Power (635), Telephone Engineering (658), Electric Railways (642), and Electric Transmission Equipment (632), for the second term. The optional professional studies illustrate the numerous ways in which theoretical considerations and judgment guide the methods of engineering practice. Each student's selection of the foregoing subjects to be included within his Course should be made with the counsel of the teaching staff and must be approved by the Head of the Department.

601. Principles of Electrical Engineering I (Electromagnetism). — Professor WICKENDEN.

PREPARATION: 801; 807 AND M22 simultaneously.

Second Term, Second Year, two hours per week. A course of lectures and recitations devoted to the fundamental concepts of electrical engineering and to the laws and properties of electric and magnetic circuits.

REQUIRED IN VI.

602. Principles of Electrical Engineering II (Direct Current Machinery). — Professors WICKENDEN; Messrs. MARSTON, RICHMOND.

PREPARATION: 801; 807; M22 AND 601.

First Term, Third Year, four hours per week. A course of lectures, recitations and supervised problem work devoted to the principles underlying the construction and performance of direct-current machinery.

REQUIRED IN VI, AFTER 1916–1917.

603. Principles of Electrical Engineering III (Variable and Alternating Currents). — Professors LAWRENCE, LYON; Mr. MARSTON.

PREPARATION: 602 OR 609.

Second Term, Third Year, four hours per week. A course of lectures, recitations and supervised problem work devoted to the phenomena and laws of electrostatics, variable currents and alternating currents in their relations to engineering applications.

REQUIRED IN VI, XIV.

604. Principles of Electrical Engineering IV (Alternating Current Machinery). — Professors LAWRENCE, ADAMS, LYON.

PREPARATION: 603.

First Term, Fourth Year, six hours per week. A course of lectures, recitations and problems devoted to discussion of the various types of alternating current machinery for the generation, transmission, and distribution of power.

REQUIRED IN VI.

605. Principles of Electrical Engineering V (Alternating Current Machinery, Power Transmission). — Professors JACKSON, LAWRENCE, LYON; Mr. MARSTON.

PREPARATION: 604, M35.

Second Term, Fourth Year, six hours per week. A course of lectures, recitations and supervised problem work continuing the instruction in alternating current machinery and taking up the problems of power transmission.

REQUIRED IN VI.

609. Principles of Electrical Engineering Ia. and IIa. — Professor WICKENDEN; Messrs. MARSTON, RICHMOND.

PREPARATION: 801, 807, M22.

First Term, Third Year, five hours per week. A course of lectures, recitations and supervised problem work covering subject matter similar to that in courses 601 and 602 with some condensation.

REQUIRED IN XIV and of men entering the third year of VI in advanced standing. REQUIRED IN VI in 1916–1917.

613, 614. Electrical Machinery. — Professor ADAMS.

PREPARATION: 801, 807, M22.

First and Second Terms, three hours per week. A course continuing throughout the year devoted to the principles and performance of electrical machinery with especial reference to naval and mechanical problems.

REQUIRED IN XIIIA. ELECTIVE IN II as a substitute for courses 616 AND 617.

615. Elements of Electrical Engineering. — Professor CLIFFORD.

PREPARATION: 801.

First Term, Third Year, three hours per week. A course of lectures and recitations in which are considered the fundamental principles of the generation, distribution and utilization of electrical power.

REQUIRED IN XV_2.

616, 617. Elements of Electrical Engineering. — Professor HUDSON.

PREPARATION: 801.

Second Term, Third Year (Fourth Year for XIIIB), two hours per week; First Term, Fourth Year (Fifth Year for XIIIB), two hours per week. A course of lectures and recitations in which are considered the fundamental principles of the generation, distribution and utilization of electric power.

REQUIRED IN II, III_2, XIIIB.

618, 619. Elements of Electrical Engineering. — Professor CLIFFORD.

PREPARATION: 801.

First Term, Third or Fourth Year (Second Term, Fourth Year for XV_3), two hours per week. A course of lectures and recitations designed as an introduction to the study of the utilization of electricity for power purposes. A brief discussion of the ordinary types of electrical measuring instruments is followed by a study of the action and application of direct and alternating current machinery.

REQUIRED IN I, III_3, VIII, X, XA, XIII, XV_1.

623. Alternating Current Machinery. — Professor LYON.

PREPARATION: 603.

First Term, Fourth Year, three hours per week. This course of recitations and problems is devoted to the discussion of various types of alternating current machinery. Its content is similar to that of course 604, although certain details of the analysis are omitted.

REQUIRED IN XIV.

625. Alternating Current Machinery. — Professor LYON.

PREPARATION: 604, 605.

First Term, Graduate Year, two hours per week. A course of conferences dealing with the advanced analysis of the theory and performance of alternating current machinery.

ELECTIVE IN VI, GRADUATE YEAR.

627. Alternating Currents. — Professor KENNELLY; Mr. SCHURIG.

First and Second Terms, Graduate Year, two hours per week. A graduate course, concerned chiefly with the transmission of power by alternating currents and its utilization. Solutions of special problems and the performance of laboratory experiments form an important part of the work. The transmission of telephone currents along conducting lines is also discussed in its relation to the general problem of long-distance alternating current transmission of power. In the whole course there are approximately fifteen laboratory exercises.

ELECTIVE IN VI, GRADUATE YEAR.

629. Electrical Engineering Seminar. — DEPARTMENT STAFF.

A series of conferences of the Instructing Staff and all men pursuing graduate work in the branches relating to electrical engineering, for the purpose of reviewing problems of timely interest in electrical engineering. Continued through the year.

REQUIRED IN VI, GRADUATE YEAR.

631. Electric Transmission Equipment. — Professor WICKENDEN.

PREPARATION: 604.

Second Term, Fourth Year, two hours per week. A course of lectures and recitations devoted to the construction and characteristics of the equipment employed in the electrical transmission of energy.

ELECTIVE IN VI.

633. Electric Transmission and Distribution of Power. — Professor JACKSON.

PREPARATION: 603 OR 615.

First Term, Fourth Year, two hours per week. A course of lectures and recitations on the problems of electric transmission and distribution of power.

REQUIRED IN XIV, XV_2.

634. Organization and Administration of Public Service Companies. — Professor JACKSON.

First and Second Terms, Graduate Year, three hours per week. A course of lectures and conferences accompanied by extensive assigned reading and examination of operating records.

ELECTIVE IN VI, GRADUATE YEAR. Open to Undergraduates only by Petition.

635. Industrial Applications of Electric Power.— Professor ADAMS.

PREPARATION: 604; 605 simultaneously, OR 613, 614, 616, 617, 623.

Second Term, Fourth Year, two hours per week. Lectures on electric motor drive, electric lighting and electric heating in industrial plants.

ELECTIVE IN II, VI, XIIIA, XIV.

637. Central Stations. — Professor HUDSON.

PREPARATION: 245; 604 OR 605 simultaneously.

First and Second Terms, Fourth Year, two hours per week. This course consists of lectures, recitations and problems dealing with the design, construction and operation of electric power generating stations, including problems of management and questions of cost.

ELECTIVE IN VI.

638. Central Stations. — Professor HUDSON.

PREPARATION: 247, 615, 633; 169 simultaneously.

Second Term, Fourth Year, two hours per week. Lectures on the design, construction and operation of electric power generating stations.

REQUIRED IN XV_2.

639. Power Stations and Distribution Systems. — Professors WICKENDEN, HUDSON.

First and Second Terms, Graduate Year. This course consists of the examination of a project relating to the generation and distribution of electric power and the preparation of a report dealing with the preliminary design and estimate of cost. Not given in 1916–1917.

ELECTIVE IN VI, GRADUATE YEAR.

642. Electric Railways. — Professor CLIFFORD.

PREPARATION: 604; 605 simultaneously.

Second Term, Fourth Year, two hours per week. A course of lectures and recitations relating to the construction, equipment and operation of different types of electric roads, together with related problems in power transmission and generation.

ELECTIVE IN VI.

643. Electric Railways. — Professor CLIFFORD.

First and Second Terms, Graduate Year, two hours per week. A course of lectures and problems on the application of electricity to the propulsion of railway trains. Special attention is paid to the pre-determination of size of equipment and energy requirements, the relative advantage of steam and electricity for propulsion, the various systems of electric traction, and to the making of estimates of the cost of construction and operation.

ELECTIVE IN VI, GRADUATE YEAR.

645. Principles of Dynamo Design. — Professor ADAMS.

PREPARATION: 602, 603.

First Term, Fourth Year, four hours per week. A course of exercises discussing direct current machines and alternating current transformers. Materials of construction, methods of construction, and the influence of the various factors in design on manufacture and operation are considered. The chief object of this course is to teach the student that there is a "reason why" in dynamo design, and to cultivate in him the desire to find it.

ELECTIVE IN VI.

646. Dynamo Design. — Professor ADAMS.

Second Term, Fourth Year, four hours per week. A course of exercises forming a continuation of course 645, treating of alternating current machines.

ELECTIVE IN VI.

651. Electric Wiring and Lighting of Buildings. — Professor HUDSON.

First Term, Fourth Year, one hour per week. A course of lectures on the design of electric wiring, lighting and power systems for buildings.

REQUIRED IN IV$_2$.

653. Storage Batteries and their Applications. — Professor LAWRENCE.

First Term, Fourth Year, fifteen lectures. A course dealing with the theory, care and application of storage batteries.

NOT GIVEN UNLESS APPLIED FOR BY SIX OR MORE STUDENTS.

655. Illumination. — Professor WICKENDEN.

First Term, Fourth Year. A course of lectures and laboratory exercises. The lectures are devoted to a discussion of the production, measurement and utilization of light. In the laboratory the student gains experience in the use of the ordinary apparatus designed for monochromatic and heterochromatic photometry.

ELECTIVE IN VI.

658. Telephone Engineering. — Professor KENNELLY; Mr. SCHURIG.

PREPARATION: 603, 604.

Second Term, Fourth Year, two hours per week. The course deals with the main systems of electrical telegraphy and telephony in practical use, with reference to their principles and modes of application. The laboratory work includes measurements of voltage and current upon several types of artificial lines, and the comparison of measured results with those deduced theoretically.

ELECTIVE IN VI.

668. Elementary Technical Electrical Measurements. — Professor LAWS; Mr. DAWES and assistants.

PREPARATION: 617 and 687 simultaneously.

First Term, Fourth Year, five laboratory exercises. A course devoted to the study and testing of commercial electrical measuring instruments.

REQUIRED IN III_2.

671, 672, 673, 674. Electrical Engineering Laboratory, I, II, III, IV. — Professors LAWS, GREEN; Instructors and assistants.

PREPARATION: 807, 601, 602, 603, 604, 605 simultaneously.

First and Second Terms, Third and Fourth Years. A course devoted to the study of technical electrical measurements and dynamo electric machinery. For purposes of administration, the work is divided into two parts.

Technical Electrical Measurements. — Professor LAWS.

The work in technical electrical measurements consists of six exercises in the first term of the third year, ten in the second term of the third year, and four in the first term of the fourth year. Particular attention is given to tests to determine the character and behavior of the materials of electrical engineering under various circumstances and the study of electrical measuring instruments. The laboratory exercises are supplemented by a series of conferences in which the general subject of technical electrical measurements is discussed.

Dynamo Electric Machinery. — Professor GREEN.

The work in dynamo electric machinery consists of six exercises in the first term of the third year, seven in the second term of the third year, seven in the first term of the fourth year, and eight in the second term of the fourth year. The tests in the third year include the determination of the characteristics, efficiency, regulation, and heating of direct current machinery. In the fourth year tests for efficiency, heating, regulation, and the like, are made on alternating current machines.

Throughout the course the laboratory work is supplemented by conferences. Preliminary reports prepared in the class room at specially assigned hours are submitted by students before performing each experiment in the laboratory.

REQUIRED IN VI; 671 REQUIRED IN XIV.

675. Electrical Engineering Laboratory, Advanced. — Professors LAWRENCE, GREEN.

First and Second Terms, Graduate Year, five hours per week. The work of this course is specially arranged for each student, and deals particularly with the more advanced problems of alternating currents.

ELECTIVE IN VI, GRADUATE YEAR.

676. Electrical Testing, Advanced. — Professor LAWS.

First Term, Graduate Year, five to ten hours per week. An advance laboratory course intended as an introduction to the more elaborate work of special investigation. Each student is assigned a particular problem and is expected to work out carefully the experimental processes involved so that a just estimate of the value may be reached. To facilitate this work, a very complete collection of instruments and standards has been provided.

ELECTIVE IN VI, GRADUATE YEAR.

678, 679, 680. Electrical Engineering Laboratory. — Professors LAWS, GREEN; Messrs. PERRY, DAWES, and assistants.

PREPARATION: 671.

Second Term, Third Year; First and Second Terms, Fourth Year. A course of laboratory exercises in continuation of course 671.

678, 679 REQUIRED IN XIV; 680 REQUIRED IN XIV_1.

681, 682. Electrical Engineering Laboratory. — Professors LAWS, GREEN; Messrs. PERRY, DAWES, and assistants.

PREPARATION: 618 OR 619.

First and Second Terms, Third Year, forty-five hours per term. A course of laboratory exercises designed to familiarize the student with the elements of technical electrical measurements and with the characteristics and operation of the ordinary types of electrical machinery. XV_1 takes only 681.

REQUIRED IN $I_{1,2}$, XV.

684, 685. Electrical Engineering Laboratory. — Professor GREEN; Messrs. PERRY, RICKER, and assistants.

First and Second Terms, Third Year. The work in this course occupies sixty hours and is arranged each year in accordance with the requirements of the individual students.

REQUIRED IN XIIIA.

687. Electrical Engineering Laboratory. — Professors LAWS, GREEN; Messrs. PERRY, DAWES, and assistants.

PREPARATION: 613 AND 614, 615, OR 616 AND 617; 618 OR 6.9 simultaneously

First or Second Term, Fourth Year, hours vary in different Courses. A course of laboratory exercises and reports thereon designed to familiarize the student with the elements of technical electrical measurements and with the characteristics and operation of the ordinary types of electrical machinery.

REQUIRED IN II, III, VIII, X, XA, XIII, XIIIB, XV_2.

691. Technical Electrical Measurements Laboratory. — Professor LAWS; Mr. DAWES and assistants.

PREPARATION: 824, 822 simultaneously.

Second Term, Third Year. Ten exercises devoted to the study of electrical measuring instruments and the materials of electrical engineering.

REQUIRED IN $VIII_3$.

SPECIAL LECTURES AND EXCURSIONS

In addition to the above regular courses of instruction, occasional lectures are given before the Electrical Engineering Society by prominent engineers not connected with the Institute upon subjects with which they are especially familiar.

Visits of inspection to the numerous activities of engineering interest about Boston, planned by the Electrical Engineering Society and carried out with the coöperation of the Instructing Staff, are made by third and fourth year students each year, and occasional tests are made of operating electrical plants in the vicinity. More extended trips of inspection under the guidance of members of the Instructing Staff are available for fourth year students to electrical enterprises at New York City, Pittsfield, Schenectady, Philadelphia, Pittsburgh and Niagara Falls.

Advantage is also taken of the courtesy of operating companies such as the Edison Electric Illuminating Co. of Boston, the New England Telephone & Telegraph Co., The Boston Elevated Railway Co., and Stone & Webster, to study the methods of organization and commercial operation of electrical enterprises.

DEPARTMENT OF BIOLOGY AND PUBLIC HEALTH

WILLIAM T. SEDGWICK, PH.D., SC.D.
Professor of Biology and Public Health.

SAMUEL C. PRESCOTT, S.B.
Professor of Industrial Microbiology.

SELSKAR M. GUNN, S.B.
Associate Professor of Sanitary Biology and Public Health.

ROBERT P. BIGELOW, PH.D.
Associate Professor of Zoölogy and Parasitology.

ROBERT S. WESTON, B.S., A.M.
Assistant Professor of Public Health Engineering.

Instructors

PERCY G. STILES, PH.D. EDWARD A. INGHAM, B.S., C.P.H.
EUGENE C. HOWE, PH.D. CLAIR E. TURNER, A.M.,
WILLIAM E. BROWN, B.S., C.P.H.

Assistant

MURRAY P. HOROWITZ, M.S.

IN the work of this Department some knowledge of chemistry and physics is indispensable by way of preparation, hence the only biological course open to first-year students is Microscopical Laboratory. In the second year, courses in General Biology and in Botany and Zoölogy are given, while in the third and fourth years instruction in professional biological and public health subjects is provided, chiefly for students of Biology, Chemistry, Sanitary Engineering, Geology, and General Science, — as is described in detail below.

The subjects fall somewhat naturally into three groups: first, the *general biological*, including the fundamental courses in Biology, Botany, Zoölogy, Anatomy and Physiology; second the *bacteriological* group, including General Bacteriology and all its professional and technical applications in the laboratory; third the *public health* group, in which broad applications to community life and public and social welfare are considered. The whole aim of the instruction in the lower years is to give a broad and solid foundation, in later years, to develop professional attainment.

A. GENERAL BIOLOGICAL GROUP

700. Microscopical Laboratory. — Mr. Ingham.

Preparation: 501.

Second Term, First Year, two hours per week, lectures, recitations and laboratory work. The aim of the course is to teach the practical use of the microscope, and to make the student familiar with its parts and their proper working. Incidentally, starches, textile fibers, and some other elementary substances are studied during practice with the micrometer, the camera lucida, etc.

Required in VII.

701. General Biology. — Mr. Ingham.

Preparation: 501, 700.

First Term, Second Year, four hours per week, recitations and laboratory work. An introduction to the study of living things. It consists essentially of a general discussion of the fundamental facts and principles common to all the biological sciences, illustrated and made real by careful laboratory examination of selected and typical plants and animals. The course is elementary and preparatory in character and aim, and is a necessary prerequisite for the more advanced subjects.

Required in VII.

702. Elements of Biology. — Mr. Ingham.

Preparation: 501.

First Term, Third Year, two hours per week, lectures, recitations and laboratory work. A briefer course of the same character as course 701, designed to furnish an introduction to the study of living things in so far as these are of especial interest to students in Chemistry, Sanitary Engineering and Geology. This course is a prerequisite for Elements of Bacteriology 731 and for Microscopy of Drinking Waters 706.

Required in V_3, XI.

703. Theoretical Biology. — Mr. Turner.

Preparation: 704, 710.

First and Second Terms, Fourth Year, two hours per week. An advanced course in General Biology of lectures and recitations designed to acquaint the student with the principal theories and hypotheses which have played an important part in the development of the subject, and particularly of those which underlie the more fruitful research work of the present day.

Required in VII.

704. Cryptogamic Botany. — Mr. Turner.

Preparation: 701.

Second Term, Second Year, four hours per week, lectures and laboratory work. A thorough treatment of the elements of the subject, with abun-

dant laboratory work, lectures, recitations, dissections, and drawings. Beginning with the lowest forms of vegetable life, the slime-moulds, bacteria, rusts, smuts, and various fungi and algæ are studied, and afterwards higher cryptogams. Some attention is also paid to the structure and development of flowering plants and to the microscopy of drinking waters.

REQUIRED IN VII.

705. Invertebrate Zoölogy. — Mr. TURNER.

PREPARATION: 701 OR 702.

Second Term, Second Year, three hours per week, lectures, recitations and laboratory work. The course covers the whole animal kingdom, and is adapted to the needs of beginners, of teachers, and of students preparing for more advanced or applied biology. Special stress is laid upon the economic aspects of the subject, and parasites, shell fish, and certain food animals, etc., receive particular attention.

REQUIRED IN VII, XII.

706. Microscopy of Drinking Waters. — Professor GUNN; Mr. TURNER.

PREPARATION: 701 OR 702.

Second Term, Fourth Year, one hour per week, lectures and laboratory work. The aim is to give first-hand knowledge of the organisms most important in the development of tastes and odors in water supplies. The treatment of water by copper sulphate, aëration, etc., is also discussed. Methods of microscopical examination are taught and practical laboratory work required.

REQUIRED IN V$_s$, XI.

707. Parasitology. — Professor BIGELOW.

Second Term, Third Year, two hours per week, lectures with demonstrations. A course on invertebrate zoölogy with special reference to the parasitic forms and their relation to disease in man and the domestic animals.

REQUIRED IN VII.

710. Vertebrate Anatomy. — Professor BIGELOW.

PREPARATION: 701.

First Term, Third Year, seven hours per week, lectures, recitations, and laboratory work. A course on the comparative anatomy of vertebrates, including man. Designed to give the student a grasp of the structure of the vertebrates, and a sufficient knowledge of mammalian (including human) anatomy to form a sound basis for subsequent study of physiology and personal hygiene. *Text-books, Wilder's History of the Human Body; Kingsley's Guides to Dissections; Bigelow's Directions for Dissection of the Cat.*

REQUIRED IN VII.

711. Embryology and Histology. — Professor BIGELOW.

PREPARATION: 710.

Second Term, Third Year, seven hours per week, lectures, recitations, and laboratory work. A continuation of the course in Vertebrate Anatomy of the first term treating of the development of the body and the microscopical anatomy of each of the principal organs. An important feature is practice in embryological and histological technique. Each student makes a series of preparations for his own use. This with the preceding course affords valuable preparation for the study of human anatomy, as well as of hygiene and public health. *Text-books, Lewis and Stöhr, Text-book of Histology; Harmon, Laboratory Outlines for Embryology.*

REQUIRED IN VII.

715. Anthropology. — Mr. INGHAM.

PREPARATION: 701 OR 702.

Second Term, Third Year, one hour per week, lectures and recitations. A general survey of the field of anthropology in which man is studied from various standpoints, such as zoölogy, evolution, archæology and ethnology.

REQUIRED IN VII.

720. General Physiology. — Dr. STILES.

PREPARATION: 710.

Second Term, Third Year, six hours per week, lectures and recitations. A course on the general principles of the physiology of protoplasms, with special emphasis upon cellular physiology. To be taken simultaneously with Physiological Laboratory 725.

REQUIRED IN VII.

721. Comparative Physiology. — Dr. STILES.

PREPARATION: 720.

First Term, Fourth Year, three hours per week, lectures, conferences and demonstrations. A continuation of course 720 covering more of the subject of physiology in great detail.

REQUIRED IN VII_1.

723. Personal Hygiene II. — Dr. STILES.

PREPARATION: 720.

Second Term, Fourth Year, two hours per week, lectures. A course designed to give an accurate idea of the operation and care of the human mechanism. The course includes an advanced discussion of such topics as the choice of foods, the effects of good and bad air upon the body, muscular activity, fatigue, sleep, rest, recreation, the care of the eyes and other sense organs, bathing and baths, the dangers of the sedentary life, and similar subjects.

REQUIRED IN VII.

725. Physiological Laboratory. (General.) — Dr. Howe.

Preparation: 710.

Second Term, Third Year, three hours per week. An introduction to the whole subject, accompanying course 720.

Required in VII.

726. Physiological Laboratory, Advanced. — Dr. Howe.

Preparation: 712, 722.

Second Term, Fourth Year, four hours per week, laboratory work. A course dealing with the more recent aspects of the subject as now treated in Europe and America.

Required in VII_1.

728. Plant Physiology. — Mr. Turner.

Preparation: 703.

First Term, Fourth Year, one hour per week, lectures and recitations. Deals with the fundamental physiological phenomena of vegetable cells, tissues, organs, and organisms. The instruction goes hand in hand with that in Comparative Physiology 721, and is designed to emphasize the principles underlying the behavior of plants under various conditions of food, light, temperature, and other elements of different environments.

Required in VII_1.

B. BACTERIOLOGICAL GROUP

730. General Bacteriology. — Professor Prescott; Mr. Ingham.

Preparation: 701, 550 simultaneously.

First Term, Third Year, five hours per week, lectures, recitations and laboratory work. A fundamental course in the biology of the bacteria consisting of a general survey of the bacteria, their distribution, activity, place in nature, and their relation to the environment. Selected types of bacteria are studied in detail both morphologically and physiologically.

Required in VII.

731. Elements of Bacteriology. — Professor Prescott; Mr. Ingham.

Preparation: 702, 512.

Second Term, Third Year, four hours per week, lectures, recitations and laboratory work. This course is designed for students in chemistry and sanitary engineering, and presents the general structure, behavior and distribution of bacteria and their relation to disease, as well as the essentials of bacteriological technique. The course is a prerequisite for Bacteriology of Water and Sewage.

Required in V_3, XI.

732. Bacteriology of Water and Sewage. — Professor PRESCOTT; Mr. INGHAM.

PREPARATION: 731.

First Term, Fourth Year, two hours per week. A course devoted largely to laboratory work on the examination of the various classes of waters, sewage and sewage effluents. Instruction is given in the most approved methods of water examination for pollution and special emphasis is placed on proper interpretation of results. *Text-book, Prescott and Winslow, Elements of Water Bacteriology.*

REQUIRED IN V_3, XI.

733. Bacteriology of Air, Water and Foods. — Professor PRESCOTT.

PREPARATION: 730, 550.

Second Term, Third Year, five hours per week, lectures and a large amount of laboratory practice. A course dealing with the bacteriological examination of air, waters, milks and dairy products, eggs, oysters, fruits and many other food preparations. Stress is laid on the development of methods for the detection, isolation and estimation of intestinal, fermentative, putrefactive and pathogenic types of bacteria and on care and accuracy in the interpretation of results.

REQUIRED IN VII.

734. Bacteriology, Advanced. — Mr. INGHAM.

PREPARATION: 730.

First Term, Fourth Year, three hours per week, lectures, recitations and laboratory work. This course is to some extent a continuation of course 730 but includes practice in the more difficult points of bacteriological technique; the application of previous knowlege to the detailed study of the physiology of bacteria; the study of representative forms of higher bacteria; and discussion of some of the more difficult phases of the subject from the theoretical and purely scientific standpoint.

REQUIRED IN VII.

735. Industrial Microbiology. — Professor PRESCOTT.

PREPARATION: 550 OR 551; 730, 733.

First Term, Fourth Year, four hours per week, lectures and laboratory work. The course deals with the application of microbiology to industrial affairs. The rôles played by micro-organisms in practical processes, such as brewing, vinegar making, tanning, sugar refining, cheese making and the preservation of foods, are considered in detail. The course includes a brief discussion of enzymes, their actions and applications; and the theory and practice of the general phenomena of fermentation are fully discussed.

REQUIRED IN V_3, VII.

736. Zymology. — Professor PRESCOTT.

PREPARATION: 733.

First Term, Fourth Year, three hours per week. A course of lectures, reviews of current literature and laboratory experimentation on enzymes. The distribution and special chemical behavior of these biochemical agents, and their relation to the theory and practice of different types of digestion and fermentation, is discussed in detail.

REQUIRED IN VII.

737. Problems in Chemical and Industrial Biology. — Professor PRESCOTT.

PREPARATION: 735, 736.

Second Term, Fourth Year, one hour per week, lectures, discussions and reports upon special problems. Questions of contemporary interest will be discussed, and problems assigned dealing with industrial or economic biological processes in the solution of which the student can bring to bear the data of chemistry, bacteriology or zymology. Special attention is given to the form and method of presentation of reports on the problem assigned.

REQUIRED IN VII.

738. Public Health Laboratory Methods. — Professor GUNN.

PREPARATION: 730; 734.

Second Term, Fourth Year, three hours per week. In this course the practical methods in use in state and municipal bacteriological laboratories are considered. Training is given in the cultural diagnosis of diphtheria, examination of specimens for tuberculosis, the Widal reaction in typhoid fever, the microscopical diagnosis of malaria, the complement fixation test, etc.

REQUIRED IN VII.

739. Biology of Water and Sewage Purification. — Mr. TURNER.

PREPARATION: 731; 753; 754.

First Term, Fourth Year, one hour per week. Conferences and studies upon the biological aspects of water purification and sewage disposal, the object being to bring the student, by immediate contact with actual problems, into vital relations with the most recent state of the art. The course is continued in the second term as a part of course 751.

REQUIRED IN VII.

740. Bacteriology of Fermentation Industries. — Professor PRESCOTT.

PREPARATION: 732; 733.

First Term, Graduate Year, two hours per week, lectures, laboratory work and conferences. In this course are undertaken investigations of selected problems in some branch of the fermentation industries, such for example as the development or improvement of methods employed in the manu

facture of alcohol, lactic acid or other products of bacterial activity. Actual personal studies in the field will be expected, and upon these reports must be submitted for criticism and advice.

ELECTIVE IN VII, GRADUATE YEAR.

741. Microbiology of Soils and Plant Diseases. — Professor PRESCOTT.

PREPARATION: 735, 736.

Second Term, Graduate Year, two hours per week, laboratory work and reports. The types of micro-organisms, both animal and vegetable, of soils and their relations to soil chemistry and to agriculture. Biological changes inducing fertility or depletion, nitrification, potash liberation, etc., are considered. Special attention will be given to the microbic enemies of economically important plants such as produce the rots, wilts, etc., and to the organisms involved in decay and dry rot of timber.

ELECTIVE IN VII, GRADUATE YEAR.

742. Bacteriology in Relation to Refrigeration, Canning and Food Preserving. — Professor PRESCOTT.

PREPARATION: 735, 737.

Second Term, Graduate Year, two hours per week. A course devoted to special studies on the microbiological phases of different methods of food conservation. The viability of bacteria and the changes produced in and by them at low temperatures; the proper working out of the factors of time, pressure and temperature in canning; and the study of the inhibitions produced in bacteria by boron compounds, essential oils, condiments, acids and other food preservatives. The student is required to investigate both the economic and the public health aspects of the subject.

ELECTIVE IN VII, GRADUATE YEAR.

743. Control of City Milk Supplies. — Professor PRESCOTT.

PREPARATION: 735.

First Term, Graduate Year, four hours per week, lectures, reports and field-work. Special problems in the milk supply of large cities are considered. The student will be expected to make personal investigations and critical studies of different systems of supply, such as those of small companies and large contractors; of bacteriological and sanitary control as practiced in different cities and different countries, of pasteurization; inspection; transportation and distribution as well as the methods of condensing, concentrating, refrigerating, etc.

ELECTIVE IN VII, GRADUATE YEAR.

C. PUBLIC HEALTH GROUP

750. Biology of Infectious Diseases I. — Professor GUNN.

PREPARATION: 701, 730.

Second Term, Third Year, one hour per week. This course deals with the fundamental biological facts of infection, resistance and immunity.

REQUIRED IN VII.

751. Biology of Infectious Diseases II. — Professor GUNN.

PREPARATION: 750.

First Term, Fourth Year, two hours per week. A continuation of Biology of Infectious Diseases I. The biological characteristics of infectious disease of special interest to the sanitarian, considered in detail.

REQUIRED IN VII.

753. Industrial Hygiene and Sanitation. — Professor GUNN.

PREPARATION: 755 simultaneously.

First Term, Fourth Year, two hours per week. The various prejudicial effects of factory life upon health, including occupational accident, industrial poisonings and the effects of defective ventilation and of dusty trades upon the prevalence of tuberculosis and other diseases. The principles are discussed along which these dangers can be minimized under existing conditions of American factory life.

REQUIRED IN VII_2.

755. Public Health Problems. — Professors SEDGWICK AND GUNN.

PREPARATION: 701; 730.

First and Second Terms, Fourth Year, two hours per week. Theory and practice of Hygiene and Sanitation, with discussions of the origin and trend of the underlying principles of sanitary science, public health science, social health and vital statistics, with constant application to current problems.

REQUIRED IN VII_2.

756. Principles of Sanitary Science and Public Health. — Professor SEDGWICK.

Second Term, Fourth Year, one hour per week, fifteen lectures richly illustrated by stereopticon, diagrams and charts. Health and disease; ancient and modern theories; parasitism; toxins and antitoxins; vital resistance, immunity, etc.; vaccination; epidemiology; preventive sanitation; and preventive hygiene.

REQUIRED IN I_1, III, IV, V_3, VII, XI, XIII, XV_1.

757. Public Health Practice. — Professor GUNN; Mr. INGHAM.

PREPARATION: 750, 751.

Second Term, Fourth Year, four hours per week. The work in detail of the modern health officer and his assistants. Instruction by means of lectures, informal discussions and recitations. A course designed to show how the health officer makes actual professional use of the scientific facts and theories taught in the preparatory courses.

REQUIRED IN VII_2.

760. Personal Hygiene, I. — Professor SEDGWICK.

Fourth Year, one hour a week. Considerations of personal health and disease, their conditions and causes, the regulation of the body temperature, the sources and remedies of discomfort in private rooms and public halls due to bad air, overheating, overcrowding, exercise, work, play, etc.

REQUIRED IN SCHOOL FOR HEALTH OFFICERS.

761. Sanitation of Ships. — Professor GUNN.

Second Term, Fourth Year, one hour per week, lectures. A course in the elements of sanitation designed for certain students of Naval Architecture. One half of the course comparable with that in Sanitary Science 756 consisting of instruction in the general principles of sanitation; disease and its causes; the germ theory; infection and contagion and the methods of their dissemination, etc. The other half dealing directly with sanitary aspects of heating and ventilation of ships, their sanitary requisites, as to lighting, water supply, drainage, sewage disposal, and the like.

NOT GIVEN IN 1916–1917.

762. Sanitation of Houses and Public Buildings. — Professor GUNN.

PREPARATION: 750; 756, 760.

First Term, Graduate Year, one hour per week. This course treats of the housing problem as it confronts American cities today. Problems such as congestion and overcrowding, building construction, requirements for air space, ventilation, illumination, plumbing, etc. The sociological aspect of the problem is considered in some detail and special emphasis laid upon administration, housing laws, inspection of buildings and methods to be employed in conducting housing investigations.

ELECTIVE IN VII, XI, GRADUATE YEAR.

765. Epidemiology. — Professor SEDGWICK.

PREPARATION: 720; 731; 750; 753; 754.

First Term, Graduate Year, one hour per week. Conferences devoted to a detailed consideration of the natural history of epidemics, especially typhoid fever, diphtheria and scarlet fever, in relation to public water

supplies, milk supplies, sewerage systems, and personal causative factors; to enable the student by critical examination of the more celebrated and instructive examples to prepare for the interpretation of corresponding phenomena arising in actual practice.

ELECTIVE IN VII, GRADUATE YEAR.

770. Public Health Field Work. Professors SEDGWICK, GUNN.

First Term, Graduate Year, six hours per week. Investigations and sanitary surveys under expert guidance, dealing with the sanitary history and actual conditions of selected communities or districts in respect to population, mortality, morbidity, infant death rates, occupational influences, food supply, and similar environmental conditions, with the preparation of reports, statistics, and diagrams for publication.

772. Sanitary Law. — Professors SEDGWICK and GUNN.

Second Term, Graduate Year, one hour per week, lectures. A course treating of sanitary procedures under the common and the statute law. Consideration of the police power as allotted under the Constitution; of federal, state and municipal powers; legal procedures in times of epidemic; the law of quarantine; of water supply; sewerage and drainage; nuisance; vaccination, and the like.

ELECTIVE IN VII, XI, GRADUATE YEAR.

773. Public Health Administration. — Professor GUNN.

Second Term, Graduate Year, one hour per week. Particular attention is paid to the organization of state and municipal health departments. The administrative duties of executive health officers and other health officials are taken up and considered at length. The course is supplemented by careful consideration of the existing organization of state and municipal departments of health.

ELECTIVE IN VII, XI, GRADUATE YEAR.

780. Journals. — THE DEPARTMENT STAFF.

PREPARATION: 710; 730.

A semi-weekly meeting of the officers and fourth-year and graduate students of the Department each member being expected to report from time to time upon his own investigations or those of others as found in current periodicals, and subjected to friendly criticism as to his conclusions or his methods of presentation, or both. The meetings extend throughout the year.

REQUIRED IN VII.

790. History of Science. — Professors SEDGWICK, TYLER.

First Term, Third Year, one hour per week; Second Term, two hours per week. The course consists of a survey of the beginnings of science, es-

pecially in Greece and the Greek colonies; its development at Alexandria, its decline and virtual eclipse in Europe in the dark ages; its rejuvenation in the Renaissance, and its growth and progress in modern times. The aim of the course is to acquaint those who follow it with the sources of the broad stream of scientific knowledge as it exists today. The instruction consists of lectures and assigned reading, and considerable illustrative material is used. Either term's work may be taken without the other.

ELECTIVE.

DEPARTMENT OF PHYSICS

CHARLES R. CROSS, S.B.
Thayer Professor of Physics and Director of the Rogers Laboratory.

HARRY M. GOODWIN, PH.D.
Professor of Physics and Electrochemistry.

LOUIS DERR, M.A., S.B.
Professor of Physics.

CHARLES L. NORTON, S.B.
Professor of Heat Measurements.

WILLIAM J. DRISKO, S.B.
Associate Professor of Physics.

MAURICE DEK. THOMPSON, PH.D.
Associate Professor of Electrochemistry.

DANIEL F. COMSTOCK, PH.D.
Associate Professor of Theoretical Physics.

NEWELL C. PAGE, S.B.
Assistant Professor of Physics.

Instructors

HERBERT P. HOLLNAGEL, PH.D.
GORDON B. WILKES, S.B.
WILLIAM R. BARSS, A.B., PH.D.
GEORGE E. WASHBURN, PH.D.
FRANKLIN L. HUNT, S.B., A.M.
ROYAL M. FRYE, A.M.

Assistants

JOSEPH C. MACKINNON, S.B.
WILLIAM G. BROWN, S.B.
LOUIS H. YOUNG, S.B.
EARL L. HAUMAN, S.B.
WALTER J. WOLFE, S.B.
BAILEY TOWNSHEND, S.B.
FREDERICK P. UPTON, S.B.
DONALD R. HUSTED, S.B.

THE instruction in general physics extends through the second year, and is common to all Courses. The fundamental principles of the subject are developed in an extended course of fully illustrated lectures, supplemented by recitations.

Parallel with the lecture course is the laboratory course in General Physical Measurements in which the work performed is, from the beginning, exclusively quantitative. It is laid out primarily to teach the student to make accurate measurements, to impart training in the manipulation of instruments employed in physical investigation, and to give practice in properly recording,

interpreting, and reducing experimental data. At the same time it leads to a better understanding of the principles of physics, with which the student has already become acquainted in the lecture-room. In a number of Courses, such as Physics, Chemistry, Electrochemistry, and Electrical, Mechanical, Chemical, and Mining Engineering, study of a more advanced scientific or technical nature is undertaken. In such work, laboratory and lecture instruction are usually combined.

Opportunity is offered for physical and electrochemical research in special laboratories, which are very extensively equipped. Original investigation is encouraged, and the result has been a considerable number of published memoirs.

For the special benefit of students who are candidates for a degree in Physics, further instruction in pure and applied physics beyond that given in the general course is provided. It is intended that students pursuing such work shall gain a familiarity with standard works on the various branches of physics in both their own and foreign languages. In connection with the advanced courses a colloquium is held, for which the students prepare and present before the class for discussion reviews of current articles appearing in the various physical journals. More advanced instruction in mathematical and experimental physics is offered to graduate students or others who are competent to pursue such courses.

801. Physics. — Professors Cross, Derr, Norton, Drisko, Page; Messrs. Hollnagel, Barss, Washburn, Hunt, Frye.

Preparation: M12.

First Term, Second Year, three lectures and three recitations per week; Second Term, three lectures and two recitations per week. The subjects considered are general mechanics, molecular mechanics, wave-motion, electricity, light and heat, which are discussed both mathematically and experimentally.

Required in all Courses.

803. Precision of Measurements. — Professors Goodwin, Drisko, Page; Messrs. Hollnagel, Barss, Washburn, Hunt, Frye.

Preparation: M21, 807 simultaneously.

Second Term, Second Year, one hour per week first ten weeks, lectures and recitations. This course forms a part of the instruction given in connection with the laboratory work of course 807. The work includes a discussion of the nature of errors and methods for their elimination and the applica-

tion of the calculus to the solution of precision problems in direct and indirect measurements. Graphical methods of treating observations are also discussed. *Text-book, Goodwin's Elements of the Precision of Measurements and Graphical Methods.*

REQUIRED IN ALL COURSES EXCEPT IV.

806. Physical Laboratory (Recitations). — Professor PAGE.

PREPARATION: 803, 807 simultaneously.

Second Term, Second Year, fifteen class-room exercises. This course in electricity is taken in connection with the laboratory course 807 in that subject.

REQUIRED IN VIII.

807. Physical Laboratory (General Physical Measurements, Mechanics, Electricity, Light, Heat). — Professors GOODWIN, DRISKO, PAGE; Messrs. HOLLNAGEL, BARSS, WASHBURN, HUNT, FRYE, and assistants.

PREPARATION: 801, 806, AND 803 simultaneously.

First and Second Terms, Second Year, two hours per week. The earlier experiments relate to general mechanics; these are followed by exercises in electricity, including the measurement of currents, resistances, potentials, capacities, and inductances. The experiments in light include the use of the compound microscope, focal length of lenses, gas photometry, indices of refraction, and a study of flame, spark and vacuum tube spectra. Those in heat include mercurial and air thermometry, calorimetry, the determination of the mechanical equivalent of heat by electrical methods, continuous calorimetry, coefficients of expansion, and vapor pressure. All work is strictly quantitative, and the attention of the student is especially directed to the precision discussion of his results. Courses I and XI omit exercises first seven weeks, first term, Course $XV_{2,3}$ omits exercises last five weeks, second term; Course XV_1 omits second term work except three exercises. *Text-books Goodwin's Physical Laboratory Experiments, Mechanics, Optics, Heat; Page's Notes on Electrical Measurements.*

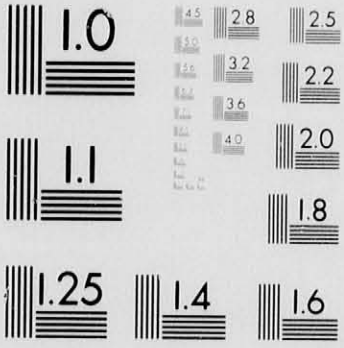
REQUIRED IN ALL COURSES EXCEPT IV.

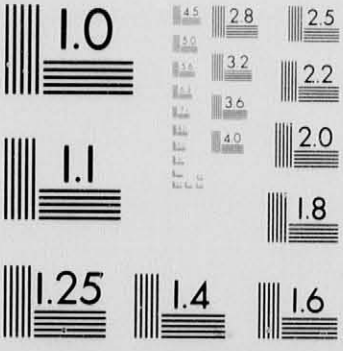
813. Heat Measurements. — Professor NORTON; Mr. WILKES and assistants.

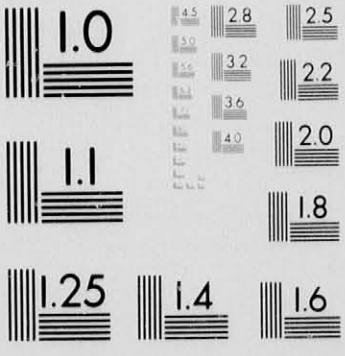
PREPARATION: 808.

First or Second Term, Third or Fourth Year, lectures and laboratory exercises. A course in the measurement of high temperature, precise thermometry, the efficiency of fuels, and determinations of thermal properties of engineering materials. Especial attention is given to the study of such temperature and heat measurements as are of technical importance, — for instance, the calorific efficiency of coal and the determination of the temperature of kilns and furnaces. The preparation and study of ther-


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mometers of the highest precision is required of students in Physics. The time devoted to the work varies in different Courses.

REQUIRED IN $III_{1,2}$, $V_{2,3}$, VIII, XII, XIV.

814. Heat Measurements. — Professor NORTON; Mr. WILKES and assistants.

PREPARATION: 808.

Second Term, Fourth Year, eight or more laboratory exercises. A course taken in connection with course 261, consisting of exercises of the same character as those of course 813, but more limited in scope.

REQUIRED IN II, VI, X, XIII, XIIIA, XIIIB.

815. Heat Measurements, Advanced. — Professor NORTON; Mr. WILKES and assistants.

PREPARATION: 813.

Second Term, Third Year, forty-five hours, lectures and laboratory exercises. A course devoted to the study of methods of measurement of the thermal properties of materials, with the greatest practicable precision, and with apparatus and methods as highly developed as possible. Because of the great lack of accurate data relating to the thermal properties of materials of engineering, this work will be in part of the nature of original research and the laboratory is equipped and will be operated with this point in view. The precise measurement of coefficients of expansion, and of the coefficients of thermal conductivity at high temperatures may be mentioned as examples.

REQUIRED IN $VIII_3$.

816. Heat Measurements. — Professor NORTON; Mr. WILKES and assistants.

PREPARATION: 813.

Second Term, Graduate Year, forty-five hours, lectures and laboratory exercises. This course is an extension of the undergraduate work in Heat Measurements, especially in the line of application to the study of furnaces and other metallurgical apparatus where the maintenance of fixed high temperatures, the supply of the necessary heat for reactions, and the minimizing of heat loss by radiation, etc., are of prime importance.

ELECTIVE IN III, GRADUATE YEAR.

821. Electricity. — Professor PAGE.

PREPARATION: M22, 801, 806, 807.

First Term, Third Year, thirty exercises. This course is intermediate in character between the second-year course Electricity 806 and the distinctly mathematical course the Theory of Electricity 842 given in the fourth year. It includes an extended discussion of Kirchhoff's Laws for both steady and transient states, the magnetic circuit, capacity and

inductance, the relations of the various systems of units, methods of determining the ohm, "v," and other fundamental electrical and magnetic constants.

REQUIRED IN VIII$_3$, ELECTIVE for other students with proper preparation.

822. Electrical Laboratory. — Professor PAGE and assistants.

PREPARATION: 801, 803, 806, 807, 821.

First and Second Terms, Third Year, fifteen and forty-five hours respectively in laboratory practice. This course is an extension of the second-year course Electricity 807. The construction and uses of the usual forms of electrical measuring instruments are carefully studied, and applications of the general methods considered in the earlier course are made to special problems assigned to each student individually.

REQUIRED IN VIII$_2$ first term, VIII second term.

825. Theoretical Electricity. — Professor COMSTOCK.

PREPARATION: 824.

Second Term, Third Year, three hours per week, lectures and recitations. The course is devoted to a consideration of the mathematical theory of electrical phenomena, less extended than course 842.

REQUIRED IN VIII$_3$.

828. Acoustics. — Professor CROSS.

PREPARATION: 801 simultaneously.

First Term, Second Year, one hour per week, lectures. An extended experimental course, giving particular attention to the phenomena of speech and hearing.

REQUIRED IN VIII.

829. Acoustics. — Professor CROSS.

PREPARATION: 801.

First Term, Third Year, five experimental lectures. This course is intended to impart to the student a knowledge of such acoustic principles as are of importance to the architect.

REQUIRED IN IV$_2$.

831. Color. — Professor CROSS.

PREPARATION: 801.

First Term, Third Year, five experimental lectures. In this course are discussed the principles of color sensation, color mixture, successive and simultaneous contrast, and their relations to phenomena in nature and art.

REQUIRED IN IV$_2$.

833. Descriptive Astronomy. — Professor DRISKO.

PREPARATION: M12; 801.

Second Term, Third Year, thirty lectures illustrated by lantern slides. The scope of the course is substantially that covered by *Young's General Astronomy.*

REQUIRED IN $VIII_{1,2}$.

841. Theoretical Physics I (Dynamics). — Dr. BARSS.

PREPARATION: M22, M36, M38 simultaneously.

First and Second Terms, Third Year, three exercises per week. This course is designed to furnish training in theoretical dynamics as a basis for subsequent work in Theoretical Physics. It considers the mathematical treatment of Newton's Laws, the dynamics of a particle and the dynamics of rigid and deformable bodies, including a consideration of some of the general dynamical methods and principles such as those of Lagrange and Hamilton.

REQUIRED IN VIII, FIRST TERM; $VIII_{1,2}$, SECOND TERM.

842. Theoretical Physics II (Electrostatics and Electrokinetics). — Professor COMSTOCK.

PREPARATION: 841.

First Term, Fourth Year, three lectures per week; Second Term, two lectures per week. The course is chiefly devoted to a mathematical treatment of the modern physical theory of electricity. The properties of the potential function are discussed, with its application to various problems in attraction, together with a discussion of the theorems of Poisson, Laplace, Gauss, and Green. The modern theory of electrodynamics is then considered and applied to such problems as the dynamics of moving charges, radiation, etc. In this connection a short introduction to the "Principle of Relativity" is given. The purpose of this course is to give the student a general insight into the fundamental principles and methods of attack underlying the most recent investigations in theoretical electricity.

REQUIRED IN $VIII_{1,2}$.

843. Theoretical Physics III (Optics). — Professor COMSTOCK.

PREPARATION: 841.

First Term, Fourth Year, three exercises per week, lectures and recitations. This course is general in character rather than distinctly analytic and devoted mainly to a consideration of the phenomena and theory of physical optics.

REQUIRED IN $VIII_{1,2}$.

844. Theoretical Physics IV (Energetics and Kinetic Theory). — Professor GOODWIN.

PREPARATION: 565, 841.

Second Term, Fourth Year, three hours per week, lectures and recitations. A course on the mathematical theory of heat exclusive of radiation and

conduction. About thirty exercises are devoted to a general treatment of thermodynamics with applications to gases, vapors, dilute solutions and chemical equilibrium, the treatment being based on the properties of entropy and thermodynamic potential functions. This is followed by a consideration of the kinetic theory of gases, including a discussion of Van der Waal's equation, and the theory of corresponding states.

REQUIRED IN $VIII_{1,2}$.

848. Theoretical and Applied Optics. — Professor DERR.

PREPARATION: 801, 807.

First Term, Fourth Year, three hours per week, lectures and laboratory work. A course chiefly devoted to the study of lenses and lens combinations and their applications in photography and microscopy.

REQUIRED IN $VIII_3$.

849. Optical Laboratory. — Professor GOODWIN.

PREPARATION: 807, 843, OR 848 simultaneously.

First Term, Fourth Year, four hours per week. This is a course in advanced optical measurements. The work includes special methods in photometry, spectrophotometry, spectroscopy, including work with plane and concave grating and echelon spectroscopes, and measurements with interferometers, refractometers and polariscopes, the experiments being of the nature of short investigations in which the student is thrown as far as possible on his own resources.

REQUIRED IN VIII.

851. Photographic Laboratory. — Professor DERR.

PREPARATION: 807, 861.

First Term, Fourth Year, four hours per week, laboratory practice. A course in photographic manipulations and the study of both familiar and obscure photographic phenomena. The work includes the sensitometry of plates, dyeing for regional sensitiveness, the preparation and use of color filters, and natural-color photography.

REQUIRED IN $VIII_3$.

852. Electrical Discharges in Vacua. — Dr. HOLLNAGEL.

PREPARATION: 822.

First Term, Fourth Year, forty-five hours (sixty for $VIII_1$), laboratory exercises. A course giving practice in the manipulation of apparatus for the production and measurement of high vacua, the preparation of vacuum tubes for spectroscopic and other purposes, and the determination of electronic constants.

REQUIRED IN $VIII_{1,3}$; ELECTIVE FOR GRADUATE STUDENTS.

853. Electrical Laboratory. — Professor PAGE.

PREPARATION: 822.

First Term, Fourth Year, fifteen laboratory exercises. A course in high frequency electrical measurements of importance to students taking up the study of radio-telegraphy. Studies will be made of apparatus for producing and measuring high frequency currents, and of the instruments adapted to such measurements.

ELECTIVE FOR FOURTH YEAR STUDENTS. Not given in 1916–1917.

855. Physical Colloquium. — Professor GOODWIN.

First and Second Terms, Fourth Year. These exercises are prefaced by a lecture on physical and electrochemical periodical literature and reference books, and on the use of a reference library. During the first term each student is required to compile the literature of some physical or electrochemical subject and to prepare an abstract of it which is submitted to the Department of English for criticism. During the second term the students lecture before the class on assigned topics in Physics and Electrochemistry. A general discussion of the lecture follows.

REQUIRED IN VIII, XIV.

860. Calculating Machines. — Professor DERR.

First Term, seven exercises. Chiefly practice with the slide rule in solving arithmetical problems taken from engineering and physics. The precision attainable with slide rules is studied, and other forms of calculating machines are briefly discussed. To minimize interference with other studies, the exercises are held at 4 P.M.

ELECTIVE.

861. Photography. — Professor DERR.

PREPARATION: 501, 801.

Second Term, one hour per week, lectures. These lectures are fully illustrated by experiments on elementary photographic optics, dry-plate processes in general, printing processes, projection apparatus, and color photography. To minimize interference with other studies, the lectures are given at 4 P.M.

REQUIRED IN VIII, OPTION 3. Elective in other courses in the second, third, and fourth years.

ELECTIVE COURSES

862. The Electrical Discharge in Gases; Radio-activity. — Professor CROSS.

Second Year, Second Term, fifteen lectures given in alternate years with course 863. The course is devoted to an elementary but rather full discussion of the various phenomena of the electrical discharge in gases and

allied subjects, including the low-vacuum discharge, cathode rays, Röntgen rays, and radio-activity. The lectures are illustrated very fully by experiments.

The course is intended to supplement that in General Physics. It is entirely elective and no examination is required. The lectures are given at a late hour in the afternoon so that students desiring to do so can attend without interference with other studies.

ELECTIVE. Offered in 1916–1917.

863. Hertz Waves; Radio-telegraphy. — Professor CROSS.

Second Term, Second Year, fifteen lectures given in alternate years with course 862. This course is devoted to a discussion of the phenomena of electrical oscillations and Hertz waves with their applications to wireless telegraphy and allied subjects. The lectures are of the same general character as those of course 862.

ELECTIVE. Not given in 1916–1917.

864. Polarized Light and its Applications. — Professor CROSS.

PREPARATION: 801.

First Term, fifteen lectures given in alternate years. The phenomena of plane, circular and elliptical polarization, rotary polarization and the electromagnetic relations of light are discussed, and fully illustrated by experiments. The principles of different forms of polarimeter and saccharimeter are also considered.

ELECTIVE. Not given in 1916–1917.

865. Principles and Application of Electrolysis. — Professor GOODWIN.

Second Term, one hour for six weeks, six experimental lectures. A course illustrating the principles underlying electrolysis and the voltaic cell together with some of their more important applications. This course is intended to supplement that in General Physics. It is elective and no examination is required. The lectures are given at four o'clock in the afternoon so as not to conflict with other work.

ELECTIVE FOR SECOND, THIRD, AND FOURTH YEAR STUDENTS.

866. General Physical Measurements. — Professors GOODWIN, NORTON, PAGE.

PREPARATION: Course in College Physics; 803 simultaneously.

First or Second Term, Graduate Year; time required varies with previous preparation. This is a course in quantitative physical measurements laid out primarily to meet the needs of graduate students taking Physics as a minor for the degree of Doctor of Philosophy. It is intended to familiarize students with the best methods for determining various physical constants in light, heat, and electricity, special emphasis being placed on the elimination of sources of error and a precision discussion of the results.

ELECTIVE IN GRADUATE YEAR.

867. Microscope Theory and Photomicrography. — Professor DERR.

PREPARATION: M22, 801.

Second Term, Graduate Year, four hours per week. The theory of the microscope, with laboratory practice in photomicrography with ordinary and natural-color plates, and in the use of the ultra-violet microscope.

ELECTIVE IN VIII, GRADUATE YEAR.

868. Radiation. — Professor GOODWIN.

First Term, Graduate Year, one hour per week, lectures. This course is devoted to a discussion of the fundamental laws of radiant energy and their applications. It begins with a consideration of the laws of Kirchhoff, Stefan-Boltzmann, Wien, Planck and others on black body radiation and their application to high temperature measurements. The radiation of gases is then taken up and includes a discussion of the effect of pressure, temperature, and magnetic field on spectra, and the application of these matters to problems in astrophysics. Offered in alternate years with course 869.

ELECTIVE IN GRADUATE YEAR. Offered in 1916–1917.

869. Theory of Radiation and its Application to Modern Physics. — Dr. HOLLNAGEL.

First and Second Terms, Graduate Year, one hour per week, lectures. A course in which the modern views of Radiant Energy are treated from a mathematical standpoint. The first fifteen lectures are devoted entirely to the development of the more general theory of Radiation and its necessary consequences, while the latter half of the course is devoted to a treatment of the properties of a perfect radiator, and Planck's theory of "quanta." Offered in alternate years with Course 868.

ELECTIVE IN GRADUATE YEAR. Not given in 1916–17.

871. The Constitution of Matter in the Light of Recent Discovery. — Professor COMSTOCK.

Second Term, Graduate Year, fifteen lectures. In this course an account is given of the present state of knowledge and hypothesis respecting the constitution of matter. The nature of negative electricity, and the structure of the atom and molecule are considered as fully as time allows and where possible the problems pressing for solution are discussed so far as is necessary to indicate the probable direction of future investigation.

ELECTIVE IN VIII, XIV, GRADUATE YEAR.

872. Radioactive Measurements. — Dr. BARSS.

PREPARATION: 308.

Second Term, Third, Fourth, and Graduate Years, two hours per week, laboratory exercises. The various methods of measuring radioactive actions

are studied with such instruction in the theory of the subject as is necessary for an adequate working knowledge of each experiment.

ELECTIVE.

ELECTROCHEMICAL COURSES

881. Elements of Electrochemistry. — Professor THOMPSON.

PREPARATION: 502, 802, 245.

First Term, Fourth Year, two hours per week. This course is adapted to the needs of electrical engineering students who have had no chemistry beyond that given in the first year. The principles of this subject essential to the understanding of the modern views of electrochemistry are discussed in connection with the theory of electrolytic conduction, the osmotic theory of primary cells, and electrolysis. The more important electrothermal and electrochemical industries are also described as fully as time permits.

ELECTIVE IN VI.

882. Electrochemistry. — Professor GOODWIN.

PREPARATION: 565, or its equivalent.

First Term, Fourth Year, three hours per week, lectures and recitations. An adequate knowledge of theoretical chemistry is assumed. The principal topics treated are electrolytic conduction, polarization and electrolysis, the voltaic cell, the principles involved in the corrosion, electro-deposition and refining of metals, and the energy principles underlying the transformation of chemical and electrical energy.

REQUIRED IN VIII, XIV; ELECTIVE IN GRADUATE YEAR.

885. Applied Electrochemistry. — Professor THOMPSON.

PREPARATION: 882.

Second Term, Fourth Year, two hours per week, lectures. A course on the industrical applications of electrochemistry. The subjects discussed include electric furnaces and their products, electro-metallurgy, accumulators, primary cells, electro-analysis and electrolytic processes for the production of various compounds.

REQUIRED IN XIV; ELECTIVE IN GRADUATE YEAR.

886. Electrochemical Laboratory. — Professors GOODWIN, THOMPSON and assistant.

PREPARATION: 882 simultaneously.

First Term, Fourth Year, seven hours per week. This course is carried on in conjunction with the lecture course 882 on Theoretical Electrochemistry. The work is devoted to measurements of such quantities as the electrical conductance of solutions and fusions, transference numbers, ionic mobilities, single potentials, decomposition voltages, polarization, etc.

REQUIRED IN XIV; ELECTIVE IN GRADUATE YEAR.

887. Electrochemical Laboratory. — Professor THOMPSON, and assistant.

PREPARATION: 883 simultaneously.

Second Term, Fourth Year, three hours per week. This course is planned to give students in Electrochemistry practice in various electric furnace operations and the production of chemicals by electrochemical means. The work consists in efficiency tests in the production of carborundum, calcium carbide, aluminum, silicon and iron, a test of an induction furnace and efficiency tests in the production of chemicals in aqueous solutions. A storage battery run to illustrate points brought out in course 883 is included.

REQUIRED IN XIV.

888. Electric Furnaces. — Professor THOMPSON and assistant.

PREPARATION: Heat Measurements and Electrical Engineering Laboratory.

First Term, Fourth Year, or Graduate Year, two hours per week laboratory, and five lectures. A course consisting of the electric furnace work of course 887. This is intended for fourth-year and graduate students, in other courses than Course XIV, who have had the requisite preparation and who wish to become familiar with electric furnace methods. Five lectures on the industrial application of the experiments performed are included.

ELECTIVE FOR FOURTH YEAR AND GRADUATE STUDENTS.

889. Electric Furnaces. — Professor THOMPSON and assistant.

PREPARATION: 687 OR 689, 813.

Second Term, Fourth Year, two hours per week. A course consisting of those electric furnace experiments described under course 887, which are best suited to the needs of students in Mining Engineering and in Industrial Physics respectively.

REQUIRED IN III_2, $VIII_1$.

890. Electrochemistry. — Professor THOMPSON and assistant.

PREPARATION: 567.

Second Term, Fourth Year, two hours per week, lectures and laboratory. The lectures will take up the fundamental principles of electrochemistry and their more important applications. The laboratory work will consist of electric furnace experiments.

REQUIRED IN III_2. Not given in 1916–1917.

893. Physico-chemical Laboratory. — Professor GOODWIN.

PREPARATION: 565 simultaneously.

Second Term, Third Year, five hours per week. This course provides instruction in exact methods of measurement employed in investigations in chemical physics. Each experiment is in the nature of a short research in which the student is thrown upon his own initiative as much as possible.

OPTIONAL IN $VIII_1$.

896. Electrochemical Seminar. — Professor GOODWIN.

PREPARATION: 882, 883.

First Term, Graduate Year, one hour per week, seminar. Memoirs and current literature dealing with the more advanced phases of theoretical electrochemistry form the basis of the discussions.

ELECTIVE FOR GRADUATE STUDENTS ONLY.

897. Applied Electrochemistry (Seminar). — Professor THOMPSON.

PREPARATION: 883, 887.

Second Term, Graduate Year, one hour per week, seminar. Assigned topics and current publications dealing with the industrial applications of electrochemistry are discussed.

ELECTIVE FOR GRADUATE STUDENTS ONLY.

898. Glass Blowing. — Professor THOMPSON.

First Term, Fourth Year, two hours per week for six weeks. A course in which the student is taught how to manipulate glass and make such simple apparatus, electrodes, vacuum tubes, etc., as are likely to be needed in physical and electrochemical research.

ELECTIVE FOR FOURTH YEAR STUDENTS IN VIII AND XIV.

DEPARTMENT OF GEOLOGY

WALDEMAR LINDGREN, M.E.
William Barton Rogers Professor of Economic Geology

THOMAS A. JAGGAR, PH.D.
Professor of Geology and Director of the Hawaiian Volcano Observatory.

CHARLES H. WARREN, PH.D.
Professor of Mineralogy.

HERVEY W. SHIMER, PH.D.
Associate Professor of Paleontology.

FREDERIC H. LAHEE, PH.D.
Assistant Professor of Geology.

Instructor

JOHN G. BARRY, S.B.

THE courses of the Department of Geology may be considered in five groups.

1. Those for students in Mining Engineering, Course III, Options 1 and 3, consisting of Mineralogy, Petrology, Dynamical and Stratigraphic Geology, Geological Surveying and Economic Geology.

2. Those for students in Metallurgical Engineering, Course III, Option 2, consisting of Mineralogy, Petrology, Dynamical Geology and Ore Deposits.

3. Those for students in Civil and Sanitary Engineering, consisting of Dynamical Geology, Field Geology, Stratigraphic Geology and Lithology. In addition the course in Dynamical Geology is given to students in Chemistry, Course V, Option 2, and a course in Geology of Materials is given to students of Option 2 in Architecture.

4. Those for students in Geology which include the same subjects as enumerated under 1, and besides other more specialized subjects, such as Geology of North America, Geology of Europe, Index Fossils, Physiography and Glacial Geology. In this course some of the subjects mentioned under 1 will be given in somewhat extended form.

In addition to these undergraduate studies, a course in General Geology is given which is listed among the "Options in General Studies" (p. 132).

5. The last section includes graduate studies and research along several lines, which are offered to candidates for the S.M. and Ph.D. degrees, and to special advanced students. The subjects include optical crystallography, advanced mineralogy and crystallography, chemical mineralogy, advanced petrography, advanced economic geology, geology of coal and petroleum, geology of igneous rocks, introductory paleontology, organic evolution and volcanology and seismology. This list may be modified or extended at any time.

A beneficial coöperation in graduate studies has been established with the Department of Geology of Harvard University by which advanced students are allowed to attend Harvard courses in subjects not regularly given at the Institute and vice versa. Among such Harvard courses open to advanced students are Geometrical Crystallography, Geology of Igneous Rocks, Physiography and Climatology offered respectively by Professors Charles Palache, Reginald A. Daly, Wallace W. Atwood and R. DeC. Ward.

1201. Mineralogy. — Mr. BARRY.

PREPARATION: 502.

First Term, Second Year, five hours per week, lectures, recitations, and laboratory. This course includes elementary crystallography, and a part of descriptive and determinative mineralogy, which are continued in course 1208.

REQUIRED IN III, XII.

1202. Mineralogy. — Professor WARREN.

PREPARATION: 502.

Second Term, Second Year, seven hours per week, one lecture, six laboratory or recitation exercises. Includes elementary crystallography, descriptive and determinative mineralogy.

REQUIRED IN $V_{2,3}$.

1208. Mineralogy and Petrology. — Mr. BARRY.

PREPARATION: 1201; 1231; 1262 simultaneously.

Second Term, Second Year, six hours per week, one lecture or recitation, five laboratory exercises. A continuation of course 1201, taking up during the latter half of the term the study of the common rock types.

REQUIRED IN III, XII.

1209. Mineralogy and Petrology. — Professor WARREN.

PREPARATION: 1208.

First Term, Third Year, two hours per week; Second Term, four hours per week, lectures and laboratory for III, Option 3; First Term, Third Year, four hours per week; Second Term, six hours per week for XII. A continuation and amplification of course 1208, but including some practice in the use of the polarizing microscope.

REQUIRED IN III_3, XII.

1211. Lithology. — Mr. BARRY.

PREPARATION: 502; 1231 simultaneously.

First Term, Third Year, one hour per week of laboratory work. The work consists of a systematic study of the common rocks and rock-forming minerals.

REQUIRED IN I, XI.

1215. Petrography. — Professor WARREN.

PREPARATION: 801; 1209.

First and Second Terms, Fourth Year, five hours per week, one lecture or recitation, four hours laboratory. This course is designed to train the student in the methods of petrographic study and familiarize him with the fundamental principles and facts of petrography.

REQUIRED IN XII; ELECTIVE IN III, GRADUATE YEAR.

1220. Elementary Crystallography. — Professor WARREN.

Second Term, Second Year, one hour per week, lecture; additional laboratory work optional. This course, which is also a part of 1202, takes up the elements of crystallography.

ELECTIVE.

1221. Physical and Chemical Crystallography. — Professor WARREN.

PREPARATION: 801; a thorough preparation in geometrical and optical crystallography is also required.

First Term, Graduate Year, three hours per week, seminar, and three hours laboratory work per week, alternate years.

ELECTIVE IN XII, GRADUATE YEAR.

1223. Optical Crystallography and Applications. — Professor WARREN.

PREPARATION: 801.

First Term, Graduate Year, five hours per week, one lecture, four laboratory exercises. This course deals primarily with the application of the polarizing microscope in the determination of crystalline material.

ELECTIVE IN V, VIII, X, GRADUATE YEAR.

1225. Advanced Petrography. — Professor WARREN.

PREPARATION: 1215.

First and Second Terms, Graduate Year, six hours per week. Consists of the study of selected suites of rocks, reading of petrographic literature, and preparation of a written report on at least one suite of rocks.

REQUIRED IN XII, GRADUATE YEAR.

1226. Chemical Mineralogy and Petrology. — Professor WARREN.

PREPARATION: 567; 1225.

Second Term, Graduate Year, three hours per week, seminar. This course considers the applications of chemistry and particularly physical chemistry to mineralogical and petrological problems. This course is given in alternate years.

ELECTIVE IN XII, GRADUATE YEAR.

1231. Dynamic Geology. — Professor LAHEE.

PREPARATION: 502; 801 simultaneously.

First Term, Second and Third Years, three hours per week. The greater geological processes — erosion, sedimentation, mountain-building, intrusion, and vulcanism — are discussed.

REQUIRED IN I, III, V_2, XI, XII.

1233. General Geology. — Professors SHIMER, LAHEE.

PREPARATION: 501; 801.

Second Term, Third Year, three hours per week. This course gives a general view of the history of the earth, showing how its present form, structure, and life have been developed. It includes dynamical, structural and historical geology, and evolution.

ELECTIVE IN ALL COURSES EXCEPT I, III, V_2, XI, XII.

1234. Structural and Field Geology. — Professor LAHEE, and assistant.

PREPARATION: 1211; 1231.

Second Term, Third Year, two hours per week. A course designed to teach the interpretation of geological maps and the principles of geological observation in the field.

REQUIRED IN I, XI.

1235. Physiography. — Professor LAHEE.

PREPARATION: 1231 OR 1233.

Second Term, Second, Third, or Fourth Year, three hours per week. It is the aim of this course to study the characteristics and development of land forms and the methods of interpretation of topographic maps.

ELECTIVE IN ALL COURSES.

1237. Stratigraphic Geology. — Professor SHIMER.

PREPARATION: 1231.

Second Term, Second Year, two hours per week. The course gives a general view of the past history of the earth. In the fifteen laboratory hours a few fossils are studied through a comparison with their nearest living representatives.

REQUIRED IN $III_{1,3}$, XII.

1238. Stratigraphic Geology. — Professor SHIMER.

PREPARATION: 1231.

Second Term, Third Year, one hour per week. A course to give a general view of the past history of the earth and the evolution of life forms.

REQUIRED IN I, XI.

1240. Historical Geology. — Professor SHIMER.

PREPARATION: 1237.

First term, Fourth Year, six hours per week, two lectures or recitations, four laboratory exercises, including determination of fossils. An amplification of 1237.

REQUIRED IN XII.

1251. Ore Deposits. — Professor LINDGREN; Mr. BARRY.

PREPARATION: 1201; 1231.

Second Term, Second Year, two hours per week. Elementary course, giving the most important features of occurrence and origin of metallic ores.

REQUIRED IN III_2.

1253. Economic Geology. — Professor LINDGREN; Mr. BARRY.

PREPARATION: 1208; 1237; 1264.

First Term, Fourth Year, three hours per week. General principles, classifications and description of important metallic and non-metallic mineral deposits.

REQUIRED IN $III_{1,3}$, XII. Omitted after 1916–1917.

1254. Economic Geology. — Professor LINDGREN; Mr. BARRY.

PREPARATION: 1253.

Second Term, Fourth Year, two hours per week. Laboratory study of ores, by petrographic and metallographic methods, supplemented by lectures on geological field examinations of mineral deposits.

REQUIRED IN III_3, XII. Omitted after 1916–1917.

1255. Economic Geology. — Professor LINDGREN; Mr. BARRY.

PREPARATION: 1208; 1237; 1264.

First and Second Terms, Fourth Year; five hours per week in first term, three hours in second term. A course of lectures supplemented by laboratory work, presenting the principles, occurrence and origin of mineral deposits, both metallic and non-metallic. *Text-book, Lindgren, Mineral Deposits.*

REQUIRED IN III_3, XII.

1256. Economic Geology. — Professor LINDGREN; Mr. BARRY.

PREPARATION: 1208; 1237; 1264.

First Term, Fourth Year, three hours per week. An elementary course on the principles, occurrence and origin of metallic and non-metallic mineral deposits.

REQUIRED IN III_1.

1257. Geology of the Materials of Construction. — Mr. BARRY.

PREPARATION: 501.

Second Term, Second Year, two hours per week. A short course in economic geology for students of architecture and engineering, who have done no previous work in geology. For the Class of 1918 this course will be given in the First Term, Third Year, one hour per week.

REQUIRED IN IV_2, ELECTIVE IN II, VI, X.

1259. Economic Geology, Advanced. — Professor LINDGREN.

PREPARATION: 1254.

First and Second Terms, Graduate Year, one hour per week, consultation or seminar; five hours per week, preparation. Laboratory study of specimens or suites from mineral deposits; metallographic and petrographic work; discussion of special topics; graphic problems; history of science of mineral deposits.

ELECTIVE IN III, GRADUATE YEAR.

1260. Geology of Coal and Petroleum. — Professor SHIMER; MR. BARRY, and Special Lecturers.

PREPARATION: 1253; 1255.

Second Term, Graduate Year, two hours per week. A course which presents in detail the geological relations of deposits of fuels and oils.

ELECTIVE IN XII, GRADUATE YEAR.

1262. Structural and Field Geology. — Professor LAHEE and assistant.

PREPARATION: 1231.

First Term, Third Year, three hours per week. A course designed to teach the elements of field observation, and the construction and interpretation of geological maps and sections.

REQUIRED IN $III_{1,3}$.

1264. Field Geology. — Mr. BARRY.

PREPARATION: 104; 1262; 1208.

Second Term, Third Year. (*Six hours a week during the last eight weeks.*) This course is designed to give the student practical methods of geologic mapping in the field.

REQUIRED IN $III_{1,3}$.

1265. Geological Surveying. — Professor LAHEE and assistant.

PREPARATION: 1237; 1262; 1264.

First Term, Fourth Year, one full day per week for five weeks (*thirty-five hours*). In this course the student makes a detailed examination of two areas, one illustrating igneous rocks and the other, folded sedimentary rocks. A written report, stating the results of the field-work, is required in each case.

REQUIRED IN $III_{1,3}$, XII.

1267. Field Geology, Advanced. — Professors LINDGREN, WARREN, LAHEE.

PREPARATION: 1265.

First and Second Terms, Graduate Year (*Fourth Year for XII*), *six hours per week.* A research course in the field investigation of assigned geologic problems.

ELECTIVE IN III, GRADUATE YEAR, XII.

1271. Introductory Paleontology. — Professor SHIMER.

PREPARATION: 1237 OR 1238.

First and Second Terms, four hours per week, mostly laboratory work. A course to give a knowledge of the extinct life of the earth through a comparison with living plants and animals.

GRADUATE YEAR, AND ELECTIVE.

1273. Index Fossils. — Professor SHIMER.

PREPARATION: 1237.

First Term, six hours per week (*forty-five hours in Fourth Year for* III_3). A practical study in the identification of rocks through their included organic remains. Mostly laboratory work.

REQUIRED IN III_3 FOR CLASS OF 1917 ONLY.

Graduate year, and elective.

1275. Organic Evolution. — Professor SHIMER.

PREPARATION: 1237 OR 1238.

Second Term, Elective, two hours per week. Lectures and reading on evolution as interpreted by comparative anatomy, embryology, paleontology, geographic distribution of life, past and present, heredity, etc.

GRADUATE YEAR, AND ELECTIVE.

1277. Advanced Paleontology. — Professor SHIMER.

PREPARATION: 1271 OR 1273.

First or Second Term, Graduate Year, six hours per week. Individual work. Laboratory work and reading upon some aspect of index fossils, stratigraphy, evolution of fossil or living forms.

ELECTIVE IN GRADUATE YEAR.

1290. Geological Seminar. — Department Staff.

First and Second Terms, Fourth Year, two hours per week. A course of reading and reports based upon various phases of geological literature.

REQUIRED IN XII.

1291. Geology of North America. — Professors LINDGREN, SHIMER, LAHEE.

PREPARATION: 1237 OR 1238.

Second Term, Graduate Year, four hours per week (fourth year for III_3). A course on the physiography, stratigraphy, igneous bodies and general geologic structures of North America.

REQUIRED IN III_3 FOR CLASS OF 1917 ONLY.

Elective in graduate year for other courses.

1294. Geology of Europe. — Professors LINDGREN, SHIMER.

PREPARATION: 1253; 1237.

First Term, Graduate Year, two hours per week. A course dealing with the stratigraphy, the geologic structure, and the igneous rocks of the continent, and with the relation of these to the present surface features.

ELECTIVE IN GRADUATE YEAR.

1296. Volcanology. — Professor JAGGAR.

PREPARATION: 1244 OR 1264.

A course of field and laboratory work to be given at the Volcano Observatory at Hawaii to advanced students of geology.

ELECTIVE.

DEPARTMENT OF NAVAL ARCHITECTURE AND MARINE ENGINEERING

CECIL H. PEABODY, S.B.
Professor of Naval Architecture and Marine Engineering.

WILLIAM HOVGAARD.
Professor of Naval Design and Construction.

HENRY H. W. KEITH, S.B.
Assistant Professor of Naval Architecture.

GEORGE OWEN, S.B.
Assistant Professor of Naval Architecture.

Instructors

EVERS BURTNER, S.B. ALEXANDER KLEMIN, B.Sc., S.M.
THOMAS W. HUFF, S.B.

Assistant

HAROLD LARNER, S.B.

THE instruction in naval architecture and marine engineering is intended for those who expect to be ship-designers, ship-builders, ship-managers, or marine engine builders or who desire to enter allied industries. The special work of the regular Course is given in the form of lectures and recitations, and drawing and computation, during the second, third and fourth years of the Course.

The advantageous location of the Institute at an important seaport enables students to see ship and engine-construction (including marine steam turbines) at the Navy Yard, at several local ship and engine-works, and to visit ships of all types. This location has made it possible to arrange for power and speed trials and progressive speed trials of ships, including turbine steamers; experiments to determine the turning moments of rudders; and tests on the economy of boilers and engines.

For information regarding graduate work and the admission of graduates of the Department of Mechanical Engineering to professional work of the Department of Naval Architecture and Marine Engineering, see pages 50, 124 and 143 to 147.

For details regarding the Course for Naval Constructors, arranged by request of the United States Navy Department to give advanced instruction to graduates of the Naval Academy, see page 122.

For description of Graduate Course in Aëronautical Engineering see page 160.

1301. Naval Architecture. — Professor PEABODY.

PREPARATION: M22, 215; 1342 simultaneously.

First and Second Terms, Third Year, two hours per week. General theory of naval architecture, including displacement and stability of ships, flooding compartments, grounding, docking, and launching. Theory of waves and rolling of ships and methods of controlling rolling.

REQUIRED IN XIII, XIIIA, AND XIIIB.

1302. Naval Architecture. — Professor PEABODY.

PREPARATION: 1301; 1343 simultaneously.

First and Second Terms, Fourth Year, two hours per week First Term and one per week Second Term. Resistance and propulsion of ships by paddle wheels, propellers and sails; method of making power and speed trials. Strength of ships, structural and local. Compass adjustments.

REQUIRED IN XIII, XIIIA, AND XIIIB.

1311. Theory of Warship Design. — Professor HOVGAARD.

PREPARATION: 1301 simultaneously.

First and Second Terms, Third Year, two hours per week, lectures and recitations. An historical account and a discussion of the development of modern warships up to the present time. Preliminary design, comprising determination of the principal elements of design, construction of lines, stability, seaworthiness, general distribution of weights, weight calculations, watertight subdivisions, and vibrations of vessels.

REQUIRED IN XIIIA, XIIIB.

1312. Theory of Warship Design. — Professors HOVGAARD, KEITH.

PREPARATION: 1311; 1302 simultaneously.

First and Second Terms, Fourth Year, two hours per week, lectures and recitations. Structural design of warships, comprising materials used in hull construction, strength and strength calculations, riveted joints, and main structural features; preliminary design and installation of boilers, engines, and propellers, as far as this work concerns the naval architect; coaling and coal stowage, liquid fuel; rudders and steering gear.

REQUIRED IN XIIIA, XIIIB.

1313. Theory of Warship Design. — Professor HOVGAARD.

PREPARATION: 1312.

First and Second Terms, Graduate Year, two hours per week, lectures. Drainage; ventilation and heating; anchors and anchor gear; boats and

boat-handling appliances; artillery, ammunition, torpedo installations; protection against artillery and submarine attack; conning towers.

REQUIRED IN XIIIA, XIIIB.

1314. Shipyard Practice. — Professor KEITH.

PREPARATION: 1301, 1302, 1311, 1312.

Second Term, Fourth Year, two hours per week. Lectures dealing with industrial organization, management, operation, equipment and practice of ship and navy yards as applied to warship construction.

REQUIRED IN XIIIA.

1321. Warship Design. — Professors HOVGAARD AND KEITH.

PREPARATION: 1301; 1311 simultaneously.

First Term, Third Year, seven hours per week; Second Term, eight hours per week. The first term is occupied by design work of a general and introductory nature. In the second term the students commence a preliminary design of a warship.

REQUIRED IN XIIIA, XIIIB.

1322. Warship Design. — Professors HOVGAARD, KEITH.

PREPARATION: 1321; 1312 simultaneously.

First Term, Fourth Year, six hours per week; Second Term, seven hours per week. Continuation of the design of a warship.

REQUIRED IN XIIIA, XIIIB.

1323. Warship Design. — Professors HOVGAARD, KEITH.

PREPARATION: 1322; 1313 simultaneously.

First and Second Terms, Graduate Year, six hours per week. Continuation of the design of a warship.

REQUIRED IN XIIIA, XIIIB.

1331. Ship Construction. — Professor OWEN.

PREPARATION: D21, 206.

Second Term, Second Year, two hours per week for ten weeks. This course gives a description of various types of ships and methods of construction, together with arrangement, equipment and operation of shipyards.

REQUIRED IN XIII, XIIIB.

1332. Ship Construction. — Professor OWEN.

PREPARATION: 1331, 1342.

Second Term, Third Year, two hours per week for ten weeks. This course is a continuation of course 1331 and deals with the construction of ships in general and in detail to conform to requirements of ship-registration societies.

REQUIRED IN XIII.

1333. Ventilation and Drainage of Ships. — Professor OWEN.

First Term, Fourth Year, two hours per week. This course deals with natural and forced ventilation of passenger accommodations, stoke-holes, engine rooms, and cargo spaces, and with the drainage and arrangements for pumping various compartments.

REQUIRED IN XIII, XIIIB.

1341. Ship Drawing. — Professor OWEN.

PREPARATION: D21.

Second Term, Second Year, two hours per week. This course gives instruction in drawing and fairing ship lines.

REQUIRED IN XIII, XIIIB.

1342. Ship Design. — Professor OWEN.

PREPARATION: 1331; 1301 simultaneously.

First Term, Third Year, five hours per week; Second Term, six hours per week. The first term deals with yacht design, drawing and computations. In the second term the design of a ship for a given purpose is begun.

REQUIRED IN XIII.

1343. Ship Design. — Professor OWEN.

PREPARATION: 1301, 1342.

First Term, Fourth Year, five hours per week; Second Term, eight hours per week. The design of a ship is carried to completion with calculations of displacement, stability, weight, trim, strength and cost. General and special plans of hull, decks, bulkheads, engines and boiler arrangement are made.

REQUIRED IN XIII.

1351. Marine Engineering. — Professor PEABODY.

PREPARATION: 229, 245.

Second Term, Fourth Year, two hours per week. This course describes marine engines and discusses methods of proportioning marine engines and determining stresses in them; and also the vibration of ships and balancing engines.

REQUIRED IN XIII.

1352. Marine Engine Design. — Professor PEABODY, Mr. BURTNER.

PREPARATION: 1351 simultaneously.

Second Term, Fourth Year, six hours per week. This course deals with the computations and drawings for a marine engine.

REQUIRED IN XIII.

1353. Marine Engine Design. — Professor PEABODY; Mr. BURTNER.

PREPARATION: 1355 simultaneously.

First Term, Graduate Year, six hours per week. This course is similar to course 1352 except that it applies to naval engines.

REQUIRED IN XIIIA, XIIIB.

1355. Marine Engineering. — Professor PEABODY.

First Term, Graduate Year, two hours per week. This course is similar to course 1351 except that it deals with naval engines.

REQUIRED IN XIIIA, XIIIB.

1360. Marine Steam Turbines. — Professor PEABODY.

PREPARATION: 245.

Second Term, Fourth Year, two hours per week. This course gives descriptions and methods of computing steam turbines, especially as applied to marine propulsion.

REQUIRED IN XIII, XIIIA, AND XIIIB.

1372. Aëronautics.

PREPARATION: M57.

Second Term, Fourth Year, two hours per week. A course of lectures giving the essential principles of experimental and theoretical aërodynamics, theory of aëroplane design, theory of dirigible design, history of flight and description of modern air craft.

REQUIRED IN XIIIA, XIIIB.

1373. Aëronautics.

PREPARATION: 1372.

Second Term, Graduate Year, six hours per week. A course in which the student will carry through the computation and drawing for an aëroplane or dirigible to meet given specifications. Special attention will be given to naval requirements. Classified plans, photographs and weights are available for comparison.

REQUIRED IN XIIIA, XIIIB.

1374. Fluid Dynamics, Experimental. — Mr. KLEMIN.

First Term, Graduate Year, two hours per week. A discussion of experimental methods of aërodynamic laboratories for aëroplanes and airships and their parts.

REQUIRED IN GRADUATE COURSE IN AËRONAUTICAL ENGINEERING.

1375. Theory of Aëroplane Design. — Mr. KLEMIN.

First Term, Graduate Year, three hours per week. This course gives the theory of flight of an aëroplane, including stability, resistance, propulsion

and maneuvering, and the methods of designing an aëroplane and its parts together with computations of strength.

REQUIRED IN GRADUATE COURSE IN AËRONAUTICAL ENGINEERING.

1376. Aëroplane Design. — Mr. KLEMIN, Mr. HUFF.

First Term, Graduate Year, six hours per week. In this course the student designs an aëroplane for a given purpose, with computation of strength and stability.

REQUIRED IN GRADUATE COURSE IN AËRONAUTICAL ENGINEERING.

1377. Theory of Airship Design. — Mr. KLEMIN.

Second Term, Graduate Year, three hours per week. This course gives the history of airships, the theory of their action, and methods of design and computations for strength, for propulsion, and maneuvering.

REQUIRED IN GRADUATE COURSE IN AËRONAUTICAL ENGINEERING.

1378. Airship Design. — Mr. KLEMIN.

Second Term, Graduate Year, six hours per week. In this course the student designs an airship for a given purpose, with calculations for weight, buoyancy, stability and power.

REQUIRED IN GRADUATE COURSE IN AËRONAUTICAL ENGINEERING.

1379. Aërial Propellers. — Mr. KLEMIN.

First Term, Graduate Year, two hours per week for ten weeks. This course gives a discussion of the theory and of experiments on aëronautical propellers. The student applies the Drzwiecki system to a design.

REQUIRED IN GRADUATE COURSE IN AËRONAUTICAL ENGINEERING.

1380. Aërodynamical Laboratory. — Messrs. KLEMIN, HUFF.

The wind tunnel will be used by students for investigating general and special problems relating to aëroplanes and airships, especially as applied to their designs.

REQUIRED IN GRADUATE COURSE IN AËRONAUTICAL ENGINEERING.

1381. Meteorology. —

By special arrangement with the Blue Hill Observatory students during several protracted visits learn the various methods of studying the conditions of the atmosphere and methods of predicting the weather.

REQUIRED IN GRADUATE COURSE IN AËRONAUTICAL ENGINEERING.

1391. Mold-Loft Work. — Professor OWEN.

This is an optional course of about ten days offered to students in Naval Architecture at the close of the spring term. The method depends on fairing lines on glass-topped tables and then transferring them to a full

sized body plan on the floor, on which are marked such details as frames, floors, longitudinals, margin plates, etc.; and practice is given in cutting bevels and making molds.

REQUIRED IN XIII, XIIIA, XIIIB.

1395. Model Making. — Professor OWEN.

PREPARATION: 1342.

First Term, Fourth Year, two hours per week for fifteen weeks (twelve weeks for XIII). Each student makes a model of the ship designed under course 1332 or 1322, for the purpose of becoming familiar with the actual form, and uses that model under course 1333 or 1323 for laying off shell plating, decks, etc. Proper machinery and methods facilitate this work.

REQUIRED IN XIII, XIIIA, XIIIB.

DEPARTMENT OF DRAWING AND DESCRIPTIVE GEOMETRY

ALFRED E. BURTON, S.B., SC.D.
Professor of Topographical Engineering.

ERVIN KENISON, S.B.
Associate Professor of Drawing and Descriptive Geometry.

W. FELTON BROWN,
Associate Professor of Freehand Drawing.

HARRY C. BRADLEY, S.B.
Assistant Professor of Drawing and Descriptive Geometry.

ARTHUR E. NORTON, PH.B.
Assistant Professor of Engineering Drawing.

Instructors

ARTHUR L. GOODRICH, S.B.
STEPHEN A. BREED, S.B.
FRANK M. GRACEY.
RALPH G. OVERLAND.
WALTER J. HAUSER, S.M.
JOHN E. BIRD.

Assistants

CHARLES M. WAREHAM, S.B.
GEORGE R. STEVENS

THE work of this department includes (I) preparatory courses in Mechanical Drawing, Descriptive Geometry, and Freehand Drawing, given throughout the first year, and Descriptive Geometry given in the first term of the second year; (II) courses in Freehand Drawing, extending through all years of the course in Architecture and a course in Applied Decorative Design given in the graduate year.

The preparatory instruction leads to the various courses in applied drawing, given in the professional departments of the Institute. The instruction therefore largely concerns the technique and principles of representation in general, or pure drawing.

The courses in Mechanical Drawing include the precise penciling and finished inking of instrumental constructions and irregular curves. Most of the drawings are first laid out in pencil and then traced. Drawings of machine details, made from given

measurements, are required, and all lettering and dimensioning is done freehand. Special stress is laid upon workmanlike and time-saving methods in drafting, including the supplementary use of freehand drawing. The standing in Mechanical Drawing is partly determined by means of a six-hour drawing given, at the end of the first year, as a test of the student's manual facility, knowledge of working methods, and speed. [1]

Special importance is attached to the study of Descriptive Geometry, both as embracing the principles of geometrical representation, and as a means for cultivating the imagination. Training in the practical use of its principles is afforded by the solution of problems taken from engineering and architectural practice.

The courses in Freehand Drawing begin with the drawing of letters, in which are presented the first principles and fundamental processes of freehand drawing in general. This work merges into practical lettering and later into object drawing.

The instruction in the courses in Freehand Drawing given in the Department of Architecture is an extension of the methods begun in the first year to drawing from the cast and from life. Instruction in art anatomy and the principles of decorative design, together with criticism along æsthetic lines, is given in connection with the exercises in drawing. Some of these exercises are held in the galleries of the Museum of Fine Arts. The wealth of examples afforded by the collection of casts, and the art atmosphere of the Museum, are considered important influences.

The work in Decorative Design includes drawing from life, the study of principles, and the making of preliminary sketches in figure composition. The students of each graduate class cooperate in designing and executing a large mural decoration, introducing the human figure.

D11. Mechanical Drawing.[1]

D15. Descriptive Geometry. — Professors KENISON, BRADLEY, NORTON; Messrs. GOODRICH, BREED, OVERLAND, HAUSER, WAREHAM.

PREPARATION: 2, 5.

First Term, First Year, six hours per week. These are correlated elementary courses. The instruction is given by means of blackboard

[1] A similar test in drawing is required of applicants for advanced standing in Mechanical Drawing, and of first-year students wishing to omit this subject.

explanation, together with considerable attention to the individual student. The time given to each course is approximately the same.

In Mechanical Drawing the student is taught the correct use of the drafting instruments and other materials for both pencil and ink work.

In Descriptive Geometry especial emphasis is placed on the ability to "see," from different points of view, first the object, then the line or plane in space. Various simple problems on lines, planes and solids are given, including sections and developments. There is included also the construction of isometric and oblique projection views.

REQUIRED IN ALL COURSES.

D12. Mechanical Drawing.[1]

D16. Descriptive Geometry.[1] — Professors KENISON, BRADLEY, NORTON; Messrs. GOODRICH, BREED, OVERLAND, WAREHAM.

PREPARATION: D11, D15.

Second Term, First Year, six hours per week. These courses are a continuation of the two just described, and the same general method of instruction obtains.

In Mechanical Drawing are made several drawings and tracings of machine parts, requiring sectioning and isometric or oblique projection views. The students are also taught the accurate construction of various rolled curves.

In Descriptive Geometry further work is given on the line, plane, and solid, with practical applications of elementary problems. The course covers the simpler cases of the intersection of two solids, including those with both plane and curved faces.

REQUIRED IN I, V, VIII, XI, XV_1.

D12a. Mechanical Drawing.[1]

D16a. Descriptive Geometry.[1] — Professors KENISON, BRADLEY; Messrs. GOODRICH, BREED, OVERLAND, WAREHAM.

PREPARATION: D11; D15.

Second Term, First Year, six hours per week. The first of these, a course of twenty hours, is a continuation of Mechanical Drawing D11. The second, a course of seventy hours, is an abridgment of the work given in courses D16 and D21.

REQUIRED IN II, III, VI, X, XII, XIII, XIV, $XV_{2,3}$.

[1] This subject may be taken separately. Applicants for advanced standing should present themselves for examination (except in the case of those offering certified records from other colleges in this subject), and all applicants should submit drawings covering the above ground as fully as possible. In case these drawings are not satisfactory, further work and examination may be required.

D14. Mechanical Drawing.[1]

D18. Descriptive Geometry.[2] — Professor KENISON; Mr. HAUSER.

PREPARATION: D11, D15.

Second Term, First Year, nine hours per week. These courses are arranged for students taking Architecture. The first, a course of forty-five hours, is a continuation of Mechanical Drawing D11. The second, a course of ninety hours, with one hour additional per week for preparation, covers the work of Descriptive Geometry D16 and D21.

The courses are open to students not in Course IV only by special arrangement with Professor Kenison.

REQUIRED IN IV.

D21. Descriptive Geometry.[1] — Professors KENISON, BRADLEY; Mr. GOODRICH.

PREPARATION: D12, D16.

First Term, Second Year, three hours per week, lectures, drawing. This course is a continuation of Descriptive Geometry D16 and deals with single and double curved surfaces; their tangent planes, intersection by oblique planes, penetrations, developments, etc. The time given to lectures is about one hour for each two hours of drawing.

REQUIRED IN II, XI, XIII, $XV_{1,2}$.

D23. Descriptive Geometry.[1] — Professors KENISON, BRADLEY.

PREPARATION: D12, D16.

First Term, Second Year, four hours per week. This course is an extension of Descriptive Geometry D21, and includes the subject of warped surfaces.

REQUIRED IN I.

D26. Descriptive Geometry.[1] (College Class.) — Professors KENISON, BRADLEY; Mr. GOODRICH.

A course of five hours per week, with four hours of outside preparation, given during the first term of each school year. The class is intended

[1] This subject may be taken separately. Applicants for advanced standing should present themselves for examination (except in the case of those offering certified records from other colleges in this subject), and all applicants should submit drawings covering the above ground as fully as possible In case these drawings are not satisfactory, further work and examination may be required.

[2] Applicants for advanced standing should present themselves for examination (except in the case of those offering certified records in this subject from other colleges) and all applicants should submit drawings covering the above ground as fully as possible. In case these drawings are not satisfactory, further work and examination may be required.

for students from other colleges entering with advanced standing, but who are deficient in Descriptive Geometry. Satisfactory completion of the work in this class is accepted as covering the complete requirements in Descriptive Geometry in any Institute Course except Course I. Members of Course I must take, in addition to the work of the college class, ten hours of class-room work and twenty hours outside preparation with the regular second year class.

The college class is open to graduates from other colleges, without restriction: also to students from other colleges, not graduates, who are entering the Institute with advanced standing, and who obtain permission from Professor Burton. The class is not intended for students who have failures to make up, and a student who has previously taken any course in Descriptive Geometry at the Institute will not be admitted.

D28. Stereotomy. — Professor BRADLEY and assistants.

PREPARATION: D23.

Second Term, Second Year, three hours perweek. A course on the application of Descriptive Geometry to the making of drawings for masonry structures, such as intersecting arches and walls, abutments, piers, and culverts. Occasional lectures are given, but the time is nearly all spent at the drawing board, with a moderate amount assigned to outside preparation.

REQUIRED IN I.

D31. Freehand Drawing.[1] — Mr. GRACEY.

NO PREPARATION IS REQUIRED.

First Term, First Year, two hours per week. The work consists of the application of the fundamental principles of drawing to the drawing of letters and the construction and design of titles, with incidental instruction in stroke lettering for working drawings. The instruction is given by short lectures on the principles and processes of freehand drawing, and individual criticism. *Text-books, Gracey's Syllabus of Freehand Drawing; Adams' Lettering Plates.*

REQUIRED IN ALL COURSES.

D32. Freehand Drawing.[2] — Mr. GRACEY.

PREPARATION: D31.

Second Term, First Year, one hour per week. The exercises consist of the application of the principles learned in D31 to the drawing of type

[1] All applicants for advanced standing should present themselves for examination and should submit examples of their lettering and object drawing.

[2] Applicants for advanced standing should present themselves for examination and should submit examples of their object drawing, lettering, and dimensioning.

solids, machine parts, and other objects. A final, finished drawing in perspective or orthographic projection is required. The Cross glass drawing slate is used as an aid.

REQUIRED IN ALL COURSES EXCEPT IV.

D41. Freehand Drawing. — Mr. GRACEY.

PREPARATION: D31.

Second Term, First Year, four hours per week. It is an amplification of the principles taught in courses D31 and D32, applying them to the drawing of casts of ornament and of the human figure.

REQUIRED IN IV.

D42. Freehand Drawing.[1] — Professor BROWN; Mr. BIRD.

PREPARATION: D41.

First and Second Terms, Second Year, four hours per week. The course is a continuation of Freehand Drawing D41. The work consists of drawing from casts of architectural ornament and details of the human figure, memory drawing, and, occasionally, drawing from life.

REQUIRED IN IV.

D43. Freehand Drawing.[2] — Professor BROWN; Mr. BIRD.

PREPARATION: D42.

First and Second Terms, Third Year, two two-hour periods per week. The course is a continuation of Freehand Drawing D42. The work includes drawing from casts of architectural ornament and the human figure, life drawing, memory drawing, and time sketching in pencil, and pen and ink.

REQUIRED IN IV_1.

D44. Life Class.[3] — Professor BROWN; Mr. BIRD.

PREPARATION: D43.

First and Second Terms, Fourth Year, six hours per week. The course is a continuation of Freehand Drawing D43. The work consists of drawing from the nude, memory drawing, time sketching, and preliminary practice in figure composition.

REQUIRED IN IV_1.

[1] Applicants for advanced standing should present themselves for examination.
[2] Candidates for advanced standing should present themselves for examination.
[3] Candidates for advanced standing should present themselves for examination.

D45. Life Class and Decorative Design.[1] — Professor BROWN.

PREPARATION: D 44.

First and Second Terms, Graduate Year, six hours per week. The course includes drawing from the nude, principles of composition, and applied decorative figure design.

ELECTIVE IN IV, GRADUATE YEAR.

[1] Candidates for advanced standing should present themselves for examination.

DEPARTMENT OF ENGLISH

HENRY G. PEARSON, A.B.
Professor of English.

ARCHER T. ROBINSON, A.M.
Professor of English.

FRANK AYDELOTTE, A.M., B.LITT.
Professor of English.

HENRY L. SEAVER, A.M.
Associate Professor of English.

Instructors

ROBERT E. ROGERS, A.M.
WILLIAM GREEN, S.M.
PERCY MARKS, A.M.
WILLIAM A. CROSBY, A.M.
WINWARD PRESCOTT, A.M.
WILLIAM B. PRESSEY, A.M.
JOHN K. TORBERT, A.M.

THE instruction in English has as its purpose to enlarge the student's acquaintance with general ideas and to broaden his interests by showing him how scientific conceptions are related to other fields of thought. Incidentally the attempt is made to make him conscious of his own processes of thought, in order that he may subject them to more intelligent control. As a test of progress in these directions, oral and written discussion is constantly required, with the emphasis always on those qualities of clearness and accuracy of expression which are essential in the work of a professional man.

In all the courses literature and composition are studied together. During the first term of the first year relatively greater emphasis, however, is given to writing, and there is some study of the elementary theory and technique of composition. The second term of the first year is given up to the reading of certain Nineteenth Century essayists, with oral and written discussion of their ideas. In the first term of the second year the time is devoted to a fairly comprehensive study of a few great representative authors. During the second term of the second year again the chief emphasis is laid on composition, though, as in earlier courses, the material for written work is furnished through reading and class discussion.

In the third year the Department offers some optional subjects, such as advanced courses in literature, and courses in argumenta-

tion and in public speaking. The required work in English for third-year and fourth-year students differs with different professional Courses. In general it is like that already described, but of a more advanced character.

The instruction in the Department is given in sections; the greater part of the corrections on written work is made in personal conferences.

E10. English (For Foreign Students). — Professor SEAVER.

First and Second Terms, First Year, two hours per week, recitations and conferences. All students bred to speak any language other than English are required, unless they pass the Entrance Examination, or unless special arrangement is made to the contrary, to take this course in their first year in place of courses E11 and E12. The work is intended to develop vocabulary and, by frequent written exercises and conference, to correct the individual student's errors of idiom, grammar, and spelling.

The work is not intended for those who are quite new to the language; but assumes that the student is able to understand exercises conducted in English, and to express himself intelligibly in written or oral English.

E11. English (Oral and Written Composition). — Professor ROBINSON;[1] Messrs. MARKS, CROSBY, PRESCOTT, PRESSEY, TORBERT.

PREPARATION: 3.

First Term, First Year, two hours per week, recitations and conferences. The chief object of this course is to give the student training in expressing himself with accuracy and precision, and to teach him to realize that the secret of clear writing is clear thinking. The subjects chosen for oral and written discussion are those naturally connected with the student's attempt to adjust himself to his new environment.

REQUIRED IN ALL COURSES.

E12. English (Nineteenth Century Essays). — Professors PEARSON, ROBINSON, AYDELOTTE,[1] SEAVER; Messrs. ROGERS, MARKS, CROSBY, PRESSEY, PRESCOTT, TORBERT.

PREPARATION: E11.

Second Term, First Year, two hours per week, recitations and conferences. The purpose of this term's work is to afford the student training in exact, thoughtful reading, and to lead him to think about important problems of literature, science, and social life. Essays of such writers as Huxley,

[1] In charge

Arnold, Ruskin, and Carlyle are studied, and the ideas presented are made the basis for oral and written discussion.

REQUIRED IN ALL COURSES.

E15. Special Composition. — Mr. ROGERS.

This course may be required at any time after the first year of any student who shows inability to write clear and correct English. It consists wholly of theme work and consultation, and is continued in each case as long as the needs of the student require.

E20. English (For Foreign Students). — Professor SEAVER.

PREPARATION: E10.

First and Second Terms, Second Year, two hours per week, recitations and conferences. This course is required, in place of courses E21 and E22 in the second year, of foreign students who took Elementary English E10 in the first year. The course aims to acquaint the student with the vocabulary of modern discussion. Magazine articles, essays, and books on topics of contemporary history and politics, are read carefully, to train the student in thorough, retentive, appreciative reading, and are made the basis of written exercises, to develop the student's capacity for orderly, intelligible expression.

E21. English (Representative Writers of English Literature). — Professors PEARSON,[1] AYDELOTTE, SEAVER; Messrs. ROGERS, MARKS, CROSBY, PRESCOTT, PRESSEY, TORBERT.

PREPARATION: E11, E12.

First Term, Second Year, two hours per week, recitations and conferences. In this course the work of a few of the more important English authors will be studied, and each will be considered at sufficient length so that the students may get a fairly comprehensive view of his interpretation of life. As in the preceding term, there will be work in composition, based upon the discussion in class.

REQUIRED IN ALL COURSES EXCEPT VI AND XI.

E22. English (Oral and Written Discussion). — Professors PEARSON, ROBINSON,[1] AYDELOTTE, SEAVER; Messrs. ROGERS, MARKS, CROSBY, PRESCOTT, PRESSEY, TORBERT.

PREPARATION: E21.

Second Year, Second Term, two hours per week, class discussions and conferences. This is a course in composition adapted to the greater maturity of the students, and making use of ideas presented in earlier terms. It is designed to give a power of thought and expression which will be useful both for general and for technical purposes.

REQUIRED IN ALL COURSES EXCEPT VI.

[1] In charge.

E23. English (Representative Writers of English Literature). — Professors PEARSON, AYDELOTTE; Mr. ROGERS.

PREPARATION: E12.

First Term, Second Year, two hours per week, recitations and conferences. Similar to course E21, but with fifteen additional hours assigned for preparation.

REQUIRED IN VI, XI.

E24. English (Oral and Written Discussion). — Professor AYDELOTTE; Mr. ROGERS.

PREPARATION: E23.

Second Term, Second Year, two hours per week, class discussions and conferences. Similar to course E22, but with fifteen additional hours assigned for preparation.

REQUIRED IN VI.

E31. English (Literature, Oral and Written Discussion). —

PREPARATION: E22.

First Term, Third Year, two hours per week. The course consists of the reading of essays in which the modern problems of science and of society are presented in literary form. These essays serve as a basis for oral and written discussion.

REQUIRED IN I, III, XI. Given only to III in 1916–1917.

E33. Report Writing. — Professor PEARSON; Messrs. GREEN, SUTHERLAND.

PREPARATION: E21, E22, Ec50.

First Term, Third Year, two hours per week. The course acquaints the student with the various kinds of writing incidental to an engineer's work, and gives practice in the writing of business letters, interdepartmental memoranda, and reports. The reports embody the results of actual investigations made by the student.

REQUIRED IN XV.

E34. English (Literature with Oral and Written Discussion). — Professor AYDELOTTE.

PREPARATION: E21, E22.

Second Term, Third Year, three hours per week, recitations and lectures, assigned readings and themes. The course consists of oral and written discussion of problems of literature and science based on the reading of engineering addresses and of English essayists of the nineteenth century. Its purpose is to give students practice in the careful reading of thoughtful English prose, and practice in oral and written discussion of the ideas suggested by the reading.

REQUIRED IN XV.

E41. English (Essays and Discussions). —

PREPARATION: E22.

First Term, Fourth Year, one hour per week. The course consists of the presentation of papers prepared by members of the class, followed by general discussion.

REQUIRED IN IV. Not given in 1916–1917.

E42. English (Essays and Discussions). —

PREPARATION: E22.

Second Term, Fourth Year, one hour per week. A continuation of course E41.

REQUIRED IN COURSE IV. Not given in 1916–1917.

E44. English (Essays and Discussions). — Professor PEARSON.

PREPARATION: E22.

Second Term, Fourth Year, two hours per week. The course consists of the presentation of papers prepared by members of the class, followed by general discussion.

REQUIRED IN VI.

E51. Shakespeare's Plays. — Professor AYDELOTTE.

PREPARATION: E21, E22.

First Term, Third Year, two hours per week. The course consists of the reading and discussion of three or four plays by Shakespeare, the plays being chosen to illustrate various aspects of his genius.

ELECTIVE.

E52. English Literature of the Nineteenth Century. — Professor PEARSON.

PREPARATION: E21, E22.

Second Term, Third Year, three hours per week. The course consists of a study of some of the masterpieces of Nineteenth Century Literature with discussion of the ways in which these works are representative of their authors and expressive of the spirit of the age.

ELECTIVE.

E53. The English Bible. — Professor SEAVER.

PREPARATION: E21, E22.

First Term, Third Year, two hours per week. The assigned readings, confined to the text of the Bible, should acquaint the student with the more significant parts of the Old and, especially, of the New Testament. The purpose of the lectures is to show the historical origin and influence of the religious thought of the Jews, and the literary structure and excellence of the Biblical writings; also to give the student, as basis for his

subsequent reading and interpretation, knowledge of the conditions under which the books of the Bible were written.

ELECTIVE.

E56. English Composition, Advanced. — Professor ROBINSON.

PREPARATION: E11.

Second Term, Third Year, two hours per week, recitations and conferences. In this course an attempt is made to follow some one general topic coherently through the term, with attention to its various expressions in literature, science, and philosophy. Readings are used as a basis for oral and written discussion. For the present the topic is the philosophy of society.

ELECTIVE.

E57. Public Speaking. — Professor ROBINSON; Mr. ROGERS.

First Term, Third Year, two hours per week. The course takes the form of both class drill and individual training, and gives an introduction to the study of gesture, enunciation, tone, and expression. At least one informal speech and one prepared address are delivered by each student. The number that can be admitted to the course is limited, and applicants are required to consult Professor Robinson before final registration.

ELECTIVE.

E58. Argumentation and Debate. — Mr. ROGERS.

Second Term, Third Year, two hours per week. The purpose of the course is to give an opportunity for both formal and informal discussion of contemporaneous questions. A large amount of outside reading will be required.

ELECTIVE.

DEPARTMENT OF ECONOMICS AND STATISTICS

DAVIS R. DEWEY, PH.D., LL.D.
Professor of Economics and Statistics.

CARROLL W. DOTEN, A.M.
Associate Professor of Economics.

MARTIN J. SHUGRUE, A.B.
Assistant Professor of Economics.

FLOYD E. ARMSTRONG, A.M.
Assistant Professor of Economics

Instructor

EUGENE O. CHRISTIANSEN, S.B.

Ec31. Political Economy. — Professors DEWEY, DOTEN, SHUGRUE, ARMSTRONG.

PREPARATION: H31 simultaneously.

First Term, Third Year, two hours per week, lectures, discussions and written work. The course is elementary, with special emphasis upon descriptive economics.

REQUIRED IN ALL COURSES EXCEPT XV.

Ec32. Political Economy. — Professor DOTEN.

PREPARATION: H12.

First Term, Second Year, three hours per week. This course is not so general in its scope as Political Economy Ec31. More emphasis is placed upon fundamental principles.

REQUIRED IN XV.

Ec33. Economic History. — Professor DOTEN.

PREPARATION: H31 simultaneously.

First Term, Third Year, one hour per week. This course is designed for students who wish to take more work in Economics than is provided by Political Economy Ec31. The industrial history of England and the United States is reviewed, showing the historical origins of present economic conditions.

ELECTIVE.

Ec34. Railroad Economics. — Professor DOTEN.

PREPARATION: Ec31.

Second Term, Third Year, two hours per week, lectures and recitations, one hour per week, investigations. The method employed is both historical and comparative, and each question is discussed, so far as practicable, in the light of European as well as American experience. The following are some of the topics covered: the history of railroad development in the United States, methods of financing new roads, character and cost of con-

struction in different countries, competition and combinations, public service, rates and fares, freight classification, methods of accounting, reports and statistics. Special attention is given to the relation of the railroads to the state, and students are encouraged to investigate problems connected with government regulation and control.

ELECTIVE.

Ec35. Transportation. — Professor DOTEN.

PREPARATION: Ec65; Ec56 simultaneously.

Second Term, Third Year, two hours per week, lectures. The lectures will deal with the making of railroad rates, classification of freight, handling of freight, terminal facilities, warehousing, powers of the Interstate Commerce Commission in relation to the shipper, ocean rates, customs and port regulations, tonnage duties, port and inland differentials, and special transit privileges.

REQUIRED IN XV.

Ec36. Banking and Finance. — Professor DEWEY.

PREPARATION: Ec31.

Second Term, Third Year, three hours per week, lectures and investigations. The following topics will be considered: national banks, state banks, trust companies, savings banks, different kinds of loans, securities for loans, the bank statement, the money market, relation of the treasury and crop movement to money market, clearing house, domestic and foreign exchange and foreign systems of banking, particularly those of Canada, England and Germany. One hour of the three will be devoted to individual investigation and the use of banking reports under the immediate supervision of the instructor.

ELECTIVE.

Ec37. Banking. — Professor DEWEY.

PREPARATION: Ec31 or Ec32.

Second Term, Second Year, three hours per week. This course is similar to Banking and Finance Ec36, but more extended, particularly in exercises in banking problems.

REQUIRED IN XV.

Ec38. Securities and Investments. —

PREPARATION: Ec65; Ec56 simultaneously.

Second Term, Third Year, three hours per week. This course treats of (1) different kinds of securities: government, railroad, industrial, public utility, etc.; (2) the construction of bond tables, interest formulas, sinking fund calculation, serial bonds, amortization, and the mathematical theory of investment; (3) stock and produce exchanges, brokerage, and speculation.

REQUIRED IN XV.

Ec45. Labor Problems. — Professor DOTEN.

PREPARATION: Ec31.

Second Term, Third Year, two hours per week, lectures and discussions. The ground covered in this course consists of a brief résumé of modern industrial history, showing the laborer's place in the industrial world; a study of the history, purposes and achievements of trade unions; and the general condition of labor as regards wages, hours of labor, sanitary and safety regulations, and workman's insurance. The following special topics are discussed: arbitration; coöperation; profit-sharing; employers' liability; strikes and lockouts; injunctions; factory legislation; railroad relief associations and welfare schemes in manufacturing establishments. A third hour may be used at the option of the instructor in special investigation work.

ELECTIVE.

Ec50. Accounting. — Professor SHUGRUE.

PREPARATION: Ec31 or Ec32.

Second Term, Second Year, three hours per week. This course is not designed to make bookkeepers, auditors, or accountants in any professional sense, but deals rather with the analysis of financial reports. Instruction will deal with bookkeeping terminology, the significance of assets and liabilities, good-will, franchise, the construction of the balance sheet and of the profit and loss statement.

REQUIRED IN XV.

Ec51. Cost Accounting. — Professor SHUGRUE.

PREPARATION: Ec50, Ec56.

First Term, Fourth Year, three hours per week. The following topics will be considered: methods of determining costs of materials, processes of labor and machines; the distribution of indirect costs and overhead expenses; cost data to secure efficiency; shipping orders; inventories; recording and payment of wages.

REQUIRED IN XV.

Ec55. Economics of Corporations. — Professor DEWEY.

PREPARATION: Ec31.

First Term, Fourth Year, two hours per week, lectures. This course treats of the nature of corporations and their legal development, accounting, valuation of bonds, holding companies, lighting companies, street railway franchises, and the taxation of corporations.

REQUIRED IN VI.

Ec56. Industrial Organization. — Professor ARMSTRONG.

PREPARATION: Ec37, Ec50.

First Term, Third Year, two hours per week; Second Term, Third Year, three hours per week. This course gives an extended survey of the forms of

organization under which business is carried on at the present time, treating more particularly of corporations. Consideration is given to the differences in state corporation laws affecting choice of state for securing a charter, methods of promoting, underwriting, and financing a corporation, reorganization methods, and the state supervision of corporations.

REQUIRED IN XV.

Ec58. Business Management. — Mr. CHRISTIANSEN.

PREPARATION: Ec56.

First Term, Fourth Year, three hours per week; Second Term, Fourth Year, four hours per week. This course includes a survey of the methods of carrying on an individual business. The following topics are considered: the organization of the executive force, departmental functions, office systems, factory efficiency, standardization of goods, stock keeping, routing of orders, management of labor, selection of employees, systems of wage payments, bonuses, efficiency methods, welfare inducements, marketing of goods, organization of the sales department, advertising and publicity, credit department, and insurance.

REQUIRED IN XV.

Ec60. Business Law. — Mr. ALBERS.

Second Term, Third Year, one hour per week, lectures. The course consists of a general treatment of the subject of business law, such topics as the definition of law, its sources, the distinction between law and equity, and the application of law to business contracts being considered. To the last of these topics the most thorough treatment is given, that being the form of business law with which the students will have most to do in their professional life.

REQUIRED IN ALL COURSES, EXCEPT XV.

Ec61. Business Law. — Mr. SCHAUB.

PREPARATION: Ec56; Ec58 simultaneously.

First and Second Terms, Fourth Year, two hours per week. The course deals with contracts, agency, negotiable instruments, patent law and trademarks.

REQUIRED IN XV.

Ec65. Statistics. — Professors DEWEY, SHUGRUE.

PREPARATION: Ec50.

First Term, Third Year, two two-hour exercises per week. Elementary instruction is given in the construction of statistical tables and charts, official sources of commercial and financial statistics of the United States, and the interpretation of such material.

REQUIRED IN XV.

Ec70. Taxation. — Professor DEWEY.

PREPARATION: Ec32, Ec50, Ec56.

First Term, Fourth Year, one hour per week, lectures. An elementary course.

REQUIRED IN XV.

DEPARTMENT OF HISTORY AND POLITICAL SCIENCE

CHARLES F. A. CURRIER, A. M.
Professor of History and Political Science.

JOHN O. SUMNER, A. B.
Professor of History.

Assistants.

WILLIAM H. J. KENNEDY, A. B. LACEY D. CASKEY, B. A., PH. D.

THE courses in History naturally divide themselves into three groups: (1) those taken by all students pursuing regular Courses; (2) those required in Course IV; and (3) elective Courses.

The courses taken by all students pursuing regular Courses have for their main objects, first, to familiarize students with the history of the nineteenth century, a century of the highest historical as well as scientific importance, and second, to study the present governments and politics of the United States and of the principal European nations; in other words, to acquaint the student with contemporary history and political institutions, to stimulate and broaden his interest in the world of today, and to lay the foundations of good citizenship. The second group is designed to meet the special needs of students in the Course in Architecture. The elective courses are those offered as options in General Studies in the third year. (See page 132.)

H12. History I (American National Development). — Professor CURRIER.

PREPARATION: 4.

Second Term, First Year, two hours per week, lectures. The subject consists of two parts, history and government. (1) About one-half of the time is devoted to a consideration of selected advanced topics in the history of the United States, with more than usual reference to the history of the last fifty years and to contemporary problems. (2) National government and municipal government occupy most of the other half of the time, and only slight opportunity is afforded for studying the government of the states.

REQUIRED IN ALL COURSES.

H31. History II (European National Development). — Professor CURRIER.

PREPARATION: H12.

First Term, Third Year (Second Year for IV and VI), two hours per week, lectures. This course is largely a study of contemporary European govern-

ments and politics, with historical introductions to explain the origin and meaning of existing systems and conditions. The principal stress is laid on the leading nations, with as much attention to the minor countries as time permits. International relations, colonial possessions, and non-European interests, especially in Asia and Africa, are also studied.

REQUIRED IN ALL COURSES.

H33. History of European Civilization and Art (First Course). — Professor SUMNER.

PREPARATION: 4.

First Term, Second Year, three hours per week; Second Term, Second Year, two hours per week, lectures. This course treats of the rise of civilization and of its westward expansion through the Mediterranean basin. The racial, economic, religious, and political elements in this development are carefully traced, and upon the background thus gained the art of each successive epoch is studied and general æsthetic principles are discussed. The greater part of the time is devoted to Hellenic civilization and art, but as the students in Course IV have already had a specialized course in the History of Architecture, attention is here particularly concentrated upon sculpture. The lectures are very fully illustrated by lantern slides, supplemented by collections of photographs and by reference to the original works and casts contained in the Boston Museum of Fine Arts.

REQUIRED IN IV. NOT GIVEN IN 1916–1917.

H34. European Civilization and Art (Second Course). — Professor SUMNER.

PREPARATION: H33.

First and Second Terms, Third Year, two hours per week, lectures. This course treats of Greek civilization and art, particularly sculpture. The lectures are fully illustrated by lantern slides, supplemented by collections of photographs and by reference to the original works and casts contained in the Boston Museum of Fine Arts.

REQUIRED IN IV.

H35. European Civilization and Art (Third Course). — Professor SUMNER.

PREPARATION: H34.

First and Second Terms, Fourth Year, two hours per week, lectures. In this course a survey of the civilization and art of the Hellenistic and Roman world is followed by outlines of mediæval history and a study of Byzantine, Gothic, and Early Renaissance art.

REQUIRED IN IV.

H36. European Civilization and Art (Special Topics). — Professor SUMNER.

PREPARATION: H35

First Term, Graduate Year, two hours per week, lectures. Modern painting: a study of its development, problems, and predominant influences, from the Renaissance to the present time.

ELECTIVE IN IV.

H37. Current Public Problems. — Professor CURRIER.

PREPARATION: H31 simultaneously.

First Term, Third Year, one hour per week, lectures and written work. An intensive study of contemporary constitutional and political questions, chiefly in the United States, England, France and Germany.

ELECTIVE.

H38. Municipal Government. — Professor CURRIER.

PREPARATION: H31.

The ground covered is chiefly municipal government in the United States; but European, and especially English, municipal systems are studied for comparison and illustration.

ELECTIVE. Not given in 1916–1917.

H39. International Law. — Professor CURRIER.

PREPARATION: H31 simultaneously.

First Term, Third Year, one hour per week. Includes the study of a text-book, together with references to current international relations and to the history of diplomacy.

ELECTIVE. Not given in 1917–1918.

DEPARTMENT OF MODERN LANGUAGES

FRANK VOGEL, A.M.,
Professor of German.

ERNEST F. LANGLEY, PH.D.,
Professor of French.

HERMAN R. KURRELMEYER, PH. D.,
Associate Professor of German.

Instructors.

JOSEPH BLACHSTEIN.
JUSTUS ERHARDT.
GEORGE R. B. MEISTER.
OTTO E. PLATH, A.M.
FREDERICK W. C. LIEDER, PH.D.
FRANK S. CAULEY, PH.D.
GUILLERMO RIVERA, S.B., A.M.

THE study of Modern Languages at the Institute has two objects: that of enabling the student to make use of the languages as instruments in scientific research, and that of giving him general training and culture. It aims to give him sufficient facility with modern texts to use them without the necessity of translating, and as much familiarity with the spoken language as his individual aptitude and the time available permit. From the beginning as much of the class-room work as possible is carried on in the language taught. Occasional talks therein are also given, and writing from dictation is frequently practiced.

A sound knowledge of grammar is attained by the careful analysis of parts of the texts read, and by oral and written illustrative exercises. To make these of value a good pronunciation is essential, and this is striven for through constant practice in the class-room. In addition to a deeper knowledge of the language and literature, the advanced courses aim to impart succinctly familiarity with the character, customs, traditions, spirit, history and development of the peoples and countries whose language is studied.

In the designation of courses the grade of Elementary and Intermediate correspond, respectively, to the definitions of the Modern Language Association of America.[1] All other courses are of advanced grade.

[1] Report of the Committee of Twelve.

L11. German (Elementary).— Professor VOGEL; Messrs. ERHARDT, MEISTER, PLATH.

First and Second Terms, First year, three hours per week. This course is intended to prepare students to fulfill the entrance requirement in German. A study of grammatical forms, syntax and vocabulary through composition exercises and rapid reading forms the basis of the work.

ELECTIVE.

L21. German (Intermediate). — Professors VOGEL, KURRELMEYER; Messrs. BLACHSTEIN, ERHARDT, MEISTER, PLATH, LIEDER, CAULEY.

PREPARATION: 7 or L11.

First and Second Terms, First Year, three hours per week. This course includes a systematic review of grammar. The reading, scientific as well as literary, gradually becomes more difficult, and the syntax, idioms and synonyms of the language are carefully studied. By the end of the course students should be able to read understandingly any ordinary newspaper or magazine article of a literary or popular scientific nature, to understand simple spoken German, and to express simple thoughts in German. As far as practicable the exercises are conducted in German.

REQUIRED IN ALL COURSES EXCEPT IV.

L31. German (Advanced). — Professors VOGEL, KURRELMEYER.

PREPARATION: L21.

First and Second Terms, Second Year, three hours per week. This course consists wholly of exercises in scientific German on chemical, biological and geological subjects. As far as practicable the exercises are conducted in German.

REQUIRED IN V, VII, VIII$_{1,2}$, XII.

L32. German (Advanced). — Professors VOGEL, KURRELMEYER.

PREPARATION: L21.

First Term, Second Year, three hours per week. This course is wholly devoted to exercises in scientific German on physical, physico-chemical and electrical subjects. The work is partly based on selections from current scientific journals. As far as practicable the exercises are conducted in German.

REQUIRED IN VIII$_3$, XIV.

L33. German (Advanced). — Professors VOGEL, KURRELMEYER.

PREPARATION: L21.

First Term, Second Year, two hours per week. This course is wholly devoted to exercises in scientific German. Selections are made from current scientific journals.

REQUIRED IN X, XV.

L35. German (Advanced). — Professor VOGEL.

PREPARATION: L21.

First Term, Second Year, one hour per week. This course is wholly devoted to readings and exercises in scientific German on mechanical subjects. Selected passages from current foreign scientific periodicals and books form the basis of the work.

REQUIRED IN II.

L41. German (Advanced). — Professor VOGEL.

PREPARATION: L21.

First Term, Third Year, one hour per week; Second Term, Third Year, two hours per week. This course forms a brief introduction to the German Literature of the Eighteenth and Nineteenth Centuries. It is given in brief lectures in German with readings from standard works. The course is conducted mainly in German. Either term's work may be taken independently.

ELECTIVE: OPTION IN GENERAL STUDIES.

L42. German (Advanced). — Professor VOGEL.

PREPARATION: L21.

First Term, Third Year, one hour per week; Second Term, Third Year, two hours per week. This course consists of lectures on the German drama with a considerable amount of reading from characteristic plays, beginning with Schiller's Don Karlos. This course is conducted mainly in German. Either term's work may be taken independently.

ELECTIVE: OPTION IN GENERAL STUDIES.

L43. German (Advanced). — Professor VOGEL.

PREPARATION: L21.

First Term, Third Year, two hours per week. This course comprises composition, dictation, reading, lectures, and conversation. The work is partly based on current newspaper and magazine articles.

ELECTIVE: OPTION IN GENERAL STUDIES.

L44. German (Advanced). — Professor VOGEL.

PREPARATION: L21.

Second Term, Third Year, two hours per week. This course consists wholly of exercises without preparation. It is distinctively a sight reading course for practice in rapid reading. The selections are from current periodicals.

ELECTIVE: OPTION IN GENERAL STUDIES.

L45. German (Advanced). — Professor VOGEL.

PREPARATION: L21.

Second Term, Third Year, two hours per week. This course consists of lectures and readings on the life and work of the most important German men of science. As far as practicable the exercises are conducted in German.

ELECTIVE: OPTION IN GENERAL STUDIES.

L46. German (Advanced). — Professor VOGEL.

PREPARATION: L21.

Second Term, Third Year, two hours per week. This course consists of lectures and readings with a study of the development of the Faust legend. Opportunity is offered for theme-writing and discussion in German.

ELECTIVE: OPTION IN GENERAL STUDIES.

L47. German (Advanced). — Professor VOGEL.

PREPARATION: L21.

Second Term, Third Year, one hour per week. This is a practical course in commercial correspondence. Under normal conditions a foreign correspondent will be provided for each member of the class.

ELECTIVE: OPTION IN GENERAL STUDIES.

L61. French (Elementary). — Professor LANGLEY.

First and Second Terms, First Year, three hours per week. This course is designed to enable students to fulfill the entrance requirement in French.

ELECTIVE.

L62. French (Intermediate). — Professor LANGLEY.

PREPARATION: 6.

First and Second Terms, First Year, three hours per week. This course consists of recitations partly conducted in French. It comprises a continuation of the study of grammar, translation into French of connected passages, letter-writing, dictation, reading and translation of some standard modern authors. At the end of the course the student should be able to understand easy spoken French, express simple ideas in French, read works of ordinary difficulty without having to go through the process of translation, and, finally, have a real appreciation of the authors read.

REQUIRED IN IV.

L71. French (Advanced). — Professor LANGLEY.

PREPARATION: L62.

First and Second Terms, Third Year, one hour per week. This course is offered in alternate years. It consists of a rapid survey of the French drama from the Seventeenth Century to the present time, with the reading of eight or nine representative plays, and brief lectures in French. Either term's work may be elected independently.

ELECTIVE: OPTION IN GENERAL STUDIES.

L72. French (Advanced). — Professor LANGLEY.

PREPARATION: L62.

First and Second Terms, Third Year, one hour per week. This course is offered in alternate years. It consists of a brief survey of the history of French Literature. Such topics as the following will be discussed in outline; the literature of the middle ages; the Renaissance; classicism; romantic movement; realism; naturalism; art for art's sake; impressionism and symbolism. Most of the work will be concentrated upon the reading of nineteenth century authors. The work of either term may be elected independently.

ELECTIVE: OPTION IN GENERAL STUDIES. OMITTED IN 1916–1917.

L73. French (Advanced). — Professor LANGLEY.

PREPARATION: L62.

First Term, Third Year, two hours per week. This course comprises conversation, reading of modern French, and a small amount of composition and letter-writing. The class work will be carried on in French as much as possible.

ELECTIVE: OPTION IN GENERAL STUDIES.

L74. French (Advanced). — Professor LANGLEY.

PREPARATION: L62.

Second Term, Third Year, two hours per week. This course consists of letter-writing, composition, conversation, and the sight reading of modern French. Part of the latter will deal with subjects, which although of special value to students in architecture, will be of general interest and profit. No preparation is required for the exercises. The class work will be conducted in French as much as possible.

ELECTIVE: OPTION IN GENERAL STUDIES.

L81. Spanish (Elementary). — Professor LANGLEY; Mr. RIVERA.

First and Second Terms, Third Year, two hours per week. This course includes the study of the elements of Spanish Grammar, regular verbs and all common irregular verbs, composition exercises, and the reading of easy Spanish texts. In 1917–18 and thereafter, Course III, Option 1, may take this subject three times per week in the second term.

ELECTIVE.

L91. Italian (Elementary). — Professor LANGLEY.

First and Second Terms, Third Year, two hours per week. This course is offered in alternate years. It includes the study of the elements of Italian Grammar, regular verbs, and all common irregular verbs, composition exercises, reading of Italian texts, and some practice in conversation.

ELECTIVE.

DEPARTMENT OF MATHEMATICS

HARRY W. TYLER, PH.D.
Walker Professor of Mathematics.

DANA P. BARTLETT, S.B.
Professor of Mathematics. (Absent.)

FREDERICK S. WOODS, PH.D.
Professor of Mathematics.

FREDERICK H. BAILEY, A.M.
Professor of Mathematics.

EDWIN B. WILSON, PH.D.
Professor of Mathematics.

NATHAN R. GEORGE, JR., A.M.,
Associate Professor of Mathematics.

LEONARD M. PASSANO, A.B.
Associate Professor of Mathematics.

CLARENCE L. E. MOORE, PH.D.
Associate Professor of Mathematics.

HENRY B. PHILLIPS, PH.D.
Assistant Professor of Mathematics.

Instructors

JOSEPH LIPKA, PH.D.
FRANK L. HITCHCOCK, PH.D.
BARNEM B. LIBBY, M.A.
GEORGE RUTLEDGE, PH.D.

GREAT importance is attached to the study of mathematics, both as a means of general education and as a necessary basis for further instruction in the engineering and other subjects. Nearly all students pursuing regular Courses study mathematics throughout their first two years, beginning with a course in plane trigonometry, and a general course in algebra, analytic geometry, and calculus which begins in the first term of the first year and continues to the middle or end of the second year, or in some Courses to the middle of the third year. This consecutive course in mathematics includes work formerly divided somewhat arbitrarily into algebra, analytic geometry, differential calculus, integral calculus, and differential equations. The sub-titles retained in parentheses indicate merely the approximate distribution

under the present plan. Care is taken to present both underlying principles and a great variety of concrete applications, the latter connecting the mathematical instruction closely with the professional studies. The instruction is given mainly by recitations in small sections, the number of the students in a section being generally limited to about twenty. Students having time and interest for the study of mathematics beyond the prescribed limits are offered opportunity for more advanced work.

The Department possesses an excellent library containing about twenty-five hundred carefully selected volumes, and an extensive collection of models which are of special interest and value in connection with the more advanced courses.

M10. Plane Trigonometry. — Professors BAILEY, GEORGE,[1] PASSANO, MOORE, PHILLIPS; Messrs. LIPKA, HITCHCOCK, LIBBY, RUTLEDGE.

PREPARATION: 1, 2, 5.

First Term, First Year, two hours per week. The course covers the following subjects: definitions of the trigonometric functions as ratios; proofs of principal formulas; trigonometric transformations; circular measure of angles; solution of trigonometric equations; inverse trigonometric functions; proofs of formulas of right and of oblique triangles; theory and use of logarithms; areas solutions of right and of oblique triangles, The course is fully illustrated by practical problems.

REQUIRED IN ALL COURSES.

M11. Mathematics (Algebra, Elements of Analytic Geometry). — Professors TYLER,[1] WOODS, BAILEY, WILSON, GEORGE, PASSANO, MOORE, PHILLIPS; Messrs. LIPKA, HITCHCOCK, LIBBY, RUTLEDGE.

PREPARATION: 1, 2, 5; M10 simultaneously.

First Term, First Year, two hours per week. This course covers the following subjects: graphical representation; the polynomial of the first degree in one variable, including the analytic geometry of the straight line; the polynomial of the *n*th degree in one variable, including the fundamental theorems of the theory of equations; the plotting of certain algebraic functions expressed by surds or fractions; differentiation of the polynomial in one variable, including problems on tangents, normals, maxima and minima, and points of inflection. The division of topics between Mathematics M11 and Mathematics M12 varies from year to year.

REQUIRED IN ALL COURSES.

[1] In charge.

M12. Mathematics (**Analytic Geometry, Elements of Calculus**). — Professors TYLER, BARTLETT, WOODS, BAILEY,[1] WILSON, GEORGE, PASSANO, MOORE, PHILLIPS; Messrs. LIPKA, HITCHCOCK, LIBBY, RUTLEDGE.

PREPARATION: M10, M11.

Second Term, First Year, four hours per week. This course is a continuation of the preceding and covers the following subjects: the derivation of the equations of curves defined by geometric properties; intersection of curves; differentiation of algebraic functions with applications to geometrical and physical problems; inverse differentiation applied to problems; change of coördinate axes; the analytic geometry of curves of the second degree; graphs and derivatives of elementary transcendental functions, and problems; parametric representation; polar coördinates; and curvature. Throughout the course special attention is given to the solution of problems, which are introduced as soon as the requisite theory has been developed.

REQUIRED IN ALL COURSES.

M20. Spherical Trigonometry. — Professor PASSANO;[1] Dr. HITCHCOCK.

PREPARATION: M10.

First Term, Second Year, ten exercises. This course covers the proofs of formulas of right and of oblique spherical triangles, and dependent problems.

REQUIRED IN I.

M21. Mathematics (**Integral Calculus**). — Professors TYLER, WOODS,[1] BAILEY, WILSON, GEORGE, PASSANO, MOORE, PHILLIPS; Messrs. LIPKA, HITCHCOCK, LIBBY, RUTLEDGE.

PREPARATION: M12.

First Term, Second Year, three hours per week. A course devoted mainly to the integral calculus of functions of one variable and covering the following subjects: infinitesimals and differentials; methods of integration; definite integrals; geometrical applications to areas and lengths of plane curves, volumes of solids of revolution, and other volumes which can be found by a single integration; and mechanical applications to work, attraction, pressure, and centers of gravity and pressure. The division of topics between Mathematics M21 and Mathematics M22 varies from year to year.

REQUIRED IN ALL COURSES.

M22. Mathematics (**Solid Analytic Geometry, Calculus**). — Professors TYLER, WOODS, BAILEY, WILSON, GEORGE, PASSANO, MOORE,[1] PHILLIPS; Messrs. LIPKA, HITCHCOCK, LIBBY, RUTLEDGE.

PREPARATION: M21.

Second Term, Second Year, three hours per week. A course in continuation of Mathematics M21, mainly devoted to the study of functions of

[1] In charge.

two variables and covering the following subjects: the elements of solid analytic geometry including a discussion of the plane, the straight line and simple surfaces; partial differentiation; multiple integration, with geometrical applications to areas and volumes, and with mechanical applications to attraction, moments of inertia, and centers of gravity; line integrals and exact differential equations.

REQUIRED IN ALL COURSES EXCEPT IV_1, V_2, 3, VII, XV_3.

M26. The Theory of Probability and Method of Least Squares. — Professor BARTLETT.

PREPARATION: M22 simultaneously.

Second Term, Second Year, two hours per week for ten weeks. In this course the fundamental principles that govern the application of the method to the adjustment of observations are first developed. Numerous problems are then solved illustrating the process of computing the most probable values of the unknown quantities, the determination of the precision measures of the results, and the discussion of the accuracy necessary to be attained in the component measurements of a series in order that the final result may be secured with a prescribed degree of accuracy. The use of the method in the development of empirical equations, the question of the rejection of discordant observations, and the occasional occurrence of special laws of distribution of the errors of observation are also considered. *Text-book, Bartlett's General Principles of the Method of Least Squares.*

REQUIRED IN $VIII_{1,2}$. Not given in 1916–1917.

M31. Mathematics (Differential Equations). — Professors BAILEY, WILSON,[1] PHILLIPS, Dr. RUTLEDGE.

PREPARATION: M22.

First Term, Third Year, three hours per week. This course is a continuation of course M22, and covers the following subjects: differential equations of the first order; singular solutions; linear differential equations; and geometrical and mechanical applications.

Course M36 is recommended in place of this to any who expect to take graduate work.

REQUIRED IN II, XIII, XIIIB.

M32. Mathematics (Advanced Calculus, Differential Equations). — Professor PHILLIPS.

PREPARATION: M22.

Second Term, Third Year, two hours per week. This is an abridgment of course M35.

REQUIRED IN XIV.

[1] In charge.

M35. Mathematics (Advanced Calculus, Differential Equations). — Professors WILSON,[1] MOORE.

PREPARATION: M22.

Second Term, Third Year, three hours per week. This course is substantially a repetition of M31.

REQUIRED IN VI, $VIII_1$.

M36. Mathematics (Advanced Calculus and Differential Equations). — Professor WOODS.

PREPARATION: M22.

First Term, Third Year, four hours per week. A course covering the following subjects: Taylor's Formula with applications to approximations in calculation and analysis, partial differentiation, complex numbers, vectors, differential equations of the first order, linear differential equations, total and partial differential equations, with numerous applications to geometry and physics.

REQUIRED IN $VIII_2$, XIIIA.

M38. Mathematics (Advanced Calculus and Differential Equations). — Professor WOODS.

PREPARATION: M36.

Second Term, Third Year, two hours per week. This course treats the following subjects: line and surface integrals, vectors, functions defined by integrals, the elements of the calculus of variations, differential equations of physics.

REQUIRED IN XIIIA.

M39. Mathematics (Advanced Calculus and Differential Equations). — Professor WOODS.

PREPARATION: M36.

Second Term, Third Year, three hours per week. This course is an amplification of course M38.

REQUIRED IN $VIII_2$.

M45. Fourier's Series; LaPlace's Coefficients. — Professor BAILEY.

PREPARATION: M31 OR M35.

First and Second Terms, Fourth Year, two hours per week. In this course the theory of Fourier's series, Bessel's functions, zonal and spherical harmonics, and their application to the solution of such problems in physics as can be expressed by certain partial differential equations, are discussed.

REQUIRED IN VIII.

[1] In charge.

History of the Mathematical Sciences. — Professor TYLER.

First and Second Terms, Third Year. This course consists of about ten lectures during each term and forms a part of course 790 on the History of Science, under which title a more detailed description may be found.

ELECTIVE.

ELECTIVE ADVANCED COURSES

In addition to the above subjects, which are required in certain Courses, opportunity for further elective work is given, the topics varying from year to year.

Graduates of the Institute, or of other colleges, desiring to prepare themselves under the conditions of a scientific school for the teaching of mathematics may advantageously include some or all of these subjects, as well as any of the above not previously taken, in programs for the degree of Master of Science.

The Department will also endeavor in particular to meet the needs of graduate students desiring to engage in mathematical investigation of problems of engineering or applied science.

It is highly desirable that students who intend to take any of the following courses should have previously completed courses M36 and M39.

M51. Curve Tracing. — Dr. HITCHCOCK.

PREPARATION: M22.

Second Term, two hours per week. A course of two exercises a week during the second term, covering the more important facts in regard to plane curves. A large variety of curves are plotted from their equations. Enough time is given to invariants, both scalar and vector, to show the meaning and use of these quantities.

ELECTIVE.

M52. Elementary Theory of the Potential Function. — Dr. HITCHCOCK.

PREPARATION: M22.

First Term, two hours per week. An elementary course introducing the student to some of the conceptions underlying modern mathematical physics: electrostatic and gravitational potential, vector fields, and vector potential. The intent of the course is to develop a point of view, rather than to study any part of the subject in detail.

ELECTIVE. NOT GIVEN IN 1916–1917.

M53. Thermodynamics. — Professor PHILLIPS.

PREPARATION: M31 OR M35.

First Term, two hours per week. This course covers the general theory of thermodynamics based either on statistical mechanics or on the two fundamental laws.

ELECTIVE. Not given in 1916–1917.

M54. Mathematical Laboratory. — Dr. LIPKA.

PREPARATION: M22.

First and Second Terms, two hours per week. A course for practical instruction in numerical, graphical and mechanical calculation and analysis as required in the engineering or applied mathematical sciences. Either term's work may be taken without the other. The course will include: methods for checking the accuracy of arithmetic and logarithmic computations; numerical solution of algebraic, transcendental and differential equations; graphical methods in the processes of arithmetic, algebra and the calculus; nomography and the construction of graphical charts; curve fitting to empirical data; approximate methods of integration, differentiation and interpolation; the use and principles of construction of instruments employed in calculation, such as slide-rules, arithmometers, planimeters and integraphs; and many kindred topics.

ELECTIVE.

M56. Elements of the Theory of Functions of a Complex Variable. — Professor TYLER or Professor WOODS.

PREPARATION: M31 OR M35.

First or Second Term, two hours per week. In this course emphasis will be placed on the general bearings of the subject in its relation to special branches of mathematics and their applications, with which the students may be already familiar, and on its significance as an introduction to more advanced subjects.

ELECTIVE.

M57. Hydrodynamics. — Professor WILSON.

PREPARATION: M38.

First or Second Term, twenty lectures. In this course the fundamental equations of hydrodynamics are developed and applied to the solution of particular problems.

ELECTIVE.

M58. Advanced Geometry. — Professor WOODS.

PREPARATION: M31 OR M35.

Second Term, two hours per week. This course is intended to extend the knowledge of analytic geometry acquired in the required mathematical

courses. Among other subjects, those of projective geometry and non-euclidean geometry will be handled.

ELECTIVE.

M59. Fluid Dynamics, Theoretical. — Professor WILSON.

First and Second Terms, Graduate Year, two hours per week. The classical mathematical treatment of the motion of fluids, Kirchhoff-Helmholtz discontinuity, cyclic and vortex motion, effect of viscosity and elasticity.

REQUIRED IN GRADUATE COURSE IN AËRONAUTICAL ENGINEERING.

M63. Mathematics of Wireless Telegraphy. — Professor WILSON.

PREPARATION: M39.

Second Term, two hours per week. This course includes a treatment of the simpler and of some of the more difficult theories of the transmission and reception of electromagnetic energy by ether waves.

ELECTIVE. Not given in 1916–1917.

M65. Analytical Mechanics. — Professor MOORE.

PREPARATION: M35.

First and Second Terms, two hours per week. This is mainly a problem course in the kinetics of particles and of rigid bodies in the plane. With the consent of the instructor the course may be taken in either half year alone.

ELECTIVE.

M66. Dynamics of Rigid Bodies. — Professor WILSON.

First and Second Terms, Graduate Year, three hours per week. A complete course of lectures and problems in theoretical mechanics with especial reference to the control of aëroplanes, their oscillations in flight, and gyroscopic effects in turning.

REQUIRED IN GRADUATE COURSE IN AËRONAUTICAL ENGINEERING.

M67. Statistical Methods in Theoretical Physics. — Professor WILSON.

PREPARATION: M39.

First and Second Terms, one hour per week. A course of lectures dealing with general aspects and particular applications of the use in physics of statistical methods, which, beginning with the kinetic theory of gases, have gradually extended over a wide range of phenomena, especially those connected with the second law of thermodynamics.

ELECTIVE. Not given in 1916–1917.

M69. Partial Differential Equations. — Professor WOODS.

PREPARATION: M35 OR M31.

First Term, two hours per week. This course is an introduction to the theory of partial differential equations, especially of the types which appear

in applied mathematics. Particular attention is paid to the solution of equations under given boundary conditions.

ELECTIVE. NOT GIVEN IN 1916–1917.

M71. The Teaching of Elementary Mathematics.

This course will consist of fifteen or more exercises conducted by various members of the Department and devoted to the discussion of selected questions with special reference to the history and literature of the subject. No specific requirement as to preparation will be made, but the course will be open only to graduate students.

ELECTIVE.

Laboratories

THE most marked characteristic of the Institute from the material point of view consists of its numerous large and well-equipped laboratories.

Recognition of the value of laboratory instruction as a fundamental element in general education and of the proper function of such instruction is of comparatively recent origin, dating only from the latter half of the last century. Such instruction has formed a very important department of the work at the Institute from the beginning, the Institute having taken the initiative in the establishment of laboratory work along various lines.

In the first Annual Catalogue it was stated that "The laboratory arrangements of the School are designed, when complete, to embrace the following departments: (1) Laboratory of Physics and Mechanics; (2) Laboratories for Chemical Analysis; (3) Laboratory for Metallurgy; and (4) Laboratory for Industrial Chemistry." "A high value is set upon the educational effect of laboratory practice, in the belief that such practice trains the senses to observe with accuracy, and the judgment to rely with confidence on the proof of actual experiment."

The system of laboratory instruction thus inaugurated has since been greatly extended, and now includes the following:

The Engineering Laboratories, including the Laboratory of Steam and Compressed Air, the Hydraulic Laboratory, the Refrigeration Laboratory, the Testing Materials Laboratory, the Gas Engine Laboratory and the Power Measurement Laboratory.
The Laboratories of Mining Engineering and Metallurgy.
The Laboratories of Chemistry.
The Research Laboratory of Physical Chemistry.
The Research Laboratory of Applied Chemistry.
The Augustus Lowell Laboratories of Electrical Engineering.
The Research Laboratory of Electrical Engineering.
The Laboratories of Biology and Public Health.
The Sanitary Research Laboratory and Sewage Experiment Station.

The Rogers Laboratory of Physics, including Laboratories of General Physics and the special Laboratories of Heat Measurements, Physico-Chemical Measurements, and Electrochemistry.
The Mineralogical and Geological Laboratories.
The Mechanical Laboratories.
The Hawaiian Volcano Observatory.
The Aërodynamic Laboratory.

The Laboratory of General Chemistry was opened in 1866, and is believed to have been the first laboratory for instruction in general chemistry to classes of considerable size. The Physical Laboratory was established in 1869, and was the first laboratory of the kind in the world to offer class instruction. Previous to 1871 metallurgical work was done in the Chemical Laboratories; but in that year a distinct Mining and Metallurgical Laboratory was put in operation, the first in the world for the treatment of ore in large quantities for purposes of instruction. An Engineering Laboratory was established on a small scale in 1874, was much enlarged in 1882, and has steadily increased in efficiency since that time. The Mechanical Laboratories were a result of President Runkle's study of the Russian exhibit at the Centennial Exhibition of 1876 in Philadelphia. The Geological Laboratory was established in 1880; the Biological Laboratories in 1883; the Research Laboratory of Physical Chemistry and the Sanitary Research Laboratory and Sewage Experiment Station in 1903; the Research Laboratory of Applied Chemistry in 1908; the Hawaiian Volcano Observatory in 1912; the Research Laboratory of Electrical Engineering in 1913; and the Aërodynamic Laboratory in 1914.

The Institute laboratory work is effectively supplemented by visits to engineering and industrial establishments, and by excursions directed by members of the Faculty.

The Engineering Laboratories, which occupy parts of Buildings 1 and 3, and the whole of a building situated east of the power house, cover an area, exclusive of offices and corridors, of 70,700 square feet.

The equipment of these laboratories has been selected with the following objects in view: — First, to give the student practice in such experimental work as an engineer in the pursuit of his profession is called upon to perform, and second, to provide ample facilities for original investigation and research in engineering subjects.

The apparatus in these laboratories will be enumerated under six main divisions.

The Steam and Compressed Air Laboratory is equipped with a number of different types of engines all of which are arranged for experimental work, i.e., a 9″–16″–24″ by 30″ triple expansion Corliss engine, an 11″–19″ by 15″ McIntosh and Seymour tandem compound engine, a 16″–30″ by 15″ American Ball Angle compound engine, a 14″–16″ by 23″ McEwen tandem compound engine, a 12″–20″ by 12″ Westinghouse compound engine, also an $8\frac{1}{2}$″ by 8″ Westinghouse simple engine, an 11″ by 30″ Brown engine; also a Harris Corliss, an Armington and Sims, two Sturtevant and three plain slide valve engines. This laboratory has also a 75 kw. Curtiss turbine, a 100 H.P. Terry steam turbine with Janesville centrifugal pump, a 150 H.P. DeLaval turbine with two-stage pump, a 16 H.P. DeLaval turbine, and a $7\frac{1}{2}$ H.P. DeLaval turbine. In the power house the following units are available for experimental work: — a 500 kw. Westinghouse Parsons turbine, a 750 kw. Curtiss turbine, and a 150 kw. Curtiss turbine. The laboratory has an adequate supply of surface condensers with the necessary circulating apparatus and dry air pumps; apparatus for determining the reaction from turbine nozzles; injector testing apparatus; pulsometers; an Emerson pump; an independently fired superheater; a three-stage air compressor, compressing to 2500 lbs. per. sq. inch, with cylinders 8″–$4\frac{5}{8}$″–$1\frac{7}{8}$″ by 12″ stroke; an 8″ by 8″ Chicago Pneumatic Tool Company's compressor; an Ingersoll Rand two-stage compound air compressor, as well as a number of smaller compressors. Three large steam driven pumps used in hydraulic work are equipped for testing.

Beside the above, there are two Spencer vacuum sweepers and a sweeper built by the Sanitary Devices Manufacturing Company, arranged for experimental work.

The Hydraulic Laboratory possesses an extensive equipment. The largest circulating unit is a 30″ centrifugal of a capacity of 22,000 gallons per minute. The discharge of this pump may be used in maintaining a flow in a system of canals built into the basement floor, and in furnishing water through a Venturi meter tube, to a steel canal 5′ by 5′, 135 feet long, located in the second story. This steel canal supplies water through a pen-stock to an 18″ water wheel, built by the S. Morgan Smith Company, of a capacity of 175 H.P. when working under a head of 35 feet, the maxi-

mum head available. This water wheel discharges into a tail race in which the level of the back water may be controlled by an hydraulic gate 10′ by 10′. On the back of the main gate is a second gate, built like a gridiron valve, which controls openings in the main gate and makes possible the regulation of the height of the back water, so that different effective lengths of draft tubes may be obtained. The water after passing this gate is carried over a submerged weir 10 feet wide and finally passes over a weir crest where the quantity of water may be accurately measured. This laboratory has also two steel pressure tanks 5 feet in diameter, one about 20 feet tall, good for 80 pounds pressure, and one 30 feet tall, good for 250 pounds pressure. The laboratory has in addition two turbine driven stage centrifugal pumps, two duplex pumps each of 1000 gallons per minute capacity and a high pressure pot valve duplex pump of 1500 gallons per minute capacity. There are a number of plunger pumps, a rotary pump of a 1000 gallons per minute capacity, two water wheels of 30 and 20 H.P. respectively; an hydraulic ram with 4″ drive-pipe; and a ram with two 3″ drive-pipes; a Luitweiler deep well pump; four large calibrated tanks, arranged with hydraulically controlled operating valves, having a combined measuring capacity of about 1000 cubic feet of water per minute. There are a number of small weirs and small weighing tanks.

Connecting with the canal system in the Hydraulic Laboratory there are two sumps, 26 feet deep, in which water may be maintained at any level by means of special 16″ valves through which water may be bled from the main canals. These sumps make possible the testing of reciprocating pumps with different depths of suction. Over these sumps there is a platform on which pulsometers, deep well pumps, and apparatus of that type may be located. The laboratory has also a number of small Venturi meters. In addition to the above enumerated pieces of apparatus should be mentioned a very excellent equipment of small orifices, nozzles, Pitot tubes, diverging tubes, and other apparatus available for research work.

The Refrigeration Laboratory contains a five ton ammonia compression machine and a five ton absorption machine each provided with a special device for weighing the amount of ammonia circulated, connected to brine tanks and arranged for efficiency tests and for experimental work upon the formation of

ice; a Kroeschell carbonic acid machine, also equipped for experimental work; brine pipes connect this laboratory with various parts of the Institute for service work; condensers of various types are arranged for experimental determination of the rate of heat transmission under different rates of water flow; also apparatus for testing the heat transfer through radiators; brine coolers of different types arranged for conductivity tests for different velocities of the brine; condensers arranged to study the effect of oil coatings on the pipe conductivity; also auxiliary apparatus and instruments needed in such a laboratory.

The Testing Materials Laboratory provides for the testing of materials in tension, compression, transverse and shear; the study of the heat treatment of metals, their hardness, toughness, and resistance to repeated stress; the physical tests of the materials used in highway construction; tests on cement, sand and concrete; and tests to determine the wearing qualities of oils and bearing metals.

The equipment of the laboratory is as follows:

An Amsler-Laffon compression machine of 1,000,000 lbs. capacity; one Universal testing machine of 400,000 lbs. capacity, with a platin allowing the testing of an 8 ft. specimen in transverse; an Emery machine of 300,000 lbs. capacity which will test a specimen 18 ft. long in compression, 12 ft. long in tension. This machine is equipped with an hydraulic accumulator weighed to 1700 lbs. per sq. in., which may be used for general pressure work; one Universal machine of 200,000 lbs. capacity fitted with outriggers for transverse tests; three Universal testing machines of 100,000 lbs. capacity, one of 70,000 lbs. capacity, one of 60,000 lbs. capacity with autographic and automatic attachments, one of 50,000 lbs. capacity, and one of 20,000 lbs. capacity; a beam machine of 100,000 lbs. capacity adapted for the testing of beams up to 25 ft. in length. This machine may also be adapted for the testing of framing joints, floor slabs, pipes, and for many other purposes; a rope and chain testing machine of 100,000 lbs. capacity; a torsion machine capable of testing a shaft 3″ in diameter and 15 ft. long; a torsion machine of 60,000 inch pounds capacity, also one of 6,000 inch pounds capacity; three vertical wire machines; one bending machine for making cold bend tests on steel; two machines for making transverse tests on cast iron; an oil and bearing testing machine; a machine for testing steel for repeated stress; a spring testing machine. The portion of the laboratory

used for the study of heat treatment is equipped with a complete outfit of furnaces, quenching baths and heat measurement apparatus necessary for the study of the effect of heat treatment on metals. Dark rooms, polishing and microscopic apparatus, a Brinell machine, a Shore scleroscope and two drilling machines for the testing of metals for hardness, are provided in connection with this laboratory.

The laboratory for the testing of highway materials is equipped with a full set of the machines recommended for the physical testing of rock for road building by the United States Department of Agriculture, Office of Public Roads, a brick rattler, a stone crusher and all necessary ovens and tanks.

The laboratory for testing cement and concrete is equipped with mixing tables, moulds, screens, mechanical shakers, heat controlled storage tanks and damp closets, testing machines for both tension and compression, hoods, boilers, etc. Two concrete mixers and a bar bender are located in the laboratory with an assortment of moulds and other accessories for the study of concrete aggregates and the fabrication of specimens. A temperature and moisture controlled room for the storage of specimens is provided in this laboratory; also a cold room and an apparatus for the testing of water proofing coatings.

The Gas Engine Laboratory which is especially designed for tests of internal combustion engines occupies two floors of a building 40′x75′, beside the Power House, on Vassar Street. It is equipped with engines and accessories for class instruction in gas, oil and gasoline engines, and is provided with facilities for erecting and testing engines which may be received temporarily for research work. This Laboratory contains the following:

A small class-room, and two rooms fitted with meters and other apparatus for gas and oil measurements; a suction gas producer plant of 50 H.P. capacity; a room for testing aëro-engines. This is partitioned off from the rest of the laboratory, so that the engines may exhaust directly into the room. It contains a cast-iron bed plate 5′x9′, so mounted that rotating-cylinder engines can be accommodated, and full-sized propellers can be used for loading the engines; a cast-iron bed plate for tests of large gasoline engines, particularly for marine motors; an electric dynamometer in line between the two above bed plates, adapted for loading or for motoring the engine on either plate; a four-cycle gas engine, 16″x24″,

of 50 H.P.; a 50 H.P. Diesel; a four-cycle gas engine, 11″x18″, of 36 H.P.; two smaller gas engines of 12 and 4 H.P. respectively; two four-cycle oil engines of 20 and 3 H.P. respectively; a two-cycle oil engine of 6 H.P.; a 10 kw. gas-electric generating set having a four-cylinder gasoline engine; three four-cylinder automobile engines; two single-cylinder, two-cycle, motor-boat engines; two hot air engines; a small gasoline engine and air compressor for starting the gas engines; two test blocks for temporary tests of automobile engines; gasoline and fuel-oil storage tanks located under ground, outside the building.

The Power Measurement Laboratory contains a belt testing machine for determining the power transmitted by belts under known tensions and known speeds at different speeds of slip; apparatus for testing fans; power scales; dynamometers; friction brakes; experimental governors, both pendulum and flywheel types; one large and one small centrifugal machine arranged for the experimental determination of the critical speeds; machines for testing efficiency of roller and ball bearings, also for the efficiency of lubricated bearings; a machine for testing the efficiency of chain drives; a machine for the experimental determination of standing or running balance of revolving parts and a balancing machine.

The Laboratories of Mining Engineering and Metallurgy. — These laboratories are designed to furnish students the means for the experimental study of operations carried on in sampling, mining, and ore-dressing, and of processes practiced in smelting, leaching, electro-depositing, and in the mechanical as well as heat treatment of metals and alloys. They aim at the same time to give the mental training necessary for professional practice. In addition to the large laboratories there are provided small rooms for special research. The apparatus has been chosen with a view to illustrating, as far as possible, the principles of the more important apparatus used in mines, mills and metallurgical plants.

Sampling is confined to taking dry samples; pulp-sampling is carried on in the ore-dressing divisions.

In mining, the machines and apparatus for drilling, blasting, lighting and ventilating form the basis of laboratory work. In ore-dressing and non-ferrous metallurgy, the mechanical and chemical treatment of ores, of lead, copper, gold, and silver serve this

purpose. The production of iron and steel in quantity is precluded by the size of the plant required, and the large amount of ores and fluxes needed; electric smelting and refining take the place of large-scale work. Heat treatment of metals and alloys followed by mechanical testing and microscopical study form the basis of the study of their physical properties.

The experimental work of the laboratories is carried on by students under the immediate charge of instructors. It is divided into class and individual work. The former is typical for mining, ore-dressing, smelting, and electro-deposition, the latter for sampling, assaying, leaching, amalgamating, heat treatment and microscopical examination. In class work, a machine is operated, or a lot of ore is treated in a series of connected ore-dressing operations or in one or more furnaces. Each member of the class is given charge of every apparatus, or carries through the several manipulations connected with a furnace until he has become familiar with the duties and has made the required observations, measurements and records. In individual work, each student is assigned an ore, a metal or alloy for assay or treatment. The materials and methods are so chosen that the individual results, when combined, will form a consecutive series which will bring out the best method of treatment and working.

It is not considered that the instruction given in these laboratories is in any sense a substitute for the experience gained in works. It is believed, however, that it prepares students to enter works and be almost immediately useful. The spirit of investigation which is developed by the work, as well as the experience gained in comparing operations and processes carried out in person with those described in books, are of great advantage.

The laboratories include eight divisions: crushing and sampling; mining; concentration and plate amalgamation; lixiviation, pan amalgamation, and electro-deposition; roasting, converting and smelting; dry and wet assaying; heat treatment and microscopical examination of metals and alloys, and the metallurgy of iron and steel.

The Crushing and Sampling Laboratory has two rooms with an area of 1150 square feet on the first floor. Ores to be sampled are received in the basement and raised by an elevator. The parts rejected in sampling go through the floor back to the basement

where with a floor of 2200 square feet ample provision is made for storage. There are provided the necessary machines for coarse and fine crushing, a special floor and tables for spreading, mixing and cutting down ores and samples, and the usual sampling apparatus. For coarse-crushing there are provided jaw breakers, gyratory and roll-jaw crushers; for medium-crushing two sets of rolls; for fine-crushing, grinders, pebble mills and bucking boards. Sampling tables and apparatus such as split shovels and Jones and Vezin samplers serve for reducing ores to the amounts required for dry and wet assays.

The Mining Laboratory with a floor area of 1000 square feet receives from the main compressor plant air under 100 pounds pressure and from the generating station the A. C. current necessary to operate various forms of percussion and rotary drills. It is provided with apparatus for the study of ventilating and lighting. Studies of a purely mechanical nature are taken up with the machines contained in the laboratories of the Mechanical Engineering Department.

Ore-dressing is carried on in the Richards and Simpkins Laboratories.

The Richards Laboratory contains the necessary assortment of concentration apparatus and machines which are smaller than natural size, but large enough to give quantitative results. A variety of ore can be treated by students in a short time without the bodily fatigue which reduces mental alertness. The laboratory, which occupies an area of 4400 square feet, has three well-lighted, connected terraces on which the apparatus and machines are distributed in such a way as to permit running each separately for individual tests and to connect them to suit various flow-sheets of mill-practice. Among different combinations there are graded crushing, graded sizing, graded jigging; hydraulic classifying as a preparation for jigging and the slime table; jigging with much or little suction; variations in slope, quantity of water, and roughness of the surfaces of slime tables; adjustments of the two 400-lb. gravity stamps, the amalgamation plates, the belt vanners, Wilfley tables, and flotation machines; the magnetic and static concentrators. There is reserved an adequate space for the instalment of new machines. The laboratory has an ample supply of water; pipes of large size are provided with pressure regulators to insure uniform head. The waste waters are collected in sumps.

Products are freed from their water-content on drying tables so as to permit weighing, to be followed by sampling and assaying.

The Simpkins Laboratory in the Rotch Building of Harvard University covers a floor area of 2400 square feet. It is provided with full-size machines for crushing, concentrating and amalgamating. It is thus especially suited for treating large quantities of ore on a working scale. The machines can be operated singly or in combination. The laboratory contains a roll-breaker, a five-stamp battery, a Frue vanner, Wilfley table, Gilpin county bumping table, a slime belt, a round slime table, belted and geared rolls, a Huntington mill, elevators, revolving screens, hydraulic classifiers, roughing and finishing jigs, amalgamating and clean-up pans, settler, clean-up table with hand-screens and pans, Munroe classifiers, flotation apparatus, a chlorination barrel and cyanide plant.

Processes in lixiviation, pan amalgamation and electro-deposition are carried on in the Wet Metallurgical Laboratory. The room, 1460 square feet, is provided with pressure and suction air, gas, A. C. and D. C. current, steam tables and chemical hoods; for lixiviation there are available four tables, 3 and 4 ft. wide and 13 ft. long, for holding stationary leaching vessels, several bottle agitators, a Dorr agitator and thickener, and a filter press. Precious metal ores are amalgamated in the small size pans. An experimental electrolytic plant of the same character as used in the multiple process for refining copper represents electro-deposition.

The Dry Metallurgical Laboratory, two stories high and having a floor area of 4000 square feet, contains two hand reverberatories, a Brückner and a Wedge furnace for ordinary roasting, a Dwight-Lloyd machine and a pot for blast roasting, and a roasting kiln for lump ore. Smelting is carried on in a blast furnace, a reverberatory furnace and crucible furnaces, converting in a barrel converter. A special furnace room is provided for quantitative fusion in small gas and electric furnaces.

Dry and wet assaying occupy two large rooms covering a floor area of 4600 square feet which are separated by the balance and supply rooms. In the former laboratory there are 12 soft-coal muffle furnaces, 12 coke-crucible furnaces, oil, gas and gasoline muffles. There are working desks for 80 men. The Wet Assay Laboratory is a chemical laboratory with 40 desks.

The Laboratory for Heat Treatment and Metallography, occupying a floor space of 3000 square feet, contains a variety of gas

and electric furnaces, pyrometers, self recording instruments, back-saws and lathes, polishing apparatus, microscopes, and special rooms for developing photo-micrographs.

The Iron and Steel Laboratory of 850 square feet is provided with an electric smelting furnace, gas furnaces for heat treatment, quenching baths, pyrometers, oxyacetylene torches and forges. The necessary mechanical tests are carried on, for the present, in the Mechanical Engineering Laboratories. It is the intention to place in this division apparatus for the study of rolling, drawing and punching of metals and alloys.

The Laboratories of Chemistry. — These laboratories include eighteen instructional laboratories for undergraduate classes, nine research laboratories, eleven special laboratories, and thirty-four private laboratories and offices, with the necessary accompaniment of balance rooms, combustion rooms, supply and storage rooms. The total number of student desks is thirteen hundred and ninety.

The Laboratories devoted to instruction in Inorganic Chemistry are located on the first and second floors, and comprise four laboratories, with one hundred and forty lockers in each. The desks are equipped with hoods for individual student use, but wall hoods are also provided, and the laboratory is fully equipped with gas and electrical devices, and with blast and vacuum. There is a small room connected with each laboratory to be used for the writing of notes and consultation of reference books, while another small room is designed for furnace work, and for work with the more disagreeable gases.

The Laboratories of Analytical Chemistry are located upon the second and third floors, and comprise two large laboratories, each containing one hundred and twenty-eight working desks, one of which is assigned to a student for his sole use during the term or year over which his work in analytical chemistry extends. The desks are of special design and each student has access to an individual hood at his desk. The laboratory is also provided with wall hoods. At each desk there is provision for vacuum, gas, water and electricity. Particular effort has been made to reduce the time consumed in procuring reagents to a minimum. There are four balance rooms, and special laboratories are equipped for electrolytic and spectroscopic apparatus. A separate laboratory is also provided for research work and a room for conferences with small groups of students.

The Laboratory of Organic Chemistry on the fourth floor accommodates one hundred and twenty-eight students, with ample working space for the use of condensers and other larger apparatus. These desks are also specially designed, and while they are not provided with desk hoods, ample provision has been made for wall hoods, and the desks are thoroughly provided with all conveniences for steam and fractional distillation. The necessary electrolysis circuits, filter presses, sodium presses, steam baths, and other appliances for organic work are near at hand. This laboratory has also associated with it an ample combustion room, a room for bomb furnaces, a separate room for undergraduate thesis work, and a roof room for work with noxious or easily inflammable materials. Six research laboratories are provided for this branch of the Department.

The Laboratories of Theoretical Chemistry are also located on the fourth floor, and accommodate one hundred students. The desks are equipped with all facilities for work in physical chemistry, including among other features specially designed and carefully regulated thermostats, numerous forms of electrical measuring instruments and mechanical stirring devices. A second laboratory is provided for thesis work. The close association of these laboratories with those of the Research Laboratory of Physical Chemistry also gives access to many additional facilities for accurate work in the physico-chemical field.

The Laboratories of Industrial Chemistry and Chemical Engineering on the first floor provide for instruction in the evolution of a chemical process from the idea as formulated in the class room, through the successive stages of laboratory development, to the design and equipment of the necessary plant. The Industrial Laboratory is provided with 70 desks for individual student work. In the equipment of these desks, great care has been exercised to utilize only such apparatus as is either found in most chemical laboratories, or is easily obtainable at a moderate cost in any locality. This is done in order that the method of attack developed in this work may have the greatest possible usefulness. Facilities are provided for rapid analytical work of any character likely to arise so that all operations may be carried out under accurate analytical control.

When the student has secured, by individual work in the Industrial Laboratory, the information which it is possible to attain

with such equipment and such methods, the further data necessary for the intelligent design of a plant for any chemical process are obtained by quantitative experimentation in the Laboratory of Chemical Engineering. This laboratory is provided with a very complete installation of typical modern machines. For problems in the preparation of solid raw material there is a Blake jaw crusher, a Gates gyratory crusher, a Symons disc crusher, a set of crushing rolls, a number of fine grinders, and ball mills. The utilization of heat for industrial purposes is studied by means of muffle, reverberatory, and blast furnaces so constructed that the chemistry of combustion as a factor in the economy of large installations can be easily investigated. High temperature work is provided for by the installation of electric furnaces of all of the approved types. A large central stack insures perfect ventilation so that obnoxious gases and excessive heat are constantly carried from the laboratory. For purposes of distillation, there is provided a copper still with a 30 plate rectifying column complete with dephlegmator, condenser, and preheater. There is also apparatus for distillation under high vacuum both with and without the aid of steam. Evaporation is studied by means of steam-heated open pans and a triple effect Swenson evaporator fitted with both a jet and a barometric condenser and the necessary pumps. Questions relative to drying are determined by the use of drying chambers of various types, together with a vacuum drier complete with its accessories of the most modern design. Filtration is studied by means of three types of centrifugal machines, a Kelly leaf filter press, an 18″ chamber filter press, and a continuous vacuum filter. All of these installations, as well as others not here specifically described, are constructed so as to make possible accurate measurement of the various conditions which obtain during their operation. Although complete from a manufacturing standpoint, they are experimental in the sense that they provide for a study of the operation.

The Laboratory for Proximate Technical Analysis located in the basement accommodates eighty-five students, and is equipped, for the examination of gases, with numerous sets of gas-absorption and explosion apparatus, with sampling apparatus, flue thermometers, a photometer, and a gas calorimeter. For the analysis of oils, the laboratory is provided with viscosimeters, testing machines, different sorts of flashpoint apparatus, and other instruments employed in this special line of work, in addition to which

is to be found the needful apparatus for the analytical examination of rubber, paper, tanning materials, and other substances of commercial importance. For the testing of bituminous road materials the following apparatus is available, in addition to that for oil analysis: the New York Testing Laboratory penetrometer, a Smith ductility machine, a set of standard sieves, Forrest and other extraction apparatus, a powerful centrifuge, and a full assortment of all apparatus needful for the exhaustive analysis of any tarry, oily or asphaltic material.

The Laboratory of Food Chemistry and Sugar Analysis located in the basement accommodates forty-two students and is provided with the most approved facilities for the chemical and microscopical examination of foods with respect to nutritive value and the detection of adulterations. The available equipment includes a number of modern standard microscopes for the examination of powdered foods as well as photomicrographic apparatus and an unique collection of pure and adulterated samples for comparative study. In addition to the usual apparatus for food analysis several types of refractometers, colorimeters and a tintometer are provided for the more critical examination of foods required by present-day practice. The number of instruments available for the optical analysis of sugars and starch conversion products is exceptionally large and includes practically every type of polariscope and saccharimeter met in practice.

The Laboratory dealing with the Chemistry of Sanitation, also located in the basement, accommodates sixty students, and possesses a complete equipment for the examination of water for sanitary and industrial purposes, for the analysis of wastes, and for the physical and chemical examination of air. In addition there are ample facilities for advanced work on specific problems connected with water supplies and the disposal of wastes, and the applications of chemistry to bacteriology and the general principles of sanitation.

The main Lecture Hall seats five hundred, but the number attending the lectures in chemical subjects is limited to three hundred at one time. The lecture table is movable, and can be transferred to and from the preparation room with apparatus in place. The equipment for demonstration purposes is exceptionally complete, as is also the collection of slides and illustrative material. Two other lecture rooms seating one hundred and twenty-five each

are available for chemical lectures, one of which is specially equipped for lectures in organic chemistry.

The Research Laboratory of Physical Chemistry. — This laboratory comprises five small unit laboratories, each of which affords accommodation for three workers. There is also a larger laboratory fitted especially for the more strictly physical sides of the work. A shop, well equipped with machine tools, including an engine lathe and a bench lathe, and containing a large variety of stock, forms part of the laboratory. In this shop a skilled instrument-maker is regularly employed in constructing apparatus for investigation. Adjoining the unit laboratories are rooms for special purposes, — photographic work, optical measurements, thermometric standardization, electrical conductivity measurements, pure-water distillation, glass-blowing, the storage of apparatus, computing and plotting, and the holding of conferences. The equipment includes a 120-volt storage battery. The laboratory has places for eighteen research workers. This research laboratory is closely associated with the Laboratory of Chemical Engineering for all such work as pertains to the engineering problems of chemical industry. There are four small laboratories fully provided with the necessary equipment for chemical research, including a well-appointed machine shop.

The Augustus Lowell Laboratories of Electrical Engineering. — These laboratories embrace the Technical Electrical Measurements Laboratory, the High Voltage Laboratory, the Laboratory of Dynamo Electric Machinery, the Transmission Laboratory, and various laboratories devoted to photometric measurements and to special research.

The Laboratory for Technical Electrical Measurements furnishes facilities for making tests and for giving instruction in electrical measurements. It is provided with circuits furnishing alternating currents at 25 and 60 cycles, single-phase, three-phase and quarter-phase, and also direct currents. The equipment is of such a nature that any proposed scheme of measurement may be subjected to careful investigation. To this end the apparatus for standardization is very complete. For direct currents a storage battery giving 1,500 amperes is provided, together with a special set of high-voltage dynamos, giving potentials to 3,000 volts. To complete this set of apparatus, there are the necessary controlling

devices, together with standard ammeters, voltmeters, and a potentiometer reading to 1,500 volts. By means of special transformers, alternating currents up to 4,000 amperes and potentials to 50,000 volts can be obtained. The necessary auxiliary apparatus for controlling and measuring these currents and potentials is provided. For the standardization of devices for power-measurement there is a set of two small machines so arranged that the instruments can be tested under various conditions of power-factor and frequency. Several oscillographs of different designs are provided for the examination of wave forms. These are so arranged as to be readily portable, and are available for any tests carried on in the Department. Included in the equipment of this laboratory is a complete set of portable potential and current transformers together with the instruments which make it possible to perform measurements in circuits of any voltage up to 13,000 volts and of current capacity up to 3,000 amperes. This equipment much facilitates the study of various problems of electrical engineering as they occur in practice. The laboratory is provided with sets of standard resistance coils, certified by the United States Bureau of Standards, all necessary apparatus for measuring both high and low resistance and for calibrating resistance boxes, and also with standards of capacity and inductance with the necessary auxiliary apparatus.

The High Voltage Laboratory is designed for the study of insulators and insulating materials as well as general high-voltage phenomena. Apparatus are provided for the determination of the insulation resistances of both large samples of insulated wire and small specimens of insulating materials under different conditions of temperature and voltage. For determining dielectric strengths there is a fifteen-kilowatt transformer, capable of giving voltages up to 100,000 volts. It is provided with all necessary protective and controlling devices. The apparatus required for measuring high voltages and other electrical quantities are provided. Current for this laboratory is furnished by a dynamo which affords a wave form closely approximating an exact sinusoid.

The Laboratory of Dynamo Electric Machinery is two stories high, occupying a large part of the two lower floors under the main dome. A balcony which encircles the laboratory is used for tests on transformers and small alternating current and direct current motors. The equipment of the main floor consists of the larger machines, which compose an extensive equipment of gen-

erators and motors for both direct and alternating currents. A ten ton crane serves the central part of the main floor, and is useful in handling the heavier apparatus.

Several portable oscillographs and a wave tracer are kept in the laboratory for the determination of alternating current and voltage wave forms under various conditions of test.

The large number of measuring instruments necessary for the tests are stored in the instrument room adjoining the main laboratory. A dumb waiter runs to the floor above, carrying instruments to the balcony and Technical Electrical Measurements Laboratory. A room adjacent to the balcony is equipped for the rapid calibration of instruments.

The power for this laboratory as well as for the other laboratories under the jurisdiction of the Electrical Engineering Department is supplied by three motor-generator sets, operating from a 2,300 volt circuit from the main power plant. Three-phase, 60 cycle current is furnished by a synchronous motor-generator set rated at 187.5 kilovolt-amperes, and the generator of this set is designed to give a pure sine wave. Three-phase, 25 cycle, and four-phase, 60 cycle currents are obtained from a similar synchronous motor-generator set of 50 kilovolt-ampere capacity. Direct currents are supplied from an induction motor-generator set. The voltage of each of the generators of these motor-generator sets is maintained constant by means of voltage regulators.

Of the photometric rooms provided, one is equipped with a special photometer designed by the Department for use in testing arc lights; two are used for special testing; and another for use in ordinary incandescent photometry. In connection with the photometric work there are various photometers of standard manufacture and a collection of primary and secondary light standards. Photographic dark rooms with conveniences for developing, printing, and washing are also provided.

The Transmission Laboratory comprises a small building fitted up for high voltage testing and alongside of it is a span 500 feet long which is a full size example of long-distance, high voltage power transmission lines. This is now being used for a variety of special investigations. An artificial line capable of affording the phenomena of a power transmission line over 700 miles long and other artificial lines are also provided.

The shop for the department mechanician is well supplied with

machine-tools, among which are two screw-cutting engine lathes, a milling machine, an emery grinder, two speed-lathes, a precision lathe with milling attachment, and an upright drill.

The highest importance is attached to work in the nature of scientific research, and special rooms, together with ample facilities in the nature of apparatus, are available.

Research Laboratory of Electrical Engineering. — Research work is being carried on in an organized way in association with the work of instruction of the Department and is conducted in laboratory rooms associated with the Electrical Engineering Laboratories. These research laboratories are provided with a small mechanical workshop and special equipment for electrical engineering research. A number of important investigations are being conducted under the direction of the Research Committee of the Electrical Engineering Department.

The Laboratories of Biology and Public Health. — These laboratories were organized in 1883. They now comprise six well-equipped laboratories for undergraduates, with smaller rooms for special lines of work, and a laboratory devoted to more advanced or special investigation. The laboratories are located in close proximity to the well-appointed library and reading-room of the Institute which contains more than four thousand volumes and monographs on biological subjects.

A large Laboratory of Microscopy and General Biology supplies the needs of classes in these subjects, as well as of those in elementary Zoölogy and Botany. It is furnished with microscopes, microscope lamps, suitable work-tables, and other appliances. The proximity of Boston to the sea offers exceptional facilities for work along these lines, as well as for the more advanced study of Zoölogy and Botany.

A second laboratory furnishes opportunities for the practical work of the classes in Comparative Anatomy, Embryology, Parasitology, and Histology. It is equipped with freezing and other microtomes, paraffin baths, microscopes, and reagents for work on the gross and microscopic anatomy of plants and animals. Students of Biology have also valuable privileges in connection with the Boston Society of Natural History, of which the museum and library are freely accessible.

For experimental work in Physiology there is a special laboratory

equipped with continuous roll and drum kymographs, induction coils, and other electrical apparatus, moist chambers, tambours, plethysmographs, etc., for physiological measurements.

The Laboratories of Bacteriology and Industrial Microbiology are supplied with microscopes, incubating chambers, thermostats, and other special appliances necessary for the detailed and practical study of micro-organisms. In connection with it there is a special room for chemical work and the preparation of nutrient media.

Finally there are research rooms for the use of graduate students and special investigators, while near by is the Sanitary Research Laboratory for investigations on water, sewage, disinfectants, etc.

This whole series of laboratories is organized for work directed chiefly towards the sanitary, hygienic, and industrial sides of biology, and offers special opportunities for those desiring to fit themselves for teaching or for medical study or for practical work in various branches of applied biology or public health science.

The Sanitary Research Laboratory and Sewage Experiment Station. — This laboratory was established in 1902, and has since been maintained by the generosity of an anonymous donor. The work of the Station is at present chiefly at Brockton, but a Chemical and a Bacteriological Laboratory are maintained for special purposes at the Institute. Here are conducted investigations bearing on water supply, sewage treatment and disposal, garbage disposal, sterilization by hypochlorites, chlorine, ultra-violet rays, etc., ventilation, food problems, and other subjects of sanitary interest. The work of this laboratory is often associated with that of various commissions, research departments of manufacturing establishments, or with the public service.

The Sanitary Research Laboratory is available for graduate students or other properly qualified investigators in their research work upon problems in Sanitary Biology and Public Health, Micro-Biology, and certain problems in Sanitary Engineering.

The Rogers Laboratory of Physics. — This laboratory comprises the following general and special divisions: the Second-Year Laboratory of Mechanics, Optics, and Heat, the Second-Year Electrical Laboratory, the Third-Year Electrical and High Frequency Laboratories, the Laboratory of Heat Measurements, the Laboratory of Technical Heat Measurements, Laboratories allotted

to Optics, Photometry, Photography, Spectroscopy, Radiation, the Electrical Discharge in Vacua, and Radioactivity. For study and investigation in Electrochemistry there are provided the Laboratory of Chemical Physics, the Laboratory of Electrochemical Measurements, and the Laboratory of Applied Electrochemistry. In addition the Department has five research rooms, four apparatus rooms, a study, a seminar and reading-room which also contains a reference library of about one thousand volumes on Physics, two small lecture rooms, a storage battery room, mechanician's shop, and offices for members of the instructing staff. The lectures on Physics of the Second Year are given in the general auditorium accommodating five hundred students, adjoining which is a preparation and apparatus room.

All research and special laboratories are provided with taps for gas, blast and suction, hot and cold water and distilled water, with panels from which the following electric circuits may be tapped; 110–220 volts D. C., 110 volts A. C. 60 cycles, 110 volts storage battery, 2 volts and 20 volts storage battery.

Connected with the Rogers Laboratory is a workshop equipped with two engine lathes, three speed lathes, a large Stark precision lathe with complete equipment and attachments, a milling machine, an upright drill, a sensitive drill and other accessories for the construction of apparatus.

The Second-Year Laboratory of Mechanics, Optics, and Heat is provided with the equipment necessary to give instruction to four hundred students per week in the more fundamental measurements met with in mechanics, optics, and heat. The instruments provided are of high grade, and in general, a precision of one or two tenths per cent is expected in the work performed.

The Electrical Laboratory contains an extensive collection of electrical measuring apparatus for the determination of current, potential, resistance, capacity, inductance, wave form, and the magnetic properties of iron.

The equipment includes a large number of sensitive galvanometers, Wheatstone bridge boxes of precision, rheostats, standard condensers, ammeters and voltmeters of various ranges for use with direct current, and much accessory apparatus. It also contains several sets of alternating and direct current meters; a Carey Foster bridge; a standard potentiometer, with Weston cells and standard resistances for use in calibrating the various meters; a

set of storage cells capable of delivering 300 amperes at four volts, with switches for series-parallel connections; a compound oscillograph for the investigation of wave forms of current and potential; apparatus for the measurement of small capacities and small inductances.

The High Frequency Laboratory offers opportunity for the study of currents used in radio-telegraphy and of instruments for their production and measurement. The equipment includes Poulsen and Chaffee arc apparatus, high tension and oscillation transformers, small rotary converters, a portable electric wave meter with apparatus for its calibration, a Duddell thermo-ammeter, and various other pieces of apparatus.

The Laboratories of Heat Measurements are devoted to the study of accurate thermometry, the measurement of high and low temperatures, the measurement of the flow of heat through insulating materials, the determination of the efficiency of fuels, the study of intense sources of heat, and the determination of many quantities and constants which are matters of concern where the maintenance of constant temperatures, or the quantity of heat flow is desired. They are equipped with a large number of pyrometers, including all the standard devices of this sort together with many special instruments constructed in the laboratory. These instruments are in part especially adapted for technical work, and are used in connection with the instruction in engineering work, and industrial physics. A considerable number of standard mercury thermometers are available for purposes of comparison and standardization.

The laboratories are supplied with alternating current from six specially designed transformers, having a total capacity of 135 kw. This supply is so arranged as to be available over a wide range of voltages for use in connection with the electric furnaces in which high temperatures can be maintained and controlled for purposes of measurement. An extensive equipment is provided for the study of the thermal conductivity of substances used as heat insulators in building construction, for the protection of steam heated surfaces and for the insulation of furnaces and similar devices. A Norwalk 4-stage compressor attached to an air liquefier is provided for the purpose of supplying liquid air for use in connection with experiments and measurements at low temperatures. An Audiffren refrigerating machine is available for the

study of methods by which measurements may be made of heat interchanges in simple refrigerating apparatus. A two-ton ammonia refrigerating machine is available for cooling by direct expansion an insulated room which may be kept at temperatures as low as -40° C.

The refrigerating apparatus, air liquefier, and low temperature room are in the basement. The rest of the work in heat measurements is provided for by two laboratories, one of which is devoted to such portions of the work as are of more scientific or purely physical types, and the other to experiments which are more in the nature of practical or industrial physics. Both laboratories are fully equipped for research along their respective lines.

The Laboratory of Chemical Physics for measurements and research in this subject is equipped with the standard apparatus for carrying out accurate determinations of the various physico-chemical constants. It is provided with alternating and direct current power circuits, storage battery circuit and electrically heated and regulated thermostats. The equipment available includes Lippmann electrometers, dynamometers, potentiometers, bridges and other apparatus required for electrochemical research, Beckmann's complete outfits for boiling and freezing point work, a König spectrophotometer for studying colored solutions, Nernst and Drude's apparatus for dielectric constants and a Berthelot platinum calorimeter for thermochemical constants.

The Optical Laboratory is located with southern exposure between the Photometric Laboratory and the Optical Research Laboratory and is connected with each. It is equipped for giving instruction in advanced optical measurements. The following special instruments are at present provided: a large Landolt-Lippich polariscope, Zeiss Pulfrich refractometer, Zeiss direct reading refractometer, Zeiss crystal refractometer, Zeiss interference apparatus, two Michelson interferometers, Zeiss auto-collimating spectrometer, optical bench, Zeiss focometer, and auxiliary apparatus for light sources. All necessary electrical circuits and automatic thermostats, etc., are provided.

The Photometric Laboratory is equipped with the following special apparatus for instruction and research work. A König spectrophotometer, Brace spectrophotometer, Weber spectrophotometer, Macbeth illuminometer, flicker photometer, Lummer Brodhun contrast photometer, Munsell photometer and a com-

plete Leeds photometric outfit for incandescent light photometry.

The Photographic Laboratory is provided with ordinary enlarging and photomicrographic cameras of high grade, an Abbé ocometer and the Zeiss ultra-violet apparatus.

The arrangement of the three rooms above mentioned is such as to make possible interference experiments with a beam of light about one hundred feet long.

The Spectroscopic Laboratory is situated in the basement to insure maximum stability. Sunlight is brought into the laboratory from a heliostat on the roof through a vertical light shaft and a 45 degree mirror. This shaft also permits a beam of sunlight to be reflected into the Photometric, Optical and Optical Research Laboratories on the third floor. The present equipment of spectroscopic apparatus is mainly for purposes of instruction. There is available a concave grating (Rowland mounting), a four and a two inch plane Rowland grating and several smaller transmission and reflection gratings, a Littrow spectroscope, an Echelon grating, a large five prism spectrometer, a Schmidt & Haensch camera spectrometer, a large Société Genevoise spectrometer, a Zeiss comparison spectroscope, and a Zeiss measuring machine.

The Electrochemical Laboratories are situated in the basement and on the first floor. The former is equipped for electric furnace and technical electrochemical operations while the latter is devoted to electrochemical measurements.

The Laboratory of Applied Electrochemistry includes a large electric furnace room, an electrolysis room, grinding and polishing room, motor generator room, battery room and supply room. The furnace laboratory is provided with three special transformers of 50, 75 and 150 kilowatts capacity respectively, each connected to its switch board from which voltages from 10 volts to 220 volts may be taken in steps of 10 volts. These furnish power for the various alternating current furnaces and processes studied. Furnaces of the Moissan, Borchers, Hoskins, Heroult, Kjellen (induction), Arsem (vacuum) types and others designed in the laboratory are provided. For direct current work the following power circuits are provided: 110 volts and 220 volts 25 kilowatts capacity from D. C. mains, 12 volts to 25 volts 25 kilowatts capacity from a special low voltage generator with adjustable field rheostat; 2 to 20 volts storage battery, 10 cells

each of 150 ampere capacity capable of being connected in combinations of series and multiple. The laboratory is provided with Wanner, Féry, resistance, and Leeds thermoelectric pyrometers, and the necessary instrument equipment of ammeters, voltmeters, and wattmeters for measuring alternating and direct current power up to the capacity of the furnaces. All tables and accessories are of concrete fire proof construction.

The electrolysis laboratory is designed particularly for electrolytic processes in which obnoxious gases such as chlorine are evolved, special ventilation being provided to carry off such fumes. The arrangement of busses permits A. C. and D. C. current up to 1000 amperes to be supplied simultaneously to this room.

The grinding, crushing and buffing room is separated from the rest of the laboratory to prevent scattering of dust. Adjacent to the furnace laboratory is a special locker and wash room provided with shower bath for the students of this laboratory.

The Laboratory of Electro-chemical Measurements is directly connected with the furnace laboratory by a special stairway to facilitate students passing from their work desks to the laboratory below. This laboratory is on the first floor and at present is equipped with desks for 24 students with the possibility of increasing the number to 28. The desks are arranged in groups of four with an electrically regulated, steam heated thermostat in the center and sinks with hot and cold water at either end. The equipment furnished each student is designed to facilitate the most rapid and efficient work. It includes a Weston ammeter (separate shunt) and voltmeter reading 3, 15, and 150 volts, slide wire bridge, resistance box, Lippman electrometer, complete conductivity apparatus, silver and copper voltameters, normal and half electrodes, transference apparatus, etc. Each desk is provided with a panel on which the following circuits are available up to 15 amperes capacity: 110 volts, three wire motor generator circuit 12½ volts–25 volts, storage battery 2 volts–20 volts, individual-2 volts storage cell, 110 volts A. C. 60-cycle, and high frequency A. C. for conductivity work. The terminals of an adjustable rheostat are also brought to the panel. Gas, blast and suction are also provided at the end of each desk and a power shaft is run along the top from which stirring devices may be operated. The laboratory is equipped with a special still for

making conductivity water, and the usual drying closets, hoods and steam closets for chemical work.

The Mineralogical and Geological Laboratories. — The laboratories for study and research in Mineralogy and Geology comprise several divisions.

The Laboratories of Mineralogy and Petrography are equipped with extensive collections of minerals, rocks, and thin sections arranged for class and advanced work. For determinative mineralogy a large laboratory for blowpipe work is provided as well as a smaller laboratory for chemical analysis. All necessary apparatus for research work in Mineralogy and Crystallography is also provided. For petrographic study of thin sections twelve microscopes of modern type are available as well as an instrument of particular precision for delicate optical measurements. Slicing and grinding machines, etc., complete the equipment.

The Laboratory of Structural Geology contains collections of rocks, models and lantern slides fully illustrating geological phenomena.

The Laboratory of Stratigraphic Geology and Paleontology contains in particular two extensive series of fossils, the one to illustrate their stratigraphic succession (Index Fossil set), the other their biologic relations. Besides these there is a reserve collection affording facilities for more extended work; and also a collection of modern shells for use in comparison with the fossil shells.

The Laboratory of Economic Geology contains exceptionally good collections of ores, non-metallic minerals, and of building stones. There are also collections of thin sections and polished sections of ores. All of these sets are arranged for study and available for the advanced student, while special parts of the collections are used for undergraduate work. A large room is provided with cases and desks for the use of advanced students; modern polarizing microscopes are used for study of thin sections. Three microscopes for reflected light are available for the study of ores, and a large metallographic microscope with camera is used for advanced work in the same line. The laboratory is fully equipped with grinding and polishing machines.

Hawaiian Volcano Observatory. — The main building is near the hotel, known as "Volcano House," on the edge of the cliff that bounds the greater crater of Kilauea in Hawaii. The building

is equipped with two laboratories, directors' room, photographic dark room, and store-room on the main floor, with porch extending along two sides commanding views of the three volcanoes, Kilauea, Mauna Loa, and Mauna Kea. In front there is a concrete post for geodetic experiments.

The seismograph cellar, 18 feet square, is of concrete on the solid ledge of basalt. It is equipped with four instruments. These are horizontal pendulum tromometers, including one component of a heavy Omori type, made in Tokyo, one Omori three-component strong-motion seismograph, and two components of a 100 kg. Bosch-Omori tromometer with damping vanes, made in Strasburg. Besides these, there is a light Omori instrument with devices for recording local tremor in the vicinity of the active lavas. Other instruments are pyrometers, photographic and surveying apparatus, microphones, gas-meter, and several special thermometers.

The Observatory is supported by the Whitney fund and by the Hawaiian Volcano Research Association. A small station at the active lava pit of Kilauea was built by the Institute in 1911. This is now an instrument house, for routine measurements and experiments. The U. S. Weather Bureau has furnished the Observatory with a set of standard meteorological instruments, and the Territorial Government in coöperation with the U. S. Geological Survey, has prepared a detailed topographic map.

The plan of work of the Observatory involves two distinct aims. First, continuous registration and record of lava movements and effects, peculiar to the district and well known to be of fundamental geologic import. Second, experimentation on physical or chemical phenomena in their relation to these geologic peculiarities. As an experiment station, the Observatory will welcome accomplished specialists, and some fellowship aid can occasionally be granted to such work. Not more than one or two such investigators can be accommodated at one time, and it is desirable, owing to the expense of the journey and the field conditions, that such persons should remain for from six to eight months, in order to insure results of value.

Mechanical Laboratories. — Instruction in the mechanic arts was begun in the school year 1876–77, when laboratories for instruction in chipping and filing and in forging were established. In the following year laboratories for teaching carpentry, woodturning, machine tool work and foundry work were added.

These laboratories were the first established in this country to give instruction by the Russian method, which has the systematic instruction of the student as its aim rather than construction.

The Mechanical Laboratories offer practical instruction in the nature of the materials of construction and in the typical operations involved in the arts, and to this end are equipped with the more important hand and machine tools, so that the student may acquire a direct knowledge of the nature of metals and woods, some manual skill in the use of tools, and a thorough knowledge of what can be accomplished with them.

The Wood-working and Pattern-making Laboratory contains thirty-three combination benches, two circular-saw benches, a band-saw, two jig-saws, a buzz-planer, thirty-three motor head-stock lathes, a large pattern-maker's lathe, and a power drill. The Foundry contains two cupola furnaces for melting iron, a tilting furnace for brass, two crucible furnaces, a soft-metal furnace, four moulding machines, a core oven, a core machine, thirty-two moulder's benches and equipment for cleaning castings including a spruce cutter, emery grinder, tumbler, and sand blast. The Forging Laboratory contains a power-hammer, twenty-four forges, ten blacksmith's vises, one blacksmith's hand-drill, one power drill, a power-shear, and a drop-hammer for drop-forging. The Machine-tool Laboratory contains thirty-one engine-lathes and fifteen hand-lathes of approved patterns, a twenty-four-inch turret-lathe, three machine-drills, two centering-machines, four planers, a shaping-machine, two universal milling-machines furnished with spiral and gear-cutting attachments, a plain milling machine, two universal grinding-machines, a bolt and nut machine, an automatic gear shaper, a cutter and reamer grinder, a twist-drill grinder, two tool grinders, a twenty four-inch standard measuring machine, special apparatus for hardening and tempering equipped with pyrometers, a scleroscope for determination of hardness, and a fully equipped tool-room. The Vise and Bench Laboratory contains thirty-two vise benches arranged for instruction in vise work, a tool grinder, an air compressor, a set of pneumatic chipping, drilling and riveting tools and equipment for pipe-fitting, babbitting and autogenous welding.

Equipment for Civil Engineering. — The equipment of instruments and apparatus for instruction in Civil Engineering may be classified as follows: a full outfit of instruments used in surveying

and in the drawing-room; a collection of hydraulic apparatus for work in the field, comprising various types of current meters and floats, a tidal gage and sounding equipment, a gaging station maintained during the Summer Camp season on Chase Stream at East Machias, Maine; apparatus for comparing the wearing properties and other physical characteristics of the various road- and pavement- materials; and continuous-record instruments for measuring the strain in bridges and other structures of metal. The very complete hydraulic apparatus for the measurement of the flow of water through orifices, nozzles, diverging tubes, pipe lines and their fittings, turbines, draft tubes, and over weirs is described elsewhere, in connection with the Engineering Laboratories.

The Department has also a collection of models illustrating bridge-details, problems in stone-cutting, etc., and a set of full-sized models of various types of road- and pavement-construction, for use in connection with the work of instruction. It has also a large collection of blue-prints, drawings, and photographs, and a considerable number of lantern-slides.

For geodetic and astronomical instruction the Department possesses the following apparatus: a transit instrument of $2\frac{1}{2}$ inch aperture, 27-inch focus, with micrometer eye-piece for latitude observations; a sidereal chronometer, a chronograph, magnetometer, a dip circle, an altazimuth instrument, and various other smaller appliances, such as level triers, mercury horizons, etc.

By the kindness of many active members of the profession, the classes are frequently enabled to inspect engineering works of interest, and to carry on field operations in favorable localities.

The Lowell Observatory. — The Director of this observatory is non-resident Professor of Astronomy in the Massachusetts Institute of Technology, and although there is no official connection between the two institutions, the Director is glad to extend to members of the Institute every facility for inspecting the work of the observatory.

The Lowell Observatory is situated at Flagstaff, Arizona, 7,250 feet above the sea. It is furnished with a twenty-four-inch refractor built by Alvan Clark & Sons, a six-inch refractor made by the same firm and a large spectroscope by Brashear which is more powerful in the red end of the spectrum than any other in existence. Owing to the quality of the air at Flagstaff the conditions for astronomical observations are exceptionally favorable.

Equipment for Naval Architecture and Marine Engineering. — The Department of Naval Architecture and Marine Engineering possesses a valuable and constantly growing equipment. The departmental library contains a large collection of standard and recent works on Naval Architecture and Marine Engineering, including technical periodicals and the students have also the advantage of the large Libraries of Engineering, Physics, Chemistry, etc., belonging to the Institute.

There is in the drawing office of the Department a collection of complete sets of drawings of ships and their machinery, both merchant ships and warships, systematically arranged and catalogued, which, together with the proper data concerning construction, power, and speed, makes it possible to proceed with the design and arrangements of ships as is done in good practice, with the difference that attention is always given to the most efficient methods of instruction.

There is a supply of planimeters, integrators, integraphs, and calculating machines with which the students become familiar by constant use. A Ritchie compass in a standard navy binnacle and a pelorus, mounted on a revolving platform, give opportunity for practice in compass adjustments. The Department has a well-equipped shop with special machinery, in which instruction is given, at suitable times, in making ships' models, use being made of lines constructed by the student in his courses on ship design, to the end that he may learn to appreciate and correctly judge forms as represented by ships' lines. The drawing room is supplied with four glass-topped tables for fairing ships' lines which are enlarged and laid down on the floor according to a recent and approved method of mold-loft work.

Aërodynamic Laboratory. — Opportunity for research in aërodynamics and for thesis work in applied aërodynamics is afforded by a wind tunnel. A four foot blast of air uniform in velocity and direction is directed against models of aëroplanes, wings, and bodies mounted on the vertical arm of a delicate balance in such a manner that the forces and couples about the three axes through the model may be determined for use in design.

Libraries

THE Library of the Institute contains about one hundred and twenty-five thousand volumes and fifty thousand pamphlets and maps, and receives regularly eight hundred and seventy periodicals. It includes the Central Library and a number of Departmental Libraries and Reading Rooms.

The Central Library. — The Central Library occupies the Rotunda, the fifth floor of the Administration Building. It contains about eighty thousand volumes and a large collection of pamphlets. Here, besides a large number of books of general literature and of reference, are gathered together the libraries of the Departments of Physics, Chemistry, Geology, Biology and Public Health, Applied Mechanics, Mechanical Engineering, Engineering Administration, Economics, and History; and a considerable number of books pertaining to other subjects, such as Civil Engineering, Military Science, Mining and Metallurgy, Modern Languages, and English Literature.

The Central Library includes a number of special collections received from time to time by gift. There are seven of these. The Rogers Geological Library consists of the private collections of the Founder and first President of the Institute, William Barton Rogers, and of his brother, Professor Henry D. Rogers. The William Ripley Nichols Chemical Library was bequeathed to the Institute by Professor Nichols, for many years a member of the Chemical Department. The Economic Library of Francis A. Walker was the property of the third President of the Institute. The Gaffield Collection of books on glass and glass manufacture was given by Mr. Thomas Gaffield, of Boston. The Vail Library was given by the American Telephone & Telegraph Company through the interest of Mr. Theodore N. Vail, now a member of the Corporation. It consists of a large number of books and pamphlets, many of great rarity, on electricity, electrical engineering, mechanical engineering, and metallurgy, which were

purchased from the heirs of the late George E. Dering of Welwyn, England. The Baldwin Collection of books on Civil Engineering was lent to the Institute by the Woburn Public Library. The gift of Mr. Edwin A. Wyeth is a Collection of general literature. The latest acquisition is the Crafts Collection, consisting of the private chemical library of Professor James M. Crafts, fourth President of the Institute.

In the center of the Rotunda is a large and architecturally beautiful Reading Room, easily accessible from all parts of the building by means of stairways and elevators. It is open during term-time from nine in the morning to ten o'clock at night, except that it is closed on Sundays and holidays, and at one o'clock on Saturdays. The room contains works of reference and especially selected books for use in connection with the various courses of study. Here may be seen also a large number of current periodicals on scientific and technical subjects, as well as those of a more general character.

In an alcove adjoining the Reading Room is the Card Catalogue of the whole Library, including the departmental libraries and reading rooms; from this may be learned what books are possessed by the Institute by any author or on any subject, and their location in the Library or reading rooms. At the desk in the Reading Room an attendant is present during library hours to assist readers in the use of the catalogue and in looking up references, and to attend to the lending of books for home use.

In the space surrounding the Reading Room are the book stacks and the offices of the Librarian and of the Library Staff. The book stacks are easily accessible and are open freely to readers during library hours.

The Reading Room for General Studies and Mathematical Library. — This room contains the greater part of the library of the Department of Mathematics, including the Runkle Mathematical Library given by Professor John D. Runkle, second President of the Institute. This library now contains a carefully selected collection of more than two thousand books in all branches of mathematics. Here will be found also a selected collection of books required for reference in the courses in English Literature, Economics, and Engineering Administration. The current mathematical periodicals and others of interest in connection with the courses in General Studies may be consulted here.

The Architectural Library. — The Library of the Department of Architecture is situated in the Rogers Building in Boston. It contains five thousand volumes of technical works and the leading American and foreign periodicals. There is also deposited in this library a carefully selected collection of eighteen thousand photographs and sixteen thousand lantern slides.

The Chemical Reading Room. — Adjoining the Chemical Laboratories is a reading room containing a collection of books most frequently required for reference, and about a hundred current periodicals. The bound volumes of periodicals will be found in the Central Library.

The Reading Room of Physical Chemistry. — For the convenience of the teachers and students of physical chemistry, a small collection of books is kept in this room for quick reference.

The Physical Reading Room. — This room contains a selection of the most useful books of reference on physics, electricity, and electrochemistry, and the current issues of seventy of the principal physical periodicals. The bound volumes of periodicals are kept in the Central Library.

The Civil Engineering Library. — This is a large room containing the principal collection of recent books on surveying and geodesy, civil and sanitary engineering, and hydraulic engineering; and here may be found a large number of current periodicals on these subjects.

The Electrical Engineering Reading Room. — In this room adjoining the laboratories of the Department of Electrical Engineering may be found the current numbers of eighty-five periodicals and a small collection of important books of reference. The bound volumes of periodicals and the main collection of books on electrical engineering are in the Central Library.

The Geological Reading Room. — This room contains a working collection of about twenty-five hundred books on geology and the current periodicals on that subject. Here is also a large collection of geological and geographical maps used in giving instruction, and a complete set of the publications of the United States Geological Survey. The remainder of the books belonging to the Rogers Geological Library are kept in the Central Library.

The Library of Mining and Metallurgy. — The Library of the Department of Mining Engineering and Metallurgy is a working library of six thousand volumes, and receives annually eighty periodicals.

The Library of Naval Architecture and Marine Engineering. — Conveniently situated near the drawing rooms of this Department is this room containing two thousand volumes and pamphlets on naval architecture, ship-building, and marine engineering, and more than a hundred volumes on aëronautics. Among them is included the Collection of Henry Bryant, which was presented to the Institute by Dr. Charles G. Weld. Forty-five periodicals and annual publications are sent regularly to this Department.

The Margaret Cheney Room. — This room contains a small library of about six hundred volumes for the use of the women students of the Institute. Eleven current periodicals of general interest are purchased from the income of the Cheney Fund and placed regularly in this room.

The Walker Memorial Library. — The nucleus of this library is a collection of four hundred and eighty volumes chiefly on athletics, sports, and personal hygiene, personally selected and given by the late Frank H. Cilley of the Class of 1889.

Scholarships and Fellowships

UNDERGRADUATE SCHOLARSHIPS

It is the policy of the Faculty to apply the available funds to the assistance of as many well qualified students as possible by assigning, in general, amounts less than the full tuition. Preference is given in making awards to students pursuing regular Courses who have completed at least a year of thoroughly satisfactory work at the Institute. In the case of an applicant not already in the Institute, it is important that full information should be presented from former teachers as to capacity. The facts considered in making assignments are the needs of the student and his promise, as indicated by his previous work. *Scholarships are awarded only to those students who produce satisfactory evidence that they are greatly in need and to those students whose records are entirely clear.* Awards will be made in the Summer, and three-fifths of the amount awarded will be credited on the term bill due in October, and the remaining two-fifths on the term bill due in February. Applications for scholarships should be made not later than May 1, on blanks supplied by the Registrar. Application for Massachusetts State Scholarships should be made only to the Commissioner of Education, State House, Boston, from whom the necessary blanks may be obtained. The scholarships described below are arranged in alphabetical order by names.

Architectural Society Scholarship Fund. — This fund has been donated by the Architectural Society of the Institute and the income will be awarded to such student or students of the Department of Architecture as may be designated by the Trustees.

Elisha Atkins Scholarship. — This scholarship was founded by Mrs. Mary E. Atkins, of Boston, with a gift of five thousand dollars.

Austin Fund. — From the estate of Edward Austin the Institute has received a bequest of three hundred and sixty thousand

dollars to assist meritorious students and teachers in the pursuit of their studies. A part of the income from this fund is available for undergraduate scholarships.

Billings Student Fund. — By the will of Robert C. Billings the Institute has received fifty thousand dollars. Any student receiving a benefit from this fund is expected to abstain from the use of alcohol and tobacco.

Jonathan Bourne Scholarship Fund. — By the bequest of Hannah B. Abbe the income from a fund of ten thousand dollars is available for scholarship purposes.

Cambridge Scholarships. — A limited number of scholarships are granted to students about to enter the first-year class at the Institute who are graduates of schools in Cambridge and children of legal residents of that city. These scholarships are awarded by competition on the results of the regular entrance examinations at the Institute held in June of each year. They are confined to students who furnish evidence of need, obtain clear records, and reach the standard required by the Faculty for scholarship aid. Those to whom scholarships are awarded in the first year receive scholarships in their second, third and fourth years provided that they maintain a scholarship record in the previous year and continue to furnish evidence of need. The amount of each scholarship is $250 in the form of remission of tuition fees. Forms of application for these scholarships, including the complete regulations concerning them, may be obtained from the Registrar. Applications must be filed with that officer during the months of May and June of the year in which the applicant intends to enter the Institute.

Lucius Clapp Scholarship Fund. — The income from this fund of five thousand dollars is available to aid students who otherwise might be unable to complete their studies at the Institute.

Class of 1891 Fund. — The Class of '91, on leaving the Institute, provided funds for a system of letter-boxes for the use of students. Any profits accruing from the rental of these letter-boxes will be applied to the assistance of scholarship applicants.

Lucretia Crocker Scholarship Fund. — The income from the bequest of Matilda Crocker is to be used to provide pecuniary assistance for one or more young women students.

Isaac Warren Danforth Scholarship Fund. — Founded by bequest of James H. Danforth as a memorial to his brother, Isaac Warren Danforth. The amount of this fund is five thousand dollars.

Dickinson Fund. — By the will of Mrs. Ann White Dickinson the Institute has received about forty thousand dollars, the income of which is applied to the assistance of young men of American origin.

Farnsworth Scholarship. — To establish this scholarship the Institute received a gift of five thousand dollars from Mrs. Mary E. Atkins, of Boston.

Charles L. Flint Scholarship. — Founded by Charles L. Flint, of Boston. This scholarship is to be awarded, by preference, to a graduate of the Boston English High School.

Sarah S. Forbes Scholarship Fund. — Originally a fund of twenty-eight hundred dollars given in trust in 1868 by Sarah S. Forbes to William Barton Rogers and Henry S. Russell, Trustees, the income to be paid toward the maintenance and education of a scholar at the Institute. This amount and accumulations was turned over to the Institute by succeeding trustees.

T. Sterry Hunt Scholarship. — Founded by bequest of T. Sterry Hunt, for seven years Professor of Geology at the Institute. This scholarship is restricted to students of Chemistry and preference will be given those in the higher years.

William F. Huntington Scholarship. — Founded in memory of William F. Huntington, who graduated in Civil Engineering in the Class of '75. Preference will be given to a student in that Course.

Joy Scholarship. — The money by which these scholarships are sustained was given by Miss Nabby Joy. They were created pursuant to a decree of the Supreme Judicial Court of Massachusetts, for the benefit of one or more women studying natural science in the Institute.

William Litchfield Scholarship. — By the will of William Litchfield the Institute has received five thousand dollars to be known as the William Litchfield Scholarship, the income to be awarded annually and paid to such student in said Institute as may upon

a competitive examination be determined by the President of said Institute to be entitled thereto for excellence in scholarship and conduct.

Elisha T. Loring Scholarship. — Founded by Elisha Thacher Loring, of Boston, by a bequest of five thousand dollars.

Massachusetts State Scholarships. — In consideration of support received from the Commonwealth, the Institute maintains eighty free scholarships which are granted by the Board of Education to residents or minor children of residents of the State. Information regarding the terms and conditions upon which they are to be awarded may be obtained by addressing the Commissioner of Education, 15 Ashburton Place, Boston. Applications for these scholarships must be filed on or before July 1 of each year.

George Henry May Scholarship Fund. — Founded by George Henry May of the Class of '92 to provide a scholarship for graduates of the High Schools of Newton, Mass. The scholarship is awarded by a committee consisting of the Superintendent of Schools, Chairman of the School Committee and the Headmasters of the Newton High Schools.

Milton High School Scholarship. — Founded by the Institute in recognition of contributions of residents of Milton. This scholarship will be conferred upon such former pupil of the Milton High School in good standing at the Institute as the master of that school and the school committee of the town may select.

James Henry Mirrlees Scholarship. — Founded by James B. Mirrlees, of Glasgow, Scotland, in memory of his son, who died in May, 1886, while attending the Institute. This scholarship will be awarded to a third- or fourth-year student in Mechanical Engineering.

Charles C. Nichols Scholarship Fund. — By the will of Charles C. Nichols the Institute has received five thousand dollars, the income of which is to be used for scholarships.

Nichols Scholarship. — Founded by bequest of Mrs. Betsey F. M. Nichols in memory of her son, William Ripley Nichols, of the Class of '69, for sixteen years Professor of General Chemistry at the Institute. Preference will be given to students in the Course in Chemistry.

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John Felt Osgood Scholarship. — By the will of Elizabeth B. Osgood, and as a memorial to her husband, John Felt Osgood, the Institute has received five thousand dollars for the establishment of a scholarship in Electrical Engineering.

Perkins Fund. — By a bequest of Richard Perkins, of Boston, the income of fifty thousand dollars is available for aiding students in such amounts as shall be recommended by the Faculty.

William Barton Rogers Scholarship Fund. — The income from this fund, which was presented by the Alumni Association of the Institute as a memorial to President Rogers, is applied to aiding students requiring financial assistance. Grants from this fund carry with them the obligation of ultimate repayment, and all amounts returned become immediately available as income.

William Barton Rogers Scholarship. — In commemoration of the connection of President Rogers with William and Mary College of Virginia, the Executive Committee has established a scholarship of the value of three hundred dollars a year to be known as the William Barton Rogers Scholarship. This scholarship will be granted to a student nominated by the Faculty of William and Mary College.

Sherwin Scholarship. — Founded by the English High School Association in memory of Thomas Sherwin. The student to receive the privilege of this scholarship is to be a graduate of the English High School of Boston and must be pursuing a regular Course at the Institute.

Susan Upham Fund. — By gift of Susan Upham the income of one thousand dollars is available for students who may be in need of financial assistance.

Vose Fund. — By the will of Mrs. Ann White Vose the Institute has received about sixty thousand dollars, the income of which is used for scholarships in aid of young men of American origin.

Louis Weissbein Scholarship. — By the will of Louis Weissbein the Institute received four thousand dollars for founding a scholarship, preference to be given to a Jewish boy in making the award.

Frances Erving Weston Scholarship Fund. — Founded by bequest of Frances Erving Weston, the income to be used to aid a native-born American Protestant girl of Massachusetts.

Samuel Martin Weston Scholarship Fund. — Founded by bequest of Frances Erving Weston in memory of her husband, the income to be used to aid a native-born American Protestant boy, preference to be given to one from Roxbury.

Jonathan Whitney Fund. — The income from this fund, established by Francis B. Greene, is available for the purpose of aiding students who need financial assistance in obtaining an education at the Institute.

FUNDS AVAILABLE FOR ADVANCED STUDY

Applications for grants for advanced study should be presented to the Secretary of the Faculty not later than the first of March, on forms provided for the purpose. This rule applies both to original applications and to the renewal of previous grants. If funds are still available, applications for grants will be considered up to the first of October. Each applicant must present with his application a detailed statement of the advanced work which he desires to pursue. If not a graduate of the Institute, he should present from the Registrar of the institution from which he comes a statement of his standing in the various subjects which he has there pursued. He should also fill out a special form, "schedule of equivalents," showing the extent to which he has pursued subjects required in the undergraduate Course at the Institute leading to the advanced study which he wishes to undertake.

A student who is working for the degree of Doctor of Philosophy or Doctor of Engineering either at the Institute or under an Institute grant at another institution, may be appointed a *Fellow* upon recommendation of the Faculty, as a mark of distinction. A certificate of appointment bearing the seal of the Institute and signature of the President and Secretary of the Faculty will be issued to each Fellow upon the approval of his appointment by the Corporation.

The Institute now possesses the following funds, the income of which is available, wholly or in part, to aid students in pursuing advanced study and research.

Austin Fund. — The Institute has received from the estate of Edward Austin a bequest of three hundred and sixty thousand dollars to assist meritorious students and teachers in the pursuit of their studies. From this fund a number of awards of two hundred and fifty dollars each, equivalent to free tuition, are made each year to students working for the degree of Master of Science. A limited number of awards not exceeding five hundred dollars each are also available for candidates for the degree of Doctor of Philosophy and Doctor of Engineering.

Two Austin Research Fellowships carrying an award of five hundred dollars each in addition to remission of tuition fees have been established. Candidates for the degree of Doctor of Philosophy or Doctor of Engineering who have shown exceptional ability may be appointed to these Fellowships.

Collomore Fund. — The income from the bequest of Helen Collomore to be applied primarily to the aid of women students in graduate courses.

Dalton Fund. — Founded by Charles H. Dalton, the income to be used for the payment of fees of American male students, graduates of the Institute, who may wish to pursue advanced chemical study and research, especially applicable to textile industries.

Moore Scholarship Fund. — The income from five thousand dollars, the gift of Mrs. F. Jewett Moore, to be awarded a graduate student for advanced study in Europe, specializing in organic chemistry. Preference will be shown to one who has distinguished himself in this subject while an undergraduate.

Willard B. Perkins Fund. — Founded by a bequest of Willard B. Perkins, of the Class of '72. The income, amounting to one thousand dollars, will be available in 1919–1920 and every fourth year for a traveling scholarship in Architecture.

Ellen H. Richards Memorial Research Fund. — The income of this fund will be devoted to the promotion of research in sanitary chemistry, the branch of science to whose development Mrs. Richards so greatly contributed. The income will be utilized by the Institute for the award of fellowships to advanced students competent to pursue this line of research, for the employment of

research assistants, and in such other ways as will best promote investigation in the field in question.

Richard Lee Russel Fund. — Founded by Theodore E. Russel in memory of his brother, Richard Lee Russel. The income of two thousand dollars is to be awarded to some student of high standing in Civil Engineering to enable him to continue his studies either as a graduate or undergraduate.

Henry Saltonstall Scholarship Fund. — By the will of Henry Saltonstall the Institute has received ten thousand dollars, to be known as "The Henry Saltonstall Scholarship Fund," the income to be used to aid students, whether undergraduates or graduates, pursuing advanced courses. About four hundred dollars from the income of this fund is available annually.

James Savage Fund. — Founded by the late James Savage About five hundred dollars from the income of this fund will be annually awarded to a graduate student of the Institute, or of some similar institution of equal standing. This sum will be awarded only to a student of ability who wishes to engage in the advanced study of some branch or branches of knowledge taught in the Institute.

Susan H. Swett Fund. — About four hundred dollars from the income of this fund will be annually awarded to a graduate student of the Institute, or of some similar institution of equal standing, who, by his character, capacity, training, and attainments, shall give evidence of special fitness to pursue advanced study in some branch or branches of knowledge taught in the Institute.

Traveling Fellowship in Architecture. — One thousand dollars to be devoted to travel and study abroad under the direction of the Department of Architecture. The competition for this fellowship is open to regular and special students who have passed at least two consecutive years in the school within the last three years, one of which must have been in the graduate class.

PRIZES

The following annual prizes are offered to the students of the Department of Architecture, and are awarded through competitions in Design:

The Boston Society of Architects' Prizes. — The gift of the Society. Two prizes of fifty dollars awarded to a regular and a special student in the senior class.

The Chamberlin Prize. — The gift of Mr. W. E. Chamberlin of the Class of 1877. Twenty-five dollars awarded to a student in the graduate class.

The F. W. Chandler Prizes. — The gift of the alumni of the Department and of Professor Chandler's friends. Five prizes of ten dollars each awarded for sketch problems in the third, fourth, and graduate years.

The "Class of 1904" Prizes. — The gift of the Class of 1904. Two prizes of ten dollars awarded to a regular and a special student in the junior class.

Rotch Prizes. — The gift of Mr. Arthur Rotch. Two prizes of two hundred dollars awarded at the end of the senior year to the regular and the special student having the best general records. The special student must have spent at least two years in residence to be eligible as a candidate.

Student Medal of the American Institute of Architects. — This medal is awarded on the recommendation of the Department to the member of the graduating class whose record for the course is the best.

School for Health Officers

ADMINISTRATIVE BOARD

WILLIAM T. SEDGWICK, Sc.D., *Chairman.*
MILTON J. ROSENAU, A.M., M.D., *Director.*
GEORGE C. WHIPPLE, S.B., *Secretary.*

THIS school for the training of health officers was established in 1913 by Harvard University and the Massachusetts Institute of Technology, and is conducted by an administrative board appointed for the purpose by both institutions.

The principal object of the School is to prepare young men for public health work; especially to fit them to occupy administrative and executive positions, such as health officers, or members of boards of health, or secretaries, agents, or inspectors of health organizations. To this end, lectures, laboratory work, and other forms of instruction are provided by both institutions, and by special instructors from national, state, and local health services. The subjects embraced in the courses of study have been selected to cover a wide range, including medical, biological, hygienic, sanitary, and engineering sciences, besides practical health administration.

The opportunities for the practical study of the arts of public sanitation offered to students of the School for Health Officers are believed to be exceptional. The city of Boston is an important port of entry for foreign and domestic shipping and for immigration, and has thirty or more municipalities in its immediate vicinity, while the state of Massachusetts is a commonwealth which has long been recognized as standing in the forefront of American communities in respect to public health arts and sciences. To the advantages of location are added the combined resources of Harvard University and the Massachusetts Institute of Technology.

Graduates of Medicine of Harvard University and other recognized medical schools will be admitted to the School for Health Officers upon their records, and registered as candidates for the Certificate in Public Health (C. P. H.). Bachelors of Science in Biology and Public Health of the Massachusetts Institute of Technology and other recognized institutions will likewise be admitted and registered as candidates for that certificate.

Masters of Civil Engineering of Harvard University who have specialized in Sanitary Engineering and Bachelors of Science in Sanitary Engineering of the Massachusetts Institute of Technology and other recognized institutions will be admitted to the School upon their records, but will be required to spend at least one year in preparation before being accepted as candidates for the Certificate in Public Health.

Other graduates of colleges or technical or scientific schools will be admitted to the School without examination, provided their collegiate courses have included adequate instruction in physics, chemistry, biology, French and German; but they will be required to spend two or more years in preparation before being accepted as candidates for the Certificate in Public Health. Applications for admission to the School will be considered from those who have spent at least two years in a recognized college or technical or scientific school and have pursued satisfactory courses in physics, chemistry, biology, French and German, and also from persons of unusual experience or special qualifications; but these will also be required to spend two or more years in preparation before being admitted as candidates for the certificate.

Special students, not candidates for the Certificate in Public Health, who desire to fit themselves for some special field may be admitted to the School and may take any course or courses for which they are properly qualified, on approval of the Administrative Board.

CERTIFICATE

The Certificate in Public Health (C. P. H.) will be granted to candidates who have satisfactorily completed the studies of an approved schedule, who have spent not less than one academic year in residence, and who have otherwise complied with all requirements. This certificate will be issued by Harvard University and the Massachusetts Institute of Technology and will be signed by authorities of both institutions.

FEES

The tuition fee for candidates for the Certificate in Public Health and for all other students pursuing regular courses in the School is $250 per year and must be paid in advance as follows: — $150 on or before the first day of the first term, and $100 on or before the first day of the second term. For one half of the school year the fee is $150.

Special students who do not pay the regular fee must pay a special fee for each course.

A deposit of $50 is required to be made in advance against charges for breakage in the laboratories, and any balance remaining at the end of the year will be returned. There will be no extra laboratory fees for instruction taken in course.

Further information may be had on application to Professor William T. Sedgwick, Massachusetts Institute of Technology, Cambridge, Mass., or to Dr. Milton J. Rosenau, Harvard Medical School, Boston, Mass.

Lowell Institute[1]

The Trustee of the Lowell Institute has established, under the auspices of the Massachusetts Institute of Technology, a Free Evening School for Industrial Foremen. The school comprises, at present, three Courses, — Mechanical Course, Electrical Course, and Buildings Course, each extending over two years.

The Courses of Instruction. — These courses are intended to bring the systematic study of applied science within the reach of young men who are following industrial pursuits and desire to fit themselves for higher positions, but are unable to attend courses during the day. The subjects included in the courses are as follows:

First-year Mechanical and Electrical Courses. — Mathematics; Physics and Elementary Electricity; Elements of Mechanism; Drawing.

Second-year Mechanical Course. — Elements of Thermodynamics; the Steam-engine and Boilers; Valve-gears; Mechanics; Elementary Hydraulics; Testing Laboratory; Steam and Hydraulic Laboratory; Mechanism and Machine Design.

Second-year Electrical Course. — Elements of Thermodynamics, the Steam-engine and Boilers; Valve-gears; Steam Laboratory; Direct Current Machinery; Alternating Currents; Electric Distribution; Electrical Testing Laboratory; Laboratory of Dynamo Electric Machinery.

First-year Buildings Course. — Mathematics; Physics and Elementary Electricity; Elements of Mechanism; Drawing; Applied Mechanics and Graphic Statics; Steam and Hydraulic Machinery; Heating and Ventilation.

Second-year Buildings Course. — Materials and Testing Materials; Structural Design; Foundations; Electrical Machinery

[1] For general information in regard to the Lowell Institute, application should be made to Professor W. T. Sedgwick, Curator, Massachusetts Institute of Technology, Cambridge, Mass.

and Electrical Laboratory; Electrical Wiring; Steam Laboratory; Buildings Laws, Contracts, Sanitation, etc.

It is the aim to adapt the courses to the men for whom the instruction is intended and to include the study of those principles with which they are not likely to become familiar in practice. The instruction embraces recitations, lectures, drawing-room practice, and laboratory exercises; and is given by members of the instructing staff of the Institute of Technology. Many of the lectures are fully illustrated by apparatus and experiments. Written tests are given from time to time, and problems are assigned for home work at nearly every exercise. Text-books are used in many of the subjects, but in some of the work, where the instruction differs widely from available books, printed notes are supplied to the students at cost. Students are expected to purchase such text-books, note-books, instruments, and other material as may be recommended throughout the course.

The scholarship of the students and their ability to continue the courses is determined in part by examinations, but considerable weight is given to the term's work. Those students who fail to keep well up with the work or to profit sufficiently by the instruction are informed that they are not qualified to pursue the course advantageously. Those who complete satisfactorily the required courses of the two years and pass the examinations are given certificates.

The School Year. — The next school year will begin September 24, 1917, and will close May 20, 1918. There will be a recess of one week at Christmas, and on legal holidays the exercises of the school will be suspended. Attendance from 7.30 to 9.30 for three or four evenings a week is required, in addition to outside study.

Requirements for Admission. — Application for admission should be made early and before June, if possible. To be admitted to the first-year course the applicant must be at least eighteen years of age, and must pass satisfactorily entrance examinations in Arithmetic (including the Metric System), Elementary Algebra, Plane Geometry, and Mechanical Drawing. These examinations may be, in a measure, of a competitive nature, and considerable weight will be attached to the applicant's occupation and practical experience. The courses are open to those only

who are ambitious and willing to study, and who purpose to complete the full course of two years. The character and amount of the instruction is such that, if the student is not well fitted to take up the work of the school, it will not be possible for him to derive full benefit from the course, or perhaps to maintain his standing.

A circular giving detailed information regarding the nature of the entrance examinations and other requirements may be obtained by sending a stamped, addressed envelope to Professor Charles F. Park, Director, Lowell Institute School for Industrial Foremen, Massachusetts Institute of Technology, Cambridge.

Alumni Associations

THE ALUMNI ASSOCIATION

THE Alumni Association of the Institute holds its annual banquet in Boston in January. It includes in its membership all graduates of the Institute. Membership is also open, by election, to non-graduate members of classes that have been graduated and to members of the former School of Mechanic Arts. Honorary membership is open to present and former members of the Corporation and of the Faculty.

Its officers for 1916 are:

President: CHARLES A. STONE, '88.

Vice-Presidents: JOSEPH H. KNIGHT, '96, JOHN L. MAURAN, '89, FRANK A. SMYTHE, '89.

Secretary-Treasurer: WALTER HUMPHREYS, '97, Massachusetts Institute of Technology.

Executive Committee: THE PRESIDENT, VICE-PRESIDENTS, SECRETARY-TREASURER, MATTHEW C. BRUSH, '01, WARREN K. LEWIS, '05, GROSVENOR D'W. MARCY, '05, HAROLD E. KEBBON, '12.

COUNCIL OF THE ALUMNI ASSOCIATION

The constitution establishes a Council which is a body thoroughly representative of the Alumni Association. The membership of this Council is made up as follows: the five latest living ex-presidents, ten members elected at large, one representative from each graduated class and from each local organization which is given representation by the Executive Committee, besides the general officers of the association.

In accordance with the constitution the present membership of the Council is as follows:

Five Latest Living Ex-Presidents:

ARTHUR A. NOYES, '86. JASPER WHITING, '89.
JAMES W. ROLLINS, '78. FREDERIC H. FAY, '93.
HENRY J. HORN, '88

Representatives at Large:

Term expires in 1917.	*Term expires in 1918*
William D. Sohier, '78.	Frank H. Briggs, '81.
Leonard C. Wason, '91.	William G. Snow, '88.
Raymond B. Price, '94.	Lester D. Gardner, '98.
William D. Coolidge, '96.	H. W. Geromanos, '02.
Proctor L. Dougherty, '97.	Charles W. Whitmore, '08.

Class Representatives:

'68, Robert H. Richards.	'92, Leonard Metcalf.
'69, Howard A. Carson.	'93, George B. Glidden.
'70,	'94, Samuel C. Prescott.
'71, Edward W. Rollins.	'95, Harold K. Barrows.
'72, C. Frank Allen.	'96, J. Arnold Rockwell.
'73, Samuel E. Tinkham.	'97, Charles W. Bradlee.
'74, George H. Barrus.	'98, Seth K. Humphrey.
'75, Thomas Hibbard.	'99, Hervey J. Skinner.
'76, Charles T. Main.	'00, Ingersoll Bowditch.
'77, Belvin T. Williston.	'01, Robert L. Williams.
'78, Charles M. Baker.	'02, Frederick H. Hunter.
'79, Charles S. Gooding.	'03, Thomas E. Sears.
'80, George H. Barton.	'04, Merton L. Emerson.
'81, John Duff.	'05, Grosvenor D'W. Marcy.
'82, James P. Munroe.	'06, John F. Norton.
'83, Horace B. Gale.	'07, Lawrence Allen.
'84, Harry W. Tyler.	'08, Herbert T. Gerrish.
'85, Isaac W. Litchfield.	'09, Carl W. Gram.
'86, Arthur A. Noyes.	'10, Charles E. Green.
'87, Henry F. Bryant.	'11, Herbert Fryer.
'88, Arthur T. Bradlee.	'12, Harold E. Kebbon.
'89, Henry Howard.	'13, William R. Mattson.
'90, William Z. Ripley.	'14, Charles Parker Fiske.
'91, Arthur H. Alley.	'15, Marshall B. Dalton.
	'16, Russell H. White.

Local Societies Represented:

Technology Club of the Merrimack Valley,
Richard A. Hale, '77.

Technology Club of New York,
Ralph H. Howes, '03.

Northwestern Association, M. I. T.,
B. R. T. Collins, '88.

Pittsburgh Alumni Association,
L. K. Yoder, '95.

TECHNOLOGY CLUB OF PHILADELPHIA,
REGINALD A. WENTWORTH, '04.

WASHINGTON SOCIETY OF THE M. I. T.,
HENRY A. MORSS, '93.

TECHNOLOGY CLUB OF MILWAUKEE,
ALEXANDER MACOMBER, '07.

THE CINCINNATI M. I. T. CLUB,
H. N. DAWES, '93.

M. I. T. CLUB OF CENTRAL NEW YORK,
THEODORE H. SKINNER, '92.

TECHNOLOGY CLUB OF NORTHERN OHIO,
CHARLES W. EATON, '85.

TECHNOLOGY CLUB OF RHODE ISLAND,
ELEAZER B. HOMER, '85.

TECHNOLOGY CLUB OF PUGET SOUND,
DON GALUSHA, '04.

TECHNOLOGY CLUB OF SOUTHERN CALIFORNIA,
JOHN C. CHASE, '74.

TECHNOLOGY CLUB OF NEW HAMPSHIRE,
ANDREW FISHER, JR., '05.

TECHNOLOGY CLUB OF BUFFALO,
ARTHUR C. ANTHONY, '86.

TECHNOLOGY ASSOCIATION OF MINNESOTA,
ALLAN W. ROWE, '01.

DETROIT ASSOCIATION OF THE M. I. T.,
EVERETT MORSS, '85.

INTERMOUNTAIN TECHNOLOGY ASSOCIATION,
GEORGE E. RUSSELL, '00.

TECHNOLOGY CLUB OF THE CONNECTICUT VALLEY,
EBEN S. STEVENS, '68.

TECHNOLOGY CLUB OF HARTFORD, CONN.,
G. H. GLEASON, '03.

INLAND EMPIRE ASSOCIATION OF THE M. I. T.,
H. W. GARDNER, '94.

TECHNOLOGY CLUB OF NEW BEDFORD,
C. F. LAWTON, '77.

TECHNOLOGY ASSOCIATION OF NORTHERN CALIFORNIA,
BURTON G. PHILBRICK, '02.

TECHNOLOGY ASSOCIATION OF OREGON,
ANDREW D. MACLACHLAN, '96.

Rocky Mountain Technology Club,
Allen H. Rogers, '90.

Technology Club of the South,
Charles F. W. Wetterer, '06.

Technology Association of Japan,
Stephen Bowen, '91.

Technology Club of Rochester,
Howard C. Turner, '03.

St. Louis Society of the M. I. T.,
C. M. Spofford, '93.

Southeastern Technology Association,
Harold S. Wonson, '07.

Southwestern Association of M. I. T.,
W. Lyman Underwood, '98.

Berkshire County Alumni Association of M. I. T.,
Walter B. Snow, '82.

Technology Club of Hawaii,
Edwin S. Webster, '88.

Technology Club of Lower Canada,
George W. Vaillant, '92.

Technology Club of Bridgeport,
Frederick C. Blanchard, '91.

Dayton Technology Association,
Charles F. Park, '92.

Technology Club of Springfield,
Frederic W. Fuller, '96.

Technology Club of Montana,
George A. Packard, '90.

THE TECHNOLOGY CLUBS ASSOCIATED

This association was organized in New York City, January 17, 1913. Its object is to promote the general interest and social relations between the various Technology clubs and to assist in spreading information concerning the Massachusetts Institute of Technology. General meetings, at which the place of the following meeting is to be designated, are to be held annually or as otherwise determined by the Executive Committee of the federation. The meeting in 1914 was held in Chicago, in 1915 in Pittsburgh, and in 1916 in Boston.

President: FRANK A. SMYTHE, '89, The Thew Automatic Shovel Co., Cleveland, Ohio.

Vice-Presidents: PAUL W. LITCHFIELD, '96, Akron, Ohio; HOLLIS GODFREY, '98, Philadelphia, Pa.; LESTER D. GARDNER, '98, New York, N. Y.; ARTHUR T. HOPKINS, '97, Cleveland, Ohio.

Secretary: MAURICE E. ALLEN, '08, 2248 Parkwood Ave., Toledo, Ohio.

Assistant Secretary: DONALD R. STEVENS, '11, Goodyear Tire & Rubber Co., Akron, Ohio.

THE M. I. T. WOMEN'S ASSOCIATION

This association was organized in 1900, in Boston, Mass., and incorporated under the law of Massachusetts in 1907. Its object is to promote education, unity and good fellowship among women graduates and past students of the Institute, and to advance the cause of education and the general welfare of the women undergraduates. A Students' Aid Committee stands ready to assist these women in any emergency. The association has about one hundred and fifty members. Social meetings are held four times during the winter, and the annual meeting and luncheon is held early in January. New members are cordially welcomed. The corresponding secretary will be glad to be notified of any change in a member's address.

President: MABEL K. BABCOCK, '08.

First Vice-President: MARION TALBOT, '88.

Second Vice-President: ISABEL F. HYAMS, '88.

Recording Secretary: CLARA P. AMES, '82.

Corresponding Secretary: LILLIE C. SMITH, '06, 1 Winchester St., Brookline, Mass.

Treasurer: ANNIE E. ALLEN, '94.

Auditor: BERTHA M. BROWN, '92.

THE TECHNOLOGY CLUB OF BOSTON

Founded in 1896 in Boston, Mass. The object of the club is to promote the welfare of the Institute and the common social interests of its past and present officers and students. The membership is at present about seven hundred, including graduates and other former students, members of the Corporation and of the instructing staff, and a limited number of undergraduates.

In view of the removal of the Institute to Cambridge the Council of the Technology Club felt it wise to take advantage of a favorable opportunity to sell the club house at 83 Newbury Street. The Engineers Club, 2 Commonwealth Avenue, has extended to the Technology Club the privileges of its house during the coming year. The Technology Club retains its own organization with the following officers:

President: SAMUEL C. PRESCOTT, '94.
Vice-President: DWIGHT PORTER.
Secretary: ROBERT S. WILLIAMS, '02, Massachusetts Institute of Technology, Cambridge, Mass.
Treasurer: ANDREW D. MACLACHLAN, '96.

NORTHWESTERN ASSOCIATION, MASSACHUSETTS INSTITUTE OF TECHNOLOGY

This association was founded in 1887, in Chicago, Ill., and originally drew for its membership upon the whole country west of Pittsburgh. During recent years Technology associations have been formed at Detroit, Pittsburgh, Indianapolis, Milwaukee, St. Louis, San Francisco and many other points in this territory, but this association still includes a few members from Michigan, Indiana, Ohio and other points South and West of the Great Lakes where there is no local association. The present regular membership is about 300. The headquarters of the association is in Chicago, and a majority of the members are located in this city and its vicinity. All former students of the Institute are welcomed to the association, and may enjoy full privileges upon payment of dues, which are $2.00 per year for resident members, — that is, members living in Chicago or vicinity, — and $1.00 for non-resident members. The association holds informal gatherings at various clubs (including at least one outdoor summer meeting) during the year, and the annual dinner occurs towards the end of February or early in March. Officers are elected at one of the winter meetings. Regular luncheons are held every Tuesday at 12.30 at the Engineers' Club, 314 Federal St. The association publishes bulletins from time to time, announcing meetings, speakers and other items of interest to the members. A directory containing addresses and occupation of all members is also published and may be obtained from the secretary.

President: HARRY M. MONTGOMERY, '79.
Vice-President: FRANK F. FOWLE, '99.
Secretary-Treasurer: HARVEY S. PARDEE, '02, 111 West Washington St., Chicago, Ill.
Alumni Council Representative: B. R. T. COLLINS, '88.
Executive Committee: This Committee acts in an advisory capacity and is composed of nine members elected from among the past presidents of the Association.
Directors: JOHN M. FITZGERALD, '02, HAROLD LOCKETT, '10, DANIEL A. TOMLINSON, '12.

THE ROCKY MOUNTAIN TECHNOLOGY CLUB

This club was founded in 1889 in Denver, Colo., and originally included members from Colorado, Kansas, Wyoming, Montana, Utah and New Mexico. The impracticability of attempting to cover so large a territory and the formation of the club in Salt Lake City have caused the reduction in scope to include Colorado alone. There are at present about one hundred Technology alumni in the state. Dinners are usually given in honor of some special event such as the visit of some man prominently associated with Tech work. An occasion of this sort crystallizes the interest of the members and insures a good attendance and an enthusiastically successful affair. Tech men visiting Denver are cordially urged to call up the president and make their presence known.

President: SAMUEL C. LIND, '02.
Vice-President: HAROLD O. BOSWORTH, '02.
Secretary: JOHN J. MULLEN, '08.
860 Emerson St., Denver, Colo.
Alumni Council Representative: ALLEN H. ROGERS, '90.

THE TECHNOLOGY CLUB OF NEW YORK

The Technology Club of New York was organized in 1895, in New York City, and incorporated in 1903. From September 1, 1903, till May 1, 1909, it occupied a small club house of three stories, only one of which was devoted to club purposes, and its membership was between two and three hundred. It then obtained an adequate club house of four stories and basement at 17 Gramercy Park, the two upper stories comprising rooms rented to resident and transient members, and the remainder of the house used for general club purposes including reception room,

dining rooms, café, library, billiard rooms, card and writing rooms. Its membership is now about one thousand, and from fifty to seventy men dine in the house daily. Students and instructors connected with the Institute for one year or more are eligible for resident or non-resident membership. Smokers and entertainments are held monthly. The annual meeting is held on the first Saturday of May. The annual dinner is held on Saturday evening, two weeks prior to the first Saturday in February. The affairs of the club are conducted by a Board of Governors of ten members, five of whom are elected from divisions of classes for five-year terms, and five elected from the membership at large for one-year terms. As a rule members of the Board are officers or chairmen of standing committess. The organization at the present time is as follows:

President: FRANK C. SCHMITZ, '95.
Vice-President: SCHUYLER SCHIEFFELIN, '90.
Treasurer: IRA ABBOTT, '81.
Assistant Treasurer: CLIFTON W. WILDER, '98.
Secretary: LESTER D. GARDNER, '98, 100 Morningside Drive, New York, N.Y.
Board of Governors: WALTER LARGE, '79; T. HOWARD BARNES, '81; HOWARD L. COBURN, '87; GEORGE V. WENDELL, '92; THEODORE I. JONES, '96; OSWALD C. HERING, '97; LESTER D. GARDNER, '98; NOEL CHAMBERLIN, '04; THOMAS C. DESMOND, '09.
Alumni Council Representative: RALPH H. HOWES, '03.
Chairman House Committee: OSWALD C. HERING, '97.
Chairman Membership Committee: HOWARD L. COBURN, '87.
Chairman Publicity Committee: LESTER D. GARDNER, '98.
Chairman Entertainment Committee: THOMAS C. DESMOND, '09.
Chairman Art and Library Committee: NOEL CHAMBERLIN, '04.
Chairman Business Opportunities Committee: THEODORE I. JONES, '96.
Chairman Annual Dinner Committee: DANIEL W. EDGERLY, '98.

THE TECHNOLOGY ASSOCIATION OF THE CONNECTICUT VALLEY

This club was formed in 1895. The region from which the membership is drawn comprises the entire territory in, and adjacent to, the Connecticut Valley. Usually a winter meeting and banquet is held at Springfield or Hartford. A summer outing is held at the Hartford Yacht Club at Fenwick, Conn. Some of the men go

down on the boat the night before and enjoy a special dinner, which is served before reaching Fenwick, and the balance of the members arrive during the early morning hours. A very interesting ball game between the Hartfords and the Springfields is played at 11 A.M. Fishing, bathing, boating and other sports are enjoyed, and a shore dinner is served at 2 P.M. All Tech men not already enrolled as members, expecting to be in this territory at the time of the annual meeting, are requested to send their names to the secretary. All Technology men living within the territory named are considered members and notices are sent to them if possible.

President: EDMUND P. MARSH, '89.
Vice-President: CLARENCE E. WHITNEY, '91.
Secretary-Treasurer: ERNEST W. PELTON, '03, 77 Forest St., New Britain, Conn.
Alumni Council Representative: EBEN S. STEVENS, '68.

THE TECHNOLOGY CLUB OF PHILADELPHIA

This club was formed in 1896, in Philadelphia, Pa., and at present has seventy-five members. Conditions of membership are, that one must have been connected with the Institute, either as student or instructor, at least one year, and must have a residence within fifty miles of Philadelphia. Meetings are held on the first Wednesday of each month. At these meetings papers or addresses on current topics are given by men eminent in the various branches of engineering and all Technology men are welcomed. A buffet lunch is usually served and the social features of the meetings are enjoyed by all present.

President: EUGENE S. FOLJAMBE, '01.
Vice-President: H. L. WALKER, '05.
Secretary-Treasurer: CLIFFORD J. WALTON, '14, 1421 Arch St., Philadelphia, Pa.
Assistant-Secretary: FREDERIC E. WATERS, '15, 3101 Haverford Ave., Philadelphia, Pa.
Alumni Council Representative: REGINALD A. WENTWORTH, '04.
Executive Committee: PRESIDENT, VICE-PRESIDENT, SECRETARY, W. H. BLAKEMAN, '05, E. EVERETT PIERCE, '99, PERCY E. TILLSON, '06, CHESTER P. WETHERBEE, '13.

THE PITTSBURGH ASSOCIATION, MASSACHUSETTS INSTITUTE OF TECHNOLOGY

This organization, which was founded in 1899, in Pittsburgh, Pa., now numbers one hundred and ninety-nine members. Any one who has been connected with the Institute as a student or an instructor is eligible for membership. The territory is not restricted, but the membership is composed mainly of men from western Pennsylvania, southeastern Ohio and northern West Virginia.

Annual meetings are held in February, the exact date being decided by the executive committee. Smokers and other informal gatherings are held at least quarterly.

President: WILLIAM B. BLAKE, '87.

Vice-President: FRANK A. MACDONALD, '90.

Secretary-Treasurer: HARRY A. RAPELYE, '08, 2123 Oliver Building, Pittsburgh, Pa.

Assistant-Secretary: L. B. DUFF, 3d., '14, 1503 Farmers' National Bank Bldg., Pittsburg, Pa.

Alumni Council Representative: L. K. YODER, '95.

Executive Committee: THE PRESIDENT, VICE-PRESIDENT, SECRETARY-TREASURER, ALUMNI COUNCIL REPRESENTATIVE, MAURICE R. SCHARFF, '09, PAUL N. CRITCHLOW, '06, RALPH M. FERRY, '12.

THE TECHNOLOGY CLUB OF BUFFALO

The club was founded in 1898, in Buffalo, N.Y., and at present has fifty-four members. Any one who has been connected with the Institute for one year, and is now living in or near Buffalo, is eligible for membership. The meetings take the form of monthly informal dinners, the January dinner being considered the annual meeting. Technology men stopping over in Buffalo are urged to get in touch with one of the officers and arrange to attend these gatherings.

President: HARRY L. NOYES, '90.

Secretary-Treasurer: ELLERY E. ROOT, '11, Standard Ink Co., Buffalo, N.Y.

Alumni Council Representative: ARTHUR C. ANTHONY, '86.

Executive Committee: THE PRESIDENT, SECRETARY-TREASURER, ROY W. LINDSAY, '07, GEORGE C. FURNESS, '06, EDWARD G. HENRICH, '01.

WASHINGTON SOCIETY OF THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY

This society was established in Washington, D.C., February 18, 1899, and at present has an address roll of about two hundred and fifty names, although only about one-fifth of this number are to be considered as active members. The territory from which the membership is drawn includes the District of Columbia, Maryland, northern Virginia and southern Delaware. Six or more meetings are held yearly and in addition excursions and trips are arranged during the summer months. The annual meeting and election of officers is held the first week in December and the annual dinner in January or February. All Technology men who come to Washington are urged to communicate with the secretary in order that they may be notified of meetings, and visiting alumni are cordially invited to meet with us.

President: OSCAR C. MERRILL, '05.
Vice-President: HERBERT S. BAILEY, '06.
Secretary: HENRY G. A. BLACK, '10, U. S. Patent Office, Washington, D.C.
Treasurer: F. CHARLES STARR, '05.
Alumni Council Representative: HENRY MORSS, '93.
Executive Committee: THE PRESIDENT, VICE-PRESIDENT, SECRETARY, TREASURER, and EARLE B. PHELPS, '99.

M. I. T. CLUB OF CINCINNATI

This club was organized in Cincinnati in 1901, and the membership now includes about one hundred, and embraces members from Cincinnati and vicinity. Any one who has been connected with the school, either as a student or instructor, for one year is eligible. Several outings and other meetings are held during the year, and the club meets regularly every week at luncheon at the Metropole Hotel, on Walnut Street, above Sixth, and out of town Tech men are always very welcome. The time is on Tuesdays, from 12.00 to 2.00 o'clock.

President: A. H. PUGH, JR., '97.
Vice-President: STUART R. MILLER, '07.
Secretary: EDWARD H. KRUCKEMEYER, '11, 111 East Fourth Ave., Cincinnati, Ohio.
Treasurer: CHARLES R. STRONG, '11.

Alumni Council Representative: HERBERT N. DAWES, '93.
Executive Committee: THE PRESIDENT, VICE-PRESIDENT, SECRETARY, TREASURER, GEORGE A. COWING, '01, H. S. MORSE, '03, JOHN M. HARGRAVE, '12.

THE TECHNOLOGY CLUB OF THE MERRIMACK VALLEY

This club was organized in 1901, in Lawrence, Mass., and now numbers about one hundred members, who are located in the Merrimack Valley. The annual meeting occurs early in February, and numerous other gatherings called by the executive committee are held during the year, the time and place varying according to convenience.

President: ROBERT F. PICKELS, '87.
Vice-President: EDGAR H. BARKER, '86.
Treasurer: WILLIAM O. HILDRETH, '87.
Secretary: JOHN A. COLLINS, JR., '97, 67 Thorndyke St., Lawrence, Mass.
Alumni Council Representative: RICHARD A. HALE, '77.
Executive Committee: THE PRESIDENT, VICE-PRESIDENT, SECRETARY, and WILLIAM M. PERLEY, '98.

THE TECHNOLOGY CLUB OF MINNESOTA

This club was organized in Minneapolis, Minn., in January, 1904, and now has about sixty members. The object of the club is to maintain the Technology influence in graduate life, to further the interests of Technology, and to be mutually helpful to one another in professional and business affairs.

Membership is limited to those who have attended the Institute for one year or longer. There is no hard and fast rule concerning meetings, but it is the custom to hold either a dinner or smoker once a month during the winter. The annual banquet and meeting is held in February or March.

President: WILLIAM H. BOVEY, '94.
Vice-President: GEORGE H. GOODELL, '92.
Secretary: WILLIS R. SALISBURY, '12, Salisbury & Satterlee Co., Minneapolis, Minn.
Treasurer: MARK G. MAGNUSON, '04.
Alumni Council Representative: ALLAN W. ROWE, '02.

THE TECHNOLOGY CLUB OF NEW BEDFORD

The club was established in 1904, in New Bedford, Mass., and now numbers about forty members. The annual meeting takes place on the first Thursday in November, and is followed shortly afterwards by the annual dinner. Other meetings are held from time to time on call of the executive committee.

President: WILLIAM A. ROBINSON, JR., '97.
Secretary-Treasurer: RICHARD D. CHASE, '92, 607 Purchase St., New Bedford, Mass.
Alumni Council Representative: CHARLES F. LAWTON, '77.
Executive Committee: THE PRESIDENT, SECRETARY-TREASURER, and IRA M. CHACE, JR., '98.

THE TECHNOLOGY CLUB OF HARTFORD

The club was established in 1905, in Hartford, Conn., and has about seventy-five members, most of whom reside in Hartford and its vicinity. Beginning in November, meetings are held once a month except in the summer, and the gatherings usually take place at Heublein's Hotel on the first Saturday in the month. Talks and discussions on subjects of general interest form a part of the program of these meetings, and all Institute men not members of the club are invited to attend. The annual meeting and dinner are held at the Hartford Club on the first Saturday in February.

President: JOHN H. FELLOWS, '07.
Vice-President: HARRY E. DART, '01.
Secretary-Treasurer: GEORGE W. BAKER, '92, Box 983, Hartford, Conn.
Alumni Council Representative: GILBERT H. GLEASON, '03.
Board of Governors: THE PRESIDENT, VICE-PRESIDENT, SECRETARY-TREASURER, CHARLES P. WATERMAN, '03, ATWOOD C. PAGE, '10.

THE TECHNOLOGY CLUB OF RHODE ISLAND

This club was formed in 1905 in Providence, R.I., was reorganized in 1910, and now numbers about two hundred members. The annual meeting takes place in March, and several informal meetings are held during the year.

President: Z. W. BLISS, '89.
Vice-President: FRANK L. PIERCE, '89.

Secretary-Treasurer: CLARENCE L. HUSSEY, '08, 1547 Smith St., Fruit Hill, Providence, R.I.

Alumni Council Representative: ELEAZER B. HOMER, '85.

Executive Committee: THE PRESIDENT, VICE-PRESIDENT, SECRETARY-TREASURER, ALUMNI COUNCIL REPRESENTATIVE, ROLAND H. BALLOU, '04. THAYER P. GATES, '02.

THE TECHNOLOGY CLUB OF NORTHERN OHIO

This club was formed in 1906, in Cleveland, Ohio, and has a membership of about two hundred alumni of the Institute residing in the northern part of Ohio. Meetings are held at frequent intervals throughout the year and have been in the nature of outdoor field days, banquets and smokers. All men moving into the vicinity are earnestly urged to affiliate.

President: PAUL W. LITCHFIELD, '96.

Vice-President: FREDERICK METCALF, '90.

Secretary-Treasurer: DONALD R. STEVENS, '11, Goodyear Tire and Rubber Co., Akron, Ohio.

Alumni Council Representative: CHARLES W. EATON, '85.

Executive Committee: FRANK A. SMYTHE, '89, HENRY B. DATES, '94, GEORGE W. SHERMAN, '94, ALBERT D. HATFIELD, '96, GEORGE E. MERRYWEATHER, '96, ARTHUR T. HOPKINS, '97, GEORGE T. GLOVER, '08, EDWIN R. HALL, '08, TYLER W. CARLISLE, '10, ALLEN A. GOULD, '10.

TECHNOLOGY ASSOCIATION OF NORTHERN CALIFORNIA

This association was organized in 1907, in San Francisco, Cal., and its list of about one hundred men is made up of Technology men residing in or near northern California. The purpose of the association is to bring all Technology men in this region into the closest possible touch with each other. Dinners and other social gatherings are held at frequent intervals, and the annual meeting takes place on the first Saturday in May. Technology men visiting California are requested to notify the secretary of their presence in order that small gatherings of special friends may be encouraged. Headquarters, Eaton Laboratories, 444 Market Street, San Francisco.

President: ARTHUR E. WELLS, '06.

Secretary-Treasurer: HOWARD F. CLARK, '12, 999 Bush St., San Francisco, Cal.

Alumni Council Representative: BURTON G. PHILBRICK, '03.
Executive Committee: FREDERICK M. EATON, '05, HORACE S. GRISWOLD, '10.

TECHNOLOGY CLUB OF THE SOUTH

This club was formed in 1907, in New Orleans, La., and has now twenty-seven members. No constitution has been published, but it is the intention to hold quarterly meetings, and on May 1 the annual meeting. Any Technology alumnus not a member is heartily welcomed to these gatherings.

President: BENJAMIN A. OXNARD, '75.
Vice-President: MOISE A. GOLDSTEIN, '04.
Secretary: JOHN H. O'NEILL, '10, State Board of Health, New Orleans, La.
Alumni Council Representative: HAROLD E. KEBBON, '12.

THE M. I. T. CLUB OF CENTRAL NEW YORK

This club was founded in 1907, in Syracuse, N.Y., with a membership of twenty-five. Any one who has been connected with the Institute for one year, either as instructor or student, and who now resides in Central New York may become a member. Technology alumni from other places are invited to attend the meetings and members of other Technology alumni societies are given full privileges.

The annual meeting is held the first Monday in October, in Syracuse, and other meetings at the call of the president, when the occasion warrants.

President: HARRY W. JORDAN, '91.
Vice-President: ERNEST M. SMITH, '06.
Secretary-Treasurer: JAMES R. VEDDER, '07, 704 Sedgwick, Andrews & Kennedy Building, Syracuse, N.Y.
Alumni Council Representative: THEODORE H. SKINNER, '92.
Executive Committee: PRESIDENT, VICE-PRESIDENT, SECRETARY-TREASURER, HOWARD H. MCCHESNEY, '07, C. S. GLENN, '03.

INLAND EMPIRE ASSOCIATION OF THE M. I. T.

This club was organized in December, 1907, in Spokane, Wash., and at present numbers thirty-eight members. The object of the club is to further the well-being of the Massachusetts Institute of Technology by increasing the interest of members in the Institute

and in each other. Any former student of the Institute may become a member of the association provided he has been a member of a class which has been graduated.

The annual meeting and banquet of the association are held on a Saturday evening between December 15 and February 15. At least two informal meetings are held during the year, the date of which is arranged by the executive committee.

President: SHIRLEY S. PHILBRICK, '98.
Vice-President: WILLIAM J. ROBERTS, '91.
Secretary: PHILIP F. KENNEDY, '07, 1129 Hamilton St., Spokane, Wash.
Alumni Council Representative: HARRY W. GARDNER, '94.
Executive Committee: PRESIDENT, VICE-PRESIDENT, SECRETARY, FRANCIS F. EMERY, '81, EDWIN R. CRANE, '04, JOHN F. GREENE, '08.

TECHNOLOGY CLUB OF SOUTHERN CALIFORNIA

The club was organized in 1908, in Los Angeles, Cal. Its object is to maintain the spirit of Technology and to promote interest in its welfare, as well as to make Institute men mutually helpful to each other. Any one who has been connected with the Institute one year is eligible for membership, and any Technology man who may be in the vicinity is urged to call on the Secretary.

President: EDWARD L. MAYBERRY, '06.
Vice-President:
Secretary-Treasurer: PAUL E. JEFFERS, '12, 472 Pacific Electric Bldg., Los Angeles, Cal.
Alumni Council Representative: JOHN C. CHASE, '74.

DETROIT TECHNOLOGY ASSOCIATION

The club was founded August 1, 1908, in Detroit, Mich., and now has one hundred and eight members. All graduates and former students of the Institute, living in or near Detroit, are eligible for membership. The annual meeting with election of officers is held the latter part of January. An outing is held in the summer and other meetings are held quarterly, or more often if desired. The purpose of the association is mainly to get all Technology men in Detroit well acquainted with each other and the secretary will be very glad to receive notice of the arrival of new men in the vicinity.

Regular monthly luncheons are held the first Wednesday of each month at the Board of Commerce Building at 12.30 P.M., and it is needless to say that any and all Tech men who happen to be in Detroit on these days are welcome.

President: GEORGE R. ANTHONY, '98.
Vice-President: FREDERICK C. SUTTER, '93.
Secretary-Treasurer: DONALD V. WILLIAMSON, '10, Care of The Detroit Edison Co., Whitney Bldg., Detroit, Mich.
Alumni Council Representative: EVERETT MORSS, '85.

TECHNOLOGY ASSOCIATION OF OREGON

The club was founded November 19, 1908, in Portland, Ore., and at present numbers about forty members. Membership includes any one who has attended or taught for one year at the Institute.

Luncheons are held once a month during the winter and business meetings whenever necessary.

President: ROBERT S. EDWARDS, '02.
Secretary-Treasurer: CHARLES A. MERRIAM, '06, 401 Worcester Bldg., Portland, Ore.
Alumni Council Representative: ANDREW D. MACLACHLAN, '96.

TECHNOLOGY CLUB OF PUGET SOUND

This club was organized in Seattle, Wash., November 20, 1908, and includes in its membership all Technology men in the Puget Sound country. Regular luncheons are held in Seattle, where the majority of the members live, once a month, usually the third Friday.

The club has about seventy members. The officers will be very glad to be notified of any Tech men who are visiting in or passing through this district, so that arrangements may be made for them to meet the Western men. Headquarters are at the Anderson Supply Co., 111 Cherry St., Seattle, Wash.

President: MAURICE P. ANDERSON, '10.
Vice-President: WALTER A. GLEASON, '97.
Secretary-Treasurer: W. SCOTT MATHESON, '99, 302 Summit Ave., N., Seattle, Wash.
Alumni Council Representative: DON GALUSHA, '04.

TECHNOLOGY CLUB OF MILWAUKEE

The Technology Club of Milwaukee, organized in 1909, in Milwaukee, Wis., has now twenty-nine active members. The members lunch together every Thursday noon at the University Club of Milwaukee, and all visiting Technology men are invited to attend. Information in regard to Tech men visiting or locating in or near Milwaukee is desired by the secretary.

Secretary: MITCHELL MACKIE, '05, Commercial Auto Co., Milwaukee, Wis.

Alumni Council Representative: ALEXANDER MACOMBER, '07.

TECHNOLOGY CLUB OF ROCHESTER

This club was organized in January, 1910, in Rochester, N.Y., and has about fifty members residing in Rochester and the vicinity. Any one who has studied or taught at the Institute is eligible to membership and all Tech men are cordially welcome to the meetings. The meetings are primarily of a social character and are called at intervals by the executive committee. The annual meeting takes place on the last Monday in October. It is hoped that Tech men visiting Rochester will make themselves known to the officers of the club.

President: ADOLPH LAMB, '92.

First Vice-President: JAMES C. DRYER, '99.

Second Vice-President: JAMES P. BARNES, '05.

Secretary-Treasurer: WILLIAM S. LUCEY, '07, Eastman Kodak Co., Rochester, N.Y.

Alumni Council Representative: HOWARD C. TURNER, '03.

Executive Committee: HAROLD O. STEWART, '09, CLARENCE C. CULVER, '96, HENRY H. TOZIER, '96, FRANK W. LOVEJOY, '94, EDGAR M. HAWKINS, 97.

TECHNOLOGY ASSOCIATION OF JAPAN

This association was organized in April, 1911, in Tokio, and is in a flourishing condition.

Secretary-Treasurer: TAKUMA DAN, '78, 344 Awoyama, Harajiku, Tokio, Japan.

Alumni Council Representative: WILLIAM H. KING, '94.

ST. LOUIS SOCIETY OF THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY

This society was organized April 11, 1911, in St. Louis, Mo., on the occasion of a banquet in celebration of the semi-centennial of the founding of the Institute, by seventeen Technology men of St. Louis and vicinity. An annual banquet in April, an outing in July, and occasional luncheons during the winter months have comprised the society's activities since its organization. The society now numbers twenty members. There are about seventy Technology men in St. Louis and vicinity on the secretary's list. Newcomers are requested to send their names and addresses to the secretary-treasurer.

Chairman: JOHN L. MAURAN, '89.
Secretary-Treasurer: AMASA M. HOLCOMBE, '04, 510 Pine St., St. Louis, Mo.
Assistant Secretary: BENJAMIN F. THOMAS, JR., '13, Electric Company of Missouri, Webster Groves, Mo.
Alumni Council Representative: CHARLES M. SPOFFORD, '93.

THE TECHNOLOGY CLUB OF NEW HAMPSHIRE

This club was organized June 27, 1911, in Manchester, N.H., with a membership of twenty-four men from Manchester and vicinity. Through the enthusiastic efforts of its first members it now numbers fifty-seven, out of a total of one hundred and twenty-five alumni in the State.

There are two regular meetings a year, one in the summer at the home of Edward W. Rollins, '71, Three Rivers Farm, Dover, N.H., and one at Manchester, N.H., in the winter.

The present officers of the club are:

President: EDWARD W. ROLLINS, '71.
Vice-President: NORWIN S. BEAN, '94.
Secretary-Treasurer: WALTER D. DAVOL, '06, Amoskeag Bank Building, Manchester, N.H.
Alumni Council Representative: ANDREW FISHER, JR., '05.

TECHNOLOGY ASSOCIATION OF WORCESTER COUNTY

This organization was formed in 1911 in Worcester, Mass., and draws its membership from a constituency of about sixty former students of the Institute, who are now residents of Worcester

County. Meetings are held semi-annually or oftener, the annual meeting being in March.

President: ALBERT S. HEYWOOD, '92.
Vice-President: FRANK E. DAVIS, '83.
Secretary-Treasurer: LOUIS E. VAUGHAN, '02, 4 Fenimore Road, Worcester, Mass.
Executive Committee: WALDO E. BUCK, '76, and ORVILLE B. DENISON, '11.

TECHNOLOGY CLUB OF ALBANY AND SCHENECTADY

This club was organized December 20, 1911, in Albany, N.Y., and has a membership of nearly one hundred and fifty in Albany, Troy, Schenectady and vicinity. Its meetings take the form of informal dinners at intervals of about two months throughout the school year; they are held in the different cities, in rotation.

President: RUSSELL SUTER, '00.
Vice-President: ROBERT PALMER, '04.
Secretary-Treasurer: EDWARD H. SARGENT, '07, 719 State St., Albany, N.Y.

ATLANTA M. I. T. ALUMNI ASSOCIATION

This association was organized in January, 1912, in Atlanta, Ga. Social gatherings and informal dinners are held at frequent intervals, the time and place varying according to convenience. The present officers of the club are:

President: FREDERICK W. HADLEY, '93.
Secretary: WILLIAM J. SAYWARD, '01, 633 Candler Bldg., Atlanta, Ga.

THE SOUTHEASTERN TECHNOLOGY ASSOCIATION

This association was formed in February, 1912, with headquarters in Birmingham, Ala., and now has twenty-two members.

President: PAUL E. CHALIFOUX, '02.
Secretary: FERNAND C. WEISS, '13, Alabama Power Co., Birmingham, Ala.
Alumni Council Representative: HAROLD S. WONSON, '07.

INTERMOUNTAIN TECHNOLOGY ASSOCIATION

This club was organized April 27, 1912, in Salt Lake City, Utah, and now numbers about thirty members, who are located in the Intermountain States. The annual meeting occurs early in January. Numerous other gatherings are held during the year, the time and place varying according to convenience.

President: JOHN. H. LEAVELL, '07.
Vice-President: EDWARD P. FLEMING, '01.
Secretary-Treasurer: WALTER H. TRASK, JR., '06, University Club, Salt Lake City, Utah.
Alumni Council Representative: GEORGE E. RUSSELL, '00.

SOUTHWESTERN ASSOCIATION, MASSACHUSETTS INSTITUTE OF TECHNOLOGY

This organization was formed in Kansas City on November 16, 1912. Fifteen Technology men located in Kansas and Missouri were present. The membership districts were defined and a constitution adopted.

President: FRANK CUSHMAN, JR., '01.
Vice-President: ALBERT E. LOMBARD, '02.
Secretary-Treasurer: HERMANN C. HENRICI, '06, 715 Reserve Bank Building, Kansas City, Mo.
Alumni Council Representative: W. LYMAN UNDERWOOD, '98.

THE TECH CLUB OF THE UNIVERSITY OF ILLINOIS

This club was organized in December, 1912, in Urbana, Ill. The membership is composed of about twenty Technology men now residing in the neighborhood of Urbana and Champaign. All Tech men coming to Illinois are invited to put themselves into communication with the club.

President: F. H. NEWELL, '85.
Secretary-Treasurer: EDWIN FRANK, '06, 1113 Arbor St., Champaign, Ill.

THE TECHNOLOGY CLUB OF HAWAII

The club was founded in 1912, in Honolulu, and has now a membership of twenty-four.

President: JACOB F. BROWN, '78.
Secretary-Treasurer: NORMAN WATKINS, 98, Box 767, Honolulu, Hawaii.
Executive Committee: PRESIDENT, SECRETARY-TREASURER, and WILLIAM C. FURER, '06.
Alumni Council Representative: EDWIN S. WEBSTER, '88.

BERKSHIRE COUNTY ALUMNI ASSOCIATION OF M. I. T.

This club was organized in Pittsfield, Mass., February 6, 1913. Fifteen alumni were present. All former students of the Institute now residing in Berkshire County are particularly urged to interest themselves in this organization.

Secretary: EARL E. FERRY, '12, 84 Elizabeth St., Pittsfield, Mass.
Treasurer: PAUL FREDERICK, '07.
Alumni Council Representative: WALTER B. SNOW, '82.
Executive Committee: CHARLES P. RANDOLPH, '10, SECRETARY and TREASURER.

TECHNOLOGY CLUB OF LOWER CANADA

The Technology Club of Lower Canada was established in Montreal, April 21, 1913. Headquarters of the association are at present located at 357 St. Catherine Street W., Montreal.

President: HERBERT O. KEAY, '00.
Vice-President: GEORGE R. HECKLE, '99.
Secretary-Treasurer: EDWARD B. EVANS, '06, 357 St. Catherine St. W., Montreal, Quebec.
Alumni Council Representative: GEORGE W. VAILLANT, '92.
Board of Governors: FERDINAND J. FRIEDMAN, '08, DAVID J. SPENCE, '97, STEPHEN P. BROWN, '00,

TECHNOLOGY CLUB OF LAKE SUPERIOR

The Technology Club of Lake Superior was organized in Duluth, Minnesota, January 1, 1914, and since then has been holding monthly meetings on the second Saturday of every month. These meetings are held in the evening, and after an informal supper the members become better acquainted with each other and talk over matters of interest in connection with the Institute.

President: SAMUEL B. SHELDON, '89.
Vice-President: WALTER G. ZIMMERMANN, '98.

Secretary: FLOID M. FULLER, '06, 812 Torrey Building, Duluth, Minn.

Executive Committee: PRESIDENT, VICE-PRESIDENT, SECRETARY, and WILLIAM PEYTON, '90.

INDIANA ASSOCIATION M. I. T.

The alumni of the Institute of Technology living in the vicinity of Indianapolis met at the University Club of that city on January 10, 1914, and perfected a local organization, to be known as the Indiana Association M. I. T. The membership is now thirty-six. Luncheons are held on the fifteenth of every month at the University Club. A picnic and annual dinner are regular functions and in addition many special activities are held during the year.

President: J. LLOYD WAYNE, 3d, '96.

Vice-President: WILLIAM G. WALL, '96.

Secretary: WILSON B. PARKER, '88, 805 Board of Trade, Indianapolis, Ind.

DAYTON TECHNOLOGY ASSOCIATION

In March, 1914, it was discovered that there were twenty-five good and loyal Technology men making their homes in Dayton, Ohio. A self-appointed committee arranged for an informal dinner, which was held at the Phillips House in Dayton on April 2nd. The Dayton Technology Association was organized with the election of the following officers:

President: WALTER G. WUICHET, '89.

Vice-President: HENRY M. WAITE, '90.

Secretary-Treasurer: CARLTON D. PUTNAM, '08, 601 Schwind Bldg., Dayton, Ohio.

Alumni Council Representative: CHARLES F. PARK, '92.

TECHNOLOGY CLUB OF BRIDGEPORT

Sixteen Technology men attended a dinner at the University Club, Bridgeport, Conn., Friday, April 17, 1914, and with Mr. Clinton E. Woods, '84, acting as chairman, a business meeting was held at which it was decided to form a permanent Alumni Association to be known as the Technology Club of Bridgeport. The following officers were elected:

President: HALSEY R. PHILBRICK, '06.

Secretary: WILBUR A. SWAIN, '15, Criterion Club, Bridgeport, Conn.

Treasurer: PHILIP W. DALRYMPLE, '12.
Alumni Council Representative: FREDERICK C. BLANCHARD, '91.
Committee on Proceedings: PHILIP W. DALRYMPLE, '12, EDWARD G. GALLAGHER, '00, WALTER D. ALLEN, '11.

TECHNOLOGY CLUB OF MONTANA

On July 19, 1914, eleven men from Butte and Anaconda, Montana, and one from Boston, Professor Robert H. Richards, '68, met in Butte for a dinner and a general good time.

The result of the occasion was the organization of the Technology Club of Montana, with the following officers:

President: CHARLES W. GOODALE, '75.
Vice-President: RALPH HAYDEN, '06.
Secretary-Treasurer: CHARLES D. DEMOND, '93, 704 Main St., Anaconda, Mont.

TECHNOLOGY CLUB OF CHINA

This club was formed in Shanghai, China, in 1915. Luncheons are held on the first Saturday of every month at the Carlton Café at 12.30 and are well attended by the Tech men in this vicinity who are always glad to meet new comrades in this part of the world.

President: WILLIAM W. STEVENS, '98.
Secretary: WILLIAM A. ADAMS, '08, 39 Nanking Road, Shanghai, China.

THE M. I. T. CLUB OF AKRON, OHIO

This club was organized early in 1915. On the first Saturday of every month, special tables are reserved at the University Club, and every Tech man, whether or not a member of the club, is welcome.

President: C. R. JOHNSON, '11.
Secretary-Treasurer: WALTER P. KEITH, '14, Goodyear Tire & Rubber Co., Akron, Ohio.
Executive Committee: PRESIDENT, SECRETARY-TREASURER and HARRY S. ALEXANDER, '11.

TECHNOLOGY CLUB OF SPRINGFIELD

Seventy-five former students of the Massachusetts Institute of Technology, all residents of Springfield, Mass., met at the Worthy

Hotel, April 6, 1915, and after a banquet formed the Technology Club of Springfield. The officers of the club are:

President: FREDERIC W. FULLER, '96.
Secretary-Treasurer: GEORGE W. HAYDEN, '95, 283 Worthington St., Springfield, Mass.
Alumni Council Representative: FREDERIC W. FULLER, '96.
Executive Committee: EDMUND P. MARSH, '89, FRANK H. PAGE, '85, MAURICE S. CHAPIN, '10.

THE TECHNOLOGY CLUB OF FALL RIVER

The Technology alumni of Fall River held a meeting at the Quequechan Club, April 21, 1915, and expressed their approval of the founding of an association which would be helpful to the community and of benefit to members of the organization. The association was formed with the election of the following officers:

President: GEORGE H. EDDY, '75.
Secretary: ARTHUR L. SHAW, '09, 383 Madison St., Fall River, Mass.
Treasurer: ARTHUR E. HIRST, '13.
Executive Committee: PRESIDENT, SECRETARY, TREASURER, JOHN ELLIS, '94, and RALPH W. REYNOLDS, '88.

TECHNOLOGY CLUB OF CHILE

The Technology Club of Chile was organized August, 1915, at a dinner held at Rancagua, Chile. The following men comprised the charter members: William L. Stevens, '00, John P. Chadwick, '07, Richard F. Goodwin, Jr., '10, John L. Bray, '12, Edmund G. Brown, '13, William S. Conner, '14, Franklin Osborn, 2d, '11.

President: WILLIAM L. STEVENS, '00.
Secretary: JOHN L. BRAY, '12, Braden Copper Co., Rancagua, Chile.

TECHNOLOGY CLUB OF LOUISVILLE

The Technology Club of Louisville was formed November 22, 1915.

President: JAMES CLARK, JR., '90.
Secretary: LEWIS S. STRENG, '98, Louisville Gas & Electric Co., 311 West Chestnut St., Louisville, Ky.

SECRETARIES OF THE CLASSES

ROBERT HALLOWELL RICHARDS '68 '69
CHARLES ROBERT CROSS . . . . '70
EDWARD WARREN ROLLINS . . . '71
CALVIN FRANK ALLEN . . . . . '72
SAMUEL EVERETT TINKHAM . . '73
CHARLES FRENCH READ . . . . . '74
EDWARD A. W. HAMMATT . . . '75
JOHN RIPLEY FREEMAN . . . . . '76
RICHARD AUGUSTUS HALE . . . '77
EDMUND POMEROY COLLIER . . '78
CHARLES S. GOODING . . . . . '79
GEORGE HUNT BARTON . . . . . '80
FRANK ELDEN CAME . . . . . '81
WALTER BRADLEE SNOW . . . . . '82
HARVEY STUART CHASE . . . . . '83
HARRY WALTER TYLER . . . . . '84
ISAAC WHITE LITCHFIELD . . . '85
ARTHUR GRAHAM ROBBINS . . . '86
EDWARD GALBRAITH THOMAS . '87
WILLIAM GAGE SNOW . . . . . '88
WALTER HARRINGTON KILHAM '89
GEORGE L. GILMORE . . . . . '90
HOWARD CARLETON FORBES . . '91
WILLIAM ATKINSON JOHNSTON '92
FREDERIC HAROLD FAY . . . . '93
SAMUEL CATE PRESCOTT . . . . '94
WINTHROP DANA PARKER . . . . '95
CHARLES E. LOCKE . . . . . '96
JOHN ARTHUR COLLINS, JR . . . '97
ARTHUR A. BLANCHARD . . . . . '98
WILLIAM MALCOLM CORSE . . . '99
INGERSOLL BOWDITCH . . . . . '00
ROBERT LONGFELLOW WILLIAMS '01
FREDERICK HUSTON HUNTER . '02
MYRON HENRY CLARK . . . . . '03
HENRY WARREN STEVENS . . . . '04
GROSVENOR DEWITT MARCY . '05
CHARLES F. W. WETTERER . . . '06
BRYANT NICHOLS . . . . . '07
RUDOLPH BOYNTON WEILER . . '08
CHARLES REED MAIN . . . . . '09
CHARLES EDWARD GREEN . . . . '10
ORVILLE BOARDMAN DENISON '11
JOHN EDDY WHITTLESEY . . . . . '12
FREDERICK DAVID MURDOCK . '13
CORNELIUS JOSEPH CALLAHAN . '14
WILLIAM BENJAMIN SPENCER . '15
JAMES M. EVANS . . . . . '16
WALTER L. MEDDING . . . . . '17
DAVID M. MACFARLAND . . . . . '18
MINOR M. BECKETT . . . . . '19

Statistics of the Graduates

DOCTORS OF PHILOSOPHY

The degree of Doctor of Philosophy was first conferred by the Institute in 1907, and of the twenty-three candidates upon whom it has been bestowed eight have received their Bachelor's degree from the Institute and four have received the Master's degree.

DOCTORS OF ENGINEERING

The degree of Doctor of Engineering was first granted by the Institute in 1910, and of the six candidates upon whom it has been bestowed four had previously received the Bachelor's degree from the Institute, and two had also received the Master's degree.

MASTERS OF SCIENCE

The degree of Master of Science was first granted by the Institute in 1886, and since then this degree has been conferred three hundred times. Of the total number of recipients of the Master's degree one hundred and sixty-four received their Bachelor's degree also from the Institute.

MASTERS OF SCIENCE BY YEARS

1886	1	1899	3	1908	12
1887	1	1901	4	1909	19
1890	1	1902	8	1910	19
1893	1	1903	7	1911	20
1894	1	1904	12	1912	22
1895	3	1905	18	1913	20
1896	3	1906	9	1914	25
1897	4	1907	15	1915	29
1898	5			1916	38
				Total	300

GRADUATES BY COURSES

The following table exhibits the number of persons who have received the Bachelor's degree in each of the several Courses since the foundation of the school.

GRADUATES BY YEARS AND COURSES.

Year.	Civil Engineering.	Mechanical Engineering.	Mining Engineering and Metallurgy.	Architecture.	Chemistry.	Electrical Engineering.	Natural History or Biology.	Physics.	General Course.	Chemical Engineering.	Sanitary Engineering.	Geology.	Naval Architecture.	Electro-Chemistry.	Total.
1868	6	1	6	—	—	—	—	—	1	—	—	—	—	—	14
1869	2	2	—	—	1	—	—	—	—	—	—	—	—	—	5
1870	4	2	2	—	1	—	—	—	1	—	—	—	—	—	10
1871	8	2	5	—	2	—	—	—	—	—	—	—	—	—	17
1872	3	1	5	—	3	—	—	—	—	—	—	—	—	—	12
1873	12	2	3	1	7	—	—	—	1	—	—	—	—	—	26
1874	10	4	1	1	—	—	—	—	2	—	—	—	—	—	18
1875	10	7	6	1	1	—	—	1	2	—	—	—	—	—	28
1876	12	8	8	—	5	—	2	3	4	—	—	—	—	—	42
1877	12	6	8	4	2	—	—	—	—	—	—	—	—	—	32
1878	8	2	2	3	3	—	—	—	1	—	—	—	—	—	19
1879	6	8	3	1	3	—	1	1	—	—	—	—	—	—	23
1880	3	—	3	—	1	—	—	—	1	—	—	—	—	—	8
1881	3	5	6	3	8	—	1	—	2	—	—	—	—	—	28
1882	2	5	5	3	6	—	1	1	1	—	—	—	—	—	24
1883	3	7	5	1	3	—	—	—	—	—	—	—	—	—	19
1884	5	6	13	—	12	—	—	—	—	—	—	—	—	—	36
1885	4	7	8	2	4	2	—	—	1	—	—	—	—	—	28
1886	9	23	7	1	7	10	1	—	1	—	—	—	—	—	59
1887	10	17	8	1	9	8	1	1	3	—	—	—	—	—	58
1888	11	25	4	5	10	17	3	1	1	—	—	—	—	—	77
1889	14	24	5	3	8	17	1	1	2	—	—	—	—	—	75
1890	25	28	3	5	13	18	3	2	6	—	—	—	—	—	103
1891	18	26	4	6	11	23	3	3	1	7	—	1	—	—	103
1892	22	26	4	13	7	36	6	1	7	4	6	1	—	—	133
1893	25	30	5	2	8	41	2	—	6	8	—	2	—	—	129
1894	21	31	4	14	11	33	1	3	5	12	3	—	—	—	138
1895	25	30	3	15	14	33	—	2	4	11	4	—	5	—	144*
1896	26	34	10	24	17	48	3	3	7	7	4	3	5	—	190*
1897	25	40	7	16	20	33	2	3	7	12	4	1	9	—	179
1898	32	41	7	29	25	33	3	4	6	9	3	—	7	—	199
1899	30	37	9	22	22	32	2	2	1	10	1	—	8	—	173*
1900	32	34	21	21	19	23	3	3	5	11	4	—	9	—	185
1901	37	39	18	21	17	25	1	1	6	14	4	1	16	—	200
1902	24	46	14	18	14	35	5	3	3	9	7	—	14	—	192
1903	26	37	27	15	13	39	1	3	1	10	4	1	12	1†	190
1904	34	45	32	24	15	34	3	5	5	7	2	1	17	8†	232
1905	46	54	26	12	23	31	3	—	3	13	5	1	24	3†	244
1906	47	69	38	22	21	37	2	4	—	10	6	—	19	3†	278
1907	37	52	22	21	10	32	—	—	—	14	3	2	10	5†	208
1908	48	61	19	19	16	38	4	—	—	15	2	—	5	2†	229
1909	51	41	30	18	12	42	5	3	—	13	9	—	5	3	232
1910	57	57	24	18	10	36	3	—	2	18	12	—	11	3	251
1911	46	49	17	10	12	49	1	1	2	19	15	—	6	5	231*
1912	55	47	21	21	7	52	4	2	1	31	14	—	3	3	260*
1913	58	50	20	26	12	43	2	1	—	30	15	—	4	8	269
1914	60	65	17	19	9	51	6	1	4	37	19	—	8	8	301*
1915	48	69	5	30	21	41	3	3	2	33	12	—	7	10	284*
1916	45	81	3	35	11	53	5	3	2	51	18	—	9‡	14	308*
Totals	1,152	1,389	521	520	488	1,041	87	65	109	395	176	14	213	76	6,225*

Names counted twice, students graduating in two different years	22
Bachelors of Science	6,203*
Masters of Science, not including 129 counted above	133
Doctors of Philosophy and of Engineering, not including 9 counted above	15
Total	6,034*

* Deducting names counted twice (students graduating in two courses).
† Prior to 1909 this Course was designated as Option 3 (Electro-chemistry) of Course VIII.
‡ Two received the degree in XIIIB.

Titles of Theses

SUCCESSFUL CANDIDATES FOR GRADUATION JUNE, 1916

CANDIDATES FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

JAMES HAWES ELLIS . . . . . Covington, Ky.

Awarded the degree of Bachelor of Science by this Institute in June, 1912. Pursued advanced studies in Physics, Mathematics, and Physical Chemistry at this Institute from September, 1914, to June, 1916. Carried on during this period an investigation of the free energy of hydrochloric acid solutions, and a study of the absolute electrode potential of the calomel electrode. Presented to the Faculty in May, 1916, a thesis describing these investigations.

JOHN DAVID MACKENZIE . . . . . Baddeck, Cape Breton

Awarded the degree of Bachelor of Science by the Massachusetts Institute of Technology in June, 1911. Was engaged one year as instructor at Cornell University, 1911–12, in the Geological Department under Professor Heinrich Ries. Field Assistant, Geological Survey of Canada, 1908–1911. Assistant Geologist in the Geological Survey of Canada, 1912–1915, for three successive field seasons, during which he studied the Graham Island of Queen Charlotte group, made reconnaissance surveys in the Hazelton region of British Columbia and examinations of oil districts in Alberta. From 1912–1916 he occupied the position of Instructor in Geology, Massachusetts Institute of Technology, with privilege of devoting a part of his time to studies for the doctorate. Presented to the Faculty, in May, 1916, a thesis describing his investigations of the geology of Graham Island in the Queen Charlotte group.

ERNEST WATERS WESCOTT . . . . . Cambridge

Awarded the degree of Bachelor of Science by Harvard College in June, 1911. Practised chemical engineering during the years 1911–1913. Awarded the degree of Master of Science in Chemistry by this Institute, June, 1914. Dalton Fellow in Chemistry, 1914–1915. Research Fellow in Physical Chemistry, 1915–1916. Pursued advanced studies in Chemistry and Mathematics during the period of these fellowships, carrying on investigations of the equilibrium of plumbous and plumbic compounds and chlorine in aqueous chloride solutions. Presented to the Faculty in May, 1916, a thesis describing these investigations.

CANDIDATES FOR THE DEGREE OF DOCTOR OF ENGINEERING

VANNEVAR BUSH . . . . . Chelsea

Received the degree of Master of Science at Tufts College, in 1913, in the Department of Electrical Engineering. One year in the Testing Department of the General Electric Co. at Schenectady and Lynn, 1913–1914. One year as Walker Special Instructor in Mathematics at Tufts College, 1914–1915. Three months, electrical inspector in the Machinery Division of the N. Y. Navy Yard (1915). He has pursued advanced studies in electrical engineering, mathematics, and physics at this Institute, from September, 1915, to June, 1916. He has carried on an investigation on "Oscillating Currents, with Applications to the Coupled Circuit and the Artificial Transmission-line." He presented to the Faculty on May 24, 1916, a thesis describing these investigations. During the year 1915–1916, he was awarded the Harvard Eveleth Scholarship.

JEROME CLARKE HUNSAKER . . . . . Brookline

Graduated from the United States Naval Academy in June, 1898. Commissioned Assistant Naval Constructor in 1910. Awarded the degree of Master of Science in Naval Architecture and Marine Engineering in 1912. Detailed to the Boston Navy Yard as assistant superintendent of shop management, 1912–1913. Detailed to the Massachusetts Institute of Technology in June, 1913, and appointed Instructor in Aeronautical Engineering. Made an investigation for the Institute of the state of the art of Aeronautical Engineering in Europe. Erected and installed aerodynamical laboratory at the Institute, and conducted numerous tests and investigations for the conduct of instruction of students, for the promotion of scientific research, for the Navy Department, and for private parties. Pursued advanced studies in aeronautics, mathematics, and naval construction, November, 1913, to May, 1916. Carried on during this period an investigation on the dynamical stability of aeroplanes, and presented to the Faculty, May 26, 1916, a thesis describing these investigations.

CANDIDATES FOR THE DEGREE OF MASTER OF SCIENCE

COURSE I. CIVIL ENGINEERING

CHARLES LEE BROAS, B.C.E., Bay City, Mich. *A Valuation of the Water-Works System of Bath, Maine.*

ARTHUR RIPONT KELLER, C.E., L.L.B., Honolulu, T. H. *A Project for the Extension of the Sewerage System of Honolulu, Hawaii.*

HENRY NIEMANN, S.B., West Newton. *An Investigation of the Degree of Precision of Indeterminate Truss Stresses as obtained by the Ordinary Approximate Method.*

HENRY CONNOR SHEILS, S.B., Roxbury. *A Design for a Reinforced Concrete Arch at Springfield, Massachusetts.*

COURSE II. MECHANICAL ENGINEERING

KSHITISH CHANDRA BASU, M.A., S.B., Howrah, India. *A Study of the Deflection of Flat Plate Under Pressure.*

GEORGE WALTER GROW, B.S.M.E., Morgantown, W. Va. *The Flow of Steam in Open Pipes.*

OTTO WILLIAM HILBERT, S.B., Holyoke. *A Study of Materials to obtain a Standard for Determining Hardness by Bauer Drill Method.*

SHIH SHUN RAYMOND, B.S., Canton, China. *The Effect of Time in the Heat Treatment of Medium Carbon Steel.*

COURSE IV. ARCHITECTURE

ROLAND WEBSTER BALDREY, S.B., Medford. *Design for a Hotel and Thermal Establishment.*

WILLIAM MELLEMA, Boston. *Design of a Steel Dome.*

ELMER HERMAN NEUMANN, S.B., Brooklyn, N Y. *Design of a Reinforced Concrete Dome.*

GEORGE FREDERIC NIXON, S.B., Leominster. *Design of a Reinforced Concrete Coal Pocket.*

ST. ELMO TOWER PIZA, S.B., New York, N. Y. *Design for a Hotel and Thermal Establishment.*

HENRY PALMER SABIN, S.B., Denver, Colo. *Design for a Hotel and Thermal Establishment.*

JOHN FANZ STAUB, B.S., S.B., Knoxville, Tenn. *Design for a Hotel and Thermal Establishment.*

COURSE V. CHEMISTRY

MING CHOW, S.B., Kiang-su, China. *The Electrode Potentials of Bismuth and Copper.*

EDGAR STANLEY FREED, B.S., Ch.E., Knoxville, Tenn. *The Equilibrium between Solid Silver Iodide and Sulfide and Hydrogen Iodide and Sulfide in Aqueous Solution.*

KEBE TOABE, S.B., Lawrence. *The Equilibrium between Tin, Lead, and their Salts in Aqueous Solution.*

COURSE VI. ELECTRICAL ENGINEERING

GEORGE RAYMOND HALE, S.B., South Boston. *A Plan of Apportioning Costs between the Heating and Electrical Services at Wm. Filene Sons Co., Boston, Mass.*

WALTER HAYNES, A.B., Cambridge. *The Radiation Resistance of an Antenna.*

VI TSING KOO, B.S., Shanghai, China. *The Construction of a Hydraulic Microphone.*

CHARLES WHITMORE WHITALL, A.B., S.B., Cambridge. *Artificial Line Tests.*

COURSE VII. BIOLOGY AND PUBLIC HEALTH

MURRAY PHILIP HOROWITZ, B.S., Bronx, N.Y., N.Y. *A Comparative Biological Study of Two Massachusetts Cities: — Quincy and Taunton.*

COURSE X. CHEMICAL ENGINEERING

LAWRENCE HUMPHREY BAILEY, S.B., Newton. *The Mathematics of Counter-Current Gas Extraction Systems.*

COURSE XI. SANITARY ENGINEERING

CLEVELAND SCOTT LOPER, B.S., Topeka, Kan. *A Design for a Plant for the Hydraulic Compression of Air by Sewage and the Aeration of the Sewage in the Presence of Activated Sludge, at Fitchburg, Massachusetts.*

NAVAL ARCHITECTURE AND MARINE ENGINEERING

COURSE XIIIA

ERNEST LLEWELLYN PATCH, U.S.N., Stoneham.

WALTER WYNNE WEBSTER, U.S.N., Fargo, N.D.

COURSE XIIIB

TSU SHANG CHU, Wusih, China. *Progressive Speed Trials of the Sea-going Dredge "Comstock."* (With C. Wang.)

CHEE-SING HSIN, S.B., Chen Hsien, China. *A Test on the Welin Quadrant Davit.* (With C. C. Chu.)

PELLIAN TEH-CHE MAR, Foo-Chow, China. *Dredging Trials of the Sea-going Dredge "Comstock."* (With T. Yuen.)

CHOU WANG, Nanking, China. *Progressive Speed Trials of the Sea-going Dredge "Comstock."* (With T. S. Chu.)

TSIN YUEN, Nanking, China. *Dredging Trials of the Sea-going Dredge, "Comstock."* (With P. T. Mar.)

AERONAUTICAL ENGINEERING

ALEXANDER KLEMIN, B.Sc., A.C.G.I., London W., England. *Experiments on a Series of Propeller Blade Sections.*

WAI PO LOO, S.B., Canton, China. *An Investigation of the Direction and Velocity of Wind in the Wake of an Aeroplane.* (With S. F. Wong.)

SHAO FUNG WONG, B.Sc., Tsinanfu, China. *An Investigation of the Direction and Velocity of Wind in the Wake of an Aeroplane.* (With W. P. Loo.)

TSOO WONG, B.Sc., Pekin, China. *The Air Resistance of Cylinder Combinations.* (With T. Yu.)

TSAO YU, B.Sc., Chinkiang, China. *The Air Resistance of Cylinder Combinations.* (With T. Wong.)

COURSE XIV. ELECTROCHEMISTRY

EASTMAN ATKINS WEAVER, S.B., Des Moines, Ia. *Design of a Lens for Lateral Magnification and a New Type of Aberration.*

CANDIDATES FOR THE DEGREE OF BACHELOR OF SCIENCE

IN TWO COURSES

FRANCIS CHANDLER FOOTE, Cooperstown, N.Y. COURSE I. *An Experimental Investigation of the Effect of Bridge Piers upon River Flow.* COURSE XI. *A Preliminary Design for a Sewerage System for Cooperstown, New York.*

VITOLD ADAM JASIONOWSKI, Sebastopol, Russia. COURSE II. *The Performance and Cost of Operation of C. H. Wheeler Cooling Tower at Malden Electric Co. Plant.* (With C. G. Paine.) COURSE VI. *An Investigation of the Application of the Laws of Chance to the Frequency with which Telephone Lines will be found Busy when Efforts are made to get a Connection.*

IN ONE COURSE

COURSE I. CIVIL ENGINEERING

RICHARD LOMBARD AHEARN, Brighton. *A Design for a High-Pressure Water System for the Northern Part of Waltham, Massachusetts.* (With B. C. Boulton.)

RAFAEL ALFARO-MORAN, Ahuachapan, Salvador. *A Project for the Elimination of the Grade Crossing at South Billerica, Massachusetts.* (With E. W. Van C. Lucas, Jr.)

MARK ARONSON, Roxbury. *A Study and Comparison of the "Mixing" and "Penetration" Methods of constructing Highways in Massachusetts.*

HORACE RALPH BENNETT, Lowell. *A Design for a Steel Highway Bridge to replace the Existing Bridge over the Merrimack River at Pawtucket Falls, Lowell, Massachusetts.*

WALTER DAVID BINGER, New York, N.Y. *Design and Specifications for Streets and Roads of Langeloth, Washington County, Pennsylvania.*

WESLEY HOWARD BLANK, Winchester. *A Design for a Highway Bridge to replace the Existing Bridge over the Boston & Maine Railroad at Winter Hill, Somerville, Massachusetts.*

BERTHOUD CLIFFORD BOULTON, Cambridge. *A Design for a High-Pressure Water System for the Northern Part of Waltham, Massachusetts.* (With R. L. Ahearn.)

FREDERICK COPELAND BRYANT, A.B., Newport, R.I. *An Experimental Investigation of the Strength of Rivets in Tension and an Application of the Results obtained to the Design of Connections between Bridge Stringers and Floor Beams.*

FRANK WHITE BUCKNAM, Swampscott. *The Relocation and Design for a Highway Bridge over the Boston & Maine Railroad at Essex Street, Swampscott, Massachusetts.*

JAMES ARCHER BURBANK, East Milton. *An Investigation of the Methods of Street Cleaning and Snow Removal in Numerous Cities, with Cost Statistics.*

GEORGE DASHIELL CAMP, B.S., San Antonio, Tex. *A Design for a "Hydrostatic Catenary" Flume.*

CHARLES JEFFERSON DAVIS, Jr., B.S., Fernandina, Fla. *A Design for a Reinforced Concrete Water Tower.*

JOSEPH FARHI, Constantinople, Turkey. *A Study of Double-track Elevated Railroad Structures.*

WILLIAM JONES FARTHING, Houston, Tex. *An Experimental Investigation of the Properties of Sands in General Use in making Concrete in the Vicinity of Boston, Massachusetts.* (With C. J. McCarthy.)

RALPH ANDREW FLETCHER, Westford. *An Investigation of the Supplying Capacity of Forge Pond, Westford, Massachusetts.* (With H. T. Freeman, II.)

HERBERT JAMES GILKEY, B.S., Grants Pass, Ore. *A Preliminary Investigation for an Irrigation System for the Rogue River Valley in Southwestern Oregon.*

MAYNARD CAMERON GUSS, Middleton. *A Design for a Sewerage System for Middleton, Massachusetts.*

JACK HEPINSTALL, St. Thomas, Ont. *A Design for a Sewage Disposal System for the City of Haverhill, Massachusetts.* (With A. F. Shuey, XI.)

FREDERICK CABOT HOLBROOK, A.B., Boston. *A Description with Cost Analysis of the Steel Coffer-dam used in constructing the 46th Street Pier, New York City.*

CARL HERBERT HOLMBERG, Wakefield. *A Design for a Structure to replace the Existing Bridge over the Charles River at Waltham, Massachusetts.* (With M. Marquez.)

EDWARD SUMMERS JENKINS, East Lynn. *A Design for a Large Penstock.*

BENJAMIN HOFFMAN KERSTEIN, Boston. *The History and Present Status of Highway Legislation with Special Reference to New England.* (With C. F. Lewis.)

ALBERT EMANUAL KLEINERT, Jr., Brooklyn, N.Y. *An Experimental Investigation of the Intensity of Pressure exerted by an Automobile Tire upon Road Surfaces.*

LAURISTON EDWARD KNOWLTON, A.B., Cambridge. *An Investigation of Several Methods of Designing Reinforced Concrete Arches with a Practical Application of one Method.*

CHESTER FRANKLIN LEWIS, Boston. *The History and Present Status of Highway Legislation with Special Reference to New England.* (With B. H. Kerstein.)

WILLIAM ANDREW LIDDELL, Lowell. *A Study for the Redevelopment of a Certain Water Power on the Merrimack Canal, Lowell, Massachusetts.*

ALBERT CARL LIEBER, Jr., Jamaica Plain, *An Investigation of Foundations of Highways.*

THOMAS WOLCOTT LITTLE, B.S., Hartford, Conn. *An Experimental Investigation of the Value of Zinc Chloride as a Preservative of Structural Timber.*

CARLETON WOODWARD LOVELL, N. Cambridge. *A Design for a Storm Water Sewerage System for the Town of Newton, Massachusetts.*

EUGENE WILLETT VAN COURT LUCAS, Jr., Sound Beach, Conn. *A Project for the Elimination of the Grade Crossing at South Billerica, Massachusetts.* (With R. Alfaro-Moran.)

CHARLES JOSEPH MCCARTHY, Lawrence. *An Experimental Investigation of the Properties of Sands in General Use in making Concrete in the Vicinity of Boston, Massachusetts.* (With W. J. Farthing.)

MIGUEL MARQUEZ, Jr., Chihuahua, Mex. *A Design for a Structure to replace the Existing Bridge over the Charles River at Waltham, Massachusetts.* (With C. H. Holmberg.)

RALPH MILLIS, Newport, R.I. *An Experimental Investigation of the Waterproofing Qualities of Various Substances when applied to Concrete.* (With C. J. Spear.)

JAMES HAROLD MURDOUGH, Dorchester. *A Project for the Elimination of the Grade Crossing at North Lexington Station of the Boston & Maine Railroad.* (With H. B. Ullian.)

ODEN BOWIE PYLE, Jr., Baltimore, Md. *A Study for a Method of increasing the Efficiency of a Reservoir at Winchester, Massachusetts.*

GEORGE THOMAS ROONEY, Norwood. *A Design for a Skew Deck Plate Girder Bridge across the Neponset River between Norwood and Canton, Massachusetts.*

BENJAMIN ROBERT ROSENBERG, Chelsea. *A Design for a Sewerage System for Marblehead, Massachusetts.* (With J. A. Rubin.)

JESSE ABRAHAM RUBIN, Chelsea. *A Design for a Sewerage System for Marblehead, Massachusetts.* (With B. R. Rosenberg.)

CARLTON JERNEGAN SPEAR, Edgartown. *An Experimental Investigation of the Waterproofing Qualities of Various Substances when applied to Concrete.* (With R. Millis.)

GEORGE MORRIS STEESE, A.B., Harrisburg, Pa. *An Experimental Investigation of the Intensity of Wind Pressure on Roofs.*

HYMAN BENJAMIN ULLIAN, Dorchester. *A Project for the Elimination of the Grade Crossing at North Lexington Station of the Boston & Maine Railroad.* (With J. H. Murdough.)

JACKSON BALDWIN WELLS, Quincy. *A Design for a Reinforced Concrete Warehouse for Cotton Storage.*

RUSSELL HUBBARD WHITE, Boston. *A Design for a System of Signals for Tewksbury Junction, Massachusetts, on the Boston & Maine Railroad.*

ANDREW CAROTHERS WITHERSPOON, Chambersburg, Pa. *A Design for a Steel Truss, Double Track Electric Railway Bridge.*

COURSE II. MECHANICAL ENGINEERING

WALTER SCOTT AIKEN, Melrose. *The Determination of the Amount of Moisture given off per Person per Hour.* (With K. Dean.)

BLAIR GRIGSBY ALDRIDGE, Arcola, Miss. *The Effect on the Elastic Limit of the Overstrain in Steel.* (With W. J. Barrett.)

PAUL PAGE AUSTIN, Jr., San Francisco, Cal. *An Investigation to determine the Distribution of the Cost per Kilowatt Hour of producing Electricity at the Jenckes Spinning Mill, Pawtucket, Rhode Island.* (With J. B. Ingle, W. M. Giles, VI, and M. G. Graff, VI.)

RALPH BRIDGES BAGBY, A.B., New Haven, Mo. *The Variation of the Modulus of Rupture with Change of Cross Section and Length of Specimen.*

PHILIP CUSTER BAKER, Lansing, Mich. *To determine the Most Suitable Foundry for the Massachusetts Institute of Technology, which will afford the Proper Technical Instruction combined with the Most Modern Foundry Equipment and Practices.* (With J. N. McDevitt.)

WILLIAM JOSEPH BARRETT, South Boston. *The Effect on the Elastic Limit of the Overstrain in Steel.* (With B. G. Aldridge.)

EDWARD HEARSEY BARRY, A.B., Newton Centre. *The Design of a Dehumidifying Apparatus for the Boston Art Museum.* (With C. A. Coleman.)

HENNING JULIUS BERG, San Francisco, Cal. *A Study of the Transverse Strength of Wired Roofing Glass.*

EMMONS BLAINE, S.B., Chicago, Ill. *A Duty Test on Laidlow Dunn Gordon Pumping Engine of Mansfield Water Supply District.* (With J. R. Hunneman.)

PAUL HENRY BUXTON, Dorchester. *Tests on the Pumping Station in Cliftondale Section, Saugus, Mass.* (With W. H. Fleming.)

LEON SERGIUS CHALATOW, Petrograd, Russia. *A Study of the Locomotive Boiler and Fire-box.*

HOWARD PAUL CLAUSSEN, Hartford, Conn. *An Investigation of the Wire-gripping Clutch Mechanisms on Lawson Aerial Loop Line Tramways, for the Ambursen Construction Co.* (With H. B. Shepard.)

CARUTHERS ASKEW COLEMAN, Como, Miss. *The Design of a Dehumidifying Apparatus for the Boston Art Museum.* (With E. H. Barry.)

ROBERT ADDISON CROSBY, Dorchester. *Crimp in Tire Fabric.* (With G. I. Crowell.)

GEORGE IRA CROWELL, Campello. *Crimp in Tire Fabric.* (With R. A. Crosby.)

THERON SMITH CURTIS, North Attleboro. *To determine the Effect of Galvanizing upon the Strength of Iron Plate and Iron Rods; also to determine the Depth of the Galvanizing.* (With W. A. Strangman.)

KEMERTON DEAN, Brookline. *The Determination of the Amount of Moisture given off per Person per Hour.* (With W. S. Aiken.)

DONALD DEFREMERY (*As of Class of 1915*), Oakland, Cal. *Tests on a Modified Form of Two-cycle Oil Engine.* (With T. H. Guething, 1915.)

JOHN DENNETT EBERHARDT, Arlington. *To Devise a Method for Making Standard Glue Tests and to compare American Glue with Typical Foreign Glues to Obtain the Relations Between the Cost per Pound and the Unit Strength.*

CARLTON WINNE EDDY, Dorchester. *A Determination of the Efficiency of Various Types of Belt Joints.*

KARL EMIL ENGSTROM, Lancaster. *To determine the Life of Copper Expansion Joints used in Steam Lines, to compare the Performance of Joints made of Seamless Tube with Joints made of Brazed Tube, and to study the Method of Failure of Joints.*

JAMES MORRISON EVANS, Paterson, N.J. *Experiments on Flashboards as outlined by Mr. H. L. Colburn.* (With A. B. Reeve.)

JOHN GUTHRIE FAIRFIELD, Littleton. *A Determination of the Coefficients of Discharge for Submerged Weirs.* (With F. Haggkvist.)

TALBOT FLANDERS, A.B., Brookline. *Test of Boilers of the Salem Gas Co., to determine the Most Economical Fuel to burn, Coke or Soft Coal, under Existing Conditions.* (With G. H. Stickney.)

WILLIAM HAROLD FLEMING, Akron, Ohio. *Tests on the Pumping Station in Cliftondale Section, Saugus, Mass.* (With P. H. Buxton.)

HOVEY THOMAS FREEMAN, Providence, R.I. *An Investigation of the Supplying Capacity of Forge Pond, Westford, Mass.* (With R. A. Fletcher, I.)

HERBERT GFROERER, Dorchester. *Comparative Tests on Boiler Braces for Elongation, Distortion of Head, Strength, etc.* (With H. Russell.)

HAROLD PARKER GRAY, Melrose. *The Operation of the Liberty Tube Cleaners with Reference to Power developed at Varying Pressures, and the Effect of Different Types of Cutting Heads, etc.* (With C. T. Guething.)

CARL THEODORE GUETHING, Hollis, N.H. *The Operation of the Liberty Tube Cleaners with Reference to Power developed at Varying Pressures, and the Effect of Different Types of Cutting Heads, etc.* (With H. P. Gray.)

FRED ERIC HAGGKVIST, Malden. *A Determination of the Coefficients of Discharge for Submerged Wiers.* (With J. G. Fairfield.)

PAUL DEXTER HARROWER, Chelsea. *The Economy of Grinding Operations as compared with Cutting by Lathe Tools.*

PAUL HATCH, Newton Center. *The Calibration and Testing of a Transmission Dynamometer.* (With B. N. Stimets.)

SPENCER DRUMMOND HOPKINS, A.B., Onancock, Va. *A Study of Deterioration and Spontaneous Combustion of Coal in Storage and Methods of Prevention.*

JOHN RICHARD HUNNEMAN, A.B., Wellesley Hills. *A Duty Test on Laidlow Dunn Gordon Pumping Engine of Mansfield Water Supply District.* (With E. Blaine.)

JOHN BYRON INGLE, San Diego, Cal. *An Investigation to determine the Distribution of the Cost per Kilowatt Hour of producing Electricity at the Jenckes Spinning Mill, Pawtucket, Rhode Island.* (With P. P. Austin, Jr., W. M. Giles, VI, and M. G. Graff, VI.)

THEODORE CARTER JEWETT, Buffalo, N.Y. *To investigate by Tests the Economy of a Three-port, Two-cycle Mietz and Weiss Kerosene Engine; and, by designing an Automatic Valve for the Intake of the Air required, to determine whether or not its Economy can be improved.* (With N. MacRae.)

PING YOK LOO, Tientsin, China. *The Effect of Heat-Treatment on the Physical Properties of Wrought Iron.* (With S. T. Tai.)

CHARLES ROGERS LORD, Newton. *A Determination of the Overall Efficiency of a Boiler, Corliss Engine, and Air Compressor to furnish Power for a Stone Quarry; and the Advisability of using the Surplus Power of the Boiler to generate Electricity for Auxiliary Machines, such as Hoists, Crushers, etc.* (With K. B. Owen.)

JOHN NEWMAN MCDEVITT, Edgewood, R.I. *To determine the Most Suitable Foundry for the Massachusetts Institute of Technology, which will afford the Proper Technical Instruction combined with the Most Modern Foundry Equipment and Practices.* (With P. C. Baker.)

NELSON MACRAE, Wilmington, N.C. *To investigate by Tests the Economy of a Three-port, Two-cycle Mietz and Weiss Kerosene Engine; and, by designing an Automatic Valve for the Intake of the Air required, to determine whether or not its Economy can be improved.* (With T. C. Jewett.)

CHARLES SALISBURY MAKEPEACE, Providence, R.I. *The Determination of the Amount of Power required to drive Cotton Machinery.*

CHARLES WALTER METZ, Waltham. *A Study of the Effect of Balance Weights on the Crankshaft of a Four-cylinder, Four-cycle, Internal Combustion Motor.* (With T. E. Raymond.)

HENRY GARDNER MORSE, Dorchester. *An Investigation of the Merits of Baertl Anti-slip Pulley Plating in Reducing Slip.* (M. J. Root.)

ROBERT ELKAN NAUMBURG, A.B., New York, N.Y. *Tests on the Amount of Moisture in Cotton.*

WILLIAM LARDNER OGDEN, A.B., Deadwood, S.D. *A Study for the Substitution of an Underground System of Distribution of Electric Light and Power for the Present Overhead System in the City of Wilkes-Barre, Pa.* (With J. B. Carr, VI.)

KNIGHT BARRY OWEN, Vineyard Haven. *A Determination of the Overall Efficiency of a Boiler, Corliss Engine, and Air Compressor to furnish Power for a Stone Quarry; and the Advisability of using the Surplus Power of the Boiler to generate Electricity for Auxiliary Machines, such as Hoists, Crushers, etc.* (With C. R. Lord.)

ARVIN PAGE, Wollaston. *An Investigation of a Draft Regulator by the Use of which a Seven Per Cent Saving of Coal is guaranteed.* (With E. S. Parsons.)

CHARLES GRAHAM PAINE, Dover. *The Performance and Cost of Operation of C. H. Wheeler Cooling Tower at the Malden Electric Co. Plant.* (With V. A. Jasionowski, II. and VI.)

EDMUND SELINGER PARSONS, Providence, R.I. *An Investigation of a Draft Regulator by the Use of which a Seven Per Cent Saving of Coal is Guaranteed* (With A. Page.)

THEODORE DILLAWAY PARSONS, Lynn. *The Strength of Lifting Eyes made from Round Stock.*

MERRILL EDWARD PRATT, B.S., Prattville, Ala. *An Investigation of the Heating and Ventilation Systems in the Public Schools of Watertown, Mass.* (With Paul H. Taylor.)

JAMES MUIR RALSTON, Allenhurst, N.J. *An Investigation of Some of the Physical Properties of Steel at High Temperatures.*

THOMAS EMMONS RAYMOND, Cambridge. *A Study of the Effect of Balance Weights on the Crankshaft of a Four-cylinder, Four-cycle, Internal Combustion Motor.* (With C. W. Metz.)

CHARLES SUMNER REED, Auburndale. *An Investigation of the Thickness of the Nappe directly over the Weir Crest of a Rectangular Vertical Suppressed Weir with Relation to the Discharge.*

AUSTIN BRYANT REEVE, Ph.B., Chicago. *Experiments on Flashboards as outlined by Mr. H. L. Colburn.* (With J. M. Evans.)

GEOFFREY LAURENCE REID, North Andover. *A Determination of the Thickness of Insulating Material necessary to prevent Condensation in Roofs and Side Walls of Factories.* (With F. Sutermeister.)

JOHN DOUGLAS ROBERTSON, Taunton. *An Investigation of the Feasibility of the Precipitation of Finely Divided Substances suspended in Air by Means of a Water Spray.* (With N. J. Vile.)

MARSHALL JEWELL ROOT, B.S., Providence, R.I. *An Investigation of the Merits of Baertl Anti-slip Pulley Plating in Reducing Slip.* (With H. G. Morse.)

HAROLD RUSSELL, Dorchester. *Comparative Tests on Boiler Braces for Elongation, Distortion of Head, Strength, etc.* (With H. Gfroerer.)

HENRY BRADBURY SHEPARD, East Derry, N.H. *An Investigation of the Wire-gripping Clutch Mechanisms on Lawson Aerial Loop Line Tramways, for the Ambursen Construction Co.* (With H. P. Claussen.)

JOHN WESLEY STAFFORD, Hackensack, N.J. *An Experimental Determination of the Efficiency of Oxy-acetylene and Electric Welds in Boiler Plate.*

ARTHUR KNOWLES STEWART, Lonsdale, R.I. *The Design and Equipment of a Textile Conditioning Room at the Massachusetts Institute of Technology.* (With W. S. Stewart.)

WALTER SCOTT STEWART, Lonsdale, R.I. *The Design and Equipment of a Textile Conditioning Room at the Massachusetts Institute of Technology.* (With A. K. Stewart.)

GEORGE HORTON STICKNEY, B.S., Beverly. *Test of Boilers of the Salem Gas Co., to determine the Most Economical Fuel to burn, Coke, or Soft Coal, under the Existing Conditions.* (With T. Flanders.)

BRUCE NEGUS STIMETS, A.B., Jersey City, N.J. *The Calibration and Testing of a Transmission Dynamometer.* (With P. Hatch.)

LEONARD STONE, Medford. *An Investigation in Regard to Standardizing the Testing of Fabrics for Strength.*

WARREN ANDREWS STRANGMAN, Needham. *To determine the Effect of Galvanizing upon the Strength of Iron Plate and Iron Rods; also to determine the Depth of the Galvanizing.* (With T. S. Curtis.)

FREDERICK SUTERMEISTER, Wollaston. *A Determination of the Thickness of Insulating Material necessary to prevent Condensation in Roofs and Side Walls of Factories.* (With G. L. Reid.)

SHIU TAO TAI, Hunan Chanteh, China. *The Effect of Heat-treatment on the Physical Properties of Wrought Iron.* (With P. Y. Loo.)

PAUL HUSE TAYLOR, Wakefield. *An Investigation of the Heating and Ventilation Systems in the Public Schools of Watertown, Mass.* (With M. E. Pratt.)

PAUL BAKER THOMAS, Keedysville, Md. *The Development of an Electric Range.*

GEORGE WOODBURY TUTTLE, Exeter, N.H. *The Stresses induced in Thick Hollow Steel Cylinders.*

NORMAN JUDD VILE, Meriden, Conn. *An Investigation of the Feasibility of Precipitation of Finely Divided Substances suspended in Air by Means of a Water Spray.* (With J. D. Robertson.)

CHARLES WALTER, 3d, Tompkinsville, N.Y. *The Strength of Cotton Fibre Gears.*

NATHANIEL WARSHAW, Quincy. *The Distribution of Power in the Plant of the Commonwealth Ice and Cold Storage Co. at South Boston, and the Formulation of a Recording System for the Plant.* (With G. W. Waymouth.)

GEORGE WILLIAM WAYMOUTH, San Juan, P.R. *The Distribution of Power in the Plant of the Commonwealth Ice and Cold Storage Co. at South Boston, and the Formulation of a Recording System for the Plant.* (With N. Warshaw.)

EDWARD ADOLF WEISSBACH, Bond Hill, Ohio. *A Design of a Belt Testing Machine.*

HAROLD EATON WHITE, Reading. *A Design for Injector Testing Apparatus for the New Technology.*

EDMUND ALDEN WHITING, Montclair, N.J. *A Study of the Flow of Ammonia in Pipes.* (With E. H. Williams.)

EDWARD HUDSON WILLIAMS, B.S.M.E., South Bend, Ind. *A Study of the Flow of Ammonia in Pipes.* (With E. A. Whiting.)

VERTREES YOUNG, B.S., Oakmont, Pa. *The Determination of the Coefficient to be used with a Pitot Tube in Measuring the Velocity of Flow of Air in Pipes of Various Sizes, the Orifice of the Tube being placed at the Center of the Pipe; and an Investigation of the Possibility of so locating the Tube that the True Velocity Head may be read without the Use of a Coefficient.*

COURSE III. MINING ENGINEERING AND METALLURGY

CARL EBERHARD CARSTENS, B.A., Ackley, Ia. *The Cyanidation of a High-grade Cupriferous Gold Ore.*

JOHN SPOTTS MCDOWELL, Clearfield, Pa. *A Study of Silica Refractories.*

KENNETH MURCHISON SULLY, Santa Rita, N. Mex. *The Treatment of Certain Sulphide Ores by the Flotation Process.*

COURSE IV. ARCHITECTURE

PEARL KINNEY ANDREWS, Yarmouth, N.S. *Design for an Official Residence for the Governor General of Canada.*

EDWIN LEO BALL, B.S., Alexandria, La. *An Investigation to determine the Relative Costs of a Single-web Plate Girder and a Riveted Warren Truss for a Given Span of 60 Feet under the Same Conditions of Loading.* (With A. L. Giles.)

MEADE BOLTON, Washington, D.C. *Design for a Spanish Renaissance Church and Monastery for Cartagena, Colombia, South America.*

THOMAS D'ARCY BROPHY, A.B., Butte, Mont. *Design for a Small Renaissance Chapel.*

CHARLES FREDERICK CELLARIUS, A.B., Norwood, Ohio. *Design for a Tudor Country House.*

CHARLES OVER CORNELIUS, A.B., Richmond. *Design for a Fellow's Quadrangle for Princeton University.*

HAROLD RYDER CROWELL, Los Angeles, Cal. *Design for a Graduate School of Architecture and the Allied Arts in a Large California University.*

DONALD OMAR DUNN, Westerly, R. I. *Design for an Administrative Building for a United States Naval Academy.*

HOWARD TASKER EVANS, Haverhill. *An Investigation of Stresses in I-Beam Columns under Heavy Eccentric Loads.* (With W. F. Howard and J. P. Uhlinger.)

JOHN ROBINSON FARRAR, Abington. *A Study of Shoe Factory Design.* (With L. H. Pratt.)

D. K. ESTE FISHER, Jr., Litt.B., Baltimore, Md. *Design for a Hunt Clubhouse in Maryland.*

OSBORN RICKER FREEMAN, Helena, Mont. *Design for a Gentleman's Estate.*

CHARLES WILBUR FRY, East Orange, N.J. *A Study of the Relation between the Strength of Mortar and Concrete.* (With E. H. Neumann, 1915.)

ALLEN LESTER GILES, Walpole. *An Investigation to determine the Relative Costs of a Single-web Plate Girder and a Riveted Warren Truss for a Given Span of 60 Feet under the Same Conditions of Loading.* (With E. L. Ball.)

EDWARD REYNOLDS HALL, Magnolia. *A Study of the Bond Stress of Plain and Deformed Bars and the Effect of Bent-up Rods over Straight Rods.*

JOHN JOSEPH HARTY, Jr. (*As of Class of 1913*), Greenville, Miss. *An Investigation of the Strains in a 10-inch I-Beam of Long and Short Spans.* (With T. S. Byrne, 1913, and A. Vogel, 1913.)

G. A. GREVILLE HASLAM (*As of Class of 1915*), Derry, N.H. *Design for a Gentleman's Sporting Estate.*

TREDICK KITTREDGE HINE, New Britain, Conn. *Design for a Memorial Chapel.*

JOHN FORBES HOGAN, Pawtucket, R. I. *Design for a Postoffice in a Small City.*

THOMAS STEELE HOLDEN, B.A., M.A., Austin, Tex. *Design for a Ranch House in Southwest Texas.*

WILLIAM FLOYD HOWARD, B.S., Fairbanks, Wash. *An Investigation of Stresses in I-Beam Columns under Heavy Eccentric Loads.* (With H. T. Evans and J. P. Uhlinger.)

HARVEY WHEELER JACKSON, A.B., Herkimer, N.Y. *Design for a Fraternity House.*

SAMUEL LAPHAM, Jr., A.B., Charleston, S.C. *Design for the Family Mansion of a South Carolina Plantation.*

MARK LEMMON, B.A., Dallas, Tex. *Design for a University Gymnasium.*

WILLIAM CANTWELL MCDONALD, Palmer. *An Investigation of the Mixing Plant, the Placing System, and Centering of a Reinforced Concrete Building in Process of Construction.* (With G. H. Petit and C. P. Wallis.)

LEWIS GERSTLE MACK, A.B., San Francisco, Cal. *Design for a Hotel for a California Seaside Resort.*

WILLIAM MELLEMA (*As of Class of 1915*), Boston. *A Study of Tests and Methods of Design of Reinforced Concrete Columns.*

ELIZABETH GREENLEAF PATTEE, Quincy. *Design for a Day School for Girls.*

GEORGE HERBERT PETIT, New York, N.Y. *An Investigation of the Mixing Plant, the Placing System, and Centering of a Reinforced Concrete Building in Process of Construction.* (With W. C. McDonald and C. P. Wallis.)

CHARLOTTE LEWIS PHELPS, A.B., Kenilworth, Ill. *Design for an Open-air Chapel for a Tuberculosis Sanitarium.*

LEWIS HOWE PRATT, Brockton. *A Study of Shoe Factory Design.* (With J. R. Farrar.)

SUMNER MAURICE SPAULDING, Ionia, Mich. *Design for a Community Building for a Small Town.*

GEORGE ASHTON SPOONER, Council Bluffs, Ia. *Design for a Large Country House.*

WILLIAM GRIFFITH SPRAGUE, Chicago, Ill. *Design for an Amusement Park on an Island.*

RAYMOND MILES STOWELL, Walpole. *Design for a Town Hall for an Important Town.*

JAMES PHILIP UHLINGER, Johnstown, N.Y. *An Investigation of Stresses in I-Beam Columns under Heavy Eccentric Loads.* (With H. T. Evans and W. F. Howard.)

CHARLES PARKER WALLIS, New York, N.Y. *An Investigation of the Mixing Plant, the Placing System, and Centering of a Reinforced Concrete Building in Process of Construction.* (With W. C. McDonald and G. H. Petit.)

ALFRED THEODORE WYMAN, Fitchburg. *Design for a Christian Science Church.*

COURSE V. CHEMISTRY

NICHOLAS BALYOZIAN, Dorchester. *The Preparation and Properties of the Nitrides of Titanium.*

RICHARD GEORGE BERGER, Bridgeport, Conn. *The Formation of Synthetic Ammonia.*

WILLARD RAYMOND CRANDALL, Westerly, R.I. *Reduction Products of* meta-*Nitrodimethylaniline.*

RALPH VIVIAN DAVIES, Plymouth. *Ternary Alloys of Tin, Antimony and Bismuth.*

ELSA CLARA HABICHT, Chicago, Ill. *The Removal of Color from Cottonseed Oil by Fuller's Earth.*

JOHN MARSHALL HOOD, Turners Falls. *The Detection of Added Acetic Acid in Vinegar.*

RUSSELL EDMUND LOWE, B.E., New York, N.Y. *A Study of the Properties of Crimson Antimony,*

JOSEPH VINCENT MEIGS, Malden. *Diagnostic Reactions of Sulphonated Compounds.*

ARTHUR WARREN MUDGE, Jr. (*As of Class of 1915*), Jamaica Plain. *The Oxidation Potential of Manganate to Permanganate.*

HOWARD MARTIN SAWYER, Litt.B. (*As of Class of 1915*), West Medford. *The Analysis of Oiled Fabrics.*

STEPHEN GERSHOM SIMPSON, Roxbury. *The Detection and Determination of Formic Acid in Foods.*

MAX ISAAC WOYTHALER, Springfield. *The Use of Silicic Acid Gel in Vapor Pressure Determinations.*

HSIEN WU, Foochow, China. *Spermaceti Derivatives.*

COURSE VI. ELECTRICAL ENGINEERING

JOSEPH WARREN BARKER, Rockford, Ill. *Economic Methods for the Improvement of Power Factor of Electric Power Distribution Circuits.* (With A. Martin.)

EUGENE JUDSON BARNEY, B.S., Dayton, O. *Contact Resistance of Carbon Brushes for Electric Machines.* (With A. D. Pettee.)

MERVIN WASHINGTON BLISS, A.B., East Concord, N.H. *An Investigation of the Effect on Rates of Two Different Methods of Valuation applied to the Reading Municipal Power Plant.* (With W. B. Littlefield.)

WILLARD COWLES BROWN, B.S., Chestertown, N.Y. *The Cost of Lighting Buildings by Electricity.* (With C. B. Easley.)

ROBERT SAMUEL BURNAP, Ivoryton, Conn. *Heat Transmission from Electric Heaters by Means of Oil.* (With E. A. Ekdahl.)

ARTHUR PERCY CALDWELL, Jr., B.S., New York, N.Y. *An Investigation of the Constituent Costs of a Modern Steam Power Plant.* (With E. S. Robinson.)

JASPER BLANCHARD CARR, Wilkes-Barre, Pa. *A Study for Substitution of an Underground System of Distribution of Electric Light and Power for the Present Overhead System in the City of Wilkes-Barre, Pennsylvania.* (With W. L. Ogden, II.)

FRANK DAVENPORT CHANDLER, Cambridge. *An Investigation of a Starting and Lighting System for an Automobile.*

BRUCE ADDISON CLARKE, Auburndale. *A Survey of the Voltage Regulation on the Circuits in a Building with a Private Power Plant, and Consideration of the Most Appropriate Means for Correcting Poor Regulation.* (With R. W. Diemer.)

FREEMAN CLARKSON, A.B., Brooklyn, N.Y. *An Estimate of the Cost of installing and operating a Private Heating and Electric Lighting Plant, at Williams College, Williamstown, Massachusetts.* (With G. Sutherland.)

BRADFORD SCOTT CURTIS, Medfield. *A Study of the Variation of Candle Power of Incandescent Lamps with Alternating Current Frequency.*

DUNCAN DANA, A.B., New York, N.Y. *Rise of Temperature in Field Coils and its Space Distribution.* (With F. G. Darlington, Jr.)

FRANK GRAEF DARLINGTON, Jr., C.E., Indianapolis, Ind. *Rise of Temperature in Field Coils and its Space Distribution.* (With D. Dana.)

ROBERT WINFIELD DIEMER, Germantown, Pa. *A Survey of the Voltage Regulation on the Circuits in a Building with a Private Power Plant, and Consideration of the Most Appropriate Means for correcting Poor Regulation.* (With B. A. Clarke.)

HAROLD FRENCH DODGE, Lowell. *A Study of a Constant Frequency Device.* (With H. A. Hands.)

CARY BRECKINRIDGE EASLEY, Richmond, Va. *The Cost of Lighting Buildings by Electricity.* (With W. C. Brown.)

EDWIN ALBERT EKDAHL, Roxbury. *Heat Transmission from Electric Heaters by Means of Oil.* (With R. S. Burnap.)

WESLEY MARSHALL GILES, Anchorage, Ky. *An Investigation to determine the Distribution of the Cost per Kilowatt Hour of producing Electricity at the Jenckes Spinning Mill, Pawtucket, R.I.* (With M. G. Graff, P. P. Austin, II, and J. B. Ingle, II.)

CHARLES GLANN, A.B., Cortland, N.Y. *An Investigation into the Conditions Existing at the Boston Commonwealth Fish Pier, and Proposed Improvements.* (With R. A. Spengler.)

MURRAY GENSEL GRAFF, Denver, Colo. *An Investigation to determine the Distribution of the Cost per Kilowatt Hour of producing Electricity at the Jenckes Spinning Mill, Pawtucket, R.I.* (With W. M. Giles, J. B. Ingle, II, and P. P. Austin, II.)

ROBERT FULTON GUNTS, Baltimore, Md. *The Errors of Measurement with Portable Voltmeters and Ammeters.* (With B. Lanphier.)

WILLIAM WEST HAMILTON, U.S.A., Allston. *The Cost of Operation in an Industrial Power Plant.*

HOWARD ALBERT HANDS, Lowell. *A Study of a Constant Frequency Device.* (With H. F. Dodge.)

CLAYTON PRESCOTT HAWES, North Dartmouth. *A Statistical Study of the Costs of Distributing Electric Power by Municipal Plants in Massachusetts.* (With A. Holmes.)

ALBERT HOLMES, Washington, D.C. *A Statistical Study of the Costs of Distributing Electric Power by Municipal Plants in Massachusetts.* (With C. P. Hawes.)

CHARLES MAYNARD HUDSON, Natick. *The Design of a Railroad Interlocking Switch and Signal System at Riverside, Mass.*

WILLIAM TOBIAS KNIESZNER, Danbury, Conn. *A Study of the Induction Phase Converter.* (With G. W. Ousler.)

FREDERICK WILLIAM KUEHLE, Baltimore, Md. *The Effects of Intermittent Heating on Insulation.* (With M. Wolk.)

BASIL LANPHIER, A.B., Omaha, Neb. *The Errors of Measurement with Portable Voltmeters and Ammeters.* (With R. F. Gunts.)

WALTER BERRY LITTLEFIELD, A.B., Roxbury. *An Investigation of the Effect on Rates of Two Different Methods of Valuation applied to the Reading Municipal Power Plant.* (With M. W. Bliss.)

FREDERICK WHITTLESEY MCKOWN, A.B., Rochester, N.Y. *The Distribution of Current and Potential in Composite Electric Lines.* (Experimental Work in Collaboration with C. W. Whitall.)

ALEXANDER MARTIN, B.S., Eugene, Ore. *Economic Methods for the Improvement of Power Factor of Electric Power Distribution Circuits.* (With J. W. Barker.)

EARL RUFUS MELLEN, Lowell. *The Construction and Test of a New Null-Method Instrument for comparing Alternating and Direct Current Strengths.* (With R. H. Mills.)

JAMES CHARLES MERRITT, North Adams. *An Experimental Study of Permeameters.* (With P. G. Morrison.)

RALPH HAROLD MILLS, Natick. *The Construction and Test of a New Null-Method Instrument for Comparing Alternating and Direct Current Strengths.* (With E. R. Mellen.)

PHILLIPS GARRISON MORRISON, Andover. *An Experimental Study of Permeameters.* (With J. C. Merritt.)

EARL MORTIMER NEWLIN (*As of Class of 1914*), Rochester, Minn. *A Plan for a Proposed Hydro-electric Development at Croyden Flats, N.H.* (With E. T. Miller, 1915.)

BURKETT DUNLAP NEWTON, A.B., Los Angeles, Cal. *The Measurement of Water Flow by Electro-hydrometry.* (With E. B. Peters.)

GEORGE WALTER OUSLER, Pittsburgh, Pa. *A Study of the Induction Phase Converter.* (With W. T. Knieszner.)

DUNCAN STEWART OWLER, Providence, R.I. *The Design and Construction of an Eddy Current Brake.*

DONALD WISE PERIN, Newton. *Improvements in the Method of Control of Electric Vehicles.*

EDWARD BROOKS PETERS, A.B., Providence, R.I. *The Measurement of Water Flow by Electro-hydrometry.* (With B. D. Newton.)

ALLEN DANFORTH PETTEE, A.B., Great Barrington. *The Contact Resistance of Carbon Brushes for Electric Machines.* (With E. J. Barney.)

EDGAR STEEL ROBINSON, A.B., Evanston, Ill. *An Investigation of the Constituent Costs of a Modern Steam Power Plant.* (With A. P. Caldwell, Jr.)

HENRY OSCAR SOMMER, Alameda, Cal. *A Portable Wave Tracer.*

RALPH ALLEN SPENGLER, Gates Mills, O. *An Investigation into the Conditions Existing at the Boston Commonwealth Fish Pier and Proposed Improvements.* (With C. Glann.)

EDWIN BLYTHE STASON, B.A., Sioux City, Ia. *The Construction of Apparatus for the Study of Commutation in a Direct Current Generator.* (With B. H. Woodruff.)

MAURICE EDWARD STRIEBY, A.B., Colorado Springs, Col. *The Dielectric Strength of Cables.*

GEORGE SUTHERLAND, Fort Plain, N.Y. *An Estimate of the Cost of installing and operating a Private Heating and Electric Lighting Plant at Williams College, Williamstown, Massachusetts.* (With F. Clarkson.)

MOSES WOLK, Malden. *The Effects of Intermittent Heating on Insulation.* (With F. W. Kuehle.)

DONALD ELIOT WOODBRIDGE, Germantown, Pa. *An Investigation of the Operation of a Repulsion-Induction Motor.* (With G. W. Wyman.)

BENJAMIN HICKS WOODRUFF, B.S., Porterdale, Ga. *The Construction of Apparatus for the Study of Commutation in a Direct Current Generator.* (With E. B. Stason.)

GEORGE WHITCOMBE WYMAN, Brighton. *An Investigation of the Operation of a Repulsion-Induction Motor.* (With D. E. Woodbridge.)

COURSE VII. BIOLOGY AND PUBLIC HEALTH

PAUL HARRINGTON DUFF, Charlestown. *A Survey of the Hygienic Conditions in the Paper Industry of Massachusetts, Including an intensive Study of One Plant.*

VALCOULON LEMOYNE ELLICOTT, Baltimore, Md. *A Study of the Hygienic Conditions Surrounding the Rubber Industry of Massachusetts.*

EVERETT BAILEY JOHNSON, Newburyport. *The Use of Chemical Analyses as Indices of Stream Pollution.*

WALTER HILTON JUNKINS, B.S., Portsmouth, N.H. *A Study of the Watermould, Leptomitus, with Special Reference to its Occurrence in Polluted Streams.*

CHARLES WILLIAM LAWRANCE, Auburndale. *The Costs of Certified Milks as related to their Bacteriological Contents.*

COURSE VIII. PHYSICS

WILLIAM GOSS BROWN, Rye Beach, N.H. *Method and Apparatus for the Determination of the Coefficient of Thermal Conductivity of Refractory Materials.* (With B. Townshend.)

BAILEY TOWNSHEND, Brookline. *Method and Apparatus for the Determination of the Coefficient of Thermal Conductivity of Refractory Materials.* (With W. G. Brown.)

FREDERICK PATTANGALL UPTON, Washington, D.C. *Determination of the Ratio of the Elementary Charge to the Mass of an Electron by the Kaufmann Method.*

COURSE IX. GENERAL SCIENCE

CHESTER RUSSELL GARDNER, Somerville. *The Structural Design of a Tower for Supporting Wireless Station Aerials.*

JAMES ALNER TOBEY, Roxbury. *Theory and Practice of Camp Sanitation as applied to Military and Construction Camps.*

COURSE X. CHEMICAL ENGINEERING

LEONARD ERNEST BEST, Brooklyn, N.Y. *The Devulcanization of India Rubber.*

CHARLES ALBERT BLODGETT, Portland, Me. *The Determination of Hydrogen and Methane.*

ELBRIDGE RUSSELL DEVINE, Needham. *Reactions of Magnesium Nitride with Alcohols and Organic Halides.*

HAROLD CHIPMAN FULLER, Salem. *Magnetic Alloys of Antimony and Manganese.*

ERNEST CAMILLE GAGNON, Lynn. *The Formation of Ferrous Hydroxide by Magnesium Hydroxide.*

PERCIVAL POOLE GOODING, Hyde Park. *An Investigation of Bismuth-Selenium Alloys.*

BARNETT DAVID GORDON, Dorchester. *An Investigation of the Composition of Hemlock Tannins.*

JOHN GORE, Auburndale, *The Recovery of Glycerine from Distillery Slop.*

RUDOLF EDUARD GRUBER, Freiburg i. B., Germany. *Counter-Current of One Liquid from another.*

EDMUND MCKENDREE HAYDEN, A.B., Brookline. *The Thermal Dissociation of Normal Dolomite.*

SAUL ALEXANDER HOFFMANN, Joliet, Ill. *The Use of Standard Color Lakes as a Basis for a Terminology of Color.* (With M. O. Schur.)

DAVID LYON JACOBSON, B.S., Jersey City, N.J. *Determination of Methyl Alcohol in Mixed Solvents.*

EDGAR LOUIS KAULA, Winter Hill. *The Absorption of Alkali by Cellulose.*

KENNETH THEODORE KING, Chicago, Ill. *The Manufacture of Bisulphite Liquor for Pulp Making.*

HERBERT CLEMENT KLIPSTEIN, A.B., New York, N.Y. *The Preparation and Properties of Ethylene-diamine.*

RICHARDSON GRANT KNOWLAND, Newburyport. *The Transmission of Heat through Corrugated Brass Pipes.*

WILLIAM BUTLER LEACH, Jr., S.B., Hubbard Woods, Ill. *A Comparison of Various Tests for determining the Value of Gas Engine Oils.*

SAUL HAROLD LIPMAN, Roxbury. *The Decolorization of Rosin Oils.*

GEORGE MADISON MAVERICK, San Antonio, Tex. *The Drying of Polished Yarns: Test of Installation at the Plant of the Ludlow Manufacturing Associates.* (With D. B. Webster.)

HERBERT MENDLESOHN, A.B., New York, N.Y. *The Equilibrium of Carbon with its Oxides at Low Temperatures.*

NICHOLAS VAN SLYCK MUMFORD, Providence, R.I. *The Efficiency of Steam Distillation.*

ARTHUR TAPLEY MUNYAN, Melrose. *The Influence of Soda on the Color of Lead Glass.*

DEXTER NORTH, B.S., Washington, D.C. *The Preparation of Magnesium Chloride from Magnesite.*

EARLE CARVER PITMAN, A.B., Salem. *The Recovery of Sulphur Dioxide from Smelter Gas.*

MELVILLE HALSTEAD ROOD, A.B., Marietta, O. *A Study of the Solubility of Crude Rubber in Organic Solvents.*

MILTON OSCAR SCHUR, Boston. *The Use of Standard Color Lakes as a Basis for a Terminology of Color.* (With S. A. Hoffmann.)

GEORGE ALBERT SWEET, Milford. *Vapor Composition of Water-glycerine Mixtures.*

DONALD BLAKE WEBSTER, Malden. *The Drying of Polished Yarns: Test of Installation at the Plant of the Ludlow Manufacturing Associates.* (With G. M. Maverick.)

ROBERT ERASTUS WILSON, Ph.B., Wooster, O. *The Vapor Pressure of Solid Hydrates.*

WILFRED ARTHUR WYLDE, North Adams. *The Preparation of Two Four Six Trinitro-benzaldehyde.*

LAURIN ZILLIACUS, Stamford, Conn. *The Electrolytic Preparation of Acetic Acid.*

COURSE XI. SANITARY ENGINEERING

THOMAS AUGUSTINE BERRIGAN, South Boston. *An Experimental Investigation of Non-siphoning Traps, and a Comparison of their Cost with that of a Double-vent System of Drainage.*

ALEXANDER BRESTH, West Acton. *A Design for a Sewage Disposal System for the Boston Consumptives' Hospital.* (With J. I. Connolly.)

AUGUSTINE JOSEPH CAFFREY (*As of Class of 1915*), Lawrence. *An Experimental Investigation of the Bacteriological Quality of Drinking Water on Interstate Trains Arriving at Boston.*

EDWARD HALE CLARKSON, Jr., Newburyport. *A Design for a Four-story Reinforced Concrete Warehouse.* (With M. A. Monroe.)

JOEL IRVING CONNOLLY, Dorchester. *A Design for a Sewage Disposal System for the Boston Consumptives' Hospital.* (With A. Bresth.)

AIME COUSINEAU, B. A. Sc., Montreal, Que. *An Investigation of the Sanitation of Slaughter Houses and Reduction Plants.*

CHARLES LEAVETT CROSIER, Hadley. *An Investigation of the Settlement of Sewers in the City of Cambridge, Massachusetts.* (With S. M. Ellsworth.)

JOSEPH RICHARD DUGGAN, Milford. *An Experimental Investigation of the Intensity of Natural Indoor and Outdoor Illumination by Means of the Macbeth Illuminator.*

SAMUEL MORRISON ELLSWORTH, Braintree. *An Investigation of the Settlement of Sewers in the City of Cambridge, Massachusetts.* (With C. L. Crosier.)

GORDON FEHR, Cape Town, So. Africa. *An Experimental Investigation of the Disposal of Trade Wastes from a Paper Mill at Fitchburg, Massachusetts.* (With H. W. Green.)

HOWARD LESLIE FOSTER, Amesbury. *An Experimental Investigation of the Wheeler-Thomas Spray Nozzle.*

JOSEPH JOHN FOUHY, Charlestown. *A Sanitary Survey of the Charles River Basin.*

HOWARD WHIPPLE GREEN, A.B., Woonsocket, R.I. *An Experimental Investigation of the Disposal of Trade Wastes from a Paper Mill at Fitchburg, Massachusetts.* (With G. Fehr.)

THOMAS FRANCIS MCSWEENEY, Framingham. *A Study of the Refuse Disposal System of the City of Cambridge, Massachusetts.*

MERRICK ATHERTON MONROE, Waltham. *A Design for a Four-story Reinforced Concrete Warehouse.* (With E. H. Clarkson, Jr.)

ARTHUR FERGUSON SHUEY, A.B., Camden, O. *A Design for a Sewage Disposal System for the City of Haverhill, Massachusetts.* (With J. Hepinstall, I.)

CHARLES MONTGOMERY WAREHAM, Swampscott. *A Study of the Reduction of the Allowable Fibre Stress in Single-Angle Tension Members to provide for Eccentricity in End Connections.*

MARSHALL SYMMES WELLINGTON, Winchester. *An Investigation of the Disposal of Tannery Wastes where the Available Area is Limited.*

NAVAL ARCHITECTURE AND MARINE ENGINEERING

COURSE XIII

CHARLES FREDERICK GROSS, Baltimore, Md. *The Graphical Determination of an Aeroplane Strut to have Uniform Strength.* (With E. F. Hanford.)

EDGAR FRANCIS HANFORD, Dorchester. *The Graphical Determination of an Aeroplane Strut to have Uniform Strength.* (With C. F. Gross.)

ROBERT FRANCIS HART, Morristown, N.J. *Design of a Steamer for Service between Toronto and Quebec.*

EDWARD FOSTER HEWINS, Hampton, Va. *An Experimental Comparison of a Gaff Sail and a Leg-of-mutton Sail in the Wind-tunnel.* (With H. Larner.)

HAROLD LARNER, Cambridge. *An Experimental Comparison of a Gaff Sail and a Leg-of-mutton Sail in the Wind-tunnel.* (With E. F. Hewins.)

WILLIAM EDWIN LONG, Rochester, N.Y. *Determination of the Relative Strength of Solid and Hollow Spars.*

SHATSWELL OBER, Arlington Heights. *An Investigation of the Wind Resistance of a Ship in the Wind-tunnel.*

COURSE XIIIB

CHI-CHE CHU, Hangchow, China. *A Test on the Welin Quadrant Davit.* (With C. S. Hsin.)

VON-FONG LAM, Canton, China. *A Study of the Launching of a Submarine Torpedo-Boat.*

COURSE XIV. ELECTROCHEMISTRY

THOMAS CALVIN ATCHISON, A.B., Lawrence. *The Effect of Oxides on the Properties of Magnetite Electrodes.*

RAYMOND GROUT BROWN, Melrose Highlands. *The Electrolytic Disposition of Tin.*

LEROY RICHARD BYRNE, East Lynn. *A Study of the Current Efficiency in Charging Edison Storage Batteries.*

JOHN RIPLEY FREEMAN, Jr., Providence, R.I. *The Electrolytic Oxidation of Carbon and of Graphite Electrodes.*

EARL LEESON HAUMAN, Revere. *A Study of Metallic Fog in the Electrolysis of Fused Lead Chloride.* (With D. R. Husted.)

DONALD ROBERTSON HUSTED, Winthrop. *A Study of Metallic Fog in the Electrolysis of Fused Lead Chloride.* (With E. L. Hauman.)

OSBORNE LEBARON MAHLMAN, Lubec, Me. *The Electrolytic Pickling of Steel.*

CHESTER NORTHUP RICHARDSON, East Lynn. *An Investigation of the Cause of Deterioration of Steel Springs in Cyanide Plating Baths.*

HENRY ERIC SCHABACKER, Erie, Pa. *The Electrolytic Oxidation of Potassium Manganate.*

HARRY BENNETT SMITH, West Somerville. *The Electrolytic Deposition of Tin-Aluminum Alloys.*

NORMAN JULIEN THOMPSON, Melrose. *The Electrolytic Oxidation of Sulfur Dioxide.*

WALLACE EDWARD WENTWORTH, East Lynn. *A Study of the Effect of Annealing on the Abrasive Properties of Fused Alumina.*

GEORGE EDWARD WHITWELL (*As of Class of 1915*), Washington, D.C. *Investigation of the Electrical and Heat Conductivities of Graphite Electrodes.*

WALTER JOHN WOLFE, Greenwood. *The Electrolytic Reduction of Sulphuric Acid.*

JOHN EDGAR WOODS, Dorchester. *A Study of Sulfation in Various Types of Lead Storage Batteries.*

CERTIFICATES IN PUBLIC HEALTH (C. P. H.) IN THE SCHOOL FOR HEALTH OFFICES OF HARVARD UNIVERSITY AND THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY

EN TSENG HSIEH, M.D. . . . . Pekin, China
EDWARD ALEXANDER INGHAM, S.B. . . . . Brookline
HAROLD HUBBARD MITCHELL, M.D. . . . . Canisteo, N.Y.
GEORGE PHILIP PAUL, M.D. . . . . Round Lake, N.Y.
AARON PAUL PRATT, A.B. . . . . Cambridge
BERNARDO SAMPER, B.A., M.D. . . . . Bogota, Colombia
SIEN MING WOO, A.B., M.D. . . . . Chong Chow, China

Register of Students

For residence addresses the following abbreviations are used

Abington	Ab.
Allston	A.
Amesbury	Ames.
Andover	And.
Arlington	Arl.
Ashmont	Ash.
Atlantic	Atl.
Auburndale	Aub.
Beachmont	Bea.
Belmont	Bel.
Beverly	Bev.
Boston	B.
Braintree	Brain.
Bridgewater	Brid.
Brighton	Bri.
Brockton	Brock.
Brookline	Br.
Burlington	Bur.
Cambridge	C.
Campello	Camp.
Canton	Can.
Charlestown	Chas.
Chelsea	Ch.
Chestnut Hill	C. H.
Cliftondale	Clif.
Concord	Con.
Danvers	Dan.
Dedham	Ded.
Dorchester	D.
East Boston	E. B.
Everett	Ev.
Fall River	F. R.
Forest Hills	F. H.
Framingham	Fram.
Franklin	F.
Georgetown	Gtn.
Gloucester	G.
Greenwood	Gr.
Grove Hall	G. H.
Haverhill	Hav.
Hingham	Hing.
Holbrook	Hol.
Hyde Park	H. P.
Ipswich	Ips.
Jamaica Plain	J. P.
Lawrence	Law.
Lexington	Lex.
Lowell	Low.
Lynn	L.
Malden	Mal.
Manchester	Man.
Mansfield	Mans.
Marblehead	Marb.
Marlboro	Mar.
Mattapan	Mat.
Medford	Med.
Melrose	Mel.
Melrose Highlands	Mel. H.
Methuen	Meth.
Middleboro	Mid.
Milford	Milf.
Milton	Mil.
Montello	Mont.
Natick	Na.
Needham	Need
Neponset	Nep.
Newbury	New.
Newburyport	Np.
Newton	N.
Newton Center	N. C.
Newton Highlands	N. H.
Newton Upper Falls	N. U. F.
Newtonville	Nv.
North Abington	N. Ab.
North Attleboro	N. At.
Norwood	Nor.
Pawtucket	Paw.
Peabody	P.
Plymouth	Ply.
Providence	Prov.
Quincy	Q.
Raynham	Ray.
Reading	Read.
Revere	Rev.
Rockland	Roc.
Roslindale	Ros.
Roxbury	R.
Salem	S.
Saugus	Sau.
Saxonville	Sax.
Scituate	Sc.
Somerville	Som.
South Boston	S. B.
So. Framingham	S. Fram.
Stoneham	St.
Stoughton	Stou.
Swampscott	Swam.
Taunton	T.
Tewksbury	Tewk.
Tufts College	T. C.
Uphams Corner	U. C.
Waban	Wab.
Wakefield	Wak.
Walpole	Walp.
Waltham	Wal.
Watertown	Wat.
Waverley	Wav.
Wellesley	Wel.
Wellesley Hills	Wel. H.
West Newton	W. N.
Weston	Wes.
West Roxbury	W. R.
Weymouth	Wey.
Whitman	Whit.
Winchester	Winc.
Winter Hill	W. H.
Winthrop	Win.
Woburn	Wo.
Wollaston	Wol.
Woonsocket	Woon.
Worcester	Wor.

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GRADUATE STUDENTS

[This list includes the names of all students who have already received a degree, either from this or another institution, and is without reference to the course of study that they are pursuing at the Institute. The names of these students will also be found under the various classifications corresponding to their work.]

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Abbott, George, 2d B.A., B.S., University of Wyoming.	*Laramie, Wyo.*	22 Bickerstaff St., B.
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Aldrin, Edwin Eugene A.B., Clark University.	*Worcester*	62 Beach St., Wo.
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Cargill, William Wallace. B.S., C.E., University of Wisconsin.	*Madison, Wis.*	225 Newbury St., B.
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Cary, Frank Wing. S.B., Haverford College.	*Baltimore, Md.*	Drayton Hall, C.
Chang, Jeean Tsolin. Graduate, Tsing Hua College.	*Changli, China.*	360 Harvard St., C.
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Chase, John Howe. B.S., University of Rochester.	*Riverside, Cal.*	34 Mass. Ave., B.
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GRADUATE STUDENTS (*continued*)

NAME	HOME	RESIDENCE
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Clark, Walter Lucas, U.S.A. Graduate, Coast Artillery School. B.S., Norwich University.	*Fort Banks*	Fort Banks.
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Guilbert, Horace Moss. A.B., Yale University.	*Southport, Conn.*	3 Revere St., J. P.
Gunn, Selskar Michael. B.S., Massachusetts Institute of Technology.	*Belmont.*	60 Goden St., Bel.
Haertlein, Albert. A.B., Harvard University.	*St. Louis, Mo.*	76 Perkins Hall, C.
Hagerty, Joseph James. M.D., Harvard Medical School.	*Norwood*	31 Day St., Nor.

GRADUATE STUDENTS (*continued*)

NAME	HOME	RESIDENCE
Hale, John Isaac, U.S.N. Graduate, United States Naval Academy.	*Washington, D. C.*	8 Arlington St., B.
Hamabe, Genjiro. Graduate, Kyoto Imperial University.	*Kyoto, Japan*	90 Gainsborough St., B.
Hamilton, Herbert Warren. BS., Bates College.	*Brockton*	250 Pleasant St., Brock.
Hand, Carl Nelson. B.S., Hobart College.	*Medina, N. Y.*	334 Harvard St., C.
Hanson, George. B.A., M.A., University of Manitoba. A.M., Harvard University.	*Manitoba, Canada*	39 Inman St., C.
Harkness, Robert Rae. Ph.B., Yale University.	*Delhi, N. Y.*	15 Lee St., C.
Harper, Carl Brown. A.B., B.S., Davis and Elkins College.	*Elkins, W. Va.*	1137 Mass. Ave., C.
Harper, John. A.B., Harvard University.	*Cambridge*	Claverly Hall, C.
Harrington, Elliott Dean. B.S., Beloit College.	*Elkhorn, Wis.*	308 Newbury St., B.
Hartley, William Elmo. A.B., Drury College.	*Springfield, Mo.*	770 Mass. Ave., C.
Hedrich, Arthur William. B.S., Northwestern University.	*Chicago, Ill.*	55 St. Stephen St., B.
Heyl, Robert Chapman, Jr. A.B., Princeton University.	*Wynnewood, Pa.*	304 Craigie Hall, C.
Hodgson, Maurice Lee. S.B., Harvard University.	*Newton*	96 Shornecliffe Rd., N.
Hogan, John Forbes. S.B., Massachusetts Institute of Technology.	*Pawtucket, R. I.*	17 Beach St., Paw.
Houghton, Seymour Phillips. A.B., Columbia University.	*Tarrytown, N. Y.*	197 St. Botolph St., B.
Huang, Shou-Heng. Graduate, Tong-Shan Engineering College.	*Yang-Chow, China*	1075 Boylston St., B.
Hung, Shao-Yu. Graduate, Tsing Hua College.	*Ningpo, China*	137 Mass. Ave., C.
Insley, Robert. B.S., Hamilton College.	*Nanuet, N. Y.*	Technology Dormitory, C.
James, Linda B.A., University of Minnesota.	*Newport, Minn.*	2 Divinity Ave., C.
Johns, Alfred Augustus. A.B., University of Rochester.	*Rochester, N. Y.*	366 Harvard St., C.
Johnston, Archibald Borhek Ph.B., Yale University.	*Bethlehem, Pa.*	334 Harvard St., C.
Jones, David Morris. A.B., University of Minnesota	*Wabasha, Minn.*	820 Mass. Ave., C.
Jordan, Helen. S.B., College of Saint Elizabeth.	*Dorchester*	60 Cushing Ave., D.
Keesler, Edward Yates. A.B., University of North Carolina. M.S., Washington and Lee University.	*Charlotte, N. C.*	1018 Beacon St., Br.
Kelly, Joyce Raymond. A.B., Reed College.	*Portland, Oregon*	54 Ellery St., C.
Kemkemian, Bedros. B.A., Syrian Protestant College.	*Cairo, Egypt*	18 Pearl St., N.

GRADUATE STUDENTS (*continued*)

NAME	HOME	RESIDENCE
Kennedy, Grafton Sherwood B.A., Yale University.	*Dayton, O.*	33 Phillips St., Wat.
Kenney, Arthur Webster S.B., S.M., Massachusetts Institute of Technology.	*Dorchester*	12 Taft St., D.
Kenway, Florence Louise B.S., Columbia University.	*Newton*	85 Lombard St., N.
Kleinschmidt, Helen A.B., Radcliffe College.	*Johnstown, Pa.*	45 Oxford St., C.
Kleinschmidt, Robert Victor A.B., Harvard University.	*Johnstown, Pa.*	67 Perkins Hall, C.
Knox, Cornelius Van Santvoord A.B., Princeton University.	*New Brunswick, N. J.*	Technology Dormitory, C.
Kuhn, Samuel Louis A.B., Harvard University.	*Cincinnati, O.*	11 Nassau St., B.
Kuhns, Austin B.A., Wesleyan University.	*Middletown, Conn.*	8 Mellen St., C.
Labarrère, Jacques Louis B.S., Sorbonne of Paris.	*Havana, Cuba*	9 Magazine St., C.
Lahee, Louie A.B., Radcliffe College.	*Cambridge*	42 Concord Ave., C.
Landis, Maurice Neuman Ph.B., Yale University.	*Chicago, Ill.*	225 Newbury St., B.
Lauer, Luther Michael A.B., Ursinius College.	*Thomasville, Pa.*	10 Pembroke St., B.
Lawrence, Elmer Walcott B.S., Bates College.	*Woods Hole*	336 Com'w'lth Ave., B.
Lawton, Edgar Herbert A.B., University of South Carolina.	*Hartsville, S. C.*	258 Newbury St., B.
Lebby, Thomas Dotterer, Jr. A.B., College of Charleston.	*Summerville, S. C.*	336 Com'w'lth Ave., B.
Lederer, Arthur M.D., University of Illinois.	*Chicago, Ill.*	51 St. Stephen St., B.
Ling, Homer Chuen-cheng B.A., St. John's University.	*Amoy, China*	Technology Dormitory, C.
Little, Edward Norton B.A., Yale University.	*Peoria, Ill.*	Technology Dormitory, C.
Little, Harold Greenleaf B.Sc., Massachusetts Agricultural College.	*Newburyport*	70 Purchase St., Np.
Little, William Hobart A.B., Hamilton College.	*Towanda, Pa.*	4 Rutledge St., W. R.
Littlefield, Walter Joseph S.B., Harvard University.	*New York, N. Y.*	Ridgely Hall, C.
Lobos, Francisco Graduate, University of Chile.	*Santiago, Chile*	20 Park St., Br.
Lohmeyer, William, Jr. S.B., Virginia Military Institute.	*Charleston, W. Va.*	59 Magazine St., C.
Loo, Pang Chieh B.S., Michigan College of Mines.	*Shanghai, China*	1075 Boylston St., B.
Lord, William Mason Bradley A.B., Bowdoin College.	*Jamaica Plain*	49 Pond St., J. P.
Loutski, Robert B.S., University of Paris.	*Boston*	Technology Dormitory, C.
Lunn, John Aleck B.S., Colorado State College.	*Fort Collins, Colo.*	484 Beacon St., B.

GRADUATE STUDENTS (*continued*)

NAME	HOME	RESIDENCE
McAdams, William Henry. B.S., M.S., State University of Kentucky.	*Lexington, Ky.*	316 Huntington Ave., B.
McClurg, Verner Blackmore. A.B., Leland Stanford, Jr., University.	*Los Angeles, Cal.*	Technology Dormitory, C.
McDill, Bruce Magaw. A.B., Miami University.	*Oxford, O.*	543 Boylston St., B.
McGuigan, Joseph Loyd, U.S.N. Graduate, United States Naval Academy.	*Washington, D. C.*	Hotel Canterbury, B.
Macheca, George Michael. A.B., Loyola University.	*New Orleans, La.*	421 Marlborough St., B.
McIntire, Ralph Davis. S.B., S.M., College of Wooster (Ohio).	*Manchester, O.*	34 William St., C.
MacKirdy, Howard Spencer. B.A., Wesleyan University.	*New Britain, Conn*	15 Lee St., C.
McKone, Frank Edward. B.S., New Hampshire State College.	*Dover, N. H.*	46 Mass. Ave., C.
McLaughlin, Edward Henry. B.S., University Santa Clara.	*Los Angeles, Cal.*	297 Newbury St., B.
McLaughlin, Harold Clarke. A.B., University of Missouri.	*Sedalia, Mo.*	94 St. Botolph St., B.
MacRae, Duncan. B.S., University of North Carolina.	*Wilson, N. C.*	51 Hemenway St., B.
Manning, George Charles, U.S.N. Graduate, United States Naval Academy.	*Washington, D. C.*	640 Huntington Ave., B.
Marron, Adrian Raphael, U.S.N. Graduate, United States Naval Academy.	*Washington, D. C.*	352 Harvard St., C.
Martin, Harold Smith, U.S.A. Graduate, United States Military Academy.	*Washington, D. C.*	1277 Com'w'lth Ave., A.
Martin, Richard Penberthy, Jr. A.B., Yale University.	*Hartford, Conn*	261 Newbury St., B.
Martinez, John Miguel. A.B., Williams College.	*New York, N. Y.*	39 Dwight St., Br.
Martinez, José Félix. National Institute of Salvador.	*Santa Ana, Salvador.*	264 Brookline Ave., B.
Martinez, Marcial Ernesto. Graduate, Naval Academy, Chile.	*Santiago, Chile.*	Technology Dormitory, C.
Meloy, Thomas K. A.B., Harvard University.	*New York, N. Y.*	Craigie Hall, C.
Melvin, Howard Lange. B.S., State College of Washington.	*Pullman, Wash.*	41 Sacramento St., C.
Miller, Charles Gideon. B.S., Virginia Military Institute.	*Richmond, Va.*	38 Westland Ave., B.
Miller, Frank Oliver. B.S. C.E., University of Georgia.	*Athens, Ga.*	200 Bay State Road, B.
Mitsui, Takanaga. B.S., Dartmouth College.	*Tokyo, Japan.*	23 Naples Road, Br.
Montgomery, Robert Alfred. B.Sc., Monmouth College.	*Ewing, Neb.*	9 Magazine St., C.
Moore, Bernard Stanislaus, Jr. A.B., Georgetown College.	*Syracuse, N. Y.*	1018 Beacon St., Br.
Moore, Walter Allan, Jr. B.S., South Carolina Military College.	*Charleston, S. C.*	17 Ivy St., B.
Mori, Hyogo. Graduate, Imperial Kyoto University.	*Japan*	49 Oxford St., C.

GRADUATE STUDENTS (*continued*)

NAME	HOME	RESIDENCE
Moulton, Robert Selden. B.S., Amherst College.	*Poughkeepsie, N. Y.*	262 Newbury St., B.
Murray, Albert Francis. B.A., Maryville College.	*New Decatur, Ala.*	21 Norway St., B.
Nakayama, Hisao. Graduate, Tokio Imperial University.	*Tokio, Japan*	15 Ellery St., C.
Nakaye, Seigo. Graduate, Meizi College of Technology.	*Kyoto, Japan*	456 Boylston St., B.
Nelson, George Augustus, Jr. B.S., College of City of New York.	*New York, N. Y.*	Technology Dormitory, C.
Nelson, Gordon Whymper, U.S.N. Graduate, United States Naval Academy.	*New York, N. Y.*	Canterbury Hotel, B.
Nelson, William, U.S.N. Graduate, United States Naval Academy.	*Washington, D. C.*	Hotel Canterbury, B.
Nichols, Bruce Salyers. A.B., Harvard University.	*St. Louis, Mo.*	45 Beck Hall, C.
Nichols, Hall. A.B., Harvard University.	*Boston*	294 Marlborough St., B.
Nichols, Paul Frothingham. B.S., Bates College.	*Malden*	26 Judson St., Mal.
Niles, Alfred Salem. A.B., Johns Hopkins University.	*Baltimore, Md.*	259 Newbury St., B.
Ockert, Paul. A.B., Western Reserve University.	*Cleveland, O.*	336 Com'w'lth Ave., B.
Oliva N., Guillermo. Graduate, Naval Academy, Chile.	*Valparaiso, Chile*	1675 Mass. Ave., C.
Ono, Rfoye. C.E., Tokio Imperial University.	*Tokio, Japan*	40 St. Paul St., Br.
Padilla, José Augusto. Graduate, Instituto Nacional de Honduras.	*Tegucigalpa, Honduras*	290 Mass. Ave., C.
Paine, George Thomas. B.S., Brown University.	*Warwick, R. I.*	53 St. Stephen St., B.
Pan, Chen-chi. Graduate, Nanyang College.	*Soo-chow, China*	1075 Boylston St., B.
Parker, Henry Godwin. B.A., William and Mary College.	*Portsmouth, Va.*	1026 Com'w'lth Ave., Br.
Pastorino, Francesco. Graduate, Turin University.	*Boston*	11 Nassau St., B.
Peers, Frank Wagner. A.B., Washburn College.	*Topeka, Kan.*	316 Huntington Ave., B.
Pelton, Fred Earl, U.S.N. Graduate, United States Naval Academy.	*Washington, D. C.*	50 Mass. Ave., C.
Peña-Polo, Jorge. A.B., Colegio del Rosario.	*Bogota, Colombia*	432 Marlborough St., B.
Perry, Harold Harwood. B.S., University of Michigan.	*Bay City, Mich.*	Technology Dormitory, C.
Pierce, David Eugene. Ph.B., University of Wooster.	*West Middlesex, Pa.*	47 Rutland Sq., B.
Pierce, Marvin. A.B., Miami University.	*Dayton, O.*	Technology Dormitory, C.
Pond, Walter Franklin. B.S., Amherst College.	*Greenfield*	Technology Chambers, B.
Pote, Kenneth Edwin. S.B., Harvard University.	*Westfield, N. J.*	31 Holyoke St., C.

GRADUATE STUDENTS (*continued*)

NAME	HOME	RESIDENCE
Priest, Chester Anderson. A.B., Harvard University.	*Nashua, N. H.*	4 Beck Hall, C.
Putnam, John Pickering, Jr. A.B., Harvard University.	*Boston*	535 Beacon St., B.
Quinn, John Joseph, Jr. A.B., Boston College.	*West Roxbury*	292 Temple St., W. R.
Reed, Howard Finley. B.A., Amherst College.	*Roxbury, O.*	33 Mellen St., C.
Richards, Clarence Earl, Jr. B.Ph., Denison University.	*Columbus, O.*	11 Newbury St., B.
Richards, George Harrison. A.B., Williams College.	*Winsted, Conn.*	12 Westland Ave., B.
Roberts, Leland Clifford. A.B., Harvard University.	*Newton Center*	184 Ward St., N. C.
Robins, Vernon. M.D., University of Louisville.	*Louisville, Ky.*	14 Garden St., C.
Robinson, Russell King. A.B., Ohio Wesleyan University.	*Ashtabula, O.*	491 Com'w'lth Ave.
Rogers, Herman Livingston. B.A., Yale University.	*Hyde Park-on-Hudson, N.Y.*	5 Story St., C.
Rogers, John Winston. A.B., Washington and Jefferson University.	*Washington, Pa.*	86 Buckingham St., C.
Rollins, Wingate. A.B., Harvard University.	*Hingham*	42 Dunster Hall, C.
Ross, William Byron. B.Sc., University of Wooster.	*Uhrichsville, O.*	47 Rutland Sq., B.
Rowe, Raphael Robinson. A.B., Harvard University.	*Grand Rapids, Mich.*	200 Bay State Rd., B.
Royce, Donald, U.S.N. Graduate, United States Naval Academy.	*Washington, D. C.*	352 Harvard St., C.
Salah, John Suleiman. A.B., Syrian Protestant College.	*Palestine, Turkey*	14 Westland Ave., B.
Sampson, Edward. C.E., M.Sc., Princeton University.	*Princeton, N. J.*	9 Norway St., B.
Sanders, Marshall Thomas. A.B., Washburn College.	*Topeka, Kansas*	161 Hancock St., C.
Sandlas, William Henry. S.B., Pennsylvania College.	*Baltimore, Md.*	196 Huntington Ave., B.
Sansberry, James Campbell. S.B., Virginia Military Institute.	*Anderson, Ind.*	4 Ames St., C.
Saville, Thorndike. A.B., Harvard University. B.S., C.E., Dartmouth College.	*Hartford, Conn.*	5 Sumner Rd., C.
Sawyer, Charles Baldwin. B.A., Yale University.	*Cleveland, O.*	312 Riverbank Court, C.
Scannell, Robert Henry. Litt.B., Princeton University.	*Cambridge*	Felton Hall, C.
Searles, Thomas Mount, U.S.N. Graduate, United States Naval Academy. S.B., Mississippi Agricultural and Mechanical College.	*Allston*	1384 Com'w'lth Ave., A.
Shirer, Hampton Francis. A.B., Washburn College	*Topeka, Kansas*	316 Huntington Ave., B.
Sih, Tse-sing. B.Sc., Nanyang College.	*Shanghai, China*	1091 Boylston St., B.

GRADUATE STUDENTS (*continued*)

NAME	HOME	RESIDENCE
Smith, Richard Harbert. B.S., Moore's Hill College.	*Dillsboro, Ind.*	82 Gainsborough St., B.
Smith, Winfred Wenner. S.B., Pennsylvania College.	*Lehighton, Pa.*	Technology Dormitory, C.
Solakian, Haig Nerses. B.A., Central Turkey College.	*Kilis, Turkey.*	602 Tremont St., B.
Spitz, Gertrude T. A.B., Radcliffe College.	*Brookline.*	1455 Beacon St., Br.
Steelsmith, Daniel Clarence. M.D., Iowa State University.	*Melvin, Iowa.*	3 Hancock Park, C.
Stevenson, Victor Enrique. Graduate, Naval Academy, Chile.	*Antofagasta, Chile.*	Technology Dormitory, C.
Stevenson, William O. Graduate, Naval Academy, Chile.	*Antofagasta, Chile.*	Technology Dormitory, C.
Storrow, James Jackson, Jr. A.B., Harvard University.	*Lincoln.*	265 Clarendon St., B.
Stowell, Raymond Miles. S.B., Massachusetts Institute of Technology.	*Walpole.*	Walpole.
Stöwhas, Carlos Alberto. Graduate, Escuela de Ingenieros navales.	*Valparaiso, Chile.*	1675 Mass. Ave., C.
Stribling, Simpson Ridley. B.S., Texas Agricultural and Mechanical College.	*Waco, Texas.*	484 Beacon St., B.
Sung, Chien Hsün. B.M.E., University of Michigan. A.B., Pekin University.	*Hinghua, China.*	146 Austin St., C.
Swan, Horace Gilbert. B.S., University of Rochester.	*Rochester, N. Y.*	34 Mass. Ave., C.
Swain, Robert Burrowes. A.B., Williams College.	*Pomfret, Conn.*	39 Dwight St., Br.
Tenney, Elmer Seth. A.B., M.D., Dartmouth College.	*Fort Warren*	Fort Warren.
Thomas, Francis Elliott. B.S., Pennsylvania State College.	*Bellefonte, Pa.*	Technology Dormitory, C.
Thomas, William Pratt. B.S., University of Alabama.	*Prattville, Ala.*	394 Marlborough St., B.
Tovey, Henry Oliver, U.S.N. Graduate, United States Naval Academy.	*Watseka, Ill.*	Hotel Canterbury, B.
Tu, Hin Yung. Graduate, Naval College, Canton.	*Canton, China.*	416 Newbury St., B.
Turner, Clair Elsmere. A.B., Bates College. A.M., Harvard University.	*Harmony, Me.*	263 Highland Ave., Som.
Tyler, John Cowperthwaite. B.A., Williams College.	*Brooklyn, N. Y.*	Bromley Court, C.
Uebelacker, Armin Adams. B.S., Princeton University.	*Hackensack, N. J.*	Technology Dormitory, C
Vanderstucken, Frank Ryland. S.B., Massachusetts Institute of Technology.	*Hanover, Germany.*	Larchwood Drive, C.
Venable, Charles Scott. A.B., M.A., University of North Carolina.	*Chapel Hill, N. C.*	51 Hemenway St., B.
Walker, Edward Cyrus, 3d. A.B., Hamilton College. S.B., Massachusetts Institute of Technology.	*Batavia, N. Y.*	191 Babcock St., Br.
Wan, Iü-shing. B.Sc., London University.	*Hong Kong, China*	25 Trowbridge St., C.

GRADUATE STUDENTS (*continued*)

NAME	HOME	RESIDENCE
Want, Cullen Henery, U.S.N. Graduate, United States Naval Academy.	*Washington, D.C.*	14 Center St., C.
Warner, Edward Pearson A.B., Harvard University.	*Concord*	47 Matthews Hall, C.
Wei, Tsen Fu Graduate, Chinese Naval Academy.	*Canton, China*	144 Hemenway St., B.
Wells, Everett Deane B.S., Grinnell College.	*Nashua, Iowa*	820 Mass. Ave., C.
Wheeler, Evan Rupert B.S., A.M., Colby College.	*Waterville, Me.*	45 St. Botolph St., B.
Whetzel, Joshua Clyde B.S., Washington and Lee University.	*Martinsburg, W. Va.*	261 Newbury St., B.
White, Chandler Tubbs B.S., Dartmouth College.	*Concord, N. H.*	290 Mass. Ave., C.
Williams, Arthur Sease B.S., University of South Carolina.	*Columbia, S. C.*	957 Mass. Ave., C.
Williford, Forrest Estey, U.S.A. Graduate, United States Military Academy.	*Allston*	25 Chester St., A.
Wilmot, Frank Alonzo M.D., A.B., Cotner University.	*Lincoln, Neb.*	599 Columbus Ave., B.
Wright, Henry Wagner B.A., Yale University.	*Danvers*	241 Locust St., Dan.
Wright, Theodore Paul B.S., Lombard College.	*Cambridge*	72 Faverweather St., C.
Wrigley, Paul Pickering B.A., Williams College.	*Brooklyn, N. Y.*	Technology Dormitory, C.
Wu, Tai Ming Graduate, Chinese Naval Academy.	*Canton, China*	416 Newbury St., B.
Wurzelbacher, George Milton B.A., St. Xavier's College	*Cincinnati, Ohio*	17 Lee St., C.
Wyer, William A.B., Yale University.	*Albany, N. Y.*	Technology Dormitory, C.
Wylde, Russell Arthur A.B., Dartmouth College.	*Lawrence*	43 St. Stephen St., B.
Yao, Char Foo Graduate, Chinese Naval Academy.	*Anhui, China*	428 Newbury St., B.
Yeaton, Philip Osborne B.S., Dartmouth College.	*Portsmouth, N. H.*	820 Mass. Ave., C.
Yeh, Chi Foo Graduate, Chinese Naval College.	*Canton, China*	416 Newbury St., B.
Yeh, Tek Chen Graduate, Tsing Hua College	*Shanghai, China*	45 Hemenway St., B.
Yen, Fuchun A.B., St. John's University. M.D., Yale Medical School.	*Changsha, China*	123 St. Botolph St., B.
Zeitfuchs, Edward S.B., University of California.	*Cambridge*	5 DeWolfe St., C

CLASSIFIED STUDENTS

FOURTH YEAR

NAME	COURSE	HOME	RESIDENCE
Abbott, George, 2d, B.A.,	B.S.-VI.	*Laramie, Wyo.*	22 Bickerstaff St., B.
Abels, Charles August	VI.	*Lowell*	Technology Dormitory, C.
Adams, Carleton Coffin	X.	*West Somerville*	14 Lesley Ave., W. Som.
Allen, Chester King	II.	*Quincy*	34 Avon Way, Q.
Althouse, Alfred Kutz	XV.	*Norristown, Pa.*	200 Bay State Rd., B.
Ames, Chester Edward	VI.	*Cambridge*	50 Highland Ave., C.
Anderson, James William	XI.	*South Lancaster*	283 Newbury St., B.
Andrews, George Angell,	U.S.N. XIII-A.	*Grand Haven, Mich.*	11 Stone Rd., Bel.
Angas, William Mack	I.	*Hobe Sound, Fla.*	916 Beacon St., B.
Astorian, Alexander	IV.	*Boston*	189 Massachusetts Ave., B.
Atkinson, Charles Edward	I.	*Newburyport*	28 Maxwell Rd., Winc.
Auty, Clarence	VI.	*Andover*	19 Haverhill St., And.
Ayer, Harold Ellsworth	IV.	*Portland, Me.*	128 St. Botolph St., B.
Babbitt, John Hancock	I.	*Northampton*	Technology Dormitory, C.
Bailey, Howard Elliott	XI.	*North Scituate*	N. Scituate
Barrows, Stanwood Roy	XV.	*Lynn*	55 Beacon Hill Ave., L.
Basch, Jacob Justin	X-A.	*Paterson, N. J.*	Technology Dormitory, C.
Batchelder, Sidney Spalding	XV.	*Dedham*	428 Charles River Rd., C.
Baxter, Horace Monroe	VI.	*Brighton*	160 Foster St., Bri.
Beattie, James Alexander	X-A.	*Louisville, Ky.*	10 Pembroke St., B.
Belden, Eduardo Daniel	IV.	*Monterey, Mex.*	10 St. Botolph St., B.
Bell, Kenneth Eldon	X-A.	*Malden*	129 Hawthorne St., Mal.
Bernard, Frederick	VII.	*Hartford, Conn.*	526 Beacon St., B.
Black, Charles Miller	I.	*Denver, Colo.*	916 Beacon St., B.
Blackall, Robert Murray, A.B.	IX.	*Watertown*	103 Church St., Wat.
Bond, Benjamin Morris	V.	*Roxbury*	10 Marcella St., R.
Bone, Herbert Lawrie	II.	*Roslindale*	26 Edgemont St., Ros.
Brandegee, Morris Marius, A.B.	X.	*Plainfield, N. J.*	484 Beacon St., B.
Brayton, Harold Morgan	II.	*Cold Brook, N. Y.*	316 Hungtington Ave., B.
Brock, Malcolm Cameron	XV.	*Newton Center*	512 Commonwealth Ave., B.
Brooks, Arthur Raymond	XIV.	*Framingham*	Technology Dormitory, C.
Brown, Roger Brigham	X.	*Marlboro*	47 St. Stephen St., B.
Brush, Charles Francis, Jr., S.B.	VI.	*Cleveland, O.*	312 Riverbank Court, C.
Buford, Albert Walter	I.	*Forrest City, Ark.*	Technology Dormitory, C.
Burk, Herbert Grover	VI.	*East Lynn*	34 Ocean Terr., E. L.
Burkhart, Theodore Walpole	II.	*Portland, Ore.*	36 St. Stephen St., B.
Butterworth, Frank Linton	IV.	*Marion, Ind.*	491 Commonwealth Ave., B.
Buttner, Fred Frank	VI.	*Waterbury, Conn.*	6 Ivy St., B.
Cady, Lowell	I.	*New York, N. Y.*	261 Newbury St., B.
Campbell, Joel William	I.	*Fullerton, Nebr.*	546 Newbury St., B.
Campion, William Leo	XI.	*Dorchester*	10 Mallon Rd., D.
Canby, Albert Thrasher	X-A.	*Dayton, O.*	1067 Beacon St., Br.
Carson, Frank Somerville	IV.	*Halifax, N. S.*	512 Commonwealth Ave., B.

FOURTH YEAR (*continued*)

NAME	COURSE	HOME	RESIDENCE
Chand, Diwan Nanak	VI.	*Kasachi, India*	67 Hammond St., C.
Chang, Yih-Tze	X–A.	*Nanking, China*	57 Westland Ave., B.
Chase, Albert Worcester	X.	*Swampscott*	176 Burrill St., Swam.
Childs, Kenneth Mason	II.	*Needham Heights*	Needham Heights
Childs, Paul Dudley, A.B.	IV.	*Kansas City, Mo.*	506 Beacon St., B.
Chisholm, Stanley Leavitt	V.	*Melrose Highl'ds*	128 Melrose St., Mel. H.
Christison, Leslie	V.	*Methuen*	24 Clinton St., C.
Cianciolo, Philip Joseph	I.	*Boston*	15 S. Margin St., B.
Clark, Edward Leeds, A.B.	VI.	*Oberlin, O.*	Technology Dormitory, C.
Clark, Ernest Morton	X–A.	*Newtonville*	150 Otis St., Nv.
Clark, William Allen	XI.	*Winthrop*	203 Woodside Ave., Win.
Clayman, Samuel	X–A.	*Dorchester*	3 Nightingale St., D.
Coakley, Cornelius Cooper	X.	*Lynbrook, L.I., N.Y.*	261 Newbury St., B.
Coburn, Charles Lyman	I.	*Lexington*	31 Percy Rd., Lex.
Coffin, John Ruskin, A.B.	VI.	*West Medford*	150 Brooks St., W. Med.
Colby, Charles Wilson, A.B.	IV.	*Portland, Me.*	1010 Mass. Ave., C.
Conaty, Francis Sylvester	I.	*Taunton*	Technology Dormitory, C.
Cook, Roy Jennings	XIV.	*Brooklyn, N. Y.*	484 Beacon St., B.
Crane, Frank Norman	I.	*Roxbury*	6 Pickering Ave., R.
Creighton, Samuel Henry, Jr.	II.	*Rockville Center, N. Y.*	261 Newbury St., B.
Cribben, Leo Thomas, A.B.	II.	*Dorchester*	35 Mt. Vernon St., D.
Crisp, Frederick Grafton, U.S.N.	XIII–A.	*Cambridge*	10 Dana St., C.
Cristal, Philip Nahm, A.B.	I.	*Bowling Green, Ky.*	203 Bay State Rd., B.
Cronin, John Timothy, A.B.	IV.	*Spokane, Wash.*	44 The Fenway, B.
Crosby, Gordon Eugene	I.	*Chestnut Hill*	279 Com'w'lth Ave., C. H.
Dana, Leo Isadore	VIII.	*Roxbury*	34 Lawrence Ave., R.
Daniels, Donald Potter	V.	*Pasadena, Cal.*	Hotel Lenox, B.
Davis, Franklin Breckenridge, A.B.	X.	*Cambridge*	33 Arlington St., C.
Davis, Lawrence	II.	*Auburndale*	4 Ames St., C.
Dean, Carlton Miles	X.	*Woburn*	Technology Dormitory, C.
DeBell, John Milton	X–A.	*Great Barrington*	512 Com'w'lth Ave., B.
deMars, Paul Alva	VI.	*Lawrence*	Technology Dormitory, C.
Demeritt, John Edgar	VI.	*Newmarket, N. H.*	99 Norway St., B.
Dickson, Arthur Donohue	I.	*Cambridge*	149 Austin St., C.
Dodge, Barnett Fred	X–A.	*Akron, O.*	179 Bay State Rd., B.
Dodson, Frederick William	XIV.	*Washington, D. C.*	179 Bay State Rd., B.
Doherty, Joseph Edmund	V.	*Newton*	Technology Dormitory, C.
Donovan, George William	II.	*Andover*	86 Chestnut St., And.
Doon, James William	XV.	*Natick*	104 Charles River Rd., C.
Dowell, Arthur Edward, Jr.	VI.	*Washington, D. C.*	526 Beacon St., B.
Drobisch, Raymond Wessells.	II.	*Decatur, Ill.*	316 Huntington Ave., B.
Dumit, Michael Jaber, B.A.	X.	*Beirut, Syria*	14 Westland Ave., B.
Dunham, Atwood Packard	II.	*Brockton*	491 Commonwealth Ave., B.
duPont, Francis Victor	IX.	*Wilmington, Del.*	44 The Fenway, B.
Duryea, George Root	II.	*Springfield*	237 Beacon St., B.
Eaton, Irving Cutts	XIV.	*Magnolia*	20 Hemenway St., B.
Eaton, Roland Hurlbut	II.	*South Sudbury*	So. Sudbury
Eaton, William West, A.B., A.M.	VI	*Hamilton, N. Y.*	Technology Dormitory, C.
Eddy, Carlton Winne, S.B.	VI.	*Dorchester*	54 Magnolia St., D.

FOURTH YEAR (*continued*)

NAME	COURSE	HOME	RESIDENCE
Eddy, Harrison Prescott, Jr.	XI.	*Newton Center*	491 Commonwealth Ave., B.
Enright, Earl Francis, U.S.N.	XIII–A.	*McCook, Nebr.*	7 Center St., C.
Erb, Robert Curtis	XV.	*Dorchester*	7 Fenelon St., D.
Fales, William Thurber	VII.	*Boston*	136 Hemenway St., B.
Farr, Walter Greene	II.	*Wenonah, N. J.*	336 Commonwealth Ave., B.
Fay, Richard Dudley, A.B.	VI.	*Nahant*	65 Fresh Pond Pkwy, C.
Ferretti, Alfred John	II.	*Lynn*	27 Chauncy Place, J. P.
Fine, Harry	X.	*Malden*	135 Bowdoin St., Mal.
Fineman, Irving, B.E.	I.	*Brooklyn, N. Y.*	101 St. Botolph St., B.
Flagg, Paul Maxwell, B.S.	II.	*Philadelphia, Pa.*	Technology Dormitory, C.
Foss, Frederic Dearborn	XI.	*Haverhill*	Technology Dormitory, C.
Frank, Harry	X.	*Dorchester*	80 McLellan St., D.
Fraser, Matilda Alexandra	IX.	*Boston*	20 Charlesgate West, B.
Freeman, John Ripley, Jr., S.B.	X–A.	*Providence, R. I.*	788 Mass. Ave. C.
Friend, Donald Osborne	X.	*Brooklyn, N. Y.*	334 Harvard St., C.
Gager, Charles Cotter, Ph.B.	XIII.	*Derby, Conn.*	Technology Dormitory, C.
Gagnon, Jules	VII.	*Newburyport*	8 Garden St., Np.
Gamage, Frederick Luther, Jr.	VI.	*Pawling, N. Y.*	526 Beacon St., B.
Gannett, Robert	II.	*Washington, D. C.*	Technology Dormitory, C.
Gardner, Hartley Burton	VI.	*Cambridge*	336 Commonwealth Ave., B.
Gargan, Joseph	XV.	*Roxbury*	110 Winthrop St., R.
Gaus, Gilbert Herman	II, VI.	*Brooklyn, N. Y.*	517 Beacon St., B.
Gayhart, Everett LeRoy, U.S.N.	XIII–A.	*Cambridge*	10 Dana St., C.
Gillespie, Kingsley Alexander.	X–A.	*Stamford, Conn.*	517 Beacon St., B.
Gilliard, Charles Thomas	II.	*Andover*	61 Elm St., And.
Gilmour, Arthur Emerson	II.	*Cambridge*	26 Upland Rd., C.
Gilt, Carl Mitchell, A.B.	VI.	*Rochester, N. Y.*	366 Harvard St., C.
Gokey, Noah Webster	XIII.	*Jamestown, N. Y.*	200 Bay State Rd., B.
Goldsmith, Henry Friedberger, B.A.	X–A.	*Philadelphia, Pa.*	Technology Dormitory, C.
Goldstein, Edwin Jacob	X.	*Hartford, Conn.*	Technology Dormitory, C.
Goodale, Francis	XI.	*Marlboro*	Technology Dormitory, C.
Gorfinkle, Louis	I.	*Boston*	35 N. Russell St., B.
Goudey, Raymond Freeman	XI.	*Everett*	8 Forest Ave., Ev.
Gramstorff, Emil Anton	IV.	*Everett*	145a Belmont St., Ev.
Gray, Guy Augustus	VI.	*Cleveland, O.*	237 Beacon St., B.
Gurney, Stuart Willis	IX.	*Brockton*	Technology Dormitory, C.
Hale, Edwin Dudley	X.	*Dorchester*	495 Columbia Rd., D.
Hall, Benjamin Taylor	II.	*Norwich, Conn.*	Technology Dormitory, C.
Hamilton, Herbert Warren, B.S.	VII.	*Brockton*	250 Pleasant St., Brock.
Hand, Carl Nelson, B.S.	X.	*Medina, N. Y.*	334 Harvard St., C.
Hannah, Thomas Ewing	I.	*Fitchburg*	Technology Dormitory, C.
Hanson, Edwin Robert	VI.	*Dorchester*	5 Carson St., D.
Harlow, Foster Chichester	I.	*Mattapan*	89 Blue Hill Pkwy, Mat.
Harper, John, A.B.	VI.	*New York, N. Y.*	Claverly Hall, C.
Hartman, Henry Frederick George	III.	*Waltham*	59 Lexington St., Wal.
Hastie, Frank Bowman	I.	*Passaic, N. J.*	1067 Beacon St., Br.
Hatch, Forrest Meldon	II.	*Malden*	38 Ferry St., Mal.

FOURTH YEAR (*continued*)

NAME	COURSE	HOME	RESIDENCE
Haviland, Theodore Z.	II.	*Norwich, Conn.*	484 Beacon St., B.
Hawes, Calvin Wesson	XV.	*Wakefield*	Technology Dormitory, C.
Heath, Elmer Hinckley, Jr.	VII.	*Neponset*	72 Minot St., Nep.
Henderson, George Winslow	I.	*Kendal Green*	Kendal Green
Hiller, Adelbert Delano	VII.	*Marion*	755 Boylston St., B.
Hills, Leander Herbert	XIV.	*Gloucester*	30 Elm St., G.
Hoffman, Leslie Albert	II.	*Roslindale*	886 Canterbury St., Ros.
Holden, Dudley Furber	XV.	*Winter Hill*	153 Central St., W. H.
Holt, Clarence Gilliland	VI.	*Melrose*	Technology Dormitory, C.
Holt, Osgood Wellington	II.	*Arlington*	16 Pleasant St., Arl.
Holton, John Hill	X–A.	*Dorchester*	10 Warner St., D.
Hou, Te Pang	X–A.	*Foochow, China*	57 Westland Ave., B.
Houghton, Seymour Phillips, A.B.	XV.	*Tarrytown, N. Y.*	197 St. Botolph St., B.
Howard, Frank Charles	X.	*Haverhill*	Technology Dormitory, C.
Hu, Peh Yuan	III.	*Shanghai, China*	1075 Boylston St., B.
Huang, Han Ho	III.	*Amoy, China*	820 Massachusetts Ave., C.
Huang, Shou-Heng	I.	*Yang-Chow, China*	1075 Boylston St., B.
Hubbard, Frank Simmons	I.	*Concord*	484 Beacon St., B.
Hulburd, Philip Edwin	IV.	*Brookline*	4 Ames St., C.
Hunt, Gilbert Agnew	I.	*Washington, D. C.*	Technology Dormitory, C.
Hunter, William Brown	X.	*Fall River*	493 Commonwealth Ave., B.
Igleheart, George Priest	II.	*Brookline*	71 Babcock St., Br.
Johnson, William Trimble, Jr.	VII.	*Washington, D. C.*	7 Atlantic St., Win.
Johnston, Archibald Borhek, Ph.B.	III.	*Bethlehem, Pa.*	334 Harvard St., C.
Jones, David Morris, A.B.	VI.	*Wabasha, Minn.*	820 Massachusetts Ave., C.
Keach, Leon	IV.	*Roxbury*	1 Weldon St., R.
Keating, Arthur Elmer	II.	*Bridgeport, Conn.*	57 Hemenway St., B.
Keene, Horatio Nelson	XV.	*Hyde Park*	Technology Dormitory, C.
Keith, Stewart	I.	*Brewster*	179 Bay State Rd., B.
Kelly, Joyce Raymond, A.B.	VI.	*Portland, Ore.*	54 Ellery St., C.
Kenigsberg, Alexander Harry	I.	*Framingham*	9 Waverly St., Fram.
Kennedy, Grafton Sherwood, A.B.	II.	*Dayton, O.*	33 Phillips St., Wat.
Killorin, Francis O'Loughlin	I.	*Boston*	11 Nassau St., B.
Kimball, Henry Maxwell	IV.	*Amherst*	308 Newbury St., B.
Kittredge, George Davis	I.	*Yonkers, N. Y.*	4 Ames St., C.
Knapp, Harold Anthony	X.	*Newbury*	26 East High St., New.
Krigger, Anselmo	I.	*Cambridge*	66 Inman St., C.
Krug, Frank Stanley, Jr.	VI.	*Cincinnati, O.*	4 Ames St., C.
Kuhn, Samuel Louis, A.B.	I.	*Cincinnati, O.*	11 Nassau St., B.
Lane, Kenneth Mortimer	XI.	*Winchester*	Technology Dormitory, C.
Lansil, Clifford Earl	VI.	*Waverley*	33 Burnham St., Wav.
Lauer, Luther Michael, A.B.	X.	*Thomasville, Pa.*	10 Pembroke St., B.
Lawrason, Levering	II.	*St. Francisville, La.*	484 Beacon St., B.
Lebby, Thomas Dotterer, Jr., A.B.	II.	*Summerville, S. C.*	336 Commonwealth Ave., B.
Levey, Benjamin	XI.	*Roxbury*	10 Castlegate Rd., R.
Levi, Elijah	II.	*Roxbury*	24 Lambert St., R.
Lewis, Benjamin Ireson	XIII.	*Nahant*	200 Bay State Rd., B.
Lewis, Earl Carleton	II.	*East Lynn*	Technology Dormitory, C.
Li, Yung Ching	XIII.	*Anhui, China*	428 Newbury St., B.

FOURTH YEAR (*continued*)

NAME	COURSE	HOME	RESIDENCE
Ling, Homer Chuen-cheng, B.A.	II.	*Amoy, China*	Technology Dormitory, C.
Littlefield, Walter Joseph, S.B.	XV.	*New York, N. Y.*	Ridgely Hall, C.
Logan, Richard Whiting	II.	*West Medford*	50 Brooks St., W. Med.
Lovejoy, George Montgomery, Jr.	II.	*Hartford, Conn.*	517 Beacon St., B.
Low, Charles Endicott	XV.	*Norwood*	4 Batavia St., B.
Lowengard, Richard Otto	XV.	*New York, N. Y.*	Hotel Hemenway, B.
Lunn, John Aleck, B.S.	II.	*Fort Collins, Colo.*	484 Beacon St., B.
Lyons, Richard Thomas	III.	*East Weymouth*	76 Middle St., E. Wey.
McCurdy, Ainsley Carlyle	VI.	*Sydney, N. S.*	70 Prospect St., C.
McDaniel, Irving Barry	IV.	*Los Angeles, Cal.*	4 Ames St., C.
McDonald, Harold Joseph	I.	*Cambridge*	31 Holyoke St., C.
McGrady, Leon Lempert	XV.	*Fall River*	1067 Beacon St., Br.
McLellan, Douglas Hull	IV.	*St. Louis, Mo.*	246 Newbury St., B.
McManus, Joseph DeLee	XV.	*Marlboro*	Technology Dormitory, C.
McNeill, Winfield Irving	XV.	*Wakefield*	25 Lafayette St., Wak.
MacPherson, Kenneth William	V.	*Palmyra, N. Y.*	33 Phillips St., Wat.
McQuaid, Howard Stafford	XIV.	*Webster*	20 Hemenway St., B.
Maeder, Raymond Aloysius	II.	*Holliston*	Charles St., H.
Mann, Howard Grover	XV.	*Boston*	193 Huntington Ave., B.
Marsilius, Neuman Marius	XV.	*Beverly*	4 Batavia St., B.
Martin, Richard Penberthy, Jr., A.B.	VI.	*Hartford, Conn.*	261 Newbury St., B.
Martinez, John Miguel, A.B.	V.	*New York, N. Y.*	39 Dwight St., Br.
Medding, Walter Lyman	XV.	*Malden*	517 Beacon St., B.
Mehaffey, William Chambers	II.	*Chambersburg, Pa.*	44 N. Beacon St., A.
Miller, Arthur Merkel	I.	*Rochester, N. Y.*	327 Huntington Ave., B.
Miller, Charles Gideon, B.S.	VI.	*Richmond, Va.*	38 Westland Ave., B.
Miller, Henry Lafayette	VI.	*Manchester, N. H.*	22 Myrtle St., J. P.
Moody, Alvah Edgar	XV.	*Golden, Colo.*	334 Harvard St., C.
Morse, Harold Everett	I.	*Swampscott*	108 Essex St., Swam.
Moulton, Robert Selden, B.S.	II.	*Poughkeepsie, N. Y.*	262 Newbury St., B.
Mulliken, Robert Sanderson	V.	*Newburyport*	Technology Dormitory, C.
Newell, Willard Bigelow	II.	*West Newton*	803 Watertown St., W. N.
Niles, Alfred Salem, A.B.	I.	*Baltimore, Md.*	259 Newbury St., B.
Noyes, Linwood Irving	IV.	*Marinette, Wis.*	4 Ames St., C.
O'Brien, James Sherry	X–A.	*Winthrop*	78 Washington Ave., Win.
O'Brien, Thomas Francis	II.	*Dorchester*	9 Hinckley St., D.
Panettiere, Vincent	II.	*Baltimore, Md.*	Technology Dormitory, C.
Parker, Dean Huntington	X–A.	*Brooklyn, N. Y.*	200 Bay State Rd., B.
Parker, Henry Godwin, A.B.	VII.	*Portsmouth, Va.*	1026 Com'w'lth Ave., Br.
Paul, Arthur Hiram, Jr.	I.	*Wakefield, N. H.*	Technology Dormitory, C.
Payne, Edward Benedict	VI.	*Nashville, Tenn.*	366 Harvard St., C.
Peacock, Frank Edward	I.	*Rockford, Ill.*	200 Bay State Rd., B.
Peterson, Oscar Rudolph	I.	*Dorchester*	16 Playstead Rd., D.
Phillips, Luther Savage	IV.	*Asticou, Me.*	237 Beacon St., B.
Pierce, Alfred	I.	*Attleboro*	Technology Dormitory, C.
Pierce, David Eugene, Ph.D.	X–A.	*West Middlesex, Pa.*	47 Rutland Sq., B.
Pollard, Edward Vaughn	II.	*Lynn*	9 Grover St., L.
Pouchain, René Augustin	VII.	*Marblehead*	34 Pond St., Marb.
Powers, Harold Frederick Lawrence	II.	Campello	15 Vancouver St., B.

FOURTH YEAR (*continued*)

NAME	COURSE	HOME	RESIDENCE
Proctor, Charles Dix	II.	*Detroit, Mich.*	517 Beacon St., B.
Proctor, Harold Eugene	VI.	*Watertown*	25 Chester St., Wat.
Proctor, Joseph Worthen	II.	*Watertown*	57 Langdon Ave., Wat.
Pryor, Willard Latourette	II.	*Rochester, N. Y.*	327 Huntington Ave., B.
Ramsbottom, John Raymond	VI.	*Fall River*	200 Bay State Rd., B.
Raymond, Edward Hayward	I.	*Roxbury*	237 Beacon St., B.
Reynolds, Edwin Drew	VII.	*Danvers*	4 Warren Ave., Dan.
Rizzo, Francesco Salvatore	II.	*Albi, Italy*	Y.M.C.A., Somerville
Roberts, Claudius Henry Mastin	XIV.	*Washington, D. C.*	526 Beacon St., B.
Robertson, Stanley Stuart	X–A.	*Framingham*	Technology Dormitory, C.
Robinson, Russell King, A.B.	I.	*Ashtabula, O.*	491 Commonwealth Ave., B.
Rogers, Frank Claxton	I.	*Waterbury, Conn.*	Technology Dormitory, C.
Rogers, Herman Livingston, A.B.	I.	*Hyde Park-on-Hudson, N. Y.*	5 Story St., C.
Roper, George, Jr.	III.	*Steubenville, O.*	44 The Fenway, B.
Ross, Charles Everett	VI.	*Watertown*	86 Fayette St., Wat.
Ross, Ralph Hersey	VI.	*St. Johnsbury, Vt.*	493 Commonwealth Ave., B.
Ross, William Byron, B.Sc.	X–A.	*Uhrichsville, O.*	47 Rutland Sq., B.
Rowe, Philip Nicholas	III.	*Somerville*	52 Boston St., Som.
Rowlett, Richard Stewart	II.	*Brookline*	4 Ames St., C.
Roy, George Louis	IV.	*Springfield*	5 Idlewild St., A.
Ryan, Thomas William, Jr.	I.	*Concord Junction*	365 Main St., Con. Jct.
Sanchez, Federico Guillermo	II.	*Santa Lucia, Cuba*	28 Westland Ave., B.
Sawyer, Ralph Henry	II.	*Framingham*	24 Clinton St., Fram.
Scannell, Robert Henry, Litt.B.	IV.	*Cambridge*	Felton Hall, C.
Schlaffhorst, Harold Anderson	X.	*Cambridge*	96 Ellery St., C.
Schoonmaker, Lucas Elmendorf	VI.	*Orange, N. J.*	366 Harvard St., C.
Searles, Thomas Mount, U.S.N., S.B.	XIII–A.	*Allston*	1384 Com'w'lth Ave., A.
Senter, Erasmus Gilbert, Jr.	XV.	*Dallas, Tex.*	512 Com'w'lth Ave., B.
Sewall, Edward Dennis	II.	*Waltham*	222 Bacon St., Wal.
Seymour, William Henry	II.	*Brookline*	1213 Beacon St., Br.
Shand, Robert Gordon	XV.	*Lynn*	14 Mace Place, L.
Siegel, Samuel	X.	*Chelsea*	278 Chestnut St., Ch.
Small, Frank Sylvester	III.	*East Boston*	149 Lexington St., E. B.
Smith, Carroll Cummings	III.	*Barre, Vt.*	Technology Dormitory, C.
Smith, Winfred Wenner, S.B.	VI.	*Lehighton, Pa.*	Technology Dormitory, C.
Solakian, Haig Nerses, B.A.	III.	*Kilis, Turkey*	602 Tremont St., B.
Stahl, Theodore Erasmus	XIII.	*Naugatuck, Conn.*	Technology Dormitory, C.
Stearns, Frederick Arlington	II.	*Melrose*	Technology Dormitory, C.
Stebbins, George Hobart	XIII.	*Fall River*	7 Blackwood St., B.
Stevens, George Radcliffe	VI.	*Brookline*	Technology Dormitory, C.
Stevens, Raymond Sawtell	XV.	*Nashua, N. H.*	512 Commonwealth Ave., B.
Stockmann, Erling Brynjulf	XV.	*Milton*	300 Central Ave., Mil.
Storrow, James Jackson, Jr., A.B.	VI.	*Lincoln*	265 Clarendon St., B.
Strong, Walter Burroughs	VI.	*Goshen, N. Y.*	517 Beacon St., B.
Strout, Henry Elmer, Jr.	XV.	*Roxbury*	11 Westerly St., R.
Sullivan, Alan Porter	XIV.	*Terryville, Conn.*	512 Commonwealth Ave., B.
Sullivan, William Aloysius	IV.	*Lawrence*	160 So. Broadway, Law.

FOURTH YEAR (*continued*)

NAME	COURSE	HOME	RESIDENCE
Sung, Chien Hsün, B. Mar. Eng.	XIII–B.	*Hinghua, China*	146 Austin St., C.
Swan, LeRoy Amos	II.	*Norwich, Conn.*	484 Beacon St., B.
Sylvander, Roy Cornelius [4]	II.	*Taunton*	277 Winthrop St., T.
Tapley, Warren Leonard	XV.	*Newtonville*	308 Cabot St., Nv.
Tarpley, Donald Greene	IV.	*Portland, Ore.*	104 Charles River Rd., C.
Thomas, Francis Elliott, S.B.	I.	*Bellefonte, Pa.*	Technology Dormitory, C.
Thomson, Gerald Whaley	I.	*Cambridge*	14 Center St., C.
Thrasher, William Erland	XI.	*Roslindale*	5 Ainsworth St., Ros.
Tierney, Harold Joseph	VI.	*Roxbury*	42 Round Hill St., R.
Toole, Harry Sylvester	XV.	*Cambridge*	298 Harvard St., C.
Tu, Hin Yung	XIII–B.	*Canton, China*	416 Newbury St., B.
Tutein, Dexter Arthur	X–A.	*Winchester*	53 Wildwood St., Winc.
Tuttle, William Fletcher	XI.	*Arlington*	11 Pelham Terr., Arl.
Twomey, Edward Francis	XI.	*Lynn*	66 Rockaway St., L.
Tyler, John Cowperthwaite, A.B.	II.	*Brooklyn, N. Y.*	Bromley Ct., C.
Waechter, Illés Edmund	III.	*Cleveland, O.*	820 Mass. Ave., C.
Waite, David Everett	V.	*Worcester*	Technology Dormitory, C.
Wallis, James Erastus, Jr.	XV.	*Cambridge*	11 Bigelow St., C.
Wang, Hsi Chang	III.	*Foochow, China*	Technology Dormitory, C.
Warner, Edward Pearson, A.B.	II.	*Concord*	47 Matthews Hall, C.
Watson, Philip Bickford	X–A.	*Brighton*	1872 Com'w'lth Ave., Bri.
Webber, Porter Clifton	XI.	*Milford*	171 Main St., Milf.
Wells, Benjamin Slocum	I.	*Dorchester*	44 Tuttle St., D.
Wells, Burling Dinant	II.	*Danbury, Conn.*	Technology Dormitory, C.
Wells, Everett Deane, B.S.	XV.	*Nashua, Ia.*	820 Massachusetts Ave., C.
Wenzel, Adolphe Helck	VI.	*Middletown, N. Y.*	491 Commonwealth Ave., B.
Westbrook, Leon Russell	V.	*Haverhill*	Technology Dormitory, C.
Weston, Timothy Herbert	I.	*Broad Cove, Me.*	177 Hancock St., C.
Wheatley, Russell Holbrook	XIV.	*North Abington*	North Abington
Wheeler, Evan Rupert, B.S., A.M.	VI.	*Waterville, Me.*	45 St. Botolph St., B.
Whitman, Walter Gordon	X–A.	*Winthrop*	364 Winthrop St., Win.
Whitney, Richard Thompson	XI.	*Glassboro, N. J.*	491 Commonwealth Ave., B.
Williams, Allison Ridley	VI.	*Yazoo City, Miss.*	572 East Broadway, S. B.
Williamson, Herbert Charles	IV.	*Rochester, N. Y.*	327 Huntington Ave., B.
Wilson, Dustin Whittier	V.	*Dover, Me.*	Technology Dormitory, C.
Wood, Walter Albert	XV.	*Concord*	484 Beacon St., B.
Woodward, Edwin Mortimer	IV.	*Odin, Ill.*	4 Ames St., C.
Woodward, Paul Gilbert	X–A.	*Washington, D. C.*	179 Bay State Rd., B.
Wu, Tai Ming	XIII–B.	*Canton, China*	416 Newbury St., B.
Yeaton, Philip Osborne, S.B.	II.	*Portsmouth, N. H.*	820 Massachusetts Ave., C.
Yeh, Chi Foo	XIII–B.	*Canton, China*	416 Newbury St., B.
Young, Irving Walker, Jr.	XV.	*Cambridge*	334 Harvard St., C.

THIRD YEAR

NAME	COURSE	HOME	RESIDENCE
Abrams, John McClelland, B.S.	X.	*Butler, Pa.*	491 Commonwealth Ave., B.
Adams, Myron Whitlock, A.B.	VI.	*West Roxbury*	4 Rutledge St., W. R.
Ahearn, William Joseph	II.	*Taunton, Mass.*	80 Foster St., Ev.
Allen, Howard Brigham	VI.	*Mexico City, Mex.*	526 Beacon St., B.

THIRD YEAR (*continued*)

NAME	COURSE	HOME	RESIDENCE
Allen, Lawrence James	II.	*Waltham*	238 Bacon St., Wal.
Alvaré, Nemesio Faustino, B.S.	II.	*Sagua la Grande, Cuba*	Technology Dormitory, C.
Atwell, Harold Vivian	XIV.	*Hopedale*	124 Cypress St., Wat.
Baber, Malcolm Johns, A.B.	XIII.	*Pottsville, Pa.*	820 Massachusetts Ave., C.
Baker, Arthur DeWint	V.	*Brooklyn, N. Y.*	4 Ames St., C.
Baker, Robert Nicholson Scott U.S.N.	XIII–A.	*Washington, D. C.*	48 Boylston St., C.
Ballantine, Benjamin Darling	II.	*Dorchester*	490 Columbia Rd., D.
Balyozian, Jacob Joseph	XIV.	*Mattapan*	655 Morton St., Mat.
Bancker, Elbert Hyatt, A.B.	VI.	*Brooklyn, N. Y.*	6 Westmorly Ct., C.
Barber, Henry Miller	XI.	*Beaver Falls, Pa.*	20 Leonard St., W. Som.
Barron, Samuel	X.	*Roxbury*	66 Clifford St., R.
Battis, Joseph Talmage Woodruff	II.	*Danvers*	428 Charles River Rd., C.
Beattie, Challen Morton	II.	*Quincy*	Technology Dormitory, C.
Beaver, Rudolf	I.	*Budapest, Hungary*	Technology Dormitory, C.
Bellis, Clifford Brown	X.	*Waltham*	11 Tolman St., Wal.
Benitez, Eduardo Dehesa	II.	*Oaxaca, Mex.*	580 Commonwealth Ave., B.
Berman, Eli	VI.	*Fitchburg*	27 Lynde St., B.
Biggar, Walter Thomas	I.	*Dorchester*	18 Windermere Rd., D.
Blaisdell, Sidney Briggs	II.	*Providence, R. I.*	164 Strathmore Rd., Bri.
Blanchard, Carleton Woodman	XV.	*Abington*	512 Commonwealth Ave.
Blanchfield, Paul Edward	X.	*Chicopee*	422 Mass. Ave., B.
Blank, Henry Millet	XV.	*Glen Ridge, N. J.*	4 Ames St., C.
Blodgett, Leo Stanislaus	XIII.	*Portland, Me.*	Technology Dormitory, C.
Boghossian, Aram	I.	*New York, N. Y.*	44 Magazine St., C.
Boice, Frank Seymour, A.B.	II, VI.	*Pasadena, Cal.*	Walter Hastings Hall, C.
Boyd, Stuart MacLeod	X.	*Malden*	67 Converse Ave., Mal.
Bradley, Donald George	IV.	*Edmonton, Alberta*	491 Commonwealth Ave., B.
Braislin, John Cameron	XIII.	*Brooklyn, N. Y.*	237 Beacon St., B.
Brewer, George Selden, A.B.	X.	*Westfield, N. Y.*	512 Commonwealth Ave., B.
Bridgwater, Ernest Reuben	X.	*Cuyahoga Falls, O.*	Technology Dormitory, C.
Brosnahan, Thomas Vincent	XV.	*Cambridge*	32 Locke St., C.
Browne, Donald	VIII.	*Malden*	31 Wolcott St., Mal.
Buchanan, Douglas Riley	XIII.	*Lowell*	Technology Dormitory, C.
Buerkin, Julius Amor	IV.	*Quincy, Ill.*	491 Commonwealth Ave., B.
Bugbee, James Marion	III.	*Boston*	1091 Boylston St., B.
Burke, Arthur Edward	VII.	*Watertown*	76 Spruce St., Wat.
Burke, Francis Carroll	IV.	*Watertown*	76 Spruce St., Wat.
Bushee, Ralph John	XI.	*Newburyport*	31 Kelley St., Np.
Butterfield, Frederick Haines, B.S.	XV.	*Sioux City, Ia.*	820 Massachusetts Ave., C.
Caird, Alexander Winton	I.	*Northampton*	316 Huntington Ave., B.
Caldwell, Stuart Hill	II.	*Newton Center*	14 Oxford Rd., N. C.
Cannon, Georgius Young	IV.	*Salt Lake City, Utah*	336 Commonwealth Ave., B.
Carr, Percy Wolcott	X.	*Lawrence*	237 Beacon St., B.
Carter, Edward Sterling, A.B.	II.	*Washington, Conn.*	81 Garfield St., C.
Cary, Frank Wing, S.B.	II.	*Baltimore, Md.*	Drayton Hall, C.
Caust, Morris Leonard	XIV.	*Boston*	34 Genesee St., B.
Chamberlain, Samuel Harrison, Jr.	II.	*Boston*	114 The Fenway, B.
Chang, Jeean Tsolin, B.A.	III.	*Changli, China*	360 Harvard St., C.
Chiu, Wei Yü, B.Sc.	VI.	*Wusih, China*	1091 Boylston St., B.

THIRD YEAR (*continued*)

NAME	COURSE	HOME	RESIDENCE
Church, Vallette Stuart, A.B.	VI.	*Washington, Conn.*	9 Hampden Hall, C.
Clark, Donald Simonton	VI.	*Belfast, Me.*	219 Harvard Ave., A.
Clark, John Alston	II.	*Clarksdale, Miss.*	1067 Beacon St., Br.
Cleveland, Byron Redmond	II.	*Lawrence*	33 Farnham St., Law.
Clogher, Eaton James	VI.	*Dorchester*	8 Nottingham St., D.
Cochrane, Edward Lull, U.S.N.	XIII-A	*Cambridge*	305 Burton Halls, C.
Collins, Earl Preston	X.	*Cambridge*	973 Massachusetts Ave., C.
Collins, Harold Ebert	XV.	*Newton Highlands*	44 Carver Rd., N. H.
Collins, William Lovejoy	VI.	*Newton Highlands*	44 Carver Rd., N. H.
Conner, Lester Carlton	X.	*Malden*	72 Medford St., Mal.
Cooper, Stanley Knox	II.	*Malden*	275 Fellsway East, Mal.
Costelloe, William Henry	VI.	*Saginaw, Mich.*	Technology Dormitory, C.
Craighead, Philip Brooks	I.	*Malden*	18 Hancock St., Mal.
Creedon, Frank Riordon	I.	*Brockton*	285 Moraine St., Brock.
Crosby, Ralph Joseph	II.	*Hartford, Conn.*	749 Saratoga St., E. B.
Crotwell, Samuel Philip, Jr., B.S.	VI.	*Newberry, S. C.*	34 Cottage St., C.
Cummings, Stanley Robinson	II.	*Wollaston*	Technology Dormitory, C.
Cyr, Howard Mason	X.	*Malden*	52 High St., Mal.
Dagnall, Clarence Herschel	VI.	*Oak Bluffs*	Technology Dormitory, C.
Dawson, Norman	XI.	*Needham Heights*	314 Webster St., Need. H.
Derrah, Robert Vincent	II.	*Salt Lake City, Utah*	491 Commonwealth Ave., B.
Dinkins, Philip Moss	X.	*Montclair, N. J.*	44 The Fenway, B.
Donnelly, Thomas Joseph, Jr.	I.	*Arlington*	63 Brattle St., Arl.
Donovan, Joseph Augustine	X.	*Cambridge*	9 Greenough Ave., C.
Dow, Charles Warren	V.	*Lynn*	117 Eastern Ave., L.
Dudley, Paul Fenno	VI.	*Milton*	185 School St., Mil.
Eales, Malcolm Alfred Lancelot	VI.	*Melrose*	Technology Dormitory, C.
Earle, Fred Martin, U.S.N.	XIII-A.	*Allston*	1125 Com'w'lth Ave., A.
Eastman, William, Jr.	II.	*Evanston, Ill.*	203 Bay State Rd., B.
Ebert, George L., S.B.	X.	*Beloit, Wis.*	6 Ashton Place, C.
Ekwall, George Olof	X.	*Waltham*	30 Fairmont Ave., Wal.
Ellis, Clarence Meredith, A.B.	IV.	*North Attleboro.*	38 Bennington St., N.
Ellsberg, Edward, U.S.N.	XIII-A.	*Denver, Colo.*	108 Hemenway St., B.
Engelbrecht, Walter Bernard	X.	*Tompkinsville, N. Y.*	108 Hemenway St. B.
Eveleth, Frederic Cooley	I.	*Windsor Locks, Conn.*	308 Newbury St., B.
Evelev, Yale	VI.	*Boston*	21 Middlesex St., B.
Ferrell, Robert White, U.S.N.	XIII-A.	*Richmond, Va.*	Burton Halls, C.
Fiske, Carlyle Darracott	II.	*West Roxbury*	94 Corey St., W. R.
Fitch, Harold Warner	II.	*Dorchester*	46 Pearl St., D.
Fletcher, Saxton Woodbury	II.	*Andover*	491 Commonwealth Ave., B.
Flett, Lawrence Hugo	V.	*Melrose*	154 Youle St., Mel.
Folsom, Rolfe Ames	XIV.	*Malden*	76 Rockland Ave., Mal.
Ford, Karl Leonard	X.	*Salem*	4 Plymouth St., S.
Ford, Wendell Bradford	IV.	*New Bedford*	132 Glenville Ave., A.
Foster, Stephen Merriman, A.B.	VI.	*Derby Line, Vt.*	2 Westmorly Hall, C.
Foster, William Chapman	VI.	*Westfield, N. J.*	493 Commonwealth Ave., B.
Franklin, Stanley Hamilton	X.	*Providence, R. I.*	Technology Dormitory, C.
Frazier, Walter Stephen, Jr.	IV.	*Aurora, Ill.*	4 Ames St., C.
Friery, John Wetherell	I.	*Jamaica Plain*	169 Chestnut Ave., J. P.

THIRD YEAR (*continued*)

NAME	COURSE	HOME	RESIDENCE
Fuller, Clarence Chisholm	XIV.	*Mansfield*	50 High St., Mans.
Fuller, John Ransom	XIV.	*Canaan, Conn.*	200 Bay State Rd., B.
Gaillac, Emile Bertrand	II.	*Chelsea*	113 Blossom St., Ch.
Garza, Roberto	XV.	*Monterey, Mex.*	8 St. Botolph St., B.
Gelinas, Maurice Edward	VI.	*Lowell*	666 Merrimack St., Low.
Giuranovich, Arthur Joseph, Jr.	I.	*Boston*	471 Columbus Ave , B.
Goodman, Aaron	VI.	*Boston*	106 Union Park St., B.
Goodwin, Thomas Laurence, Jr.	II.	*Newton Highlands*	916 Beacon St., B.
Goss, Donald Chapin	IV.	*Lynn*	39 Deer Cove, L.
Gray, Charles Harry Grace	VI.	*Dorchester*	36 Alpha Rd., D.
Gray, William Ayres, Jr.	III.	*Elizabeth, N. J.*	Technology Dormitory, C.
Greely, Benjamin Morrill, Jr.	X.	*Dorchester*	10 Ainsley St., D.
Greenleaf, Earl Austin	I.	*Woburn*	11 South St., Wo.
Crunsfeld, Ernest Alton, Jr.	IV.	*New York, N. Y.*	137 Newbury St., B.
Guilbert, Horace Moss, A.B.	II.	*Southport, Conn.*	3 Revere St., J. P.
Gustaveson, John Warren	VI.	*Norfolk, Va.*	2 Foster St., Br.
Gustin, Ernest Ellis	II.	*Somerville*	3 Virginia St., Som.
Haertlein, Albert, A.B.	I.	*St. Louis, Mo.*	76 Perkins Hall, C.
Hale, John Isaac, U.S.N.	XIII–A.	*Washington, D. C.*	8 Arlington St., B.
Halfacre, George Frederick	III.	*Boston*	63 St. Germain St., B.
Hamilton, Norman Ray	VIII.	*Cambridge*	43 Upland Rd., C.
Hancock, Grenville Laing	IV.	*Fargo, N. D.*	4 Ames St., C.
Hanley, John Merrill	I.	*Dorchester*	30 Woodford St., D.
Hansberry, Thomas William	I.	*East Milton*	20 Gilmore St., Q.
Harper, Carl Brown, A.B., B.S.	VI.	*Elkins, W. Va.*	1137 Massachusetts Ave., C.
Harrall, Edwin Russell	I.	*Providence, R. I.*	334 Harvard St., C.
Harrington, Elliott Dean, B.S.	VI.	*Elkhorn, Wis.*	308 Newbury St., B.
Hartley, William Elmo, A.B.	X.	*Springfield, Mo.*	770 Massachusetts Ave., C.
Hatch, Herbert Willard	IV.	*Brockton*	7 Berwick Park, B.
Herfurth, Walter Robert	XIII.	*Boston*	70 Batavia St., B.
Holt, Wilfred Reynolds	X.	*East Haven, Conn.*	282 Massachusetts Ave., C.
Hooper, Benjamin Morris	II.	*Wollaston*	112 Beach St., Wol.
Hopkins, Frank Herbert	I.	*Rockland*	85 W. Water St., Roc.
Howard, Alan Frank	XV.	*Woburn*	48 Nashua St., Wo.
Howard, Paul Henry	XV.	*Woburn*	48 Nashua St., Wo.
Howe, Julian Cheever	XV.	*Cohasset*	203 Bay State Rd., B.
Hoye, Stephen Aloysius	XV.	*Dorchester*	1016 Washington St., D.
Hsu, Chuan Yuan	I.	*Peking, China*	316 Huntington Ave., B.
Hsu, Yun-chung	XIV.	*Nanking, China*	57 Westland Ave., B.
Hugo, Ottomar Gay	II, VI.	*San Antonio, Tex.*	334 Harvard St., C.
Hutchings, George Bradfield, Jr.	II.	*Stamford, Conn.*	517 Beacon St., B.
Hutchinson, Edward Howard	IV.	*Brighton*	10 Sparhawk St., Bri.
Imhoff, Willard Earl	II.	*Port Arthur, Tex.*	334 Harvard St., C.
Johnson, Arthur Sanborn	XIV.	*Newburyport*	50 Woodland St., Np.
Johnson, Gardner Endicott	XV.	*Danvers*	179 Bay State Rd., B.
Jones, William Alfred	I.	*Cambridge*	42 Bigelow St., C.
Joslin, Asher Winthrop	I.	*West Roxbury*	134 Stratford St., W. R.
Kaler, Harold Vincent LeRoy	I.	*Sharon*	200 Bay State Rd., B.
Kelley, Joseph Aloysius	X.	*Haverhill*	9 Hawthorne St., Hav.
Kelly, Thomas Patrick	X.	*Jamaica Plain*	15 Pond St., J. P.
Kemkemian, Bedros, B.A.	II.	*Cairo, Egypt*	18 Pearl St., N.

THIRD YEAR (*continued*)

NAME	COURSE	HOME	RESIDENCE
Kennard, John William Bennett	VI.	*Dorchester*	15 Folsom St., D.
Kennedy, Charles Thomas	I, XI.	*Boston*	38 Batavia St., B.
Kiley, John Timothy	VI.	*Somerville*	11 Morton St., Som.
Kilgore, Harold Dustin	I.	*Gloucester*	20 Exchange St., G.
Kleinschmidt, Robert Victor, A.B.	II.	*Johnstown, Pa.*	67 Perkins Hall, C.
Krasnoff, Nathaniel	VI.	*Union, S. C.*	Technology Dormitory, C.
Lacey, Henry Richard	I.	*Somerville*	20 Sargent Ave., Som.
Landis, Maurice Neuman, Ph.B.	III.	*Chicago, Ill.*	225 Newbury St., B.
Lane, Frederic Allen	VI.	*Gloucester*	Technology Dormitory, C.
Larner, Herbert Beamish	VII.	*Cambridge*	948 Massachusetts Ave., C.
Lawrence, Elmer Walcott, B.S.	I.	*Woods Hole*	336 Com'w'lth Ave., B.
Legge, Elmer Earle	II.	*Brockton*	44 The Fenway, B.
Lemp, Boudy	IV.	*Erie, Pa.*	249 Berkeley St., B.
LeVine, Harry Carl	II.	*Melrose*	25 Holbrook Ct., Mel.
Levine, Leonard Isaac	II.	*Dorchester*	5 Nottingham St., D.
Lindgren, Carl Alfon, Jr.	VI.	*Hathorne*	Hathorne.
Linscott, Chester Earl	V.	*Roxbury*	479 Dudley St., R.
Little, Edward Norton, A.B.	VI.	*Peoria, Ill.*	Technology Dormitory, C.
Lobos, Francisco	IV.	*Santiago, Chile*	20 Park St., Br.
Long, Francis Leroy	II.	*Lawrence*	28 Union St., Law.
Longley, James Edward	I.	*Kalamazoo, Mich.*	Technology Dormitory, C.
Longley, John Robert	I.	*Kalamazoo, Mich.*	Technology Dormitory, C.
Lord, William Mason Bradley, A.B.	XV.	*Jamaica Plain*	49 Pond St., J. P.
Lorenz, Otto Carl	IV.	*Scranton, Pa.*	237 Beacon St., B.
Lufkin, Olvin Garland	XV.	*Arlington*	17 Trowbridge St., Arl.
McAllister, Paul	XIV.	*Auburndale*	94 Central St., Aub.
MacArdle, Donald Wales	V.	*Roslindale*	27 Sherwood St., Ros.
McDill, Bruce Magaw, A.B.	XI.	*Oxford, Ohio*	543 Boylston St., B.
McDonald, Raymond Emmet	X.	*Natick*	13 Grant St., Na.
MacGregory, Sherman Albert	I.	*Brockton*	51 Silver Rd., Brock.
McGuigan, Joseph Loyd, U.S.N.	XIII–A.	*Washington, D. C.*	Hotel Canterbury, B.
McIntire, Ralph Davis, S.B., S.M.	V.	*Manchester, O.*	34 William St., C.
McIvor, Carlisle Chandler	VI.	*Brookline*	15 Euston St., Br.
McLaughlin, Carl Patrick	II.	*Portland, Me.*	80 Hammond St., C.
McLaughlin, George Edward	II.	*Brookline*	112 Davis Ave., Br.
McLaughlin, Harold Clarke, A.B.	IV.	*Sedalia, Mo.*	94 St. Botolph St., B.
McLaughlin, Richard Joseph	XV.	*Boston*	526 Beacon St., B.
MacLeod, William Rodney	XV.	*Lowell*	44 Swan Ave., Low.
McNally, Edwin Mongan	II, VI.	*Chelsea*	140 Clark Ave., Ch.
Magoun, Frederick Alexander	II.	*Cambridge*	70 Kirkland St., C.
Mahony, Ralph Gerard	II.	*Sterling*	3 Summer St., C.
Malley, George Francis	I.	*Adams*	Technology Dormitory, C.
Mann, Samuel	VI.	*Plainfield, N. J.*	209 Massachusetts Ave., C.
Manning, George Charles, U.S.N.	XIII–A.	*Washington, D. C.*	640 Huntington Ave., B.
Manter, Elwood McElwain	II.	*Auburndale*	69 Oak Sq. Ave., Bri.
Marron, Adrian Raphael, U.S.N.	XIII–A.	*Washington, D. C.*	352 Harvard St., C.
Marshall, Lawrence Parsons	XV.	*Everett*	71 Summer St., Ev.

THIRD YEAR (*continued*)

NAME	COURSE	HOME	RESIDENCE
Marshall, Leslie Howard	X.	*Waltham*	298 Crescent St., Wal.
Merrill, Donald Godfrey	II.	*Taunton*	27 Ingall St., T.
Miao, En-chao	I.	*Kiangsŭ, China*	282 Massachusetts Ave., C.
Miller, Alan Baldwin	XIV.	*Elizabeth, N. J.*	512 Commonwealth Ave., B.
Miller, Raymond Percy	II.	*Swampscott*	76 Middlesex Ave., Swam.
Moffatt, Edward Hopkins	VI.	*Cambridge*	50 Massachusetts Ave., C.
Moore, Walter Allan, Jr., B.S.	IV.	*Charleston, S. C.*	17 Ivy St., B.
Mullowney, John Mansfield	VI.	*Brookline*	298 Boylston St., Br.
Mumford, Albert Russell	XIV.	*Boston*	827 Boylston St., B.
Murray, George Sutherland	XIII.	*Milton*	12 Spofford Rd., Mil.
Nelson, Gordon Whymper, U.S.N.	XIII–A.	*New York, N. Y.*	Canterbury Hotel, B.
Nelson, William, U.S.N.	XIII–A.	*Washington, D. C.*	Canterbury Hotel, B.
Neuberg, William Doyé	X.	*Westwood, N. J.*	Technology Dormitory, C.
Newton, Edwin Meade	VI.	*Boston*	484 Beacon St., B.
Nichols, Hall, A.B.	I.	*Boston*	294 Marlborough St., B.
Norton, Frederick Harwood	VIII.	*Boston*	39 Chestnut St., B.
Norton, John Torrey	VIII.	*Boston*	39 Chestnut St., B.
Nute, Alden Davis	X.	*Fall River*	76 St. James Ave., B.
O'Daly, Bernard	X.	*Dorchester*	11 Stockton St., D.
Olson, Frank	VI.	*Arlington*	35 Cleveland St., Arl.
Palmer, Gretchen Abigail	V.	*Cambridge*	131 Magazine St., C.
Parker, John Acton	VI.	*Somerville*	246 Broadway, Som.
Parsons, John Langdon	V.	*Rye, N. H.*	512 Commonwealth Ave., B.
Pasos-Diaz, José	I.	*Boston*	497 Huntington Ave., B.
Pearson, Frank Cogswell	II.	*Keene, N. H.*	1395 Com'w'lth Ave., A.
Peers, Frank Wagner, A.B.	IV.	*Topeka, Kansas*	316 Huntington Ave., B.
Pelton, Fred Earl, U.S.N.	XIII–A.	*Washington, D. C.*	50 Massachusetts Ave., C.
Peña-Polo, Jorge, A.B.	I.	*Bogota, Colombia, S.A.*	86 St. James Ave., B.
Philbrick, Frederick Brueton	VI.	*South Weymouth*	432 Marlborough St., B.
Pinkerton, Henry	VII.	*Randolph*	49 Hemenway St., B.
Pinkham, Bernard Orville	II.	*Roxbury*	33 Wabon St., R.
Pope, Arthur Wilson, Jr.	II.	*Geneva, Ill.*	428 Charles River Rd., C.
Porter, Garnett Hartle	X.	*Cambridge*	15 Pleasant Pl., C.
Pote, Kenneth Edwin, S.B.	II.	*Westfield, N. J.*	31 Holyoke St., C.
Purves, John Coleman	I.	*Philadelphia, Pa.*	428 Charles River Rd., C.
Putnam, John Pickering, Jr., A.B.	II.	*Boston*	535 Beacon St., B.
Read, Clifford Sheldon	II.	*Cambridge*	32 Lee St., C.
Reed, Howard Finley, B.A.	II.	*Roxbury, O.*	33 Mellen St., C.
Reid, Kenneth	IV.	*Dorchester*	15 Chase St., D.
Richards, Clarence Carl, Jr., B.Ph.	IV.	*Columbus, O.*	11 Newbury St., B.
Richards, Henry Edward	VI.	*Lynnfield Center*	Lynnfield Center
Rimbach, Richard	I, XI.	*New York, N. Y.*	Technology Dormitory, C.
Robertson, Walter Harrison	I.	*Dorchester*	56 Wellesley Park, D.
Rollins, Wingate, A.B.	XV.	*Hingham*	42 Dunster Hall, C.
Roper, Kenyon	IV.	*Steubenville, O.*	44 The Fenway, B.
Rossman, Edwin Forrest	II, VI.	*St. Louis, Mo.*	179 Bay State Rd., B.
Rounds, Edward Wadsworth	II, VI.	*Tacoma, Wash.*	512 Commonwealth Ave., B.
Rowe, James Everett	II.	*Pawtucket, R. I.*	336 Commonwealth Ave., B.
Rowe, Raphael Robinson, A.B.	I.	*Grand Rapids, Mich.*	200 Bay State Rd., B.
Royce, Donald, U.S.N.	XIII–A.	*Washington, D. C.*	352 Harvard St., C.

THIRD YEAR (*continued*)

NAME	COURSE	HOME	RESIDENCE
Rubin, David Nathan	I.	*Holyoke*	290 Massachusetts Ave., C.
Russell, Arthur Litchfield	VI.	*Roxbury*	57 Circuit St., R.
Ryan, William Patrick	X.	*West Medway*	45 Pemberton St., C.
Sackett, George Arthur	X.	*Revere*	45 Barrett St., Rev.
Salah, John Suleiman, A.B.	II.	*Ram Allah, Palestine, Turkey*	14 Westland Ave., B.
Sanborn, Lewis Parker	X.	*East Saugus*	62 Lincoln Ave., E. Saugus
Sanger, Alan Bridgeman	III.	*Dorchester*	Technology Dormitory, C.
Saunders, Albert	II.	*Malden*	10 Henry St., Mal.
Sawyer, Enos Clifford	VI.	*Cambridge*	7 Clinton St., C.
Scott, Warren Joseph	XI.	*Cambridge*	1423 Cambridge St., C.
Seltzer, Max	X.	*Lexington*	495 MassachusettsAve., Lex.
Shirer, Hampton Francis, A.B.	IV.	*Topeka, Kansas*	316 Huntington Ave., B.
Sibley, Dean Sheridan	II.	*North Newport, N. H.*	283 Newbury St., B.
Sih, Tse-sing, B.Sc.	I.	*Shanghai, China*	1091 Boylston St., B.
Simpson, Roy Merton	II.	*Somerville*	19 Walker St., Som.
Smith, Arthur	X.	*Port Chester, N. Y.*	205 West Newton St., B.
Smith, Granville Byam	VI.	*Glen Rock, N. J.*	493 Commonwealth Ave., B.
Smith, Raymond Slack	I.	*Freehold, N. J.*	200 Bay State Rd., B.
Smith, Richard Harbert, B.S.	XV.	*Dillsboro, Ind.*	82 Gainsborough St., B.
Spear, George Dana	VI.	*Walpole*	32 Common St., Walp.
Starr, Daniel Laurence	XI.	*Danbury, Conn*	55 Sacramento St., C.
Steere, John Averill	I.	*Los Angeles, Cal.*	1469 Beacon St., Br.
Sterner, Harold	IV.	*New York, N. Y.*	428 Charles River Rd., C.
Stockman, Charles Currier, 2d.	VII.	*Newburyport*	153 High St., Np.
Strang, Peter MacDonald	XV.	*Auburndale*	348 Central St., Aub.
Sturtevant, Harold Vaughan	II.	*Lynn*	Technology Dormitory, C.
Swan, Horace Gilbert, B.S.	X.	*Rochester, N. Y.*	34 Massachusetts Ave., C.
Thomas, George Washington	I.	*Lowell*	40 West Sixth St., Low.
Tovey, Henry Oliver, U.S.N.	XIII–A.	*Watseka, Ill.*	Hotel Canterbury, B.
Tucker, Carlton Everett	VI.	*Whitman*	136 School St., Whit.
Turner, William Hugh	III.	*Hyde Park*	Technology Dormitory, C.
Uebelacker, Armin Adams, B.S.	VI.	*Hackensack, N. J.*	Technology Dormitory, C.
Underwood, Harold Ray	II.	*Marblehead*	Endicott Ave., Marb.
Van Kirk, Robert Woods, Jr.	X.	*Chicago, Ill.*	237 Beacon St., B.
Vought, Alfred Benedict	II.	*Rutherford, N. J.*	53 St. Stephen St., B.
Walker, Sibyl	XII.	*Salt Lake City, Utah*	14 Browne St., Br.
Want, Cullen Henery, U.S.N.	XIII–A.	*Waskington, D. C.*	14 Center St., C.
Warner, Donald Dann	XV.	*Allston*	1251 Com'w'lth Ave., A.
Weber, Harold Christian	X.	*Milton*	160 Brook Road, Mil.
Wells, Franklin Henry	II.	*Winthrop*	60 Sea View Ave., Win.
Whitcomb, Ralph Leslie	II.	*Sharon*	So. Main St., Sharon.
White, Frederick William, Jr.	XV.	*West Hartford, Conn.*	4 Ames St., C.
Whitmore, John Thoreau	IV.	*Brookline*	37 Chestnut St., Br.
Whorf, Benjamin Lee	X.	*Winthrop*	94 Somerset Ave., Win.
Wiley, Sumner Kennard	IV.	*Winter Hill*	25 Fenwick St., W. H.
Wilkins, Richard Alfred	X.	*Brookline*	97 St. Paul St., Br.
Williams, John Albert	IV.	*Baltimore, Md.*	104 Charles River Rd., C.
Wills, Royal Barry	IV.	*Melrose*	Oakland St., Mel.
Wilson, Walter Chadbourne	XV.	*Lowell*	34 Thirteenth St., Low.
Windle, Arthur Elmer	II.	*Montello*	104 St. Botolph St., B.

THIRD YEAR (*continued*)

NAME	COURSE	HOME	RESIDENCE
Wirt, Harrison Loring	XIII.	*Brookline*	Technology Dormitory, C.
Wong, Zeng-Tse	II, VI.	*Shanghai, China*	1075 Boylston St., B.
Woodland, Lester Northrup	IV.	*Melrose H'l'ds*	204 Franklin St., Mel. H.
Wright, Theodore Paul, B.S.	IV.	*Cambridge*	72 Fayerweather St., C.
Wrigley, Paul Pickering, B.A.	VI.	*Brooklyn, N. Y.*	Technology Dormitory, C.
Wu, Ching Lieh	X.	*Chekiang, China*	362 Harvard St., C.
Wyer, William, A.B.	XV.	*Albany, N. Y.*	Technology Dormitory, C.
Wyman, Louis Ernst	XI.	*Cambridge*	55 Magazine St., C.
Young, Ira Randolph	II.	*Waverley*	74 Agassiz Ave., Wav.

SECOND YEAR

NAME	COURSE	HOME	RESIDENCE
Adams, Edmund Chancey	VI.	*Cambridge*	290 Massachusetts Ave., C.
Adams, Franklin Stanley	VI.	*Stockbridge*	393 Broadway, C.
Ames, Aubrey Payson	XV.	*Camden, Me.*	129 Pembroke St., B.
Ames, Percy Davis	II.	*Chelsea*	34 Tudor St., Ch.
Anderson, Edward Clifford	XV.	*Richmond, Va.*	428 Charles River Rd., C.
Baker, Frederic Alson	VI.	*Rockland*	215 Market St., Roc.
Balfour, Marshall Coulter	VII.	*Marlboro*	237 Beacon St., B.
Banks, William Howard, Jr.	VI.	*Roslindale*	336 Commonwealth Ave., B.
Barney, Frederick Waldo	II.	*Providence, R. I.*	104 Charles River Rd.
Bartlett, Ray Hayward	XIII.	*Lowell*	370 Beacon St., Low.
Bates, Clarence Westinghouse	XIV.	*Medford*	14 Paris St., Med.
Beaulieu, Leo Edward	VI.	*Holyoke*	24 Belvidere St., B.
Beckett, Minor Millikin	X.	*Hamilton, O.*	4 Ames St., C.
Beéche, George Augustus, B.M.	III.	*Santiago, Chile*	Technology Dormitory, C.
Beers, Gilbert Francis	I.	*Taunton*	517 Beacon St., B.
Bennett, William Francis, Jr.	VI.	*Somerville*	24 Spring St., Som.
Bent, Roderic Leslie	II.	*Gardner*	526 Beacon St., B.
Berkowitz, Morris	II.	*Roxbury*	2 Hutchings St., R.
Besa-Montt, Hernán	VI.	*Santiago, Chile*	Technology Dormitory, C.
Best, Herbert Walter	XV.	*New York, N. Y.*	493 Commonwealth Ave., B.
Blumberg, Henry Bernard	II.	*Roxbury*	64 Brunswick St., R.
Blye, Paul Woodbury	VI.	*Haverhill*	460 Water St., Hav.
Bolan, Robert Stuart	X.	*Dorchester*	19 Stonehurst St., D.
Bond, George Raynolds, Jr.	X.	*Springfield*	237 Beacon St., B.
Bonnell, Willard Everett	III.	*Hyde Park*	11 Walter St., H. P.
Braaten, Ingvald Theodore, B.A.	VI.	*Northfield, Minn.*	195 Auburn St., C.
Breed, Stanton Holway	II.	*Worcester*	200 Bay State Rd., B.
Brennan, Céleste Johnson	VII.	*Boston*	Hotel Westminster, B.
Bristol, Benjamin Hiel, 2d	II.	*Foxboro*	916 Beacon St., B.
Brito, Evelio	VI.	*Havana, Cuba*	Technology Dormitory, C.
Brown, Daniel Hyman	X.	*Lawrence*	34 McLean St., B.
Brown, Malcolm Cotton	XIV.	*Hinsdale, Ill.*	491 Commonwealth Ave., B.
Brown, Philip Renwick, B.S.	I.	*San Diego, Cal.*	316 Huntington Ave., B.
Brunelle, Samuel Albert	IV.	*Holyoke*	120 Huntington Ave., B.
Burbank, Royden Lyman	X.	*Somerville*	39 Tennyson St., Som.
Burbank, Wilbur Swett	III.	*Amesbury*	10 Oxford St., C.

SECOND YEAR (*continued*)

NAME	COURSE	HOME	RESIDENCE
Burckett, Douglas Mellen	VI.	*Somerville, N. J.*	160 St. Botolph St., B.
Camp, Harry Upson	VI.	*Newton Upper Falls*	28 Richardson Rd., N. U. F.
Cann, George William	XIII.	*Lynn*	Kernwood Drive, L.
Cannell, Joseph Elliot	VI.	*Everett*	6 Foster St., Ev.
Canzanelli, Andrew	I.	*Dorchester*	16 Harbor View St., D.
Carter, John Stanley	II.	*Malden*	96a Fairmont St., Mal.
Cartland, Laurence Winslow, B.S.	XV.	*Saco, Me.*	336 Com'w'lth Ave., B.
Cartwright, Ralph Arthur	II.	*Cambridge*	147 Magazine St., C.
Cassidy, Henry Leo	X.	*Holyoke*	24 Westland Ave., B.
Chayne, Charles Augustine	II.	*Harrisburg, Pa.*	283 Newbury St., B.
Clark, Myron Harrison	II.	*Concord*	484 Beacon St., B.
Clark, Waldo Bishop	I.	*West Somerville*	21 Westminster St., W. Som.
Clarkson, Albert Batchelder	XV.	*Newburyport*	Technology Dormitory, C.
Cohen, Bernard Simpson	VII.	*Boston*	30 Eliot St., B.
Contieri, Anthony William	X.	*Cambridge*	17 Holworthy Pl., C.
Cook, Andrew Annan, B.S.	IV.	*Jacksonville, Fla.*	916 Beacon St., B.
Corthell, Huron DeWitt	I.	*Laramie, Wyo.*	99 Norfolk St., C.
Coyne, Francis James	IV.	*Cambridge*	60 Holworthy St., C.
Curran, John Thomas	II.	*Lawrence*	16 Willow St., Law.
Dalton, Laurance Melvin	II.	*Portland, Me.*	491 Commonwealth Ave., B.
Daube, Harold Jack	X.	*Chicago, Ill.*	Technology Dormitory, C.
Davidson, Kenneth Seymour Moorhead	II.	*Buffalo, N. Y.*	4 Ames St., C.
Davidson, Victor	IV.	*Malden*	236 Bryant St., Mal.
Davis, Cutter Pierce	II.	*Dorchester*	71 Waldeck St., D.
Deacon, Edward Francis	IV.	*Detroit, Mich.*	526 Beacon St., B.
Dearden, Raymond Henry	IV.	*Fall River*	76 St. James Ave., B.
Dehon, Theodore, Jr.	VI.	*Spartanburg, S. C.*	428 Newbury St., B.
Denison, Horace Webster	VI.	*Chelsea*	60 Garland St., Ch.
Derby, Henry Staniford	XIV.	*Somerville*	81 Oxford St., Som.
DeSalvo, Leopold	II.	*Dedham*	Fairbanks Park, Ded.
Dias, Moacyr Rodrigues	I.	*Sao Paulo, Brazil*	Technology Dormitory, C.
Dimmick, Harold Edgerton	X.	*Westfield, N. Y.*	352 Harvard St., C.
Doten, Everett Fitz	II.	*Somerville*	115 Glenwood Rd., Som.
Durland, Robert Walcott	II.	*Lynn*	83 Chestnut St., L.
Edson, Albert Lovell	VI.	*Braintree*	121 St. Stephen St., B.
Elliott, John Telford	VI.	*Newburyport*	18 Washington St., Np.
Everit, Richard Sturtevant	III.	*Barre*	Wellesley Farms.
Farist, Charles Joel	VI.	*Cheshire, Conn.*	203 Bay State Rd., B.
Farrand, Edmund Goldthorpe	VI.	*Penacook, N. H.*	102 Fuller St., Br.
Farrisee, William James	I.	*Cambridge*	817 Somerville Ave., C.
Flewelling, Ralph Carlin, B.S.	IV.	*Cambridge*	399 Broadway, C.
Flynn, Edmund Joseph	X.	*Taunton*	112 Broadway, T.
Ford, Arthur Roland	II.	*Salem*	6 Plymouth St., S.
French, George Franklin	VIII.	*New York, N. Y.*	491 Commonwealth Ave., B.
Gail, George Philip, B.S.	II.	*Roland Park, Md.*	50 Massachusetts Ave., C.
Gaylord, Wynn	XIV.	*Beverly*	34 Baker Ave., Bev.
Gibson, James Wallace	XV.	*West Newton*	484 Beacon St., B.
Gilbert, Ralph Hallett	VI.	*Needham*	709 Webster St., Need.
Given, Frederick James	VI.	*Woburn*	116 Bedford St., Wo.
Goldstein, Louis Julius	XV.	*Hartford, Conn.*	Technology Dormitory, C.

SECOND YEAR (*continued*)

NAME	COURSE	HOME	RESIDENCE
Gomez, Alfonso Javier	X.	*Medellin, Colombia*	432 Marlborough St., B.
Goodridge, Maurice Elmer	XV.	*Melrose*	148 E. Foster St., Mel.
Gould, Joseph Herbert, Jr.	II.	*Dorchester*	15 Bruce St., D.
Griebel, Frederick William	II.	*Somerville*	353 Highland Ave., Som.
Hackett, Robert Prescott	II.	*West Roxbury*	336 Commonwealth Ave., B.
Hall, Daniel Clifton	X.	*Arlington*	62 Fairmont St., Arl.
Hall, Roger Tryon	XI.	*Arlington*	62 Fairmont St., Arl.
Hamilton, Russell	X.	*Brookline*	165 Thorndike St., Br.
Hammond, William Scott	I.	*New Orleans, La.*	14 Garden St., C.
Hannigan, Ralph Joseph	II.	*Brockton*	71 Ellis St., Brock.
Hayes, Stuart Jackson	VII.	*Everett*	95 Bradford St., Ev.
Herrick, Charles Merton	VI.	*Ward Hill*	I St., Ward Hill.
Herzog, Herman Alfred	X.	*Lawrence*	36 Lee St., C.
Hewes, Frederick Roy	I.	*Hyde Park*	1841 Hyde Park Ave., H. P.
Heyman, Samuel	II.	*Detroit, Mich.*	20 Barton St., B.
Higgins, Joseph	II.	*Cambridge*	1 Leonard Ave., C.
Hill, Edmund Walton	II.	*Norwich, Conn.*	512 Com'w'lth Ave., B.
Hirsch, George Berner	II.	*Pittsburgh, Pa.*	18 Inman St., C.
Hoffman, Alfred George	VI.	*Bolton*	1109 Saratoga St., E. B.
Holmgren, Richard Sigfrid	I.	*East Lynn*	184 Harvard St., C.
Holt, James	II.	*South Somerset*	Technology Dormitory, C.
Hopkinson, Frederick James	X.	*Dayton, O.*	1067 Beacon St., Br.
Hough, Alfred William	XIII.	*East Braintree*	152 Hayward St., E. Brain.
Hoyt, Frank Clark	X.	*Chicago, Ill.*	916 Beacon St., B.
Hu, Kuang Piao	VI.	*Tientsin, China*	Technology Dormitory, C.
Huang, Chi Yen	I.	*Canton, China*	Technology Dormitory, C.
Hung, Shao Yu	X.	*Ningpo, China*	137 Massachusetts Ave., C.
Hunt, Reginald Stuart		*Swampscott*	259 Humphrey St., Swam.
Hunter, Frederick Lincoln, Jr.	XIV.	*El Paso, Texas*	261 Newbury St., B.
Hysom, Roscoe Hartwell	VI.	*Cambridge*	23 Bigelow St., C.
Ilsley, Charles Hale	II.	*Melrose Highlands*	42 North Ave., Mel. H.
Inglis, George Andrew	XIII.	*Fall River*	421 Walden St., C.
Ireland, Harold Kent	VII.	*Newburyport*	80 High St., Np.
Irwin, George Alexander	VI.	*Lawrence*	334 Harvard St., C.
Jackson, Leslie Allerton	XI.	*Lawrence*	63 Bigelow St., Law.
Jacobs, Jay Edwin	X.	*Roxbury*	57 Copeland St., R.
Jewett, Harry Parker	XV.	*Plainfield, N. J.*	424 Newbury St., B.
Johns, Alfred Augustus, A.B.	XI.	*Rochester, N. Y.*	366 Harvard St., C.
Jones, Bertram Francis	V.	*Boston*	637 Shawmut Ave., B.
Jones, Ira Payne	II.	*Nashville, Tenn.*	282 Massachusetts Ave., C.
Kahn, George	VII.	*Boston*	117 Chambers St., B.
Kaiser, John Harold	X.	*Marietta, O.*	421 Walden St., C.
Karmire, John Leefers	II.	*Shelbyville, Ind.*	1067 Beacon St., Br.
Kaufman, Joseph	VI.	*Dorchester*	12 Browning Ave., D.
Kaufman, Samuel Albert	X.	*Malden*	34 Newton St., Mal.
Kayser, Wendell Howard	II.	*San Diego, Cal.*	517 Beacon St., B.
Keith, Scott	I.	*Newton Highlands*	20 Hartford St., N. H.
Kelley, Leo Alexis	VI.	*Arlington*	30 Cleveland St., Arl.
Kelsey, Alton Stuart	V.	*Winthrop*	24 James Ave., Win.
Kenison, Arthur Cilley	VI.	*Lexington*	45 Parker St., Lex.
Kenison, Ervin Montague	VI.	*Lexington*	45 Parker St., Lex.

SECOND YEAR (*continued*)

NAME	COURSE	HOME	RESIDENCE
Kilduff, John West	XI.	*Boston*	354 Columbus Ave., B.
Kitchin, Donald Wentworth	V.	*Lawrence*	203 Bay State Rd., B.
Knobel, Max	XIV.	*Walpole*	75 Allen St., Walp.
Krebs, Carlos	XIII–B.	*Jamaica Plain*	31 Robinwood Ave., J. P.
Langley, Harold Edward	I.	*Haverhill*	32 Lorette St., W. Rox.
Lavagnino, John Francis	XV.	*Pasadena, Cal.*	820 Massachusetts Ave., C.
Lawton, Edgar Herbert, A.B.	II.	*Hartsville, S. C.*	258 Newbury St., B.
Leahy, William Joseph	II.	*Randolph*	Main St., Ran.
Lee, Kuangtao Tsufan	XV.	*Shanghai, China*	137 Massachusetts Ave., C.
Lewis, Robert Fairn	III.	*East Lynn*	Technology Dormitory, C.
Litchiser, Robert Reid	I.	*Eaton, O.*	11 Nassau St., B.
Little, William Hobart, A.B.	III.	*Towanda, Pa.*	4 Rutledge St., W. Rox.
Loomis, Phillips Wainwright	VI.	*Plymouth*	33 St. Botolph St., B.
Lundquist, Arthur	XIII.	*Dorchester*	146 Draper St., D.
Luykx, Dirk Jacobus	II.	*Tulsa, Okla.*	1067 Beacon St., Br.
McCarten, George Clyde	X.	*Lancaster, N. H.*	1067 Beacon St., Br.
McCarthy, Edward Benedict	II.	*Scituate*	Willow St., Sc.
McClintic, Howard Hale, Jr.	I.	*Pittsburgh, Pa.*	44 The Fenway, B.
McCloskey, Lawrence Charles	XIV.	*Dorchester Center*	14 Ashmont St., D. Cen.
Mackay, William Roy	VI.	*Boston*	19 Batavia St., B.
McKenney, Walter Raymond	II.	*Bridgeport, Conn.*	57 Hemenway St., B.
McLaughlin, Eugene Reginald	VI.	*Holbrook*	So. Franklin St., Hol.
McMorran, Alexander Morrison	II.	*Oakhill, N. B.*	526 Beacon St., B.
MacMullin, Robert Burns	X.	*New York, N. Y.*	31 Inman St., C.
McNary, Herbert Louis	XV.	*South Boston*	566 Seventh St., S. B.
Magraw, George Frederic	II.	*East Lynn*	56 Goldthwait St., E. L.
Maher, Philip Francis	XIII.	*Dorchester*	9 Argyle St., D.
Martin, George Rainsford	III.	*Rye, N. Y.*	44 The Fenway, B.
Martinez, José Félix, B.A.	I.	*Santa Ana, Salvador*	264 Brookline Ave., B.
Martinez, Marcial Ernesto	III.	*Santiago, Chile*	Technology Dormitory, C.
Martinson, Oscar Sigfrid	I.	*Barre, Vt.*	316 Huntington Ave., B.
May, Elliot Darwin	II.	*Winchendon*	49 Hancock St., C.
Mayer, David Oscar	III.	*New York, N. Y.*	Technology Dormitory, C.
Maynard, Warren Alston	XV.	*Rutherford, N. J.*	334 Harvard St., C.
Mead, Edward Adams	X.	*Arlington*	484 Beacon St., B.
Mead, Francis Leo	X.	*Milford*	43 Jefferson St., Milf.
Means, Robert Snow	I.	*Somerville*	5 Austin St., Som.
Merrill, John Ogden	IV.	*St. Paul, Minn.*	172 Huntington Ave., B.
Michelson, George	VI.	*Roxbury*	80 Holworthy St., R.
Miller, Wesley Barrington	II.	*Freeport, N. Y.*	427 Marlborough St., B.
Miner, Henry Albert	VI.	*Bellows Falls, Vt.*	17 Ivy St., B.
Mirabelli, Eugene	I.	*Dorchester*	20 Pleasant St., D.
Mitchell, Robert Williamson	II.	*Taunton*	15 Prospect St., T.
Moberg, Harold Carl	II.	*Campello*	126 Leyden St., Camp.
Morrill, Harold Bell	XV.	*Roxbury*	19 Highland Ave., R.
Müller, Adolf Lancken	IV.	*Brooklyn, N. Y.*	179 Bay State Rd., B.
Newcomb, Raymond	XV.	*Dorchester*	26 Bradlee St., D.
Newell, Joseph Shipley	I.	*Cambridge*	83 Brattle St., C.
Noyes, Mason Shaw	XIII.	*Taunton*	94 Dean St., T.
Nutter, Karl Locke	II.	*Newton Upper Falls*	1174 Boylston St., N. U. F.
Nutting, Clarence Leighton	V.	*West Roxbury*	54 Lasselle St., W. R.

SECOND YEAR (*continued*)

NAME	COURSE	HOME	RESIDENCE
Obert, Arthur Aloysius	X.	*Erie, Pa.*	82 Dana St., C.
O'Donnell, Aloysius Francis	X.	*Natick*	3 Kimball Ct., Na.
Page, Sherwood	II.	*Melrose Highlands*	20 Pearl St., Mel. H.
Palmer, Russell Smith	VI.	*Somerville*	93 Central St., Som.
Pan, Chen-chi	X.	*Soo-chow, China*	1075 Boylston St., B.
Parker, Frederick Andrew	VI.	*Cambridge*	91 Trowbridge St., C.
Parks, George Urbane	VI.	*Salt Lake City, Utah*	336 Commonwealth Ave., B.
Parsons, Charles Jewett	II.	*Brooklyn, N. Y.*	179 Bay State Rd., B.
Passell, Sol	XIII.	*Cleveland, O.*	149 Allston St., C.
Paterson, Ellsworth George Daniel	VI.	*Melrose Highlands*	976 Main St., Mel. H.
Patterson, Webb Connie	XV.	*Waterville, Me.*	336 Commonwealth Ave., B.
Peach, Harry Lawrence	V.	*Malden*	47 Walnut St., Mal.
Pease, Ralph Hotchkiss	IV.	*Torrington, Conn.*	517 Beacon St., B.
Peltier, Paul Desnoyers	VII.	*New York, N. Y.*	1067 Beacon St., Br.
Perkins, Ernest Fred	X.	*Melrose*	153 East Emerson St., Mel.
Pero, Donald Cary	II.	*Indian Orchard*	Technology Chambers, B.
Pickop, Edwin Morgan	I.	*Unionville, Conn.*	14 Lyman St., N. C.
Pierce, Edward Franklin, Jr.	II.	*Melrose Highlands*	46 Clifton Park, Mel. H.
Powers, Ray	VII.	*Orange*	20 Hemenway St., B.
Prescott, Amos Neal	XV.	*Passaic, N. J.*	517 Beacon St., B.
Priest, Holden Chouteau	VI.	*Brookline*	101 Abbottsford Rd., Br.
Reid, Armour Lionel	XV.	*Glen Ridge, N. J.*	104 Charles River Rd.
Reis, James Ward, Jr.	III.	*New Castle, Pa.*	1067 Beacon St., Br.
Reynolds, Albert Barnes	VI.	*Atlantic City, N. J.*	212 Huntington Ave., B.
Reynolds, Frank Percival	X.	*Malden*	46 Boston St., Mal.
Richards, Arklay Seymour	VI.	*Cambridge*	22 Bigelow St., C.
Richardson, Edward Adams	II.	*Germantown, Pa.*	18 Trowbridge St., C.
Richardson, Harold Moulton	XV.	*West Acton*	129 Mt. Auburn St., C.
Richardson, Leonard Atwood	XIII.	*Richardson, N. B.*	7 Batavia St., B.
Riegel, John Lawrence	XV.	*New York, N. Y.*	491 Commonwealth Ave., B.
Roberts, George Whiting	XIV.	*Watertown*	114 Riverside St., Wat.
Roberts, Walter Carlyle	XV.	*Newton Center*	184 Ward St., N. C.
Rodgers, Karl Freeman	II.	*West Somerville*	731 Broadway, W. Som.
Rommer, Henry	II.	*Boston*	37 Joy St., B.
Sanford, David Curtis, Jr.	IV.	*Bridgeport, Conn.*	44 The Fenway, B.
Sargent, Ralph	XV.	*Glencoe, Ill.*	104 Charles River Rd., C.
Scheeline, Paul Daniel	VI.	*San Francisco, Cal.*	52 Massachusetts Ave., C.
Schefer, Albert Philip	I.	*Taunton*	40 East Britannia St., T.
Schwartz, Ernest Lincoln	VI.	*Franklin, N. H.*	16 Clinton St., C.
Scofield, Edward Ellis	VI.	*Oconto, Wis.*	4 Ames St., C.
Scranton, Charles Wallace	IV.	*Brookline*	15 University Rd., Br.
Searles, Howard Hall	IV.	*Marlboro*	47 St. Stephen St., B.
Selya, Hyman Philip	X.	*Brookline*	31 Perry St., Br.
Shea, Timothy Edward	VI.	*Newton Upper Falls*	49 Worcester St., N. U. F.
Shedlovsky, Theodore	X, XIV.	*Boston*	127 St. Botolph St., B.
Sherman, Benjamin Howland	X.	*Newport, R. I.*	237 Beacon St., B.
Sherman, Samuel Alfred	X.	*Stamford, Conn.*	21 Lee St., C.
Simonds, Howard Messinger	I.	*Marlboro*	Warren Ave., Mar.
Slotnik, Isidor	I.	*Chelsea*	10 Lawrence St., Ch.
Smith, Edgar Reynolds	XIV.	*Wilmington, Del.*	203 Bay State Rd., B.
Smith, Leighton Bruerton	X.	*Auburndale*	158 Central St., Aub.

SECOND YEAR (*continued*)

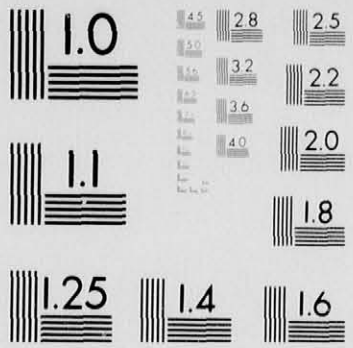
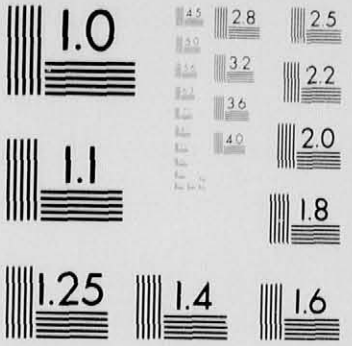
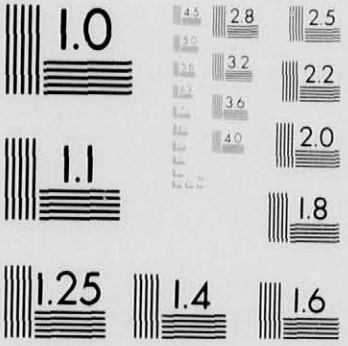
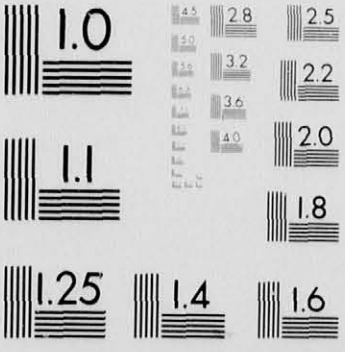
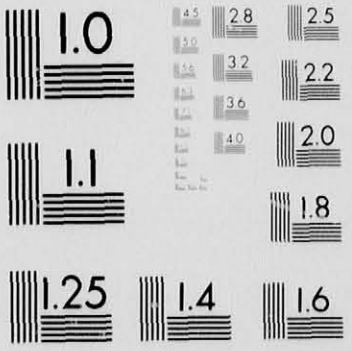
NAME	COURSE	HOME	RESIDENCE
Smith, Merritt Parker	I.	*North Scituate, R. I.*	Technology Dormitory, C.
Smith, Morton Arthur	VI.	*Great Barrington*	393 Broadway, C.
Smith, Russell Storer	XI.	*Arlington*	853 Massachusetts Ave., Arl.
Snow, Leon Isaac	X.	*Brookline*	35 Beals St., Br.
Snow, William Bradlee	XV.	*Newton Center*	11 Devon Rd., N. C.
Soars, Everett Alexander	VI.	*Newburyport*	366 Harvard St., C.
Sorenson, Lloyd Raymond	VI.	*Dorchester*	19 Boyden St., D.
Southwick, Bertram Holden	II.	*Lynn*	126 Bowler St., L.
Spector, Hyman	X.	*Boston*	13 Oswego St., B.
Stam, Jesse	VI.	*New York, N. Y.*	Technology Dormitory, C.
Staubach, Arnold Baldwin	IV.	*Highland Park, Mich.*	33 Trowbridge St., C.
Stehle, Richard Brehm	X.	*Philadelphia, Pa.*	372 Metropolitan Ave., Ros.
Stetler, Marvin Mayfield	IV.	*Dallas, Texas*	4 Ames St., C.
Stevenson, Victor Enrique, U.S.N.	III.	*Antofagasta, Chile*	Technology Dormitory, C.
Stevenson, William O., U.S.N.	III.	*Antofagasta, Chile*	Technology Dormitory, C.
Stewart, Chester Cameron	X.	*Medford*	6 Sumner Ave., Med.
Stöwhas, Carlos Alberto	VI.	*Valparaiso, Chile*	1675 Massachusetts Ave., C.
Strang, James MacLaren	VII.	*Auburndale*	348 Central St., Aub.
Svenson, Carl Louis	II.	*Mattapan*	303 Wood Ave., Mat.
Swasey, Paul Francis	IV.	*Waterbury, Vt.*	190 Linden St., Ev.
Taber, Sherwood Holmes	X.	*Canton*	299 Washington St., Can.
Thomas, Carl Edison	II.	*Waverley*	37 Holt St., Wav.
Tribou, Ralph Ellsworth	I.	*Montello*	68 Westland Ave., B.
Untersee, Maximilian	IV.	*Brookline*	161 Davis Ave., Br.
Walworth, Walter Frederick	I.	*Lowell*	48 Crawford St., Low.
Way, Donald Dickinson	VI.	*New York, N. Y.*	493 Commonwealth Ave., B.
Webber, Eaton	II.	*Newton*	199 Hunnewell Terrace, N.
Webster, Dean Kingman, Jr.	X.	*Lawrence*	237 Beacon St., B.
Wellcome, Hubert Eugene	II.	*Waltham*	11 Charles St., Wal.
Wells, Robert Hawley	XII.	*Los Angeles, Cal.*	104 Charles River Rd., C.
Wells, Robert Kirk	X.	*Winthrop*	60 Sea View Ave., Win.
Westland, Charles Edward	I.	*Somerville*	4 Aldrich St., Som.
Weymouth, Henry Stanley	I.	*Dexter, Me.*	261 Newbury St., B.
White, Charles Eaton Browning	I.	*Toledo, O.*	820 Massachusetts Ave., C.
White, Horace Dyball	I.	*Cambridge*	67 Yerxa Rd., C.
Whiton, Henry Rogers	VI.	*Hingham Center*	42 The Fenway, B.
Willey, Dean Frederick	II.	*Manchester, N. H.*	336 Commonwealth Ave., B.
Williams, Abraham José	I.	*Choluteca, Honduras*	68 Huntington Ave., B.
Williams, Russell Estes	II.	*Taunton*	62 Tremont St., T.
Wilson, Henry Everett	I.	*Ipswich*	79 County Rd., Ips.
Winkfield, Holley Stetson	VI.	*Winter Hill*	186 Pearl St., W. H.
Wiswall, George Henry, Jr.	XV.	*Watertown*	39 Marion Rd., Wat.
Wolfe, Lester	XIII.	*New York, N. Y.*	102 Elm Hill Ave., R.
Wolff, Louis	VII.	*Revere*	23 Dana St., Rev.
Wright, Kenneth Andrews	XV.	*Dorchester*	54 Kenwood St., D.
Wyse, Francis Octavus	II.	*Toronto, Ontario*	44 The Fenway, B.
Yeh, Tek Chen	XV.	*Shanghai, China*	45 Hemenway St., B.

FIRST YEAR

NAME	HOME	RESIDENCE
Abbott, Norris Greenleaf, Jr.	*Providence, R. I.*	484 Beacon St., B.
Abercrombie, Ralph Pidgin	*Boston*	131 St. Botolph St., B.
Addicks, Allen	*Philadelphia, Pa.*	Technology Dormitory, C.
Akers, Kenneth Fellows	*Brookline*	108 University Rd., Br.
Allen, Lawrence Herman	*Attleboro*	60 Dean St., At.
Allen, Raymond Dearborn	*Skowhegan, Me.*	Technology Dormitory, C.
Atwater, Arthur Clark	*Newburyport*	7 Collins St., Np.
Ayala, S Heliodoro, S.B	*Ibarra, Ecuador*	46 Massachusetts Ave., C.
Bailey, Wayland Solon	*Cambridge*	1569 Massachusetts Ave., C.
Baker, Eben Hayward	*Cambridge*	385 Concord Ave., C.
Bangratz, Ernest George	*Boston*	19 Hemenway St., B.
Barker, John Clement	*Portland, Me.*	Technology Dormitory, C.
Barnes, Garrett Henry, Jr.	*Roslindale*	65 Huntington Ave., Ros.
Barron, William Norman	*Springfield*	Technology Dormitory, C.
Barry, Elmer Lawrence Wesley	*Holliston*	Holliston.
Bartlett, Ralph Wilbur, Jr.	*Newton*	29 Arlington St., N.
Bates, Herbert Franklin	*Brockton*	190 Prospect St., Brock.
Bean, Karl David	*Winchester*	1089 Boylston St., B.
Béïque, Jean Edgar	*Montreal, Canada*	493 Commonwealth Ave., B.
Bell, Hymen Williams	*Cambridge*	97 Pemberton St., C.
Berg, Lawrence Fabian	*Malden*	15 Dell St., Mal.
Berko, Paul Matthew	*Lynn*	200 Lewis St., L.
Bibber, Harold Whitney	*Gloucester*	31 Beacon St., G.
Bigelow, Edmund Clarence Stedman	*Boston*	84 Huntington Ave., B.
Black, Robert Douglas	*Arlington*	32 Addison St., Arl.
Blackmer, Franklin Henry	*Melrose*	293 W. Emerson St., Mel.
Boettner, Francis Ernest	*Peabody*	130 Lowell St., P.
Bond, Clinton Lucius	*Adams*	Technology Dormitory, C.
Booth, Ralph Douglas	*Methuen*	2 Merrill St., Meth.
Bowditch, Frederic Channing, Jr.	*Brookline*	164 Rawson Rd., Br.
Bower, Richard	*Braintree*	414 Elm St., Brain.
Bowman, John Drummond	*Alton, Ill.*	224 Newbury St., B.
Boyden, Laurence Elbridge	*Brookline*	44 Cypress Pl., Br.
Bradley, Frank Leo	*Everett*	26 Broadway, Ev.
Bray, Charles Collins	*Framingham*	42 Hartford St., Fram.
Breck, Frank Pratt	*Boston*	237 Beacon St., B.
Brickett, Edward Montgomery	*Lynn*	42 Shepard St., L.
Brown, Adin Allen	*Taunton*	92 Broadway, T.
Brown, David Paul	*Quincy*	95 Monroe Rd., Q.
Brown, George Irving	*Auburn, Me.*	69 Gainsborough St., B.
Brown, Philip Sewall	*Salem*	19 Oakland St., S.
Brown, Waldo Hayward	*Brookline*	Riverbank Court, C.
Brownell, Dorothea DeWolf	*Portsmouth, N. H.*	258 Newbury St., B.
Brumer, Isidor Spencer	*New York, N. Y.*	551 Massachusetts Ave., B.
Bruno, Henry Joseph	*Brookline*	101 Coolidge St., Br.
Bugbee, Harold	*Boston*	1091 Boylston St., B.
Bugbee, Percy	*Boston*	1091 Boylston St., B.
Burker, Francis Joseph	*Cambridge*	5 Ashton Place, C.
Burdell, Edwin Sharp	*Columbus, O.*	Technology Dormitory, C.
Burke, Alan Wollison	*Pittsfield*	Technology Dormitory, C.

FIRST YEAR (*continued*)

NAME	HOME	RESIDENCE
Burnham, Laurence Haskell	*Lexington*	East St., Lex.
Burr, Reginald Geddes	*Hingham*	Lincoln St., Hing.
Burroughs, Malcolm Sturtevant	*Melrose*	43 Adams St., Mel.
Butler, Allan Mitchell	*Egypt, Me.*	50 Hampden Hall, C.
Button, Herbert Cogswell	*Cazenovia, N. Y.*	484 Beacon St., B.
Byrne, Philip Joseph, Jr.	*Dorchester*	10 Thetford Ave., D.
Byron, Vaughn Johonnott	*Mercersburg, Pa.*	Technology Chambers, B.
Caldwell, Harold Biedler	*Mt. Vernon, N. Y.*	334 Harvard St., C.
Campos, Francis Pastor	*Yucatan, Mexico*	52 Westland Ave., B.
Carroll, Edward Vincent	*Fall River*	6 St. Paul St., C.
Carter, James Rose	*Andover*	High Plain Rd., And.
Casey, Bartholomew Francis	*Bridgewater*	Technology Dormitory, C.
Cate, Norman Russell	*Dover, N. H.*	8 Buckminster St., Bri.
Chaffin, Warren Leland	*East Dedham*	Greenhood St., E. Ded.
Chidsey, Halmer Carleton	*Windsor, Conn.*	7 Cleveland St., C.
Chun, Ki Kee	*Shanghai, China*	108 Hemenway St., B.
Clark, Bradford Judson	*Hartford, Conn.*	916 Beacon St., B.
Clark, Eugene Kenneth	*Ashland*	Pleasant St., Ashland
Clark, Ormond Wesley	*Lawrence*	85 Farnham St., Law.
Cochran, Archie Prentiss	*Louisville, Ky.*	44 The Fenway, B.
Coffin, George Wheeler	*Dorchester*	10 Rosedale St., D.
Cofren, Warren Louis	*Melrose*	87 Wyoming Ave., Mel.
Collins, Howarth Cody	*Norwich, Conn.*	1018 Beacon St., Br.
Cooper, Oswald Elmer	*Hinton, W. Va.*	173 St. Botolph St., B.
Corbin, Paul Franklin	*Malden*	18 Horace St., Mal.
Corr, George Theodore	*Cambridge*	15 Brown St., C.
Cosgrove, John Thomas	*East Lexington*	13 Maple St., E. Lex.
Couch, Henry Ruffner	*Charleston, W. Va.*	290 Massachusetts Ave., C.
Coughlin, Edward Joseph	*Maynard*	55 Summer St., May.
Cousins, Edward	*Chicopee*	19 Bigelow St., C.
Coward, Raymond Stewart	*Cambridge*	18 Wendell St., C.
Crowley, John D.	*Fall River*	6 St. Paul St., C.
Cudworth, James Rowland	*Norwich, Conn.*	1018 Beacon St., Br.
Culbertson, Francis Barnaby	*Boston*	33 Newbury St., B.
Curry, Justin Richard	*Lynn*	4 Forest St., L.
Cusick, Walter Murray	*Dorchester*	21 Chamberlain St., D.
Cutter, George Harwood	*Allston*	218 Brighton Ave., A.
Daghlian, Haroutune Krikor, A.B.	*Aintab, Asia Minor*	Waverley.
Dana, Norman Putnam	*Portland, Me.*	Technology Dormitory, C.
Dandrow, Charles George, Jr.	*South Boston*	920 E. Fourth St., S. B.
Dean, William Judson	*Andover*	Technology Dormitory, C.
DeMeulenaer, John	*Boston*	425 Massachusetts Ave., B.
Dewey, William Farnham	*Great Barrington*	393 Broadway, C.
Deyette, Joe Coleman	*Portland, Ore.*	334 Harvard St., C.
Doane, Foster Parker, Jr.	*Arlington Heights*	243 Lowell St., Arl. Hts.
Doble, Enoch Hall	*Quincy*	Technology Dormitory, C.
Donovan, George James	*Clinton*	370 High St., Clinton.
Dooley, Henry Gerard	*Dorchester*	15 Schafter St., D.
Dowlin, Fred Forest	*North Adams*	Technology Dormitory, C.
Dowling, Donald Lynde	*Ridgewood, N. J.*	2 Clinton St., C.
Doyle, Jesse Irwin	*Philadelphia, Pa.*	484 Beacon St., B.


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FIRST YEAR (*continued*)

NAME	HOME	RESIDENCE
Duffill, Hugh Perrins	*Somerville*	34 Willoughby St., Som.
Dyke, Freeman Huntington	*Andover*	Andover.
Eaton, Charles Wesley	*Woods Hole*	Technology Dormitory, C.
Eaton, Ralph Carter	*Lexington*	Bedford St., Lex.
Eddy, Lawrence Bailey	*Bangor, Me.*	45 Ridgely Hall, C.
Eksergian, Carolus Levon	*Somerville*	9 Madison St., Som.
Ellis, Carl Ambrose	*Waltham*	85 Waverley Oaks Rd., Wal.
Ellis, Robert Carl	*Dorchester*	170 Magnolia St., D.
Emerson, Howard William	*Shirley*	16 Howes St., D.
Erickson, Henry William	*Quincy*	111 Glendale Rd., Q.
Esner, Arthur	*Wakefield*	75 Pleasant St., Wak.
Etherington, Eric Llewellyn	*Cambridge*	37 Lee St., C.
Fairbrother, Earle Chester	*Toronto, Canada*	89 Gainsborough St., B.
Fassitt, Andrew Jackson, Jr.	*Cambridge*	27 Walden St., C.
Federhen, Herbert Melancthon	*Allston*	1141 Commonwealth Ave., A.
Fiske, David Lewis	*Exeter, N. H.*	526 Beacon St., B.
Fitzgerald, William Joseph	*West Roxbury*	266 Park St., W. R.
Flashman, David Harry	*Roxbury*	37 Schuyler St., R.
Fleming, Willard Ames	*Somerville*	73 Florence St., Som.
Forrest, Henry Ogley	*North Andover*	154 Railroad Ave., N. And.
Franck, Jerome James	*Brookline*	15 Euston St., Br.
Frease, Hurxthal Field	*Canton, O.*	Technology Dormitory, C.
Fredrickson, Gustaf Olaf	*Cambridge*	30 Pilgrim St., C.
Freeman, Evert Wendell	*Providence, R. I.*	788 Massachusetts Ave., C.
Freeman, William Morton Breakey	*Newtonville*	66 Highland Ave., Nv.
French, Everett Ballou	*Orange*	35 Williams St., C.
French, Grant Keith	*Lowell*	35 Victoria St., Low.
Fuller, William Francis	*Newtonville*	107 Central Ave., Nv.
Garrigus, Alfred Clarence	*Bristol, Conn.*	393 Broadway, C.
Gausenberg, Valentin	*Odessa, Russia*	43 St. Botolph St., B.
Gee, Richard Hawkins	*Fall River*	517 Beacon St., B.
Gelt, Gabriel George., A.B.	*Havana, Cuba*	45 East Newton St., B.
Gelt, Philip Jesus, A.B.	*Havana, Cuba*	45 East Newton St., B.
Genaske, Albert	*Chestnut Hill*	266 Com'w'lth Ave., C. H.
Gibson, Richard King, Jr.	*Knoxville, Tenn.*	104 Charles River Rd., C.
Gill, Fred Morton	*Gloucester*	90 Bloomfield St., D.
Gilliatt, Leland Warren	*Lynn*	286 Lynnfield St., L.
Glassett, Alfred Thomas	*Roxbury*	79 Warren St., R.
Glover Everett Clifford	*South Easton*	Depot St., S. Easton.
Goldsmith, Richard Hunt	*New York, N. Y.*	Technology Dormitory, C.
Gonzalez-Rosa, Francisco, B.C.	*Tegucigalpa, Honduras*	68 Huntington Ave., B.
Goodwin, Harold Lothrop	*Roxbury*	133 Ruthven St., R.
Goward, Kenneth Newcombe	*Lowell*	274 Appleton St., Low.
Granger, Harry Inwood	*South Weymouth*	S. Wey.
Graves, Donald Stone	*Brookline*	51 Verndale St., Br.
Green, Heland Joseph	*Lowell*	359 Walker St., Low.
Greene, Albert Beale	*Washington, D. C.*	16 Ash St., C.
Greenwood, Tancred Spencer	*Gardner*	35 Williams St., C.
Griesemer, Elmer Philip	*Oak Park, Ill.*	336 Commonwealth Ave., B.
Grover, Newell Arthur	*Rutland, Vt.*	147 Magazine St., C.
Hadden, Weston	*Brooklyn, N. Y.*	336 Commonwealth Ave., B.

FIRST YEAR (*continued*)

NAME	HOME	RESIDENCE
Haebler, Philip Ebling	*New York, N.Y.*	95 Robinwood Ave., J. P.
Hall, Clyde Keith	*Ipswich*	69 Central St., Ips.
Hall, George Linwood	*Mansfield*	177 West St., Mans.
Hall, Merton Colvin	*Brockton*	52 West Park St., Brock.
Hallinan, Clement Joseph	*New Britain, Conn.*	26 St. Germaine St., B.
Hammond, Carl Wing	*Quincy*	45 Beech St., Q.
Handy, William Russell	*Manville, R. I.*	282 Massachusetts Ave., B.
Harris, Lawrence Isaac	*Roxbury*	43 Copeland St., R.
Harris, Louis Barrett	*Wilmington, Del.*	203 Bay State Rd., B.
Harrop, James	*New Bedford*	Technology Dormitory, C.
Harshowitz, Louis	*New London, Conn.*	111 Norway St., B.
Harvey, Theron Finson	*Gloucester*	20 St. Paul St., C.
Hathaway, Samuel Devereux	*Marblehead*	526 Beacon St., B.
Hedberg, Harold Frederick	*Malden*	8 Evelyn Ave., Mal.
Hedlund, Wilhelm Theodor	*West Somerville*	54 Lowden Ave., W. Som.
Hemeon, James Russell	*Dorchester*	9 Standish St., D.
Hennessy, Daniel Joseph	*Brookline*	16 Henry St., Br.
Herron, John Cuthbert	*Telluride, Colo.*	Technology Dormitory, C.
Hickey, Thomas Francis	*Dorchester*	210 Harvard St., D.
Higgins, Austin Denison	*Clinton, Conn.*	Technology Dormitory, C.
Hills, Henry Willard	*Everett*	174 Vine St., Ev.
Hines, John Jerome, Jr.	*Brooklyn, N. Y.*	4 Ames St., C.
Hingston, Townsend Hill	*Wollaston*	38 Davis St., Wol.
Hitchcock, Lauren Blakely	*Belmont*	Hillside Terrace, Bel.
Hobson, Theodore Foster	*Lowell*	164 Holyrood Ave., Low.
Holt, Arthur Ratcliffe	*Newton Center*	15 Rice St., N. C.
Honig, Albert Ralph, Jr.	*Lowell*	614 Westford St., Low.
Honiss, William Tibbits	*Hartford, Conn.*	916 Beacon St., B.
Hooper, Wilford Priest	*Maynard*	517 Beacon St., B.
Howe, Charles Walter	*Winthrop*	215 Court Rd., Win.
Howe, Malcolm Stuart	*East Milton*	208 Edgehill Rd., E. Mil.
Hudnut, Frank Parker, Jr.	*New Bedford*	Technology Dormitory, C.
Hughes, Thomas Joseph	*Newton*	181 Cabot St., N.
Hunt, Franklin Bicknell	*Swampscott*	259 Humphrey St., Swam.
Hunter, Harold Frierson	*Brookline*	168 Aspinwall Ave., Br.
Huntress, Ernest Hamlin	*East Lynn*	14 Porter St., E. Lynn
Johansen, Elmer Lawrence	*Somerville*	5 Arthur St., Som.
Johnson, William Sanborn	*Newburyport*	45 Washington St., Np.
Kahn, Leo David	*Dorchester*	3 Morse St., D.
Kaplan, David Julius	*Jersey City, N. J.*	23 Mellen St., C.
Kellar, John William	*West Newton*	174 Webster St., W. N.
Kinghorn, Archibald Hendrie, Jr.	*Lawrence*	204 Bailey St., Law.
Kitson, Sydney William	*Greenfield*	540 Newbury St., B.
Kjaer, Homo John	*Jamaica Plain*	73 Spring Park Ave., J. P.
Knapp, Albert Myer	*Denver, Colo.*	40 Evergreen St., R.
Knight, George Roger	*Brockton*	179 Bay State Rd., B.
Kruse, Albert	*Wilmington, Del.*	Technology Dormitory, C.
Lambert, Laurence Emil	*Haverhill*	121 St. Stephen St., B.
Lariviere, John Bautista	*Fall River*	25 Inman St., C.
Larsen, Ralph Robert	*Dorchester*	175 Glenway St., D.
Lavedan, Peter Francis	*New Orleans, La.*	46 Mt. Auburn St., C.

FIRST YEAR (*continued*)

NAME	HOME	RESIDENCE
Lavelle, Kenneth Thomas	*Pottsville, Pa.*	1067 Beacon St., Br.
Lawton, Frank Watson	*Harlingen, Tex.*	Technology Dormitory, C.
Leander, Carl Hilding	*Quincy*	145 Whitwell St., Q.
Leander, Carl Thorsten	*Dorchester*	144 Spencer St., D.
Lee, Myron Harry	*Riverhead, N. Y.*	136 Hancock St., C.
Lee, Yuan	*Canton, China*	65 Hammond St., C.
Lees, Malcolm Bruce	*Leominster*	308 Newbury St., B.
Leonori, William Henry, Jr.	*Brooklyn, N. Y.*	261 Newbury St., B.
Levangie, George Walter	*Dedham*	46 Clark St., Ded.
Levinson, Samuel	*Dorchester*	80 McLellan St., D.
Levy, Henry Mannheim	*Roxbury*	137 Hutchings St., R.
Lipp, Morris Nathan	*Chelsea*	146 Bloomingdale St., Ch.
Littlefield, Arthur Stanley	*Peabody*	57 Franklin St., P.
Littlefield, Mendum Bartlett	*Salem*	3 Woodside St., S.
Lockhart, Herbert Garrison	*W. Philadelphia, Pa.*	493 Commonwealth Ave.,B.
Logan, John Wood, Jr.	*Bala, Pa.*	916 Beacon St., B.
Loomer, Harold Nelson	*Beverly*	103 Lovett St., Bev.
Lord, Erskine Daniel	*Lawrence*	98 Ames St., Law.
Lovejoy, Henry Foster	*Milford, N. H.*	17 Lee St., C.
Lucas, John	*Lynn*	86 Eastern Ave., L.
Lynch, [illegible]n Povah	*Dorchester*	260 Geneva Ave., D.
Lyons, John Joseph	*Dorchester*	23 Frederika St., D.
McCarthy, Daniel Edward	*Newton*	42 Fairmont Ave., N.
McGowan, Andrew Joseph	*Lawrence*	39 Bennington St., Law.
McGuire, Donald Ball	*New Berlin, N. Y.*	820 Massachusetts Ave., C.
MacLeod, William Donald	*Wakefield*	22 Eaton St., Wak.
MacMahon, William Kennedy	*Atlantic*	6 Walker Place, Atl.
MacManus, Francis Joseph	*Taunton*	57 Ashland St., T.
McNear, George Roger	*Auburndale*	191 Auburn St., Aub.
Maconi, Frank	*Newton Center*	76 Clark St., N. C.
Magee, William Louis	*Taunton*	115 Broadway, T.
Maloney, Charles William	*Woburn*	103 Montvale Ave., Wo.
Maloy, Charles Barney	*St. Louis, Mo.*	526 Beacon St., B.
Margolis, Joseph Isador	*Dorchester*	76 Kingsdale St., D.
Marovitz, Herman Joseph	*Everett*	88 Irving St., Ev.
Martin, Frederick Eastman	*Colebrook, N. H.*	292 Newbury St., B.
Martinez, Lauro	*Monterey, Mex.*	580 Commonwealth Ave., B.
Massey, Henry Peirce	*Brookline*	234 Harvard St., Br.
Matthews, George Kelly	*Richmond, Va.*	290 Newbury St., B.
Matthews, Medwin	*Andover*	Shawsheen Road, And.
Meissner, William Emil	*West Hoboken, N. J.*	334 Harvard St., C.
Merrian, Harold Wesley	*Canton*	59 Independence St., Can.
Miller, Alden Williams	*Medford*	16 Chestnut St., Med.
Miller, Robert Alan	*Campello*	1314 Main St., Camp.
Milliken, Samuel Alger	*Roxbury*	149 Warren St., R.
Moir, James Govan, Jr.	*Arlington*	15a Jason St., Arl.
Morse, Alan Luther	*Arlington*	125 Pleasant St., Arl.
Mosscrop, Roger Gambee	*Rochester, N. Y.*	Technology Dormitory, C.
Moy-Ding, William	*Boston*	15 Essex St., B.
Murdough, Edwin Bennett	*Dorchester*	25 Windermere Rd., D.
Murphy, Leo Hayes	*North Andover*	39 Sargent St., N. And.

FIRST YEAR (*continued*)

NAME	HOME	RESIDENCE
Musnitsky, Joshua	*Fitchburg*	26 Grove St., Ch.
Myers, Austin Southard	*Mount Vernon, N. Y.*	81 Westland Ave., B.
Nash, John Crandon	*Cherryfield, Me.*	526 Beacon St., B.
Nelles, Philip Augustus, Jr.	*Lexington*	69 Hancock St., Lex.
Nelson, John Heisler	*Roxbury*	51 Fenwood Rd., R.
Newhall, Kenneth Cyrus	*Lynn*	124 Ocean St., L.
Noelke, Harry Montgomery	*Mertzon, Texas*	493 Commonwealth Ave., B.
Norton, Clyde Arthur	*Washington, D. C.*	63 Magazine St., C.
Novack, Jacob	*Dorchester*	4 Maybrook St., D.
O'Donnell, Charles Henry James	*Lowell*	60 Varnum St., Low.
Oliva N., Guillermo	*Valparaiso, Chile*	1675 Massachusetts Ave., C.
Ormon, James Brodie	*Newton Upper Falls*	995 Chestnut St., N. U. F.
Owen, Frank Sewall	*Brighton*	1516 Com'w'lth Ave., Bri.
Owens, Grafton Ray	*Manchester*	Putnam Court, Man.
Padilla, José Augusto	*Tegucigalpa, Honduras*	290 Massachusetts Ave., C.
Palis, Saul	*Roxbury*	20 Intervale St., R.
Patterson, Robert	*So. Manchester, Conn.*	484 Beacon St., B.
Peale, William Barrows	*New York, N. Y.*	2 Claverly Hall, C.
Peirce, John Trevor	*Philadelphia, Pa.*	179 Bay State Rd., B.
Peirce, Russell Moulton	*West Newbury*	Lincoln, Mass.
Pender, Robert Theodore	*Nahant*	Technology Dormitory, C.
Perkins, Elliott Ronald	*Arlington*	33 Addison St., Arl.
Peterson, Martin Samuel	*Norwich, Conn.*	18 Bowker St., Br.
Philbrick, John Alden, Jr.	*New York, N. Y.*	4 Ames St., C.
Pierce, Henry Carleton	*West Newton*	136 Eliot Ave., W. N.
Pizá, José Geigel	*San Juan, Porto Rico*	820 Massachusetts Ave., C.
Pope, Kennedy	*Chicago, Ill.*	428 Charles River Rd., C.
Powell, Albert Perry	*Allston*	530 Cambridge St., A.
Pratt, Hazen Curtis	*Chicago, Ill.*	602 Strathcona Hall, C.
Preston, William Henry	*Ponce, Porto Rico*	41 Thomas Road, Swam.
Priest, Chester Anderson, A.B.	*Nashua, N. H.*	4 Beck Hall, C.
Proctor, Carleton Treat	*Malden*	124 Linden Ave., Mal.
Quinn, John Joseph, Jr., A.B.	*West Roxbury*	292 Temple St., W. R.
Quirk, Thomas Addis	*Dorchester*	30 Speedwell St., D.
Quirós A., Teodorico, A.B.	*San José, Costa Rica*	103 Mt. Vernon St., B.
Radasch, Arthur H.	*Longmeadow*	Technology Dormitory, C.
Randlett, Francis Chivers	*Winchester*	2 Legrange St., Winc.
Reardon, Daniel Francis	*Lynn*	234 Essex St., L.
Reyburn, Francis Clarke	*St. Louis, Mo.*	428 Charles River Rd., C.
Rich, Edwin Newell	*Newton*	6 Channing St., N.
Richardson, Ernest Henry	*Medford*	41 Royal St., Med.
Riley, William Andrew	*Milton*	196 Blue Hills Pkwy, Mil.
Robillard, Robert Edouard	*Cambridge*	486 Huron Ave., C.
Robinson, Frank Robert	*Rutland, Vt.*	517 Beacon St., B.
Rockafeller, John Daniel	*Asbury Park, N. J.*	1045 Beacon St., Br.
Rolle, Edward	*Cambridge*	46 Massachusetts Ave., C.
Roman, Kenneth Jacob	*Brookline*	117 Stedman St., Br.
Ross, Mott Benner	*Summit, N. J.*	44 The Fenway, B.
Rowe, George Ernest	*Fall River*	25 Inman St., C.
Rowell, Eugene Perry, Jr.	*Plymouth*	Technology Chambers, B.
Rowen, Thomas Carlton, Jr.	*Swampscott*	72 Banks Rd., Swam.

FIRST YEAR (*continued*)

NAME	HOME	RESIDENCE
Ryer, Edwin Delamater	*Brookline*	29 Gorham Ave., Br.
Sale, William Hutchison, Jr.	*Hartford, Conn.*	18 Inman St., C.
Sammet, Wendell Phillips	*Malden*	20 Chestnut St., Mal.
Sandiford, Raymond Benedict	*Cambridge*	20 Vincent St., C.
Saxe, Myer	*Boston*	5 Revere St. Place, B.
Schildbach, Walter Albert	*Brookline*	36 Columbia St., Br.
Scott, James Hamilton, Jr.	*Richmond, Va.*	1572 Massachusetts Ave., C.
Sears, Francis Weston	*Plymouth*	169 St. Botolph St., B.
Seavey, Harold Victor, 2d	*Wollaston*	414 Highland Ave., Wol.
Shlager, Abraham Esau	*Boston*	109 Leverett St., B.
Shlager, Max	*Malden*	158 Franklin St., Mal.
Sias, Oscar Buzzell	*Ossipee, N. H.*	Technology Dormitory, C.
Silverman, Louis Maurice	*Lawrence*	81 Concord St., Law.
Sjostrom, Robert Ludwig	*North Andover*	179 Bay State Rd., B.
Skinner, Robert Llewellyn	*Winchester*	30 Glen Rd., Winc.
Sloan, Howard Backus	*Swampscott*	179 Redington St., Swam.
Smiddy, Harold Francis	*Fayville*	975 Dorchester Ave., D.
Smith, Albert Valentine	*Winthrop*	32 Oakland St., Win.
Smith, Hosea Hart	*New Bedford*	291 Beacon St., B.
Snow, Lancy	*Whitman*	412 Washington St., Whit.
Somerby, Philip Bickner	*Winthrop*	125 Grovers Ave., Win.
Spencer, Ralph Brackett	*Brockton*	156 Spring St., Brock.
Stacey, James Harold	*White River Jct., Vt.*	200 Bay State Rd., B.
Stanwood, Creighton Boyd	*Portland, Me.*	Technology Dormitory, C.
Steele, Bruce Munger	*Herkimer, N. Y.*	428 Newbury St., B.
Stevens, John	*Appleton, Wis.*	268 Newbury St., B.
Strobridge, James Gordon	*Cincinnati, O.*	173 St. Botolph St., B.
Stuart, Lyall Love	*St. Louis, Mo.*	Technology Dormitory, C.
Sullivan, Edmund Carey	*Lowell*	39 Loring St., Low.
Sweeney, Frank Morgan	*Peabody*	83 Tremont St., P.
Swift, George Whitney	*Taunton*	55 Oak St., T.
Syner, Clarence Marshall	*Taunton*	100 Bay St., T.
Taber, Thomas Reed	*Lowell*	282 Westford St., Low.
Talcott, Carleton Hart	*Torrington, Conn.*	225 Newbury St., B.
Tattersfield, Gerald	*Philadelphia, Pa.*	Technology Dormitory, C.
Taylor, Ermond Albert	*Greenwich, Conn.*	484 Beacon St., B.
Taylor, Gavin Robert	*Methuen*	40 Mystic St., Meth.
Tirrell, Robert Wilson	*Brockton*	Technology Dormitory, C.
Tortorelli, Christopher Lucius	*Chicago, Ill.*	11 Newbury St., B.
Travers, Fred Hartt	*Haverhill*	66 Howard St., Hav.
Travis, Robert Earle	*Framingham*	3 Lexington St., Fram.
True, Osmond Smalley	*Readville*	19 Hawthorne St., Readville.
Turner, Robert Laird	*Roslindale*	372 Metropolitan Ave., Ros.
Tushin, Aaron	*Chelsea*	154 Shawmut St., Ch.
Visscher, John Sherman	*Waterbury, Conn.*	Technology Dormitory, C.
Vroom, Robert Douglas Wright	*Port Richmond, N. Y.*	283 Newbury St., B.
Wait, Philip Everett	*Winchester*	28 Symmes Rd., Winc.
Walmsley, George	*New Bedford*	Technology Dormitory, C.
Wason, Alfred Boyd	*Brookline*	1530 Beacon St., Br.
Waters, Louis Addison	*Syracuse, N. Y.*	788 Massachusetts Ave., C.
Watts, Earle Francis	*Quincy*	735 E. Squantum St., Q.

FIRST YEAR (*continued*)

NAME	HOME	RESIDENCE
Webber, Ralph Bickerstaff	*Brookline*	1195 Beacon St., Br.
Wei, Tsen Fu	*Canton, China*	144 Hemenway St., B.
Wells, Scott Hunter	*Korea, Japan*	104 Charles River Rd., C.
Wenberg, Jordan William	*Lawrence*	973 Massachusetts Ave., C.
Wexler, David	*Fall River*	12 Elmhurst St., D.
Wexler, Hymen Albert	*Lawrence*	33 Bevel St., Law.
Weymouth, Laurence Elmer	*Dexter, Me.*	261 Newbury St., B.
Whelan, Daniel Edward, Jr.	*Campello*	91 No. Leyden St., Camp.
White, Kenneth Blake	*Morrisville, Pa.*	Technology Dormitory, C.
Whitney, Richard Baxter	*Winchendon*	517 Beacon St., B.
Whitten, Lyman Perley	*Malden*	56 Hawthorne St., Mal.
Wilde, Winfred Charles	*North Andover*	105 Middlesex St., N. And.
Wilson, George Arthur	*Newburyport*	9 Beacon St., Np.
Wilson, Irving Harrison	*Lynn*	14 Rhodes Ave., L.
Wilson, Leland David	*New Rochelle, N. Y.*	423 Marlborough St., B.
Winant, Walter Lawrence	*Poughkeepsie, N. Y.*	526 Beacon St., B.
Winebaum, Arthur	*Lawrence*	390 Hampshire St., Law.
Wolfson, James Jacob	*Cambridge*	953 Massachusetts Ave., C.
Wolozin, Julius	*East Boston*	142 Chelsea St., E. B.
Wright, Livingston	*Quincy*	86 Goffe St., Q.
Wurzelbacher, George Milton	*Cincinnati, O.*	17 Lee St., C.
Young, Edward Leavitt	*Bellport, N. Y.*	290 Newbury St., B.
Young, Oscar Philip	*Stony Brook*	Weston.
Young, Philip Lee	*Louisville, Ky.*	44 The Fenway, B.
Zahn, Edward Gustav	*Jamaica Plain*	11 Enfield St., J. P.
Zimmerman, William Earl	*Portland, Ore.*	334 Harvard St., C.
ZurWelle, Fred Ernest	*East St. Louis, Ill.*	Technology Dormitory, C.

SPECIAL STUDENTS

NAME	COURSE	HOME	RESIDENCE
Abele, Charles Arthur, Ch.E., B.S.	VII.	*Ensley, Ala.*	394 Marlborough St., B.
Akerley, Arthur William Kenagh, M.D., C.M.	VII.	*Milwaukee, Wis.*	73 Gainsborough St., B.
Aldrin, Edwin Eugene, A.B.	II.	*Worcester*	62 Beach St., Wo.
Ames, Norman Bruce, B.Sc.	VI.	*Washington, D. C.*	4 Merlin St., D. Cen.
Ariseka, Ryohei	Aero. Eng.	*Annaka, Japan*	175 Fuller St., Br.
Atkinson, Henry Morrell, Jr., A.B.	VI.	*Atlanta, Ga.*	9 Linden St., C.
Barry, John Gerald, S.B.	XII.	*Salem*	1075 Boylston St., B.
Bartlett, Fred Howard, B.S.	V.	*East Weymouth*	P. O. Box 260, E. Wey.
Beal, Lester Irving	IV.	*Portland, Me.*	Technology Dormitory, C.
Bedell, Arthur Sidney, A.B.	VII.	*Constantinople, Turkey*	16 Stoughton St., Med. H.
Bicknell, Esther Wallace, A.B.	VII.	*Weymouth*	258 Front St., Wey.
Brown, David Mungall	IV.	*Lawrence*	235 Jackson St., Law.
Brown, Harvey Huntington, Jr., A.B.	III.	*Cleveland, O.*	Winthrop Hall, C.
Cahill, Lawrence Blair, Jr.	IV.	*Cincinnati, O.*	90 Beach St., B.
Chapin, Ernest Wilder, A.B.		*Somerville*	82 Monroe St., Som.
Chase, Nelson Chauncy	IV.	*Cambridge*	174 Lexington Ave., C.
Cho, Wen-Yueh	I.	*Canton, China*	49 Bickerstaff St., B.
Ciampolini, Ettore, M.D.	VII.	*Siena, Italy*	50 Charlesgate East, B.
Clark, Walter Lucus, B.S.	VI.	*Fort Banks*	Fort Banks.
Colleary, William Bartholomew, B.A.	IV.	*Forest Hills*	300 Hyde Park Ave., F. H.
Connolly, Joseph Peter, A.B., A.M.		*Cleveland, O.*	35 Conant Hall, C.
Dakin, Loretta Mildred	VII.	*Cleveland, O.*	232 Bay State Rd., B.
Douglas, Lewis Williams, B.A.	III.	*Douglas, Ariz.*	Drayton Hall, C.
Drury, Herbert, M.D., C.M.	VII.	*Montreal, Canada*	424 Massachusetts Ave., B.
Elliott, Stuart Ellis, A.B.		*Osterville*	30 Holyoke St., C.
Farnham, Charles Mason		*Barre Plains*	5 Sumner Rd., C.
Fischer, Frederick William, B.S.	I.	*Plant City, Fla.*	261 Newbury St., B.
Fitton, Willard Gardner	IV.	*Dorchester*	16 Bowdoin Ave., D.
Flaherty, James Charles	IV.	*Dorchester*	29 Monadnock St., D.
Gifford, Robert Lindley	V.	*East Boston*	98 Princeton St., E.B.
Gigger, Augustus George, M.D.	VII.	*Concord*	Concord.
Goldsmith, Herbert Joshua	III.	*Chicago, Ill.*	91 Gainsborough St., B.
Gunn, Selskar Michael, S.B.	VII.	*Belmont*	60 Goden St., Bel.
Hagerty, Joseph James, M.D.	VII.	*Norwood*	31 Day St., Nor.
Hamabe, Genjiro, M.M.E.	Aero. Eng.	*Kyoto, Japan*	90 Gainsborough St., B.
Hanson, George, B.A., M.A., A.M.		*Manitoba, Canada*	39 Inman St., C.
Hanson, John James	IV.	*So. Weymouth*	65 West St., S. Wey.
Harkness, Robert Rae, Ph.B.	VII.	*Delhi, N. Y.*	15 Lee St., C.
Hedrich, Arthur William, B.S.	VII.	*Chicago, Ill.*	55 St. Stephen St., B.
Hodgson, Maurice Lee, S.B.	XV.	*Newton*	96 Shornecliffe Rd., N.
Holden, Ellsworth Vincent	IV.	*Kansas City, Mo.*	Technology Dormitory, C.

SPECIAL STUDENTS (*continued*)

NAME	COURSE	HOME	RESIDENCE
James, Linda, B.A.	VII.	*Newport, Minn.*	2 Divinity Ave., C.
Jordan, Helen, S.B.	V.	*Dorchester*	60 Cushing Ave., D.
Jorgensen, Virgil Williams	IV.	*Cambridge*	37 Langdon St., C.
Keesler, Edward Yates, A.B., M.S.	VI.	*Charlotte, N. C.*	1018 Beacon St., Br.
Kenway, Florence Louise, S.B.	V.	*Newton*	85 Lombard St., N.
Kline, Franklin Latimore	IV.	*Chattanooga, Tenn.*	44 The Fenway, B.
Knox, Cornelius Van Santvoord, A.B.	I.	*New Brunswick, N. J.*	Technology Dormitory, C.
Labarrère, Jacques Louis, B.S.		*Havana, Cuba*	9 Magazine St., C.
Lahee, Louie, A.B.		*Cambridge*	42 Concord Ave., C.
Lederer, Arthur, M.D.	VII.	*Chicago, Ill.*	51 St. Stephen St., B.
Little, Harold Greenleaf, B.Sc.	VII.	*Newburyport*	70 Purchase St., Np.
Lohmeyer, William, Jr., S.B.	I.	*Charleston, W. Va.*	59 Magazine St., C.
Loo, Pang Chieh, B.S., E.M.	III.	*Shanghai, China*	1075 Boylston St., B.
McClurg, Verner Blackmore, A.B.	IV.	*Los Angeles, Cal.*	Technology Dormitory, B.
Mackler, Max Joseph	VII.	*New Bedford*	1038 Boylston St., B.
McLaughlin, Edward Henry, B.S.	XV.	*Los Angeles, Cal.*	297 Newbury St., B.
Markus, Fritz Emil	IV.	*Lawrence*	20 Norris St., Law.
Maxfield, Horatio Winfred	II.	*Portland, Me.*	54 Columbia St., C.
Mitsui, Takanaga, B.S.		*Tokio, Japan*	23 Naples Rd., Br.
Montague, Paul Nissen		*Winston-Salem, N. C.*	213 Huntington Ave., B.
Mori, Hyogo	VI, VIII.	*Tokio, Japan*	49 Oxford St., C.
Nakayama, Hisao	VI.	*Tokio, Japan*	15 Ellery St., C.
Nakaye, Seigo	III.	*Kyoto, Japan*	456 Boylston St., B.
Neff, Edwin Wallace	IV.	*Alladena, Cal.*	Hotel Buckminster, B.
Neumann, Harold Carl	IV.	*Des Moines, Ia.*	491 Commonwealth Ave., B.
Nichols, Paul Frothingham, B.S.	VII.	*Malden*	26 Judson St., Mal.
Ockert, Paul, A.B.	IV.	*Cleveland, O.*	336 Commonwealth Ave., B.
Ono, Rfoye, C.E.		*Tokio, Japan*	40 St. Paul St., Br.
O'Reilly, Gerald Joseph	IV.	*Miami, Fla.*	262 Newbury St., B.
Pastorino, Francesco	II.	*Boston*	11 Nassau St., B.
Petter, John Reginald	IV.	*London, Eng.*	43 St. Stephen St., B.
Pond, Walter Franklin, B.S.	III.	*Greenfield*	Technology Chambers, B.
Reed, David Allen, Jr.	IV.	*Springfield*	138 Newbury St., B.
Reinhertz, Nathaniel Allen	IV.	*San Francisco, Cal.*	89 St. James Ave., B.
Riddell, Willard Bruce	IV.	*Hamilton, Ont.*	316 Huntington Ave., B.
Robins, Vernon, M.D.	VII.	*Louisville, Ky.*	14 Garden St., C.
Sampson, Edward, C.E., M.Sc.	III.	*Princeton, N. J.*	9 Norway St., B.
Sargent, John Albert		*Westminster*	79 Magazine St., C.
Schroeder, Fred Ernest	IV.	*Fond du Lac, Wis.*	307 Harvard St., C.
Seely, Clarence Knight	VI.	*Springfield*	80 Park St., L.
Shields, Edward James	IV.	*Somerville*	332 Summer St., Som.
Skogstad, Herbert William	IV.	*La Crosse, Wis.*	316 Huntington Ave., B.
Songkla, Prince of Siam	VII.	*Bangkok, Siam*	48 Brattle St., C.
Spitz, Gertrude Theresa, A.B.	VII.	*Brookline*	1455 Beacon St., Br.
Stearns, Harry Chandler	IV.	*Oakland, Cal.*	98 Hemenway St., B.
Steelsmith, Daniel Clarence, M.D.	VII.	*Melvin, Ia.*	3 Hancock Park, C.
Swain, Robert Burrough, A.B.	II.	*Pomfret, Conn.*	39 Dwight St., Br.
Tayntor, Lewis Olds.	VII.	*Erie, Penn.*	38 Hemenway St., B.
Tenney, Elmer Seth, A.B., M.D.	VII.	*Fort Warren*	Fort Warren

SPECIAL STUDENTS (*continued*)

NAME	COURSE	HOME	RESIDENCE
Turner, Clair Elsmere, A.B., A.M.	VII.	*Harmony, Me.*	263 Highland Ave., Som.
Wan, Tu-shing, B.Sc.	V.	*Hong Kong, China*	25 Trowbridge St., C.
White, Chandler Tubbs, B.S.	V.	*Concord, N. H.*	290 Massachusetts Ave., C.
Williams, Arthur Sease, B.S.	V.	*Columbia, S. C.*	957 Massachusetts Ave., C.
Williford, Forrest Estey, U.S.A.	II.	*Allston*	25 Chester St., A.
Wilmot, Frank Alonzo, M.D., A.B.	VII.	*Lincoln, Neb.*	599 Columbus Ave., B.
Woodruff, George Waldo	II.	*Atlanta, Ga.*	263 Newbury St., B.
Wright, Henry Wagner, B.A.	IV.	*Danvers*	241 Locust St., Dan.
Wylde, Russell Arthur, A.B.	VII.	*Lawrence, Mass.*	43 St. Stephen St., B.
Yen, Fuchun, A.B., M.D.	VII.	*Shanghai, China*	123 St. Botolph St., B.

UNCLASSIFIED STUDENTS

[The numeral following the name indicates the year of the major subjects taken by the student.]

NAME	COURSE	HOME	RESIDENCE
Alexander, Carleton Ernest [1]		*St. Albans, Vt.*	Technology Chambers, B.
Anable, Anthony [1]		*New York, N. Y.*	44 The Fenway, B.
Andersen, Oscar William [2]	II.	*Muskegon, Mich.*	307 Harvard St., C.
Anderson, George William [1]		*Dorchester*	21 Raven St., D.
Angell, Cyril Matthew [3]	VIII.	*Attleboro*	1067 Beacon St., Br.
Ash, Prentice Durfey [1]		*Brooklyn, N. Y.*	44 The Fenway, B.
Avery, Julian Miles [3]	XIV.	*Framingham*	512 Commonwealth Ave., B.
Babbitt, Frank Madison [2]	II.	*Fairhaven*	343 Harvard St., C.
Badger, Edward Franklin [1]		*Hyde Park*	6 Water St., H. P.
Barnes, Dana Avery [3]	IV.	*Boston*	916 Beacon St., B.
Barrett, Herbert William [2]	XV.	*Somerville*	115 Cedar St., Som.
Barrett, Sherman Joseph [1]		*Lawrence*	43 West St., Law.
Barry, Edwin Fry, B.S. [4]	VI.	*Marshall, Tex.*	336 Commonwealth Ave., B.
Bassett, Clarence Eustus [3]	XV.	*Taunton*	8 King St., T.
Bassett, William Hastings, Jr. [2]	X.	*Cheshire, Conn.*	203 Bay State Rd., B.
Bates, John Harold [1]		*Brookline*	1537 Beacon St., Br.
Baum, George Lockhart [2]	III.	*Washington, Pa.*	203 Bay State Rd., B.
Beadle, Walter Jay [4]	II.	*Lima, N. Y.*	Technology Dormitory, C.
Becker, James Howard [2]	II.	*Clyde, O.*	261 Newbury St., B.
Bell, Dudley Edwards [4]	XV.	*Bristol, Pa.*	484 Beacon St., B.
Benson, Arthur Francis [4]	II.	*Wenonah, N. J.*	173 St. Botolph St., B.
Berliner, Henry Adler [3]	II.	*Washington, D. C.*	Riverbank Court, C.
Bermingham, Franklin Andrews [2]	IV.	*Allerton*	1705 Com'w'lth Ave., Bri.
Bertelsen, Paul Jens [4]		*Winthrop*	336 Commonwealth Ave., B.
Best, Theodore Harding, Jr. [1]		*Dorchester*	2 Chamblet St., D.
Betts, Erving Goodwin [3]	VI.	*Newburyport*	Technology Dormitory, C.
Bigler, Paul Gray [1]		*St. Augustine, Fla.*	85 Newbury St., B.
Blake, Arthur Henry [2]	II.	*Wollaston*	261 Safford St., Wol.
Blanchard, Raymond Hall [4]	X.	*Malden*	38 Barrett St., Mal.
Bliss, George [2]	VI.	*Washington, D. C.*	1067 Beacon St., Br.
Blodgett, James Herbert [1]		*Lexington*	17 Grant St., Lex.
Blood, Roderic Miller [2]	XV.	*Newton Center*	20 Orient Ave., N. C.
Boley, Frederick William [2]	IV.	*Buenos Aires, Argentina*	526 Beacon St., B.
Bolotin, Jacob Joseph [3]	II.	*Youngstown, O.*	149 Austin St., C.
Bomar, Ernest Cleveland, A.B., A.M. [2]	XV.	*Spartanburg, S. C.*	428 Newbury St., B.
Bond, Nelson Arthur [3]	XI.	*Roxbury*	203 Bay State Rd., B.
Bonneval, Henry Antoine de, B.S. [2]	II.	*New Orleans, La.*	212 Bay State Rd., B.
Boright, William Nelson [1]		*Mansonville, Que.*	64 Wendell St., C.
Bossert, Theodore William [1]		*Milwaukee, Wis.*	283 Newbury St., B.
Bouknight, William Miller, B.S. [3]	VI.	*Johnston, S. C.*	916 Beacon St., B.
Bragdon, Stanley Bryant [2]	XV.	*Westbrook, Me.*	218 Newbury St., B.
Britton, Frederick Schall [2]	VI.	*Lexington*	8 Bedford St., Lex.

UNCLASSIFIED STUDENTS (*continued*)

NAME	COURSE	HOME	RESIDENCE
Brodrick, Ralph Wilson [1]		*Sterling, Ill.*	Technology Dormitory, C
Brooks, Edward Pennell [4]	XV.	*Westbrook, Me.*	526 Beacon St., B.
Brooks, Ralph Frederick Fleming [4]	I.	*Roxbury*	47 Julian St., R.
Brown, Edward [2]	II.	*Dorchester*	243 Harvard St., D.
Brown, Louis Armistead, Jr.[2]	IV.	*Charlottesville, Va.*	38 Bigelow St., C.
Brown, Louis Joseph [2]	II.	*Roxbury*	133 Warren St., R.
Brown, Orlando Wendell [1]		*Sanford, Me.*	22 Lakeview St., Arl.
Brown, Willis Clark [2]	VI.	*Ashland*	7 Harcourt St., B.
Bruner, Meylert, Jr.[1]		*Newton*	206 Waverly Ave., N.
Bryant, Eliot Hoxie [2]	X.	*Woonsocket, R. I.*	8 Highland St., Woon.
Bryne, Perry Bush [2]	XV.	*Allston*	1056 Commonwealth Ave., A.
Buckley, John Edward, Jr.[2]	VI.	*Nashua, N. H.*	13 Hall Ave., Nash.
Burnham, Brainerd Cogswell [2]	VI.	*South Essex*	Technology Dormitory, C.
Burr, Samuel Huntley, Jr.[1]		*Brooklyn, N. Y.*	Technology Dormitory, C.
Burt, George Henry [1]		*Urbana, Ill.*	203 Bay State Rd., B.
Burton, Oliver Donn [3]	V.	*Asbury Park, N. J.*	5 Park Vale, Br.
Burton, Wesley Hopkins [1]		*Plainville*	40 School St., Plainville.
Butler, Alexander Short [3]	XIII.	*Penryn, Cal.*	512 Commonwealth Ave., B.
Butler, Harold Bernard [3]	V.	*Brookline*	316 Harvard St., Br.
Butter, Harold Martin [2]	III.	*Roxbury*	23 Wabon St., R.
Callanan, Francis Joseph [2]	VI.	*Keeseville, N. Y.*	281 Payson Rd., Bel.
Calvert, Albert [1]		*Brookline*	Clyde St., Br.
Cameron, Edwin John [3]	VII.	*Cambridge*	99 Garden St., C.
Cammann, Oswald, Jr.[2]	XV.	*Dayton, O.*	1067 Beacon St., Br.
Campbell, Dugald Wylie [2]	VI.	*Lawrence*	239 Bailey St., Law.
Campbell, Tristram Joseph [3]	VIII.	*Dorchester*	123 Ashmont St., D.
Capps, Court Brooke [1]		*Fort Worth, Tex.*	179 Bay State Rd., B.
Carleton, Charles DuBois [1]		*New York, N. Y.*	Technology Dormitory, C.
Carlson, Carl Edward [1]		*Hartford, Conn.*	Technology Dormitory, C.
Carlton, Arthur Clifford [4]	III.	*Baltimore, Md.*	Technology Dormitory, C.
Carpenter, Fontinelle Scott [1]		*Chelsea*	123 Washington Ave., Ch.
Cashin, Richard Francis, Jr.[2]	V.	*Cambridge*	31 Blackstone St., C.
Cassidy, John Edward [3]	VI.	*Roxbury*	6 Carmel St., R.
Castor, Amasa Hungerford [2]	VI.	*Manchester, N. H.*	50 Astor St., B.
Catlin, Nino Tesher [3]	II.	*New Haven, Conn.*	493 Commonwealth Ave., B.
Chamberlain, Samuel Vance [3]	IV.	*Aberdeen, Wash.*	47 St. Botolph St., B.
Chandler, Lester Van Deventer [2]	VII.	*Plainfield, N. J.*	Technology Dormitory, C.
Chase, John Howe, B.S.[3]	I.	*Riverside, Cal.*	34 Massachusetts Ave., B.
Chen, Chun-yang [3]	III.	*Shanghai, China*	1075 Boylston St., B.
Church, Arthur Albert [4]	VI.	*Roxbury*	21 Alaska St., R.
Claflin, Frederick Evarts [2]		*Marlboro*	237 Beacon St., B.
Clark, James Lomax [3]	XV.	*Newton*	80 Claremont St., N.
Clarke, William John [3]	II.	*Cambridge*	20 Chilton St., C.
Clarkson, John Wheeler [3]	XV.	*Newburyport*	Technology Dormitory, C.
Clarkson, Joseph Jennings [4]	II.	*New Haven, Conn.*	336 Commonwealth Ave., B.
Clayton, Henry Comyn [3]	XIV.	*Canton*	261 Newbury St., B.
Clayton, Lawrence Locke [4]	XIV.	*Canton*	261 Newbury St., B.
Cochrane, Clarence [3]	II.	*Melrose*	63 Howard St., Mel.
Coit, Elizabeth [2]	IV.	*Winchester*	15 Hillside Ave., Winc.
Colby, Lawrence Carlton [2]	XV.	*Beverly*	132 Dodge St., Bev.
Coldwell, John Sharples [2]	VI.	*South Swansea*	179 Bay State Rd., B.

UNCLASSIFIED STUDENTS (*continued*)

NAME	COURSE	HOME	RESIDENCE
Coleman, Francis Thomas [2]	II.	*Campello*	26 St. Germain St., B.
Colley, William Clarence [2]	IV.	*Nashville, Tenn.*	282 Massachusetts Ave., C.
Collier, Robert Thach [3]	I.	*Salt Lake City, Utah*	179 Bay State Rd., B.
Collins, Hubert Walter, S.B., A.M. [4]	I.	*Holly Springs, N. C.*	16 Grays Hall, C.
Collins, Virgil Dewey [1]		*Congers, N. Y.*	84 St. Stephen St., B.
Connett, Harold, B.A. [3]	X.	*New York, N. Y.*	Drayton Hall, C.
Conniers, Norman Douglas [2]		*Covington, Ky.*	Technology Dormitory, C.
Connors, Myles Francis [2]	I.	*Washington, D. C.*	499 Audubon Rd., B.
Cook, Charles Cheveau [2]	X.	*Washington, D. C.*	418 Newbury St., B.
Cook, Jere Hewett [2]	I.	*Boston*	108 Hemenway St., B.
Coombs, Richard Horace [2]	X.	*Waltham*	99 Norfolk St., C.
Cormier, Henri Joseph, A.B. [1]		*Waltham*	192 Felton St., Wal.
Coyle, John Henry [1]		*Hartford, Conn.*	18 Inman St., C.
Coyne, Harry John [3]	I.	*Cambridge*	60 Holworthy St., C.
Creedon, Walter Jeremiah [2]	I.	*Brockton*	285 Moraine St., Brock.
Crosby, Irving Ballard [3]	XII.	*Jamaica Plain*	9 Park Lane, J. P.
Crowell, Christopher Chase [3]	II.	*Campello*	104 St. Botolph St., B.
Crowley, John William Arthur [1]		*Boston*	3 Cobden St., B.
Cruise, Edward Richard [1]		*Lynn*	20½ New Park St., L.
Cunningham, Kenneth MacLean [2]	II.	*Rochester, N. Y.*	973 Massachusetts Ave., C.
Cunningham, Lawrence, [3] A.B.	VI.	*Brookline*	135 Ivy St., Br.
Curtis, Ingraham [2]	VI.	*Corning, N. Y.*	334 Harvard St., C.
Damon, John Warren [3]	XV.	*Plymouth*	334 Harvard St., C.
Dasso, Luis [2]	IV.	*Lima, Peru*	246 Newbury St., B.
Davis, Guy Hammett [2]	XIV.	*El Paso, Texas*	179 Bay State Rd., B.
Davis, Raymond Edward [1]		*Brookline*	122 Park St., Br.
Dean, James Lindley [1]		*Andover*	Technology Dormitory, C.
Deane, Andrew [2]	II.	*Wollaston*	853 Hancock St., Wol.
deLeon, Sancho Balantacbo, A.B. [3]	I.	*Santa Cruz, P. I.*	316 Huntington Ave., B.
DeMerritt, Robert Elwyn [3]	I.	*Reading*	119 Haven St., Read.
Demond, Daniel Bradford [3]	X.	*Boston*	237 Beacon St., B.
Dennen, William Llewellyn [3]	XII.	*Gloucester*	63 Dana St., C.
Dennison, Edward Stanford [3]	I.	*Mexico City, Mex.*	74 Reservoir St., C.
Dexter, Franklin Closson [4]	VI.	*Brookline*	129 Dean Rd., Br.
Dixon, Enslo Smith [3]	V.	*Boston*	50 Peterborough St., B.
Doe, Albion [1]		*San Francisco, Cal.*	529 Mass. Ave., B.
Dorr, Herbert Reedy [1]		*Dalton, Ga.*	7 Cleveland St., C.
Downey, James Francis, Jr. [1]		*Boston*	144 Warren Ave., B.
Dowsley, Felix Raymond [3]	II.	*Cambridge*	11 Everett St., C.
Drew, Charles Wayland, Jr. [2]	XV.	*Minneapolis, Minn.*	104 Charles River Rd., C.
Drury, Eric William [3]	IV.	*Victoria, B. C.*	82 Huntington Ave., B.
Duffy, Christopher William [1]		*Watertown*	285 Arsenal St., Wat.
Duffy, Herbert Lewis [2]	XIII.	*Cambridge*	414 Walden St., C.
Dumas, Albert-Victor [1]		*St. Casimir, Que.*	15 Columbia St., C.
Dunning, Stanley Covert [3]	XV.	*Cambridge*	491 Commonwealth Ave., B.
DuVernet, John Neville [1]		*Jamaica Plain*	7 Glade Ave., J. P.
Duyos, Oscar [1]		*Havana, Cuba*	3 Revere St., J. P.
Dyer, Herbert Arthur [3]	II.	*Schenectady, N. Y.*	28 Richardson Rd., N. U. F.
Dziadik, Walter Basil [1]		*Derby, Conn.*	146 Austin St., C.
Edgarton, Lewis Stearns [2]	XV.	*Fulton, N. Y.*	41 Granite St., C.
Edmonds, Reginald Whitney [1]		*Roslindale*	86 Hewlett St., Ros.

UNCLASSIFIED STUDENTS (*continued*)

NAME	COURSE	HOME	RESIDENCE
Ellsworth, Alfred Augustus [1]		*Braintree*	117 Adams St., Brain.
Elwell, Fenton Groves [2]	II.	*Waltham*	30 Crafts St., Wal.
Ely, Dinsmore [3]	IV.	*Winnetka, Ill.*	200 Bay State Rd., B.
Elz, George Adolph [3]	VI.	*Jamaica Plain*	86 Orchard St., J. P.
Emerson, William Key Bond, Jr., A.B.[2]	II.	*New York, N. Y.*	20 Haviland St., B.
Fairbanks, Robert Dow [2]	X.	*Newton Highlands*	21 Carver Road, N. H.
Fales, Herbert Gordon [2]	II.	*West Newton*	145 Highland St., W. N.
Falkenberg, John Joseph [2]		*Kansas City, Mo.*	115 Gainsborough St., B.
Falkenberg, Robert Lawrence [2]	I.	*Kansas City, Mo.*	115 Gainsborough St., B.
Farrer, John Arnold, Jr.[1]		*Cambridge*	28 Hurlbut St., C.
Farrington, Arthur Everett [2]	I.	*Roxbury*	19 Waumbeck St., R.
Farrow, Edward Samuel, Jr.[1]		*Asbury Park, N. J.*	1045 Beacon St., Br.
Fennessey, Elizabeth Mary, B.S.[3]	VII.	*Boston*	25 Decatur St., B.
Fields, Edwin Simon, Jr.[2]	I.	*Dorchester*	9 Maybrook St., D.
Fisher, James Carl, B.S.[4]	VI.	*Martinsburg, W. Va.*	261 Newbury St., B.
Fisher, William Penn, Jr.[3]	X.	*Glen Ridge, N. J.*	203 Bay State Rd., B.
Fisk, Harry Howland, B.A.[3]	VI.	*Green Bay, Wis.*	427 Marlborough St., B.
Flather, Ralph Francis [2]	IV.	*Nashua, N. H.*	512 Commonwealth Ave., B.
Fleming, George Grimes [2]	III.	*Washington, D. C.*	1067 Beacon St., Br.
Flint, James Arthur [3]	II.	*Denver, Colo.*	44 No. Beacon St., A.
Fogarty, Thomas Smith [3]	XV.	*Plymouth*	Technology Dormitory, C.
Fogler, Florence [1]		*Billings, Mont.*	79 Chandler St., B.
Ford, Frederic Leslie [3]	IV.	*New Bedford*	132 Glenville Ave., A.
Fraser, Alfred Alexander [1]		*Wellesley*	65 Linden St., Wel.
Freed, Samuel [4]	V.	*Cambridge*	40 Market St., C.
Freeman, Wilbur Herbert [2]	II.	*Dorchester*	8 Humphreys Place, D.
French, Herbert Nichols, B.A.[4]	VI.	*Brookline*	40 Gardner Rd., Br.
Fuess, Carl Andrew, B.S.[4]	IV.	*Cuero, Tex.*	558 Newbury St., B.
Fuller, Samuel [3]	I.	*East Bridgewater*	East Bridgewater.
Fulreader, Oscar John [2]	IV.	*Rochester, N. Y.*	615 Washington St., Br.
Gardner, Joseph Paul [3]	IV.	*Los Angeles, Cal.*	61 Avon St., Som.
Garnsey, Arlo Ellsworth [2]	VI.	*White Plains, N. Y.*	526 Beacon St., B.
Gartner, Walter Christian Frederick [4]	I.	*Jamaica Plain*	283 Newbury St., B.
Gay, Grant Elliott [2]	X.	*Worcester*	65 Astor St., B.
Gay, Robert Neil, A.B.[3]	XV.	*Waco, Tex.*	104 Charles River Rd., C.
Geisler, Hugo Paul, Jr.[3]	VI.	*Saginaw, Mich.*	Technology Dormitory, C.
Gibbons, Thomas Manning [4]	I.	*Milton*	61 Warren Ave., Mil.
Gibbs, Egerton Fairbanks [1]		*Port Arthur, Ont.*	77 Pearl St., C.
Gidley, Robert Titus [3]	IV.	*Springfield*	7 Berwick Park, B.
Giles, Henry Cunning [2]	I.	*Anchorage, Ky.*	336 Commonwealth Ave., B
Gillett, Laurence Arnold [3]	XI.	*Newburyport*	92 Bromfield St., Np.
Gleason, Harold Low [3]	VI.	*Dorchester*	8 Peacevale Rd., D.
Gleason, Robert Winfred [2]	I.	*Framingham*	3 Summit St., Fram.
Goddard, Ross Eugene [2]	IV.	*Wurtsboro, N. Y.*	131 Newbury St., B.
Gokey, George Frank, Jr.[1]		*Jamestown, N. Y.*	200 Bay State Rd., B.
Gore, Edward Watson, A.B.[3]	II.	*Medford*	45 Brooks St., W. Med.
Gould, Gardner Seabury [2]	II.	*Fitchburg*	526 Beacon St., B.
Green, Grant Dickson, Jr.[2]	X.	*Syracuse, N. Y.*	427 Marlborough St., B.

UNCLASSIFIED STUDENTS (*continued*)

NAME	COURSE	HOME	RESIDENCE
Greenewald, Herbert, B.S.[4]	V.	*Moorestown, N. J.*	343 Harvard St., C.
Griffin, Arthur Ernest [2]	I.	*Boston*	290 Massachusetts Ave., C.
Grohe, Robert Ferdinand [3]	VI.	*Roxbury*	3 Westerly St., R.
Groisser, Bennet Meyer [1]		*Roxbury*	48 Devon St., R.
Grosscup, Henry Arthur [2]	XIII.	*Camden, N. J.*	543 Boylston St., B.
Grossman, Alfred Paul [3]	III.	*Melrose*	18 Holbrook Ct., Mel.
Hadley, Henry Simmons [2]	V.	*Englewood, N. J.*	202 Maplewood Ave., Wat.
Hafner, Victor Leonard Simon [4]	IV.	*Boston*	34 Appleton St., B.
Haigh, Herbert Richard [3]	VI.	*Methuen*	4 Annis St., Meth.
Hall, Irving Gilmore, Jr.[3]	II.	*Somerville*	336 Commonwealth Ave., B.
Hall, Walter Turnbull [2]	X.	*Glencoe, Ill.*	120 Mt. Auburn St., C.
Hamilton, Arthur Leo [3]	II.	*Boston*	718 Commonwealth Ave., B.
Hardy, James Barron [1]		*Boston*	89 St. James Ave., B.
Hartman, Lewis Evans [2]	II.	*Lancaster, Pa.*	526 Beacon St., B.
Harvey, Arthur Ross [2]	X.	*Middletown, O.*	74 Oxford St., C.
Hatten, Earl Robert [3]	I.	*Waco, Tex.*	Technology Dormitory, C.
Heath, Carl Jeffrey [4]	II.	*Stockbridge*	150 Otis St., Nv.
Hedin, Conrad Hanson [2]	VI.	*Cambridge*	367 Harvard St., C.
Herczel, Richard Edmund [1]		*Chicago, Ill.*	29 Inman St., C.
Herman, Ervine Olney [3]	VIII.	*Allston*	21 St. Luke's Rd., A.
Hewitt, Perry Anderson [3]	V.	*Montgomery, Ala.*	200 Bay State Rd., B.
Heyl, Robert Chapman, Jr., A.B.[3]	VI.	*Wynnewood, Pa.*	304 Craigie Hall, C.
Hickman, Ernest Trammel [3]	II.	*Lake Wales, Fla.*	953 Massachusetts Ave., C.
Hill, Francis Thomas [1]		*Canton*	45 Sherman St., Can.
Hill, Lucius Tuttle [4]	XV.	*Longwood*	493 Commonwealth Ave., B.
Hinckley, Nelson Crosby [3]	XV.	*Vineyard Haven*	178 Huntington Ave., B.
Hoffman-Pinther, Lincoln [2]	X.	*Mexico City, Mex.*	526 Beacon St., B.
Hollender, Edward August [1]		*Woodhaven, L. I.*	134 Redlands Rd., W. R.
Holta, Johan [3]	VI.	*Skien, Norway*	225 Newbury St., B.
Homer, Joseph Warren, Jr.[2]	XV.	*Brookline*	38 Webster Pl., Br.
Horton, Freeman Hudson [3]	I.	*Bradentown, Fla.*	12 Newbern St., J. P.
Howard, Edward Millard [2]	X.	*Danbury, Conn.*	47 West Cedar St., B.
Howlett, Walter Maynard [2]	XV.	*Cambridge*	23 Irving St., C.
Hubbard, Eben Russell [2]	VI.	*Newton*	65 Washington St., N.
Hubbell, Richard Van Arsdale [1]		*Lexington*	6 Parker St., Lex.
Huckins, Edgar Wolcott [3]	XV.	*Roxbury*	40 Crawford St., R.
Hughes, Thomas Lewis [1]		*Canton*	50 Eliot St., Can.
Hulseman, Giles Daniel [3]	VI.	*Kansas City, Mo.*	512 Commonwealth Ave., B.
Insley, Robert [2]	II.	*Nanuet, N. Y.*	Technology Dormitory C.
Jensen, Harold Camillo [1]		*Savannah, Ga.*	820 Mass. Ave., C.
Jermain, Herbert Foster [3]	XIV.	*Stamford, Conn.*	316 Huntington Ave., B.
Johnson, Andrew Ture [1]		*Dorchester*	27 Topliff St., D.
Johnson, Arthur Kimbal [4]	VII.	*Andover*	838 East Second St., S. B.
Johnston, Norwood Paxton [2]	III.	*Pittsburgh, Pa.*	44 The Fenway, B.
Jones, Clyde Charles [2]	VI.	*Cambridge Springs, Pa.*	21 Cottage St., C.
Jones, Edward Vaughn [1]		*Cumberland, Md.*	104 Ames St., C.
Jones, Hosmer Creed [2]	IV.	*Dorchester*	6 Magnolia St., D.
Kaiser, Karl Herman [3]	IV.	*Boston*	18 Haviland St., B.
Katz, Harry Leon [3]	I.	*Malden*	100 Granville Ave., Mal.
Kaupe, Arthur Friedrich [2]	III.	*New York, N. Y.*	916 Beacon St., B.
Keating, Clarence Edward [2]	II.	*Bridgeport, Conn.*	57 Hemenway St., B.

UNCLASSIFIED STUDENTS (*continued*)

NAME	COURSE	HOME	RESIDENCE
Keeler, Harold Young [3]	XV.	*Ridgefield, Conn.*	44 The Fenway, B.
Kennard, Richmond Parry [3]	VI.	*Brookline*	428 Charles River Rd., C.
Kennedy, Parker Henry [3]	II.	*Middleboro*	336 Commonwealth Ave., B.
Kent, Edmund Randolph [3]	VI.	*Berkeley, Cal.*	39 Austin St., C.
Kimball, Wirt Fuller [2]	XV.	*Brookline*	210 Winthrop Rd., Br.
Kingsbury, Chester Lyman [3]	XV.	*Keene, N. H.*	526 Beacon St., B.
Kleinschmidt, Helen, A.B. [3]	IV.	*Johnstown, Pa.*	45 Oxford St., C.
Knight, Arthur Raymond [4]	X.	*Newburyport*	21 Bromfield St., Np.
Knowland, Thomas Millbury [3]	X.	*Newburyport*	49 Green St., Np.
Knudsen, Rolf [3]	XIV.	*Borkestad, Norway*	225 Newbury St., B.
Kuhns, Austin, B.A. [4]		*Middletown, Conn.*	8 Mellen St., C.
Kwan, Sung-sing [3]	IV.	*Tientsin, China*	96 St. James Ave., B.
Lafean, Raymond Guy [2]	X.	*York, Pa.*	517 Beacon St., B.
Lane, Stanley Mayall [4]	X.	*Brookline*	82 Evans Rd., Br.
Langille, Wilfred Otto [2]	VI.	*Jamaica Plain*	148 Paul Gore St., J. P.
Langlan, Joseph Gould [1]		*Roslindale*	25 Lorraine St., Ros.
Laskey, William Gallup [4]	VI.	*Boston*	Hotel Puritan, B.
Law, Granville Raymond [2]	IV.	*Fort Madison, Ia.*	1675 Massachusetts Ave., C.
Lawson, Charles Judson [1]		*Philadelphia, Pa.*	316 Huntington Ave., B.
Lee, Marshall Baldwin [2]	II.	*Clinton*	1758 Beacon St., Br.
Lee, Wee Kua [3]	II.	*Chengchow, China*	898 Massachusetts Ave., C.
Lehmkuhl, Joakim [3]	VI.	*Bergen, Norway*	Riverbank Court, C.
Leland, Roger Maxwell [2]	II.	*Wellesley Hills*	6 Arlington Rd., Wel. H.
Leonard, Julian Tobey [3]	XV.	*Boston*	484 Beacon St., B.
Leonard, Paul Cooledge [4]	XV.	*Brookline*	1067 Beacon St., Br.
Libby, Alton Everett [1]		*Vinalhaven, Me.*	69 Babcock St., Br.
Liebensberger, Merrill Clifford [4]	IV.	*Hazelton, Pa.*	517 Beacon St., B.
Likins, Charles Cecil [2]	IV.	*Springfield, Mo.*	21 Bigelow St., C.
Litchfield, Allyne Cushing [3]		*New York, N. Y.*	Arnold Circle, C.
Little, Charles Edmund [2]	II.	*Melrose*	95 Malvern St., Mel.
Liu, Gee Call [3]	I.	*Hong Kong, China*	820 Massachusetts Ave., C.
Lloyd, Thomas Morse [2]	VI.	*Portsmouth, O.*	333 Massachusetts Ave., B.
Lloyd, William Kenyon [1]		*Cambridge*	44 Bigelow St., C.
Lobdell, Harold Edward [4]	IV.	*Watervliet, N. Y.*	203 Bay State Rd., B.
Lockwood, Ralph Cooper [2]	VII.	*Saratoga Springs, N. Y.*	124 Huntington Ave., B.
Long, Charles Clarke [3]	VI.	*Hull*	316 Huntington Ave., B.
Loucks, Milton Albert [2]	II, VI.	*Gloversville, N. Y.*	Technology Dormitory, C.
Loutski, Robert, B.S. [3]	VI.	*Boston*	Technology Dormitory, C.
Lovejoy, Donald Hill [2]	IV.	*Portland, Me.*	Technology Dormitory, C.
Lutz, William Edmund Aloysius [3]	VI.	*Somerville*	102 Prospect St., Som.
MacAlister, Alexander Goodall, Jr. [3]	VI.	*Camden, N. J.*	Technology Dormitory, C.
MacAskill, Donald [3]	IV.	*Salem Depot, N. H.*	Salem Depot, N. H.
McCann, Russell Bowen [3]	XIII.	*North Attleboro*	176 Elm St., N. At.
McCarthy, Louis Augustine [2]	VI.	*Minneapolis, Minn.*	29 Inman St., C.
McCausland, John Woods [4]	II, VI.	*Chicago, Ill.*	Technology Dormitory, C.
McClellan, James Lewis [3]	V.	*Dorchester*	83 Esmond St., D.
McClintock, Rodman [1]		*Pittsburgh, Pa.*	44 The Fenway, B.
McCloskey, John, Jr. [1]		*Dorchester*	14 Ashmont St., D.
McCreery, George William [2]	I.	*Fall River*	316 Huntington Ave., B.
McDonald, James William, Jr. [1]		*Marlboro*	23 Prospect St., Mar.

UNCLASSIFIED STUDENTS (*continued*)

NAME	COURSE	HOME	RESIDENCE
McDougall, James Greenwood [4]	VII.	*Franklin, N. H.*	283 Newbury St., B.
Macfarland, Arthur Wendell [2]	II.	*Wollaston*	226 Arlington St., Wol.
McFarland, David Meconkey [3]	X.	*West Chester, Pa.*	Technology Dormitory, C.
McGill, Francis John [1]		*Dorchester*	16 Corona St., D.
McGreenery, Paul Aloysius [3]	II.	*Winchester*	32 Calumet Rd., Winc.
McGuire, Waldemar Stanwood [3]	X.	*Revere*	78 Highland St., Rev.
Macheca, George Michael, A.B.[3]	VI.	*New Orleans, La.*	421 Marlborough St., B.
McIntosh, Alan Henderson [2]	III.	*West Roxbury*	29 Westover St., W. R.
McIntosh, Harold Wales [2]	VI.	*Needham*	431 Great Plain Ave., Need.
McKinley, Malcolm Robertson [2]	XV.	*Lowell*	474 Beacon St., Low.
MacKirdy, Howard Spencer, A.B.[2]	I.	*New Britain, Conn.*	15 Lee St., C.
Madancy, Sarkis Mardiros [3]	I.	*Huseynig, Turkey*	274 Spruce St., Ch.
Maguire, James Francis, Jr.[4]	V.	*Allston*	1398 Com'w'lth Ave., A.
Maizlish, Israel [2]	VIII.	*Lynn*	40 Blossom St., L.
Mandelbaum, Isadore [2]		*Lawrence*	29 Spruce St., Law.
Manny, Constantine Christ [2]	I.	*Koritza, Albania*	70 W. Newton St., B.
Manuelian, Hamazasb Der [3]	XV.	*Lowell*	323 Columbia St., C.
Mardoian, Haroutune Hagop [2]	I.	*Aintab, Turkey*	71 Montgomery St., B.
Marine, James Sidney [3]	II.	*Brooklyn, N. Y.*	336 Commonwealth Ave., B.
Markham, John Raymond [3]	II.	*Cambridge*	91 Thorndike St., C.
Marshall, Harold Francis [2]	II.	*Cranford, N. J.*	283 Newbury St., B.
Mayo, Sheldon Smith [2]	VI.	*Gloucester*	7 Harcourt St., B.
Meader, John [2]	XV.	*Boston*	203 Bay State Rd., B.
Means, Leland Munger [4]	XV.	*Shreveport, La.*	44 Francis St., Br.
Meloy, Thomas K., A.B.[4]	XV.	*New York, N. Y.*	Craigie Hall, C.
Merrill, Herbert Cummings [2]	VII.	*West Somerville*	90 Curtis St., W. Som.
Merrill, Leland Hawthorne [2]	VI.	*Melrose Highlands*	54 Woodland Ave., Mel. H.
Merryweather, Weir Orford [1]		*Montclair, N. J.*	225 Newbury St., B.
Mesmer, James Aloysius [1]		*Los Angeles, Cal.*	297 Newbury St., B.
Meyerowitz, Paul [4]	VI.	*Saratow, Russia*	88 St. Botolph St., B.
Miller, Frank Oliver, B.S., C.E.[4]	XI.	*Athens, Ga.*	200 Bay State Rd., B.
Miller, Harold Lionel [3]	II.	*Needham*	35 Dedham Ave., Need.
Mills, Bruce Mortrom [1]		*Rutland, Vt.*	147 Magazine St., C.
Mills, Oliver Adams [1]		*Roxbury*	25 Alaska St., R.
Minard, David P.[2]	XIII.	*Aberdeen, S. D.*	33 Philips St., Wat.
Miskovsky, Robert Joseph [3]	XV.	*Omaha, Neb.*	38 Westland Ave., B.
Monasterio, Henry Rivero [1]		*Cienfuegos, Cuba*	Technology Dormitory, C.
Montgomery, Robert Alfred, B.Sc.[2]	V.	*Ewing, Neb.*	9 Magazine St., C.
Moore, Bernard Stanislaus, Jr., A.B.[2]	VI.	*Syracuse, N. Y.*	1018 Beacon St., B.
Moore, Clinton Douglas [2]	X.	*Allston*	19 Allston Heights St., A.
Moore, James Rhodes [2]	XV.	*Brookline*	104 Charles River Rd., C.
Moran, Francis Aloysius [3]	I.	*Taunton*	47 Friend St., T.
Morse, Benjamin Clarke, Jr.[1]		*Manila, P. I.*	385 Concord Ave., C.
Mulrooney, Thomas Joseph [1]		*Allston*	1384 Commonwealth Ave., A.
Murphie, Harold Hubbard [2]	XIII.	*Dorchester*	102 Talbot Ave., D.
Murphy, Dudley Bowles [2]	VI.	*Winchester*	104 Charles River Rd., C.
Murphy, William Matthew [2]	X.	*Dorchester*	33 Bicknell St., D.
Murray, Albert Francis, B.A.[3]	VI.	*New Decatur, Ala.*	21 Norway St., B.
Murray, Harold James [2]	I.	*Brockton*	37 May Ave., Brock.
Muther, Herbert Carl [2]	VI.	*Newton*	Technology Dormitory, C.

UNCLASSIFIED STUDENTS (*continued*)

NAME	COURSE	HOME	RESIDENCE
Naigles, Myer Harry [1]		*Dorchester*	57 Greenwood St., D.
Nangle, Charles Joseph [3]	X.	*Somerville*	42 Richdale Ave., Som.
Nathan, Thomas Cushman [1]		*Newton Center*	518 Com'w'lth Ave., N. C.
Nelson, Addis Dewey [1]		*Brookline*	85 Perry St., Br.
Nelson, George Augustus, Jr., B.S.[4]	I.	*New York, N. Y.*	Technology Dormitory, C.
Nichols, Bruce Salyers, A.B.[4]	VI.	*St. Louis, Mo.*	45 Beck Hall, C.
O'Brien, James William, Jr.[3]	II.	*Cambridge*	10 Howland St., C.
O'Donnell, Harold Francis [3]	I.	*Taunton*	3 Granite St., T.
O'Hara, Francis Patrick [4]	II.	*Charlestown*	Technology Dormitory, C.
Omelich, Felix Louis [2]	V.	*Detroit, Mich.*	Technology Dormitory, C.
Orcutt, John Wesley [2]	X.	*Dorchester*	324 Franklin St., C.
Osgood, Frank George [3]	X.	*Laconia, N. H.*	23 Fletcher St., Ros.
Page, Arthur Ellsworth [2]	XV.	*Medford*	42 Marion St., Med.
Page, Kenneth Bausman [1]		*Springfield*	491 Commonwealth Ave., B.
Parker, Meredith Francis [2]	X.	*Long Branch, N. J.*	20 Hemenway St., B.
Parkinson, Donald Berthold [3]	IV.	*Los Angeles, Cal.*	104 Charles River Rd., C.
Patten, David Longfellow [3]	XV.	*Brighton*	491 Commonwealth Ave., B.
Paulsen, Carley Herbert [2]	II.	*New York, N. Y.*	Technology Dormitory, C.
Pearson, Joseph Keighley [3]	II.	*Lawrence*	236 Farnham St., Law.
Peart, Frederick Lawther [3]	III.	*Denver, Colo.*	307 Harvard St., C.
Pedersen, Nichol Andrew [1]		*Beverly*	45 Wallis St., Bev.
Pfohl, Roswell Edward Louis [3]	IV.	*Buffalo, N. Y.*	5 Idlewild St., A.
Phelps, Carl Wright [2]	X.	*Springfield*	68 St. Germain St., B.
Pickett, Earle Robinson [3]	VII.	*Georgetown*	24 Andover St., Gtn.
Pierce, Carl Hilton [1]		*West Somerville*	15 Chester Pl., W. Som.
Pierce, George Randall [3]	XV.	*Nashua, N. H.*	491 Commonwealth Ave., B.
Pierce, Marvin, A.B.[3]	I.	*Dayton, O.*	Technology Dormitory, C.
Pierson, Theodore Adolphus, Jr.[3]	II.	*Hopewell, N. J.*	44 Magazine St., C.
Pike, Moses Bernard [1]		*Lubec, Me.*	129 Pembroke St., B.
Pike, William Kenneth [2]	VI.	*Cambridge*	34 Massachusetts Ave., C.
Pinkney, William, Jr.[2]	XV.	*Rowayton, Conn.*	484 Beacon St., B.
Piza, Pedro Antonio [2]	XV.	*San Juan, Porto Rico*	Technology Dormitory, C.
Platt, John Cheney, Jr.[4]	XV.	*Montclair, N. J.*	St. Anthony Hall, Charles River Rd., C.
Polley, Edgarton Goldthwaite [3]	II.	*Waltham*	37 Banks St., Wal.
Polleys, Herbert Rhodes [2]	XV.	*Providence, R. I.*	1004 Beacon St., Br.
Pray, Alfred Newell [3]	X.	*New York, N. Y.*	Technology Dormitory, C.
Prescott, Henry Batchelder [1]		*Franklin, N. H.*	262 Newbury St., B.
Putnam, Harold Marshall [3]	I.	*Lowell*	24 Ivy St., B.
Quick, Lansing Mott [2]	XV.	*Yonkers, N. Y.*	102 St. Botolph St., B.
Ranen, Albert Harold [1]		*Boston*	17 Lowell St., B.
Ranney, Bliss Martin [2]	X.	*Rockland*	245 Howard St., Roc.
Rasmussen, Frederick Jessen [2]	XIV.	*Quincy*	125 Greenleaf St., Q.
Rathbone, Clifford Kyler [1]		*Denton, Tex.*	820 Mass. Ave., C.
Ray, Arthur [2]	II.	*Quincy*	55 Merrymount Rd., Q.
Ray, Leslie Sewall [4]	II.	*Topsfield*	49 Hemenway St., B.
Read, Mahlon Milton [3]		*Cambridge*	69 Mt. Vernon St., C.
Rhodes, Philip Leonard, B.S.[2]	XIII.	*Newark, O.*	47 Rutland Sq., B.
Richards, Alan Gerard [2]	X.	*Dorchester*	37 Burgess St., D.
Richards, George Harrison, A.B.[3]	V.	*Winsted, Conn.*	12 Westland Ave., B.
Roberts, Arthur [2]	XIII.	*Philadelphia, Pa.*	517 Beacon St., B.

UNCLASSIFIED STUDENTS (*continued*)

NAME	COURSE	HOME	RESIDENCE
Roberts, Leland Clifford, A.B.[3]	VI.	*Newton Center*	184 Ward St., N.C.
Robinson, Wirt Russell [3]	I.	*West Point, N. Y.*	428 Charles River Rd., C.
Rockett, Francis Haynes [4]	VI.	*Hingham*	North St., Hingham.
Rogal, Edward [3]	VI.	*Brookline*	30 Claflin Rd., Br.
Rogers, John Winston, A.B.[3]	II.	*Washington, Pa.*	86 Buckingham St., C.
Rogers, Ralph Tupper [3]	VI.	*Medford*	12 Sheridan Ave., Med.
Rogers, Robert Wells [2]	III.	*Chicago, Ill.*	179 Bay State Rd., B.
Role, Morris [2]	II, VI.	*Boston*	34 No. Russel St., B.
Root, George Welles [2]	X.	*Middletown, Conn.*	493 Commonwealth Ave., B.
Ropes, Lawrence Gardner [2]	X.	*New York, N. Y.*	517 Beacon St., B.
Rouse, Arthur Wanton [1]		*Taunton*	49 Oak St., T.
Rowe, William Hugh [1]		*Cambridge*	770 Massachusetts Ave., C.
Russell, Warren King [2]	II.	*Dorchester*	13 Allston St., D.
Russell, Whitney Allen [2]	XV.	*Hyde Park*	82 Dana St., C.
Russert, Walter Richard Carl [3]	III.	*Roxbury*	14 Hillside St., R.
Sada, Francisco Ge, Jr.[4]	XV.	*Monterey, Mex.*	18 St. Botolph St., B.
St. John, Laurence Darius [2]	II.	*New Canaan, Conn.*	216 Newbury St., B.
Salisbury, DeRoss [3]	II.	*Boston*	283 Newbury St., B.
Sanders, Marshall Thomas, A.B.[3]	X.	*Angola, Africa*	161 Hancock St., C.
Sansberry, James Campbell, S.B.[2]	IV.	*Anderson, Ind.*	4 Ames St., C.
Santos, Alexander Heria [2]	II.	*Summit, Pa.*	428 Charles River Rd., C.
Sarafian, Haigh Henry [3]	V.	*Lawrence*	515 Massachusetts Ave., B.
Sattels, Joseph Tillou [3]	XV.	*Plainfield, N. J.*	283 Newbury St., B.
Savage, Russell Heath [2]	XV.	*Greenwood*	Oak St., Gr.
Sawyer, Albert Francis [3]	II.	*Haverhill*	115 Gainsborough St., B.
Schindler, Ernest Francis [2]	I.	*Cambridge*	21 Orchard St., C.
Schroeder, Rolf Alwin [4]	XII.	*Brookline*	53 Westbourne Terrace, Br.
Schur, Albert Paul [2]	VII.	*Boston*	84 Salem St., B.
Schwollman, Alexander [1]		*Jamaica Plain*	119a Green St., J. P.
Scudder, Norman Clark [1]		*Cambridge*	67 Lake View Ave., C.
Scully, James Bennett [2]	III.	*Hyde Park*	1374 River St., H. P.
Seifert, Edgar Frank Karl [2]	V.	*Lawrence*	56 College Ave., W. Som.
Shapero, Hyman Nathan [2]	X.	*Lynn*	14 Crosby St., L.
Shaw, Philip Martin [2]	IV.	*Detroit, Mich.*	517 Beacon St., B.
Shelton, Philo Sherwood [3]	VI.	*Bridgeport, Conn.*	137 Newbury St., B.
Sherman, Edward Mowry [2]	II.	*Marlboro*	142 Hemenway St., B.
Shippey, Webster Batcheller [2]	IV.	*Chicago, Ill.*	4 Ames St., C.
Shultz, Edwin Chester [2]		*Montclair, N. J.*	336 Commonwealth Ave., B.
Sidman, Edward Abraham [3]	II.	*Dorchester*	9 Bradshaw St., D.
Skidmore, William Lorenzo [2]	IV.	*Preston, Idaho*	558 Newbury St., B.
Slator, Grover Cleveland [3]	VI.	*Boston*	38 Westland Ave., B.
Smith, Archer Greenlaw [2]	II.	*Brooklyn, N. Y.*	336 Commonwealth Ave., B.
Smith, Frederick Bradford, Jr.[3]	II.	*Detroit, Mich.*	230 Newbury St., B.
Smith, Frederick Gorham Clark, Jr.[2]	X.	*Greenwich, Conn.*	484 Beacon St., B.
Smith, Maynard Long [3]	XV.	*Bay City, Mich.*	104 Charles River Rd., C.
Smith, Robert Farquharson [3]	V.	*DesMoines, Ia.*	121 St. Stephen St., B.
Smith, Van Dorn Cranford [1]		*Montclair, N. J.*	Technology Dormitory, C.
Smoley, Eugene Ralph [2]	X.	*Scranton, Pa.*	Technology Dormitory, C.
Smyser, Frederic Hawley [2]	XIV.	*Harwich*	22 Beal St., Br.
Smyth, Charles Armstrong [1]		*Dorchester*	21 Larchmont St., D.

UNCLASSIFIED STUDENTS (*continued*)

NAME	COURSE	HOME	RESIDENCE
Southwick, Arthur Maurice [2]	X.	*Waban*	176 Waban Ave., Wab.
Spangenberg, Gilbert Richard [1]		*Harrisburg, Pa.*	15 Lee St., C.
Stagg, Joseph Henry, Jr.[3]	XV.	*Bridgeport, Conn.*	4 Ames St., C.
Stark, Harold Lester.[1]		*Cincinnati, O.*	179 Bay State Rd., B.
Stephens, Henry Caldwell [3]	III.	*Wheeling, W. Va.*	179 Bay State Rd., B.
Stewart, Gordon [1]		*Brookline*	54 University Rd., Br.
Stewart, Howard Raitt [4]	XV.	*Worcester*	334 Harvard St., C.
Stiller, Harry [2]	I.	*Roxbury*	96 Harrishof St., R.
Stockbarger, Donald Charles [2]	XIV.	*Crown Point, Ind.*	7½ Center St., C.
Stokes, Frederick Malcolm [1]		*Malden*	8 Waverly St., Mal.
Stribling, Simpson Ridley, B.S.[4]	VI.	*Waco, Tex.*	484 Beacon St., B.
Sullivan, Joseph William [1]		*Marblehead*	428 Newbury St., B.
Taylor, Merritt Harrison [1]		*Wayne, Pa.*	Technology Dormitory, C.
Thomas, William Pratt, B.S.[2]	XV.	*Prattville, Ala.*	394 Marborough St., B.
Thompson, Phil Richmond [2]	X.	*Dorchester*	111 Wheatland Ave., D.
Thurber, James Perry [2]	VI.	*Milton*	32 Hollis Hall, C.
Thurston, Robert Ray [1]		*New Milford, N. J.*	Technology Dormitory, C.
Timanus, Clarence Sydney [3]	I.	*Kansas City, Mo.*	16 St. Botolph St., B.
Tipton, John Howard [3]	VI.	*Elizabethton, Tenn.*	108 St. Botolph St., B.
Todd, James Madison [3]	X.	*Lexington, Ky.*	104 Charles River Rd., C.
Tooley, Joseph Hicks [2]	II.	*El Paso, Tex.*	Technology Dormitory, C.
Tourtellotte, Neal Everett [4]	IV.	*Boise, Idaho*	179 Bay State Rd., B.
Travers, Frank Alva [3]	X.	*Haverhill*	66 Harvard St., Hav.
Tu, Yu Ching [4]	I.	*Hupeh, China*	546 Newbury St., B.
Tutein, Chester Robinson [3]	II.	*Winchester*	33 Lloyd St. Winc.
Tuttle, Albert Edward [3]	VI.	*Cambridge*	350 The Esplanade, C.
Vakhliotes, John Pantilemon [3]	VI.	*Boston*	147 Appleton St., B.
Van Nesté, Raphael [2]	XIV.	*Dorchester*	28 Algonquin St., D.
van Zelm, Louis Franklin [2]	IV.	*New Rochelle, N. Y.*	104 Charles River Rd., C.
Viano, Alfred Eugene [1]		*Arlington*	5 Winter St., Arl.
von Voss, Ernst Frederick Ditler [2]	X.	*Fredericia, Denmark*	290 Newbury St., B.
Wade, Howard Rossiter [3]	II.	*Cambridge*	4 Carver St., C.
Wales, Arthur Edward [2]	II.	*Brookline*	173 Davis Ave., Br.
Wallace, Stuart Gilbert [3]	V.	*Jamaica Plain*	36 Green St., J. P.
Ward, John Robertson [2]	IV.	*Easton, Pa.*	428 Charles River Rd., C.
Warren, Alfred Lockhart [2]	VI.	*Lowell*	Technology Dormitory, C.
Warriner, Robert Peverell [1]		*Quincy*	80 Goffe St., Q.
Wasgatt, Harold Clinton [2]	X.	*Everett*	512 Commonwealth Ave., B.
Washburn, Frederick Arthur [3]	VI.	*Dorchester*	1 South Sydney St., D.
Wason, Elbridge [1]		*Brookline*	1530 Beacon St., Br.
Watt, Charles Henry [3]	III.	*Lexington*	14 Hill St., Lex.
Weaver, Leon Howard Alexander [2]	II.	*Montclair, N. J.*	200 Bay State Rd., B.
Weiscopf, Marcus William [3]	II.	*Brookline*	1782 Beacon St., Br.
Weiskittel, Francis Anton [2]	XV.	*Baltimore, Md.*	18 Inman St., C.
Welch, William Grow [2]	II.	*Milford*	21 Purchase St., Milf.
Wells, Harold Curtis [3]	IV.	*Watertown*	34 Bates Rd., Wat.
Wells, Howard Hawley [3]	IV.	*Los Angeles, Cal.*	104 Charles River Rd., C.
Wetherbee, Winslow [1]		*Newton Highlands*	47 Terrace Ave., N. H.
Wheeler, Herbert Blish [2]	II.	*Cambridge*	1654 Massachusetts Ave., C.
White, George Roland [3]	XV.	*Steelton, Pa.*	Hotel Somerset, B.

UNCLASSIFIED STUDENTS (*continued*)

NAME	COURSE	HOME	RESIDENCE
White, Joris MacDonald [3]	I.	*Basking Ridge, N. J.*	44 The Fenway, B.
Whitehead, Ernest Parker [1]		*Worcester*	9 Hall St., Wor.
Widdowson, Russell Jerome [2]	V.	*Holyoke*	183 St. Botolph St., B.
Williams, Amory Leland [3]	IV.	*Woodstock, Vt.*	Bromley Court, C.
Williams, Arthur Frederic [1]		*Somerville*	79 Concord Ave., Som.
Williams, Lester Albert [4]	II.	*Boston*	34 Bickerstaff St., B.
Wilson, Charles Thomas [1]		*St. Louis, Mo.*	84 Coolidge St., Br.
Wilson, John Chester [1]		*Portland, Ore.*	334 Harvard St., C.
Winslow, Edward Nicholas [3]	IV.	*Elizabeth, N. J.*	Garrison Hall, B.
Wisnew, Louis Lewellyn [3]	II.	*Passaic, N. J.*	Technology Dormitory, C.
Wood, Kenneth Fuller [2]	IV.	*Framingham*	26 Pleasant St., Fram.
Wood, Walter Cromwell [3]	X.	*Edgewood, R. I.*	484 Beacon St., B.
Woodward, John Blossom [3]	IV.	*Nassau, N. Y.*	484 Beacon St., B.
Woolf, Peter Jerome [1]		*Providence, R. I.*	7 Vancouver St., B.
Wooten, James Council, 2d [2]	III.	*Columbia, Tenn.*	179 Bay State Rd. B.
Works, Nelson Clark [3]	III.	*Cleveland, O.*	1067 Beacon St., Br.
Wright, Leigh Washburn [1]		*Belmont*	582 School St., Bel.
Wynne, Victor Ainslie [2]	III.	*Albany, N. Y.*	45 St. Stephen St., B.
Yao, Char Foo [2]	XIII–B.	*Anhui, China*	428 Newbury St., B.
Young, Herbert Franklin [2]	II.	*Buffalo, N. Y.*	334 Harvard St., C.
Young, Jacob [3]	VI.	*Winthrop*	65 Johnson Ave., Win.
deZubiría S., Alfred [3]	V.	*Cartagena, Colombia*	237 Beacon St., B.

SUMMARY

Fellows	7	Graduate Students	309
Candidates for the Degree of Doctor of Engineering	2	Classified Students, 4th year	326
Candidates for the Degree of Doctor of Philosophy	9	" " 3d year	309
Candidates for the Degree of Master of Science	27	" " 2d year	286
		" " 1st year	383
		Special Students	100
		Unclassified Students	515

Total	2273
Names counted more than once	316
Total Registration	1957

Alphabetical List of Students

Abbreviations. — S. H. O. = School for Health Officers; F. = Non-resident Fellow; Sp. = Special Student; U. = Unclassified Student; G = Graduate Student. Numerals denote the year of classified students. For lists of officers, see pages 15 to 36. For lists of students by classes, see pages 451 to 505.

Abbott, G., 2d....4
Abbott, N. G., Jr....1
Abele, C. A....Sp.
Abels, C. A....4
Abercrombie, R. P....1
Abrams, J. M....3
Adams, C. C....4
Adams, E. C....2
Adams, F. S....2
Adams, M. W....3
Addicks, A....1
Ahearn, W. J....3
Akerley, A. W. K....Sp.
Akers, K. F....1
Aldrin, E. E....Sp.
Alexander, C. E....U. 1
Allen, C. K....4
Allen, H. B....3
Allen, L. H....1
Allen, L. J....3
Allen, R. D....1
Althouse, A. K....4
Alvaré, N. F....3
Ames, A. P....2
Ames, C. E....4
Ames, N. B....Sp.
Ames, P. D....2
Anable, A....U. 1
Andersen, O. W....U. 2
Anderson, E. C....2
Anderson, G. W....U. 1
Anderson, J. W....4
Andrews, G. A....4
Angas, W. M....4
Angell, C. M....U. 3
Ariseka, R....Sp.
Ash, P. D....U. 1
Astorian A....4
Atkinson, C. E....4
Atkinson, H. M., Jr....Sp.
Atwater, A. C....1
Atwell, H. V....3
Auty, C....4
Avery, J. M....U. 3
Ayala, S. H....1
Ayer, H. E....4

Babbitt, F. M....U. 2
Babbitt, J. H....4
Baber, M. J....3
Badger, E. F....U. 1
Bailey, H. E....4
Bailey, W. S....1
Baker, A. D....3
Baker, E. H....1
Baker, F. A....2
Baker, R. N. S....3
Balfour, M. C....2
Ballantine, B. D....3
Balyozian, J. J....3
Bancker, E. H....3
Bangratz, E. G....1
Banks, W. H., Jr....2
Barber, H. M....3
Barker, J. C....1
Barnes, D. A....U. 3
Barnes, G. H., Jr....1
Barney, F. W....2
Barrett, H. W....U. 2
Barrett, S. J....U. 1
Barron, S....3
Barron, W. N....1
Barrows, S. R....4
Barry, E. F....U. 4
Barry, J. G....Sp.
Barry, E. L. W....1
Bartlett, F. H....Sp.
Bartlett, R. W., Jr....1
Bartlett, R. H....2
Basch, J. J....4
Bassett, C. E....U. 3
Bassett, W. H., Jr....U. 2
Batchelder, S. S....4
Bates, C. W....2
Bates, H. F....1
Bates, J. H....U. 1
Batschy, J. M....G.
Battis, J. T. W....3
Baum, G. L....U. 2
Baxter, H. M....4
Beadle, W. J....U. 4
Beal, L. I....Sp.
Bean, K. D....1

Beattie, C. M....3
Beattie, J. A....4
Beaulieu, L. E....2
Beaver, R....3
Becker, J. H....U. 2
Beckett, M. M....2
Bedell, A. S....Sp.
Beéche, G. A....2
Beers, G. F....2
Béique, J. E....1
Belden, E. D....4
Bell, D. E....U. 4
Bell, H. W....1
Bell, K. E....4
Bellis, C. B....3
Benitez, E. D....3
Bennett, W. F., Jr....2
Benson, A. F....U. 4
Bent, R. L....2
Berg, L. F....1
Berko, P. M....1
Berkowitz, M....2
Berliner, H. A....U. 3
Berman, E....3
Bermingham, F. A....U. 2
Bernard, F....4
Bertelsen, P. J....U. 4
Besa-Montt, H....2
Best, H. W....2
Best, T. H., Jr....U. 1
Betts, E. G....U. 3
Bibber, H. W....1
Bicknell, E. W....Sp.
Bigelow, E. C. S....1
Biggar, W. T....3
Bigler, P. G....U.
Black, C. M....4
Black, R. D....1
Blackall, R. M....4
Blackmer, F. H....1
Blaisdell, S. B....3
Blake, A. H....U. 2
Blakemore, T. L....G.
Blanchard, C. W....3
Blanchard, R. H....U. 4
Blanchfield, P. E....3

BLANK, H. M.....3
BLISS, G.....U. 2
BLODGETT, J. H.....U. 1
BLODGETT, L. S.....3
BLOOD, R. M.....U. 2
BLUMBERG, H. B.....2
BLYE, P. W.....2
BOETTNER, F. E.....1
BOGHOSSIAN, A.....3
BOICE, F. S.....3
BOLAN, R. S.....2
BOLEY, F. W.....U. 2
BOLOTIN, J. J.....U. 3
BOMAR, E. C.....U. 2
BOND, B. M.....4
BOND, C. L.....1
BOND, G. R., JR.....2
BOND, N. A.....U. 3
BONE, H. L.....4
BONNELL, W. E.....2
DEBONNEVAL, H. A.....U. 2
BOOTH, R. D.....1
BORIGHT, W. N.....U. 1
BOSSERT, T. W.....U. 1
BOUKNIGHT, W. M.....U. 3
BOWDITCH, F. C., JR.....1
BOWER, R.....1
BOWMAN, J. D.....1
BOYD, P. B.....G.
BOYD, S. M.....3
BOYDEN, L. E.....1
BRAATEN, I. T.....2
BRADLEY, D. G.....3
BRADLEY, F. L.....1
BRAGDON, S. B.....U. 2
BRAISLIN, J. C.....3
BRANDEGEE, M. M.....4
BRAY, C. C.....1
BRAYTON, H. M.....4
BRECK, F. P.....1
BREED, S. H.....2
BRENNEN, C. J.....2
BREWER, G. S.....3
BRICKETT, E. M.....1
BRIDGWATER, E. R.....3
BRISTOL, B. H., 2d.....2
BRITO, E.....2
BRITTON, F. S.....U. 2
BROCK, M. C.....4
BRODRICK, R. W.....U. 1
BROOKS, A. R.....4
BROOKS, E. P.....U. 4
BROOKS, R. F. F.....U. 4
BROSNAHAN, T. V.....3
BROWN, A. A.....1
BROWN, D. H.....2
BROWN, D. M.....Sp.
BROWN, D. P.....1
BROWN, E.....U. 2
BROWN, G. I.....1
BROWN, H. H., JR.....Sp.
BROWN, L. A., JR.....U. 2
BROWN, L. J.....U. 2
BROWN, M. C.....2
BROWN, O. W.....U. 1
BROWN, P. R.....2
BROWN, P. S.....1
BROWN, R. B.....4
BROWN, W. C.....U. 2
BROWN, W. H.....1
BROWNE, D.....3
BROWNELL, D. D.....1
BRUMER, I. S.....1
BRUNELLE, S. A.....2
BRUNER, M., JR.....U. 1
BRUNO, H. J.....1
BRUSH, C. F., JR.....4
BRYANT, E. H.....U. 2
BRYNE, P. B.....U. 2
BUCHANAN, D. R.....3
BUCKLEY, J. E., JR.....U. 2
BUERKIN, J. A.....3
BUFORD, A. W.....4
BUGBEE, H.....1
BUGBEE, J. M.....3
BUGBEE, P.....1
BUNKER, F. J.....1
BURBANK, R. L.....2
BURBANK, W. S.....2
BURCKETT, D. M.....2
BURDELL, E. S.....1
BURK, H. G.....4
BURKE, A. E.....3
BURKE, A. W.....1
BURKE, F. C.....3
BURKHART, T. W.....4
BURNHAM, B. C.....U. 2
BURNHAM, L. H.....1
BURNS, C. H.....G.
BURR, R. G.....1
BURR, S. H., JR.....U. 1
BURROUGHS, M. S.....1
BURT, G. H.....U. 1
BURTON, O. D.....U. 3
BURTON, W. H.....U. 1
BUSHEE, R. J.....3
BUTLER, A. M.....1
BUTLER, A. S.....U. 3
BUTLER, H. B.....U. 2
BUTTER, H. M.....U. 2
BUTTERFIELD, F. H.....3
BUTTERWORTH, F. L.....4
BUTTNER, F. F.....4
BUTTON, H. C.....1
BYRNE, P. J., JR.....1
BYRON, V. J.....1

CADY, L.....4
CAHILL, L. B., JR.....Sp.
CAIRD, A. W.....3
CALDWELL, H. B.....1
CALDWELL, S. H.....3
CALLANAN, F. J.....U. 2
CALVERT, A.....U. 1
CAMERON, E. J.....U. 3
CAMMANN, O., JR.....U. 2
CAMP, H. U.....2
CAMPBELL, D. W.....U. 2
CAMPBELL, J. W.....4
CAMPBELL, T. J.....U. 3
CAMPION, W. L.....4
CAMPOS, F. P.....1
CANAN, W. D.....G.
CANBY, A. T.....4
CANN, G. W.....2
CANNELL, J. E.....2
CANNON, G. Y.....3
CANZANELLI, A.....2
CAPPS, C. B.....U. 1
CARGILL, W. W.....G.
CARLETON, C. D.....U. 1
CARLSON, C. E.....U. 1
CARLTON, A. C.....U. 4
CARPENTER, F. S.....U. 1
CARR, P. W.....3
CARROLL, E. V.....1
CARROLL, P. L.....G.
CARSON, F. S.....4
CARTER, E. S.....3
CARTER, J. R.....1
CARTER, J. S.....2
CARTLAND, L. W.....2
CARTWRIGHT, R. A.....2
CARY, F. W.....3
CASEY, B. F.....1
CASHIN, R. F., JR.....U. 2
CASSIDY, H. L.....2
CASSIDY, J. E.....U. 3
CASTOR, A. H.....U. 2
CATE, N. R.....1
CATLIN, N. T.....U. 3
CAUST, M. L.....1
CHAFFIN, W. L.....3
CHAMBERLAIN, S. H., JR.....3
CHAMBERLAIN, S. V.....U. 3
CHAND, D. N.....4
CHANDLER, L. V. D.....U. 2
CHANG, J. T.....3
CHANG, Y. T.....4
CHAPIN, E. W.....Sp.
CHASE, A. W.....4
CHASE, J. H.....U. 3
CHASE, N. C.....Sp.
CHAYNE, C. A.....2
CHEN, C. Y.....U. 3
CHIDSEY, H. C.....1
CHILDS, K. M.....4
CHILDS, P. D.....4
CHISHOLM, S. L.....4
CHIU, W. Y.....3

Cho, W. Y.....Sp.
Chow, M.....G.
Christison, L.....4
Chun, K. K.....1
Church, A. A.....U. 4
Church, V. S.....3
Ciampolini, E.....Sp.
Cianciolo, P. J.....4
Claflin, F. E.....U. 2
Clark, B. J.....1
Clark, D. S.....3
Clark, E. K.....1
Clark, E. L.....4
Clark, E. M.....4
Clark, J. A.....3
Clark, J. L.....U. 3
Clark, M. H.....2
Clark, O. W.....1
Clark, W. A.....4
Clark, W. B.....2
Clark, W. L.....Sp.
Clarke, W. J.....U. 3
Clarkson, A. B.....2
Clarkson, J. J.....U. 4
Clarkson, J. W.....U. 3
Clayman, S.....4
Clayton, H. C.....U. 3
Clayton, L. L.....U. 4
Cleveland, B. R.....3
Clogher, E. J.....3
Coakley, C. C.....4
Coburn, C. L.....4
Cochran, A. P.....1
Cochrane, C.....U. 3
Cochrane, E. L.....3
Coffin, G. W.....1
Coffin, J. R.....4
Cofren, W. L.....1
Cohen, B. S.....2
Coit, E.....U. 2
Colby, C. W.....4
Colby, L. C.....U. 2
Coldwell, J. S.....U. 2
Coleman, F. T.....U. 2
Colleary, W. B.....Sp.
Colley, W. C.....U. 2
Collier, R. T.....U. 3
Collins, E. P.....3
Collins, H. C.....1
Collins, H. E.....3
Collins, H. W.....U. 4
Collins, V. D.....U. 1
Collins, W. L.....3
Conaty, F. S.....4
Conklin, O. E.....G.
Conner, L. C.....3
Connett, H.....U. 3
Conniers, N. D.....U. 2
Connolly, J. I.....G.
Connolly, J. P.....Sp.
Connors, M. F.....U. 2
Contieri, A. W.....2
Cook, A. A.....2
Cook, C. C.....U. 2
Cook, J. H.....U. 2
Cook, R. J.....4
Coombs, R. H.....U. 2
Cooper, O. E.....1
Cooper, S. K.....3
Corbin, P. F.....1
Cormier, H. J.....U. 1
Corr, G. T.....1
Corthell, H. D.....2
Cosgrove, J. T.....1
Costelloe, W. H.....3
Couch, H. R.....1
Coughlin, E. J.....1
Cousins, E.....1
Coward, R. S.....1
Coyle, J. H.....U. 1
Coyne, F. J.....2
Coyne, H. J.....U. 3
Craighead, P. B.....3
Crane, F. N.....4
Creedon, F. R.....3
Creedon, W. J.....U. 2
Creighton, S. H., Jr.....4
Cribben, L. T.....4
Crisp, F. G.....4
Cristal, P. N.....4
Cronin, J. T.....4
Crosby, G. E.....4
Crosby, I. B.....U. 3
Crosby, R. J.....3
Crotwell, S. P., Jr.....3
Crowell, C. C.....U. 3
Crowley, J. D.....1
Crowley, J. W. A.....U. 1
Cruise, E. R.....U. 1
Cudworth, J. R.....1
Culbertson, F. B.....1
Cummings, S. R.....3
Cunningham, K. M.....U. 2
Cunningham, L.....U. 3
Curran, J. T.....2
Curry, J. R.....1
Curtis, I.....U. 2
Cusick, W. M.....1
Cutter, G. H.....1
Cyr, H. M.....3

Daghlian, H. K.....1
Dagnall, C. H.....3
Dakin, L. M.....Sp.
Dalton, L. M.....2
Damon, J. W.....U. 3
Dana, L. I.....4
Dana, N. P.....1
Dandrow, C. G., Jr.....1
Daniels, D. P.....4
Dasso, L.....U. 2
Daube, H. J.....2
Davidson, K. S. M.....2
Davidson, V.....2
Davis, C. P.....2
Davis, F. B.....4
Davis, G. H.....U. 2
Davis, L.....4
Davis, R. E.....U. 1
Dawson, N.....3
Deacon, E. F.....2
Dean, C. M.....4
Dean, J. L.....U. 1
Dean, W. J.....1
Deane, A.....U. 2
Dearden, R. H.....2
DeBell, J. M.....4
Dehon, T., Jr.....2
deLeon, S. B.....U. 3
deMars, P. A.....4
Demeritt, J. E.....4
DeMerritt, R. E.....U. 3
DeMeulenaer, J.....1
Demond, D. B.....U. 3
Denison, H. W.....2
Dennen, W. L.....U. 3
Dennison, E. S.....U. 3
Derby, H. S.....2
Derrah, R. V.....3
DeSalvo, L.....2
Dewey, W. F.....1
Dexter, F. C.....U. 4
Deyette, J. C.....1
Dias, M. R.....2
Dickinson, R. G.....G.
Dickson, A. D.....4
Dickson, J. B.....G.
Dimmick, H. E.....2
Dinkins, P. M.....3
Dixon, E. S.....U. 3
Doane, F. P., Jr.....1
Doble, E. H.....1
Dodge, B. F.....4
Dodge, W. W., Jr.....G.
Dodson, F. W.....4
Doe, A.....U. 1
Doherty, J. E.....4
Dolmage, V.....G.
Donnelly, T. J., Jr.....3
Donovan, G. J.....1
Donovan, G. W.....4
Donovan, J. A.....3
Dooley, H. G.....1
Doon, J. W.....4
Dorr, H. R.....U. 1
Doten, E. F.....2
Douglas, L. W.....Sp.
Dow, C. W.....3
Dowell, A. E., Jr.....4
Dowlin, F. F.....1

Dowling, D. L.....1
Downey, J. F., Jr.....U. 1
Dowsley, F. R.....U. 3
Doyle, J. I.....1
Drew, C. W., Jr.....U. 2
Drobisch, R. W.....4
Drury, E. W.....U. 3
Drury, H.....Sp.
Dudley, P. F.....3
Duffill, H. P.....1
Duffy, C. W.....U. 1
Duffy, H. L.....U. 2
Dumas, A. V.....U. 1
Dumit, M. J.....4
Dunham, A. P.....4
Dunning, S. C.....U. 3
duPont, F. V.....4
Durland, R. W.....2
Duryea, G. R.....4
DuVernet, J. N.....U. 1
Duyos, O.....U. 1
Dyer, H. A.....U. 3
Dyke, F. H.....1
Dziadik, W. B.....U. 1

Eales, M. A. L.....3
Earle, F. M.....3
Eastman, W., Jr.....3
Eaton, C. W.....1
Eaton, I. C.....4
Eaton, R. C.....1
Eaton, R. H.....4
Eaton, W. W.....4
Ebert, G. L.....3
Eddy, C. W.....4
Eddy, H. P., Jr.....4
Eddy, L. B.....1
Edgarton, L. S.....U. 2
Edmonds, R. W.....U. 1
Edson, A. L.....2
Eksergian, C. L.....1
Ekwall, G. O.....3
Elliott, J. T.....2
Elliott, S. [illegible].....Sp.
Ellis, C. A.....1
Ellis, C. M.....3
Ellis, R. C.....1
Ellithorp, J. S., Jr.....G.
Ellsberg, E.....3
Ellsworth, A. A.....U. 1
Elwell, F. G.....U. 2
Ely, D.....U. 3
Elz, G. A.....U. 3
Emerson, H. W.....1
Emerson, W. K. B., Jr..U. 2
Engelbrecht, W. B.....3
Enright, E. F.....4
Erb, R. C.....4
Erickson, H. W.....1
Esner, A.....1
Etherington, E. L.....1
Eveleth, F. C.....3
Evelev, Y.....3
Everit, R. S.....2

Fairbanks, R. D.....U. 2
Fairbrother, E. C.....1
Fales, H. G.....U. 2
Fales, W. T.....4
Falkenberg, J. J.....U. 1
Falkenberg, R. L.....U. 2
Farist, C. J.....2
Farnham, C M.....Sp.
Farr, W. G.....4
Farrand, E. G.....2
Farrar, J. A., Jr.....U. 1
Farrington, A. E.....U. 2
Farrisee, W. J.....2
Farrow, E. S., Jr.....U. 1
Fassitt, A. J., Jr.....1
Fay, R. D.....4
Federhen, H. M.....1
Felsing, W. A.....G.
Fennessey, E. M.....U. 3
Ferrall, J. P., Jr.....G.
Ferrell, R. W.....3
Ferretti, A. J.....4
Fields, E. S., Jr.....U. 2
Fine, H.....4
Fineman, I.....4
Fischer, F. W.....Sp.
Fisher, J. C.....U. 4
Fisher, W. P., Jr.....U. 3
Fisk, H. H.....U. 3
Fiske, C. D.....3
Fiske, D. L.....1
Fitch, H. W.....3
Fitton, W. G.....Sp.
Fitzgerald, W. J.....1
Flagg, P. M.....4
Flaherty, J. C.....Sp.
Flashman, D. H.....1
Flather, R. F.....U. 2
Fleming, G. G.....U. 2
Fleming, W. A.....1
Fletcher, S. W.....3
Flett, L. H.....3
Flewelling, R. C.....2
Flint, J. A.....U. 3
Flynn, E. J.....2
Fogarty, T. S.....U. 3
Fogler, F.....U. 1
Folsom, R. A.....3
Ford, A. R.....2
Ford, F. L.....U. 3
Ford, K. L.....3
Ford, W. B.....3
Forrest, H. O.....1
Foss, F. D.....4
Foster, S. M.....3
Foster, W. C.....3
Franck, J. J.....1
Frank, H.....4
Franklin, S. H.....3
Fraser, A. A.....U. 1
Fraser, M. A.....4
Frazier, W. S., Jr.....3
Frease, H. F.....1
Fredrickson, G. O.....1
Freed, E. S.....G.
Freed, S.....U. 4
Freeman, E. W.....1
Freeman, J. R., Jr.....4
Freeman, W. H.....U. 2
Freeman, W. M. B.....1
French, E. B.....1
French, G. F.....2
French, G. K.....1
French, H. N.....U. 4
Friend, D. O.....4
Friery, J. W.....3
Fuess, C. A.....U. 4
Fuller, C. C.....3
Fuller, J. R.....3
Fuller, S.....U. 3
Fuller, W. F.....1
Fulreader, O. J.....U. 2

Gager, C. C.....4
Gagnon, J.....4
Gail, G. P.....2
Gaillac, E. B.....3
Gamage, F. L., Jr.....4
Gannett, R.....4
Gardner, H. B.....4
Gardner, J. P.....U. 3
Gargan, J.....4
Garnsey, A. E.....U. 2
Garrigus, A. C.....1
Gartner, W. C. F.....U. 4
Garza, R.....3
Gaus, G. H.....4
Gausenberg, V.....1
Gay, G. E.....U. 2
Gay, R. N.....U. 3
Gayhart, E. L.....4
Gaylord, W.....2
Gee, R. H.....1
Geisler, H. P., Jr.....U. 3
Gelinas, M. E.....3
Gelt, G. G.....1
Gelt, P. J.....1
Genaske, A.....1
Gibbon, C. O.....G.
Gibbons, T. M.....U. 4
Gibbs, E. F.....U. 1
Gibson, J. W.....2
Gibson, R. K., Jr.....1
Gidley, R. T.....U. 3
Gifford, R. L.....Sp.

Gigger, A. G. ..... Sp.
Gilbert, R. H. 2
Giles, H. C. ..... U. 2
Gill, F. M. 1
Gillespie, K. A. 4
Gillett, L. A. ..... U. 3
Gilliard, C. T. 4
Gilliatt, L. W. 1
Gilmour, A. E. 4
Gilt, C. M. 4
Giuranovich, A. J., Jr. 3
Given, F. J. 2
Glassett, A. T. 1
Gleason, H. L. ..... U. 3
Gleason, R. W. ..... U. 2
Glover, E. C. 1
Goddard, R. E. ..... U. 2
Gokey, G. F., Jr. ..... U. 1
Gokey, N. W. 4
Goldsmith, H. F. 4
Goldsmith, H. J. ..... Sp.
Goldsmith, R. H. 1
Goldstein, E. J. 4
Goldstein, L. J. 2
Gomez, A. J. 2
Gonzales-Rosa, F. 1
Goodale, F. 4
Goodman, A. 3
Goodridge, M. E. 2
Goodwin, H. L. 1
Goodwin, T. L., Jr. 3
Gore, E. W. ..... U. 3
Gorfinkle, L. 4
Gorrell, E. S. ..... G.
Goss, D. C. 3
Goudey, R. F. 4
Gould, G. S. ..... U. 2
Gould, J. H., Jr. 2
Goward, K. N. 1
Gramstorff, E. A. 4
Granger, H. I. 1
Graves, D. S. 1
Gray, C. H. G. 3
Gray, G. A. 4
Gray, W. A., Jr. 3
Greely, B. M., Jr. 3
Green, G. D., Jr. ..... U. 2
Green, H. J. 1
Greene, A. B. 1
Greenewald, H. ..... U. 4
Greenleaf, E. A. 3
Greenwood, T. S. 1
Griebel, F. W. 2
Griesemer, E. P. 1
Griffin, A. E. ..... U. 2
Grohe, R. F. ..... U. 3
Groisser, B. M. ..... U. 1
Grosscup, H. A. ..... U. 2
Grossman, A. P. ..... U. 3
Grover, N. A. 1
Grunsfeld, E. A., Jr. 3
Guilbert, H. M. 3
Gunn, S. M. ..... Sp.
Gurney, S. W. 4
Gustaveson, J. W. 3
Gustin, E. E. 3

Hackett, R. P. 2
Hadden, W. 1
Hadley, H. S. ..... U. 2
Haebler, P. E. 1
Haertlein, A. 3
Hafner, V. L. S. ..... U. 4
Hagerty, J. J. ..... Sp.
Haigh, H. R. ..... U. 3
Hale, E. D. 4
Hale, J. I. 3
Halfacre, G. F. 3
Hall, B. T. 4
Hall, C. K. 1
Hall, D. C. 2
Hall, G. L. 1
Hall, I. G., Jr. ..... U. 3
Hall, M. C. 1
Hall, R. T. 2
Hall, W. T. ..... U. 2
Hallinan, C. J. 1
Hamabe, G. ..... Sp.
Hamilton, A. L. ..... U. 3
Hamilton, H. W. 4
Hamilton, N. R. 3
Hamilton, R. 2
Hammond, C. W. 1
Hammond, W. S. 2
Hancock, G. L. 3
Hand, C. N. 4
Handy, W. R. 1
Hanley, J. M. 3
Hannah, T. E. 4
Hannigan, R. J. 2
Hansberry, T. W. 3
Hanson, E. R. 4
Hanson, G. ..... Sp.
Hanson, J. J. ..... Sp.
Hardy, J. B. ..... U. 1
Harkness, R. R. ..... Sp.
Harlow, F. C. 4
Harper, C. B. 3
Harper, J. 4
Harrall, E. R. 3
Harrington, E. D. 3
Harris, L. I. 1
Harris, L. B. 1
Harrop, J. 1
Harshowitz, L. 1
Hartley, W. E. 3
Hartman, H. F. G. 4
Hartman, L. E. ..... U. 2
Harvey, A. R. ..... U. 2
Harvey, T. F. 1
Hastie, F. B. 4
Hatch, F. M. 4
Hatch, H. W. 3
Hathaway, S. D. 1
Hatten, E. R. ..... U. 3
Haviland, T. Z. 4
Hawes, C. W. 4
Hayes, S. J. 2
Heath, C. J. ..... U. 4
Heath, E. H., Jr. 4
Hedberg, H. F. 1
Hedin, C. H. ..... U. 2
Hedlund, W. T. 1
Helrich, A. W. ..... Sp.
Hemeon, J. R. 1
Henderson, G. W. 4
Hennessy, D. J. 1
Herczel, R. E. ..... U. 1
Herfurth, W. R. 3
Herman, E. O. ..... U. 3
Herrick, C. M. 2
Herron, J. C. 1
Herzog, H. A. 2
Hewes, F. R. 2
Hewitt, P. A. ..... U. 3
Heyl, R. C., Jr. ..... U. 3
Heyman, S. 2
Hickey, T. F. 1
Hickman, E. T. ..... U. 3
Higgins, A. D. 1
Higgins, J. 2
Hill, E. W. 2
Hill, F. T. ..... U. 1
Hill, L. T. ..... U. 4
Hiller, A. D. 4
Hills, H. W. 1
Hills, L. H. 4
Hinckley, N. C. ..... U. 3
Hines, J. J., Jr. 1
Hingston, T. H. 1
Hirsch, G. B. 2
Hitchcock, L. B. 1
Hobson, T. F. 1
Hodgson, M. L. ..... Sp.
Hoffman, A. G. 2
Hoffman, L. A. 4
Hoffman-Pinther, L. ..... U. 2
Hogan, J. F. ..... G.
Holden, D. F. 4
Holden, E. V. ..... Sp.
Hollender, E. A. ..... U. 1
Holmgren, R. S. 2
Holt, A. R. 1
Holt, C. G. 4
Holt, J. 2
Holt, O. W. 1
Holt, W. R. 4
Holta, J. ..... U. 3
Holton, J. H. 4
Homer, J. W., Jr. ..... U. 2

HONIG, A. R., JR. 1
HONISS, W. T. 1
HOOPER, B. M. 3
HOOPER, W. P. 1
HOPKINS, F. H. 3
HOPKINSON, F. J. 2
HORTON, F. H. ..... U. 3
HOU, T. P. 4
HOUGH, A. W. 2
HOUGHTON, S. P. 4
HOWARD, A. F. 3
HOWARD, E. M. ..... U. 2
HOWARD, F. C. 4
HOWARD, P. H. 3
HOWE, C. W. 1
HOWE, J. C. 3
HOWE, M. S. 1
HOWLETT, W. M. ..... U. 2
HOYE, S. A. 3
HOYT, F. C. 2
HSU, C. Y. 3
HSU, Y. C. 3
HU, K. P. 2
HU, P. Y. 4
HUANG, C. Y. 2
HUANG, H. H. 4
HUANG, S. H. 4
HUBBARD, E. R. ..... U. 2
HUBBARD, F. S. 4
HUBBELL, R. V. A. ..... U. 1
HUCKINS, E. W. ..... U. 3
HUDNUT, F. P., JR. 1
HUGHES, T. J. 1
HUGHES, T. L. ..... U. 1
HUGO, O. G. 3
HULBURD, P. E. 4
HULSEMAN, G. D. ..... U. 3
HUNG, S. Y. 2
HUNT, F. B. 1
HUNT, G. A. 4
HUNT, R. S. 2
HUNTER, F. L., JR. 2
HUNTER, H. F. 1
HUNTER, W. B. 4
HUNTRESS, E. H. 1
HUTCHINGS, G. B., JR. 3
HUTCHINSON, E. H. 3
HYSOM, R. H. 2

IGLEHEART, G. P. 4
ILSLEY, C. H. 2
IMHOFF, W. E. 3
INGLIS, G. A. 2
INSLEY, R. ..... U. 2
IRELAND, H. K. 2
IRWIN, G. A. 2

JACKSON, L. A. 2
JACOBS, J. E. 2
JAMES, L. ..... Sp.
JENSEN, H. C. ..... U. 1
JERMAIN, H. F. ..... U. 3
JEWETT, H. P. 2
JOHANSEN, E. L. 1
JOHNS, A. A. 2
JOHNSON, A. K. ..... U. 4
JOHNSON, A. S. 3
JOHNSON, A. T. ..... U. 1
JOHNSON, G. E. 3
JOHNSON, W. S. 1
JOHNSON, W. T., JR. 4
JOHNSTON, A. B. 4
JOHNSTON, N. P. ..... U. 2
JONES, B. F. 2
JONES, C. C. ..... U. 2
JONES, D. M. 4
JONES, E. V. ..... U. 1
JONES, H. C. ..... U. 2
JONES, I. P. 2
JONES, W. A. 3
JORDAN, H. ..... Sp.
JORGENSEN, V. W. ..... Sp.
JOSLIN, A. W. 3

KAHN, G. 2
KAHN, L. D. 1
KAISER, J. H. 2
KAISER, K. H. ..... U. 3
KALER, H. V. L. 3
KAPLAN, D. J. 1
KARMIRE, J. L. 2
KATZ, H. L. ..... U. 3
KAUFMAN, J. 2
KAUFMAN, S. A. 2
KAUPE, A. F. ..... U. 2
KAYSER, W. H. 2
KEACH, L. 4
KEATING, A. E. 4
KEATING, C. E. ..... U. 2
KEELER, H. Y. ..... U. 3
KEENE, H. N. 4
KEESLER, E. Y. ..... Sp.
KEITH, SCOTT. 2
KEITH, STEWART 4
KELLAR, J. W. 1
KELLEY, J. A. 3
KELLEY, L. A. 2
KELLY, J. R. 4
KELLY, T. P. 3
KELSEY, A. S. 2
KEMKEMIAN, B. 3
KENIGSBERG, A. H. 4
KENISON, A. C. 2
KENISON, E. M. 2
KENNARD, J. W. B. 3
KENNARD, R. P. ..... U. 3
KENNEDY, C. T. 3
KENNEDY, G. S. 4
KENNEDY, P. H. ..... U. 3
KENNEY, A. W. ..... G.
KENT, E. R. ..... U. 3
KENWAY, F. L. ..... Sp.
KILDUFF, J. W. 2
KILEY, J. T. 3
KILGORE, H. D. 3
KILLORIN, F. O. 4
KIMBALL, H. M. 4
KIMBALL, W. F. ..... U. 2
KINGHORN, A. H., JR. 1
KINGSBURY, C. L. ..... U. 3
KITCHIN, D. W. 2
KITSON, S. W. 1
KITTREDGE, G. D. 4
KJAER, H. J. 1
KLEINSCHMIDT, H. ..... U. 3
KLEINSCHMIDT, R. V. 3
KLINE, F. L. ..... Sp.
KNAPP, A. M. 1
KNAPP, H. A. 4
KNIGHT, A. R. ..... U. 4
KNIGHT, G. R. 1
KNOBEL, M. 2
KNOWLAND, T. M. ..... U. 3
KNOX, C. V. S. ..... Sp.
KNUDSEN, R. ..... U. 3
KRASNOFF, N. 3
KREBS, C. 2
KRIGGER, A. 4
KRUG, F. S., JR. 4
KRUSE, A. 1
KUHN, S. L. 4
KUHNS, A. ..... U. 4
KWAN, S. S. ..... U. 3

LABARRÈRE, J. L. ..... Sp.
LACEY, H. R. 3
LAFEAN, R. G. 2
LAHEE, L. ..... Sp.
LAMBERT, L. E. 1
LANDIS, M. N. 3
LANE, F. A. 3
LANE, K. M. 4
LANE, S. M. ..... U. 4
LANGILLE, W. O. ..... U. 2
LANGLAN, J. G. ..... U. 1
LANGLEY, H. E. 2
LANSIL, C. E. 4
LARIVIERE, J. B. 1
LARNER, H. B. 3
LARSEN, R. R. 1
LASKEY, W. G. ..... U. 4
LAUER, L. M. 4
LAVAGNINO, J. F. 2
LAVEDAN, P. F. 1
LAVELLE, K. T. 1
LAW, G. R. ..... U. 2
LAWRASON, L. 4
LAWRENCE, E. W. 3
LAWSON, C. J. ..... U. 1
LAWTON, E. H. 2
LAWTON, F. W. 1

Leahy, W. J. 2
Leander, C. H. 1
Leander, C. T. 1
Lebby, T. D., Jr. 4
Lederer, A. ..... Sp.
Lee, K. T. 2
Lee, M. B. ..... U. 2
Lee, M. H. 1
Lee, W. K. ..... U. 3
Lee, Y. 1
Lees, M. B. 1
Legge, E. E. 3
Lehmkuhl, J. ..... U. 3
Leland, R. M. ..... U. 2
Lemp, B. 3
Leonard, J. T. ..... U. 3
Leonard, P. C. ..... U. 4
Leonori, W. H., Jr. 1
Levangie, G. W. 1
Levey, B. 4
Levi, E. 4
LeVine, H. C. 3
Levine, L. I. 3
Levinson, S. 1
Levy, H. M. 1
Lewis, B. I. 4
Lewis, E. C. 4
Lewis, R. F. 2
Li, Y. C. 4
Libby, A. E. ..... U. 1
Liebensberger, M. C. ..... U. 4
Likins, C. C. ..... U. 2
Lindgren, C. A., Jr. 3
Ling, H. C. C. 4
Linscott, C. E. 3
Lipp, M. N. 1
Litchfield, A. C. ..... U. 3
Litehiser, R. R. 2
Little, C. E. ..... U. 2
Little, E. N. 3
Little, H. G. ..... Sp.
Little, W. H. 2
Littlefield, A. S. 1
Littlefield, M. B. 1
Littlefield, W. J. 4
Liu, G. C. ..... U. 3
Lloyd, T. M. ..... U. 2
Lloyd, W. K. ..... U. 1
Lobdell, H. E. ..... U. 4
Lobos, F. 3
Lockhart, H. G. 1
Lockwood, R. C. ..... U. 2
Logan, J. W., Jr. 1
Logan, R. W. 4
Lohmeyer, W., Jr. ..... Sp.
Long, C. C. ..... U. 3
Long, F. L. 3
Longley, J. E. 3
Longley, J. R. 3
Loo, P. C. ..... Sp.
Loomer, H. N. 1
Loomis, P. W. 2
Lord, E. D. 1
Lord, W. M. B. 3
Lorenz, O. C. 3
Loucks, M. A. ..... U. 2
Loutski, R. ..... U. 3
Lovejoy, D. H. ..... U. 2
Lovejoy, G. M., Jr. 4
Lovejoy, H. F. 1
Low, C. E. 4
Lowengard, R. O. 4
Lucas, J. 1
Lufkin, O. G. 3
Lundquist, A. 2
Lunn, J. A. 4
Lutz, W. E. A. ..... U. 3
Luykx, D. J. 2
Lynch, J. P. 1
Lyons, J. J. 1
Lyons, R. T. 4

McAdams, W. H. ..... G.
MacAlister, A. G., Jr. ..... U. 3
McAllister, P. 3
MacArdle, D. W. 3
MacAskill, D. ..... U. 3
McCann, R. B. ..... U. 3
McCarten, G. C. 2
McCarthy, D. E. 1
McCarthy, E. B. 2
McCarthy, L. A. ..... U. 2
McCausland, J. W. ..... U. 4
McClellan, J. L. ..... U. 3
McClintic, H. H., Jr. 2
McClintock, R. ..... U. 1
McCloskey, J., Jr. ..... U. 1
McCloskey, L. C. 2
McClurg, V. B. ..... Sp.
McCreery, G. W. ..... U. 2
McCurdy, A. C. 4
McDaniel, I. B. 4
McDill, B. M. 3
McDonald, H. J. 4
McDonald, J. W., Jr. ..... U. 1
McDonald, R. E. 3
McDougall, J. G. ..... U. 4
Macfarland, A. W. ..... U. 2
McFarland, D. M. ..... U. 3
McGill, F. J. ..... U. 1
McGowan, A. J. 1
McGrady, L. L. 4
McGreenery, P. A. ..... U. 3
MacGregory, S. A. 3
McGuigan, J. L. 4
McGuire, D. B. 1
McGuire, W. S. ..... U. 3
Macheca, G. M. ..... U. 3
McIntire, R. D. 3
McIntosh, A. H. ..... U. 2
McIntosh, H. W. ..... U. 2
McIvor, C. C. 3
Mackay, W. R. 2
McKenney, W. R. 2
McKinley, M. R. ..... U. 2
MacKirdy, H. S. ..... U. 2
Mackler, M. J. ..... Sp.
McKone, F. E. ..... G.
McLaughlin, C. P. 3
McLaughlin, E. H. ..... Sp.
McLaughlin, E. R. 2
McLaughlin, G. E. 3
McLaughlin, H. C. 3
McLaughlin, R. J. 3
McLellan, D. H. 4
MacLeod, W. D. 1
MacLeod, W. R. 3
MacMahon, W. K. 1
MacManus, F. J. 1
McManus, J. D. 4
McMorran, A. M. 2
MacMullin, R. B. 2
McNally, E. M. 3
McNary, H. L. 2
McNear, G. R. 1
McNeill, W. I. 4
Maconi, F. 1
MacPherson, K. W. 4
McQuaid, H. S. 4
MacRae, D. ..... G.
Madancy, S. M. ..... U. 3
Maeder, R. A. 4
Magee, W. L. 1
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Maguire, J. F., Jr. ..... U. 4
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Maloy, C. B. 1
Mandelbaum, I. ..... U. 2
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Manning, G. C. 3
Manny, C. C. ..... U. 2
Manter, E. M. 3
Manuelian, H. D. ..... U. 3
Mardoian, H. H. ..... U. 2
Margolis, J. I. 1
Marine, J. S. ..... U. 3
Markham, J. R. ..... U. 3
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Marovitz, H. J. 1
Marron, A. R. 3
Marshall, H. F. ..... U. 2
Marshall, L. H. 3
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Marsilius, N. M. 4

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Martin, H. S. ..... G.
Martin, R. P., Jr. 4
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Martinez, L. 1
Martinez, M. E. 2
Martinson, O. S. 2
Massey, H. P. 1
Matthews, G. K. 1
Matthews, M. 1
Maxfield, H. W. ..... Sp.
May, E. D. 2
Mayer, D. O. 2
Maynard, W. A. 2
Mayo, S. S. ..... U. 2
Mead, E. A. 2
Mead, F. L. 2
Meader, J. ..... U. 2
Means, L. M. ..... U. 4
Means, R. S. 2
Medding, W. L. 4
Mehaffey, W. C. 4
Meissner, W. E. 1
Meloy, T. K. ..... U. 4
Melvin, H. L. ..... G.
Merriam, H. W. 1
Merrill, D. G. 3
Merrill, H. C. ..... U. 2
Merrill, J. O. 2
Merrill, L. H. ..... U. 2
Merryweather, W. O. ..... U. 1
Mesmer, J. A. ..... U. 1
Meyerowitz, P. ..... U. 4
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Michelson, G. 2
Miller, A. B. 3
Miller, A. M. 4
Miller, A. W. 1
Miller, C. G. 4
Miller, F. O. ..... U. 4
Miller, Harold L. ..... U. 3
Miller, Henry L. 4
Miller, R. A. 1
Miller, R. P. 3
Miller, W. B. 2
Milliken, S. A. 1
Mills, B. M. ..... U. 1
Mills, O. A. ..... U. 1
Minard, D. P. ..... U. 2
Miner, H. A. 2
Mirabelli, E. 2
Miskovsky, R. J. ..... U. 3
Mitchell, R. W. 2
Mitsui, T. ..... Sp.
Moberg, H. C. 2
Moffatt, E. H. 3
Moir, J. G., Jr. 1
Monasterio, H. R. ..... U. 1
Montague, P. N. ..... Sp.
Montgomery, R. A. ..... U. 2
Moody, A. E. 4
Moore, B. S., Jr. ..... U. 2
Moore, C. D. ..... U. 2
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Mori, H. ..... Sp.
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Morse, B. C., Jr. ..... U. 1
Morse, H. E. 4
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Moulton, R. S. 4
Moy-Ding, W. 1
Müller, A. L. 2
Mulliken, R. S. 4
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Mulrooney, T. J. ..... U. 1
Mumford, A. R. 3
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Murphie, H. H. ..... U. 2
Murphy, D. B. ..... U. 2
Murphy, L. H. 1
Murphy, W. M. ..... U. 2
Murray, A. F. ..... U. 3
Murray, G. S. 3
Murray, H. J. ..... U. 2
Musnitsky, J. 1
Muther, H. C. ..... U. 2
Myers, A. S. 1

Naigles, M. H. ..... U. 1
Nakayama, H. ..... Sp.
Nakaye, S. ..... Sp.
Nangle, C. J. ..... U. 3
Nash, J. C. 1
Nathan, T. C. ..... U. 1
Neff, E. W. ..... Sp.
Nelles, P. A., Jr. 1
Nelson, A. D. ..... U. 1
Nelson, G. A., Jr. ..... U. 4
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Nelson, J. H. 1
Nelson, W. 3
Neuberg, W. D. 3
Neumann, H. C. ..... Sp.
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Norton, C. A. 1
Norton, F. H. 3
Norton, J. T. 3
Novack, J. 1
Noyes, L. I. 4
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Osgood, F. G. ..... U. 3
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Pearson, F. C.....3
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Pedersen, N. A.....U. 1
Peers, F. W.....3
Peirce, J. T.....1
Peirce, R. M.....1
Peltier, P. D.....2
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Perkins, E. F.....2
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Pero, D. C.....2
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Preston, W. H.....1
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Quinn, J. J., Jr.....1
Quirk, T. A.....1
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Rowen, T. C., Jr.....1
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SEAVEY, H. V., 2d. 1
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SHAW, P. M. ..... U. 2
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SHELTON, P. S. ..... U. 3
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SHIELDS, E. J. ..... Sp.
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SIMONDS, H. M. 2
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SKINNER, R. L. 1
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SMITH, A. V. 1
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SMITH, F. B., JR. ..... U. 3
SMITH, F. G. C., JR. ..... U. 2
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SMITH, M. A. 2
SMITH, M. L. ..... U. 3
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SMITH, R. F. ..... U. 3
SMITH, R. H. 3
SMITH, RAYMOND S. 3
SMITH, RUSSELL S. 2
SMITH, V. D. C. ..... U. 1
SMITH, W. W. 4
SMOLEY, E. R. ..... U. 2
SMYSER, F. H. ..... U. 2
SMYTH, C. A. ..... U. 1
SNOW, L. 1
SNOW, L. I. 2
SNOW, W. B. 2
SOARS, E. A. 2
SOLAKIAN, H. N. 4
SOMERBY, P. B. 1
SONGKLA, PRINCE OF SIAM. . Sp.
SORENSON, L. R. 2
SOUTHWICK, A. M. ..... U. 2
SOUTHWICK, B. H. 2
SPANGENBERG, G. R. ..... U. 1
SPEAR, G. D. 3
SPECTOR, H. 2
SPENCER, R. B. 1
SPITZ, G. T. ..... Sp.
STACEY, J. H. 1
STAGG, J. H., JR. ..... U. 3
STAHL, T. E. 4
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STANWOOD, C. B. 1
STARK, H. L. ..... U. 1
STARR, D. L. 3
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STEARNS, F. A. 4
STEARNS, H. C. ..... Sp.
STEBBINS, G. H. 4
STEELE, B. M. 1
STEELSMITH, D. C. ..... Sp.
STEERE, J. A. 3
STEHLE, R. B. 2
STETLER, M. M. 2
STEPHENS, H. C. ..... U. 3
STERNER, H. 3
STEVENS, G. R. 4
STEVENS, J. 1
STEVENS, R. S. 4
STEVENSON, V. E. 2
STEVENSON, W. O. 2
STEWART, C. C. 2
STEWART, G. ..... U. 1
STEWART, H. R. ..... U. 4
STILLER, H. ..... U. 2
STOCKBARGER, D. C. ..... U. 2
STOCKMAN, C. C., 2d. 3
STOCKMANN, E. B. 4
STOKES, F. M. ..... U. 1
STORROW, J. J., JR. 4
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STÖWHAS, C. A. 2
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STRANG, P. M. 3
STRIBLING, S. R. ..... U. 4
STROBRIDGE, J. G. 1
STRONG, W. B. 4
STROUT, H. E., JR. 4
STUART, L. L. 1
STURTEVANT, H. V. 3
SULLIVAN, A. P. 4
SULLIVAN, E. C. 1
SULLIVAN, J. W. ..... U. 1
SULLIVAN, W. A. 4
SUNG, C. H. 4
SVENSON, C. L. 2
SWAIN, R. B. ..... Sp.
SWAN, H. G. 3
SWAN, L. A. 4
SWASEY, P. F. 2
SWEENEY, F. M. 1
SWIFT, G. W. 1
SYLVANDER, R. C. 4
SYNER, C. M. 1

TABER, S. H. 2
TABER, T. R. 1
TALCOTT, C. H. 1
TAPLEY, W. L. 4
TARPLEY, D. G. 4

TATTERSFIELD, G.....1
TAYLOR, E. A.....1
TAYLOR, G. R.....1
TAYLOR, M. H.....U. 1
TAYNTOR, L. O.....Sp.
TENNEY, E. S.....Sp.
THOMAS, C. E.....2
THOMAS, F. E.....4
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THOMPSON, P. R.....U. 2
THOMSON, G. W.....4
THRASHER, W. E.....4
THURBER, J. P.....U. 2
THURSTON, R. R.....U. 1
TIERNEY, H. J.....4
TIMANUS, C. S.....U. 3
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TODD, J. M.....U. 3
TOOLE, H. S.....4
TOOLEY, J. H.....U. 2
TORTORELLI, C. L.....1
TOURTELLOTTE, N. E.....U. 4
TOVEY, H. O.....3
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TRAVERS, F. H.....1
TRAVIS, R. E.....1
TRIBOU, R. E.....2
TRUE, O. S.....1
TU, H. Y.....4
TU, Y. C.....U. 4
TUCKER, C. E.....3
TURNER, C. E.....Sp.
TURNER, R. L.....1
TURNER, W. H.....3
TUSHIN, A.....1
TUTEIN, C. R.....U. 3
TUTEIN, D. A.....4
TUTTLE, A. E.....U. 3
TUTTLE, W. F.....4
TWOMEY, E. F.....4
TYLER, J. C.....4

UEBELACKER, A. A.....3
UNDERWOOD, H. R.....3
UNTERSEE, M.....2

VAKHLIOTES, J. P.....U. 3
VANDERSTUCKEN, F. R.....G.
VAN KIRK, R. W., JR.....3
VAN NESTÉ, R.....U. 2
VAN ZELM, L. F.....U. 2
VENABLE, C. S.....G.
VIANO, A. E.....U. 1
VISSCHER, J. S.....1
VON VOSS, E. F. D.....U. 2
VOUGHT, A. B.....3
VROOM, R. D. W.....1

WADE, H. R.....U. 3
WAECHTER, I. E.....4
WAIT, P. E.....1
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WALKER, E. C., 3d.....G.
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WALLACE, S. G.....U. 3
WALLIS, J. E., JR.....4
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WAN, T. S.....Sp.
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WARREN, A. L.....U. 2
WARRINER, R. P.....U. 1
WASGATT, H. C.....U. 2
WASHBURN, F. A.....U. 3
WASON, A. B.....1
WASON, E.....U. 1
WATERS, L. A.....1
WATSON, P. B.....4
WATT, C. H.....U. 3
WATTS, E. F.....1
WAY, D. D.....2
WEAVER, L. H. A.....U. 2
WEBBER, E.....2
WEBBER, P. C.....4
WEBBER, R. B.....1
WEBER, H. C.....3
WEBSTER, D. K., JR.....2
WEI, T. F.....1
WEISCOPF, M. W.....U. 3
WEISKITTEL, F. A.....U. 2
WELCH, W. G.....U. 2
WELLCOME, H. E.....2
WELLS, B. D.....4
WELLS, B. S.....4
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WELLS, F. H.....3
WELLS, H. C.....U. 3
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WELLS, R. H.....2
WELLS, R. K.....2
WELLS, S. H.....1
WENBERG, J. W.....1
WENZEL, A. H.....4
WESTBROOK, L. R.....4
WESTLAND, C. E.....2
WESTON, T. H.....4
WETHERBEE, W.....U. 1
WEXLER, D.....1
WEXLER, H. A.....1
WEYMOUTH, H. S.....2
WEYMOUTH, L. E.....1
WHEATLEY, R. H.....4
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WHITE, F. W., JR.....3
WHITE, G. R.....U. 3
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WHITE, J. M.....U. 3
WHITE, K. B.....1
WHITEHEAD, E. P.....U. 1
WHITMAN, W. G.....4
WHITMORE, J. T.....3
WHITNEY, R. B.....1
WHITNEY, R. T.....4
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WHITTEN, L. P.....1
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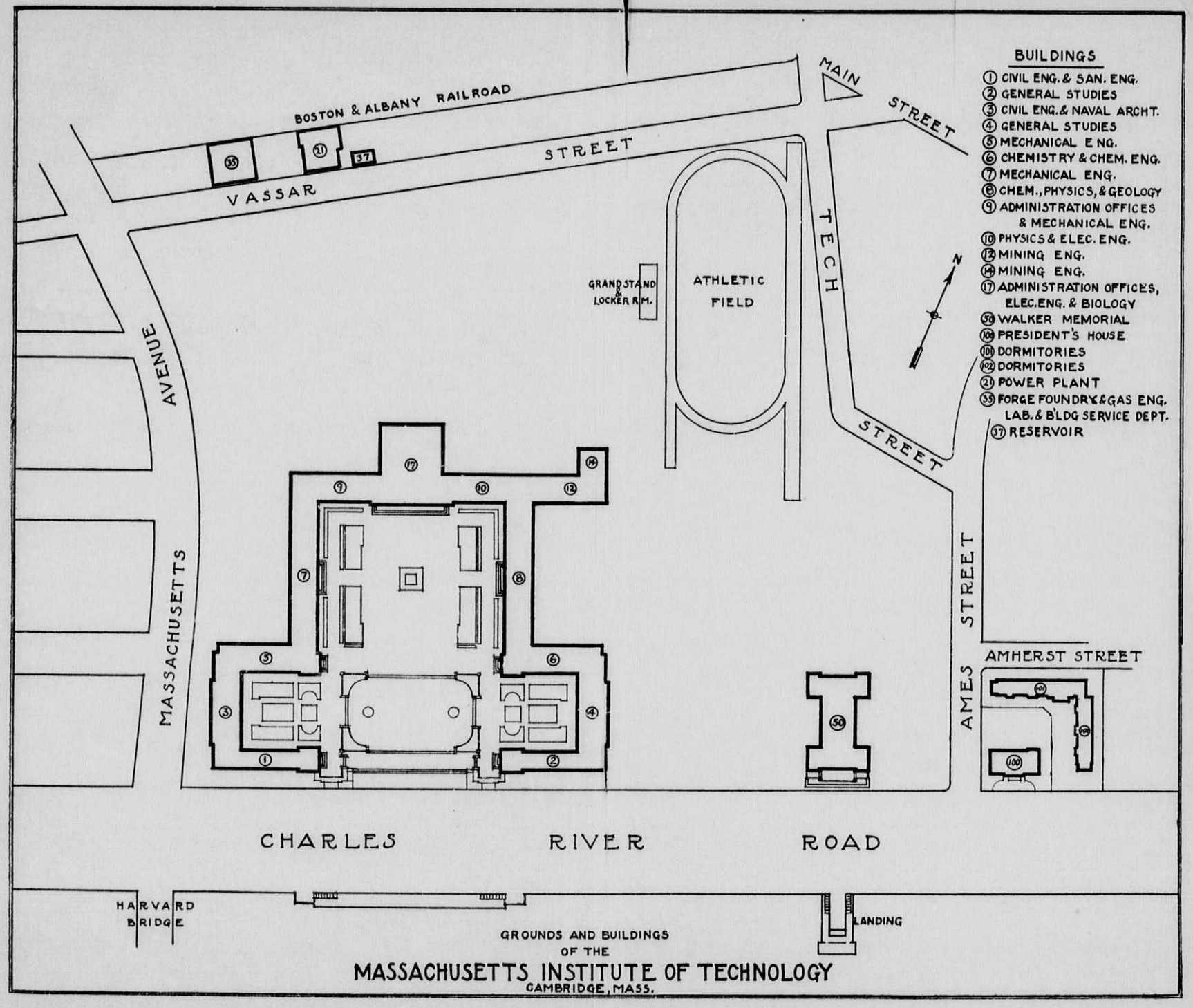
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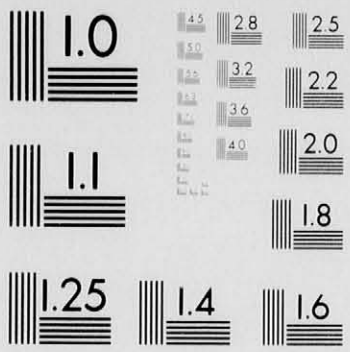
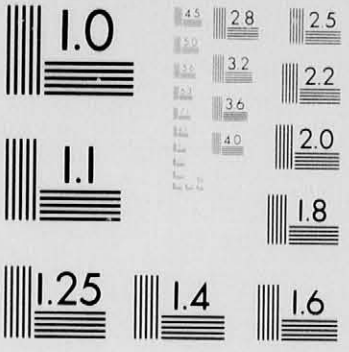
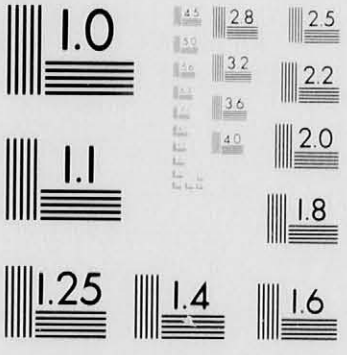
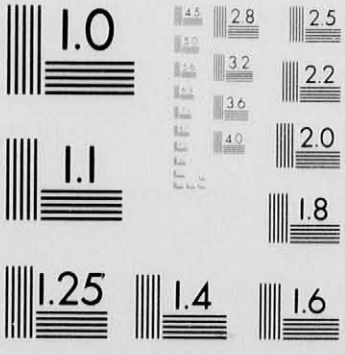
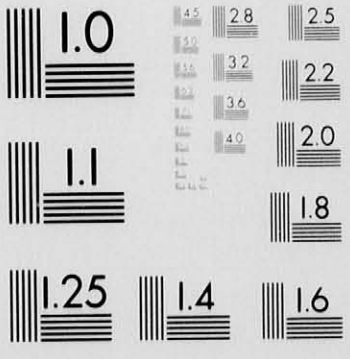
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GROUNDS AND BUILDINGS
OF THE

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

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