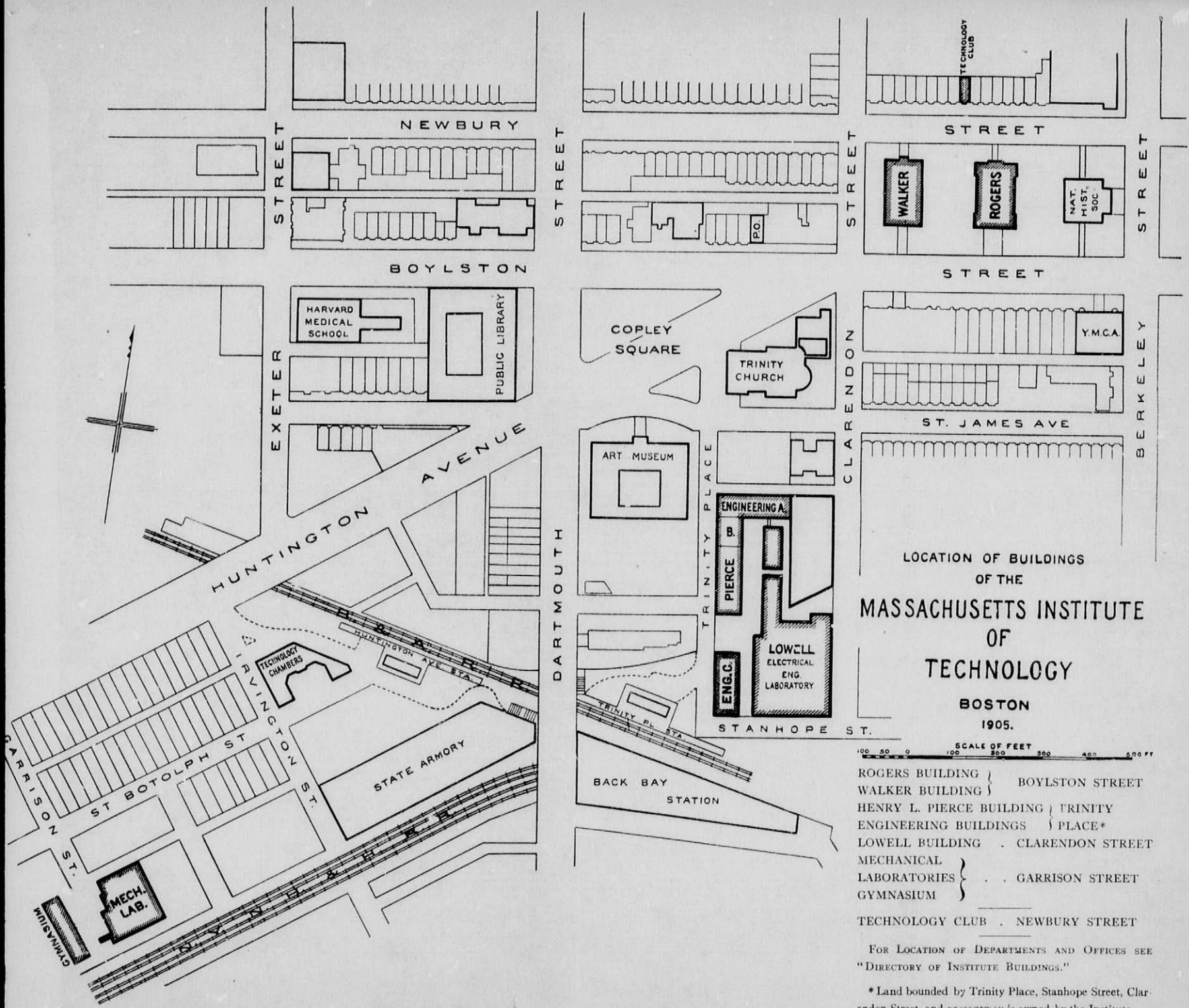


LOCATION OF BUILDINGS
OF THE

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

BOSTON
1905.

SCALE OF FEET
100 50 0 100 200 300 400 500 FT

ROGERS BUILDING, WALKER BUILDING } BOYLSTON STREET
HENRY L. PIERCE BUILDING, ENGINEERING BUILDINGS } TRINITY PLACE*
LOWELL BUILDING . CLARENDON STREET
MECHANICAL LABORATORIES, GYMNASIUM } . . GARRISON STREET

TECHNOLOGY CLUB . NEWBURY STREET

For Location of Departments and Offices see "Directory of Institute Buildings."

* Land bounded by Trinity Place, Stanhope Street, Clarendon Street, and passageway is owned by the Institute.

Volume 41. Number 1.

BULLETIN

OF THE

Massachusetts Institute of Technology

BOSTON

CATALOGUE

OF THE

OFFICERS AND STUDENTS

WITH

A STATEMENT OF THE REQUIREMENTS FOR ADMISSION

AND

A DESCRIPTION OF THE COURSES OF INSTRUCTION

DECEMBER

1905

CALENDAR FOR 1905–1906.

School Year began	Wednesday, Sept. 27, 1905.
Semi-annual Examinations begin	Tuesday, Jan. 16, 1906.
Second Term begins	Tuesday, Feb. 6, 1906.
Annual Examinations begin	Tuesday, May 22, 1906.
Degrees conferred.—School Year ends	Tuesday, June 5, 1906.
First Entrance Examinations	Wednesday, June 27, 1906, Thursday, June 28, 1906, Friday, June 29, 1906, and Saturday, June 30, 1906.
Examinations for Advanced Standing begin	Monday, Sept. 17, 1906.
Second Entrance Examinations[1]	Tuesday, Sept. 18, 1906, Wednesday, Sept. 19, 1906, and Thursday, Sept. 20, 1906.

CALENDAR FOR 1906–1907.

School Year begins	Wednesday, Sept. 26, 1906.
Semi-annual Examinations begin	Tuesday, Jan. 15, 1907.
Second Term begins	Tuesday, Feb. 5, 1907.
Annual Examinations begin	Tuesday, May 21, 1907.
Degrees conferred.—School Year ends	Tuesday, June 4, 1907.
First Entrance Examinations	Wednesday, June 26, 1907, Thursday, June 27, 1907, Friday, June 28, 1907, and Saturday, June 29, 1907.
Examinations for Advanced Standing begin	Monday, Sept. 23, 1907.
Second Entrance Examinations[1]	Tuesday, Sept. 24, 1907, Wednesday, Sept. 25, 1907, and Thursday, Sept. 26, 1907.
School Year of 1906–1907 begins	Wednesday, Oct. 2, 1907.

Stated Meetings of the Corporation for 1906	March 14, June 1, October 10, December 12.
Stated Meetings of the Executive Committee of the Corporation	Second and fourth Tuesdays of every month.

[1] See page 90.

YEARLY CALENDAR

1906

JANUARY

S	M	T	W	T	F	S
--	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31	--	--	--
--	--	--	--	--	--	--

FEBRUARY

S	M	T	W	T	F	S
--	--	--	--	1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	--	--	--

MARCH

S	M	T	W	T	F	S
--	--	--	--	1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31
--	--	--	--	--	--	--

APRIL

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	--	--	--	--	--

MAY

S	M	T	W	T	F	S
--	--	1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31	--	--

JUNE

S	M	T	W	T	F	S
--	--	--	--	--	1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
--	--	--	--	--	--	--

JULY

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31	--	--	--	--
--	--	--	--	--	--	--

AUGUST

S	M	T	W	T	F	S
--	--	--	1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	--

SEPTEMBER

S	M	T	W	T	F	S
--	--	--	--	--	--	1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	--	--	--	--	--	--

OCTOBER

S	M	T	W	T	F	S
--	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31	--	--	--

NOVEMBER

S	M	T	W	T	F	S
--	--	--	--	1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	--

DECEMBER

S	M	T	W	T	F	S
--	--	--	--	--	--	1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31	--	--	--	--	--

1907

JANUARY

S	M	T	W	T	F	S
--	--	1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31	--	--

FEBRUARY

S	M	T	W	T	F	S
--	--	--	--	--	1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	--	--

MARCH

S	M	T	W	T	F	S
--	--	--	--	--	1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31	--	--	--	--	--	--

APRIL

S	M	T	W	T	F	S
--	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	--	--	--	--
--	--	--	--	--	--	--

MAY

S	M	T	W	T	F	S
--	--	--	1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	--

JUNE

S	M	T	W	T	F	S
--	--	--	--	--	--	1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	--	--	--	--	--	--

JULY

S	M	T	W	T	F	S
--	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31	--	--	--

AUGUST

S	M	T	W	T	F	S
--	--	--	--	1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

SEPTEMBER

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	--	--	--	--	--
--	--	--	--	--	--	--

OCTOBER

S	M	T	W	T	F	S
--	--	1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31	--	--
--	--	--	--	--	--	--

NOVEMBER

S	M	T	W	T	F	S
--	--	--	--	--	1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

DECEMBER

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31	--	--	--	--
--	--	--	--	--	--	--

TABLE OF CONTENTS.

PAGE

CALENDAR 2

MASSACHUSETTS INSTITUTE OF TECHNOLOGY.

GENERAL INFORMATION:

Historical Sketch 9
Charter and Government 10
Corporation 11
School of Industrial Science 12
Society of Arts 12
Technology Quarterly 12
Location 13
Buildings 13

OFFICERS:

Members of the Corporation 15
Committees of the Corporation 16
Officers of Administration 18
Officers of Instruction 18
Faculty 30

COURSES OF INSTRUCTION:

General Statement 31
Choice of Courses 32
Course Options 33
Five-year Regular Courses 33
Alternative Studies 34
Summer Reading 35

PAGE

Statements and Schedules of Courses 36
Options in General Studies 72
Summer Courses 74
Professional Summer Schools 77
Requirements for Graduation 81
Graduate Courses 84
Graduate School of Engineering Research 90
Scientific Research 91

REQUIREMENTS FOR ADMISSION:

Admission to the First Year 93
Entrance Examinations in Boston 94
Order of Examinations in Boston 94
Examinations of the College Entrance Examination Board . . 95
Table of Equivalents 97
Certificates 97
Conditions 98
Division of Examinations 98
Subjects for Examination 99
Elective Subjects 105
Admission to Advanced Standing 109
Admission of Special Students 110

SUBJECTS AND METHODS OF INSTRUCTION:

General Statement 112
Alphabetical Subject Index 114
Mathematics 121
Theoretical and Applied Mechanics 128
Drawing and Descriptive Geometry 134
Mechanic Arts 139
English 144
History and Political Science 148
Economics 151
Modern Languages 155
Civil Engineering and Sanitary Engineering 160

PAGE

Mechanical Engineering 174
Mining Engineering and Metallurgy 187
Architecture 194
Chemistry and Chemical Engineering 204
Research Laboratory of Physical Chemistry 220
Electrical Engineering 222
Biology 231
Physics 243
Geology and Geodesy 257
Naval Architecture 267
Military Science and Tactics 273

LABORATORIES AND EQUIPMENT 275
The Engineering Laboratories 276
The John Cummings Laboratories of Mining Engineering and Metallurgy 281
The Kidder Laboratories of Chemistry 283
The Research Laboratory of Physical Chemistry 285
The Augustus Lowell Laboratories of Electrical Engineering . . 285
The Biological Laboratories 289
The Sanitary Research Laboratory and Sewage Experiment Station 290
The Rogers Laboratory of Physics 291
The Geological and Mineralogical Laboratories 295
The Mechanical Laboratories 296
Equipment for Civil Engineering: Geodetic Observatory . . . 297
Equipment for Naval Architecture 298

LIBRARIES 299

REGULATIONS:
School Year 304
Calendar 304
Status of Students 305
Examinations 305

PAGE

Reports of Standing 306
Attendance Card 306
Deposit 306
Fees 307
Payments 307
Undergraduate Scholarships 307
Graduate Scholarships and Fellowships 311
Prizes 312
Residence and Expenses 313
Attendance 313
Advisers 313
Medical Adviser 313
Gymnastics 314
Conduct 314

LOWELL INSTITUTE:

School for Industrial Foremen 315
School of Design 316

ALUMNI ASSOCIATIONS 318

STATISTICS OF THE GRADUATES 324

TITLES OF THESES OF THE CLASS OF 1905 333

REGISTER OF STUDENTS:

Fellows 349
Candidates for the Degree of Doctor of Philosophy 350
Candidates for the Degree of Master of Science 351
Graduate Students 351
Regular Students 359
Special Students 379
Summary 393

ALPHABETICAL LIST OF OFFICERS AND STUDENTS 404

INDEX 404

Massachusetts Institute of Technology.

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 sub-committee 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 Jan. 11, 1861, a public meeting of persons interested in the proposed institution was held in Mercantile Hall, and a preliminary organization was effected. Professor Rogers was chairman of this meeting, and John D. Runkle secretary. The first meeting of the Institute for organization was held April 8, 1862. The civil war led to the postponement of the opening of the School of Industrial Science until 1865; but the Society of Arts was organized, began its meetings on Dec. 17, 1862, and has maintained them ever since. A preliminary session of the School of Industrial Science was opened, fifteen students attending, on Feb. 20, 1865. The regular courses of instruction began Oct. 2, 1865.

Charter and Government.—On April 10, 1861, a legislative act was passed to incorporate the Massachusetts Institute of Technology, and to grant aid to said Institute and to the Boston Society of Natural History. William B. Rogers and twenty other members were named in the act. They, with their associates and successors, were made a body corporate under the above title, "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 square of State land on Back Bay in Boston was set apart as an open space, and the Corporation was allowed upon certain conditions to erect buildings covering not more than one-third part of the westerly two-thirds of this square.

The Corporation was authorized to hold property to an amount not exceeding two hundred thousand dollars.

May 30, 1865, an additional act authorized the holding of property yielding an annual income of thirty thousand dollars.

May 17, 1905, an additional act was passed permitting the Institute to hold property to any amount.

April 27, 1863, an additional act allotted to the Institute one third of the interest received by the State from the United States Land Grant, to support colleges of agriculture and the mechanic arts, under the condition that instruction in military tactics should be provided, and that the Governor, the Chief Justice of the Supreme Court, and the Secretary of the State Board of Education should be each a member *ex-officio* of the government of the Institute.[1]

The control of the Institute was exercised by a body called the Government, elected from among its members. The form

[1] By the terms of the Land Grant the gifts to the States were to be appropriated "to 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."

of the Government at first constituted proved inconvenient, a change was made in the mode of selection of the governing body, and the present Government of the Institute derives its powers from the following charter, of March 20, 1869:

AN ACT IN ADDITION TO THE SEVERAL ACTS INCORPORATING THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY.

Be it enacted, etc., as follows:

SECTION 1. All the powers and privileges now vested by law in the Massachusetts Institute of Technology shall hereafter be exercised and enjoyed by the government of said Institute, as the same is now constituted; *provided, however,* that the governor of the Commonwealth, the chief justice of the Supreme Judicial Court, and the secretary of the Board of Education shall continue to be members of said government, as is now provided by law.

SECT. 2. Said government shall have power to establish any by-laws which they may deem expedient for the regulation of the affairs of said corporation; *provided,* the same are not repugnant to the general laws of this Commonwealth.

SECT. 3. All persons who are now associate members of said Institute, or who hereafter shall become such, shall be entitled to be members of the Society of Arts, with the rights and privileges thereof, as the same are or hereafter may be established by the by-laws.

SECT. 4. This act shall take effect upon its passage.

The Corporation.—The government of the school is vested under this charter in the Corporation. Its by-laws prescribe that the Corporation shall consist of not more than fifty members, to hold office for life, and to be chosen by votes of the Corporation by ballot. The *ex officiis* members are included in the total number.

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, as well as at those of the Society of Arts.

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, exercises control over the Faculty, and has the general superintendence of all matters relating to the School of Industrial Science. The Corporation appoints other committees whose functions and membership are stated on pages 16 and 17.

The School of Industrial Science has become the prominent feature of the Institute; and, indeed, nearly all persons know this, and this alone, as the Institute. It is devoted to investigation and the teaching of science as applied to the various engineering professions; namely, Civil, Mechanical, Mining, Electrical, Chemical, and Sanitary Engineering, and Naval Architecture, as well as to Architecture, Chemistry, Metallurgy, Biology, Physics, and Geology. A course in General Science, in which the studies are elective after the first year, is also provided.

The Society of Arts aims to awaken and maintain an interest in the practical applications of the sciences, and to aid in their advancement. Meetings are held semi-monthly from October to May, at which reports of inventions, discoveries, and matters of scientific and technical interest are presented.

Graduates of the Institute and other persons interested in the aims of the Society are eligible to membership, and its meetings are open to students.

The "Technology Quarterly" contains the proceedings of the Society of Arts and papers presented at its meetings. It is

issued at regular intervals, and affords a medium for the publication of the results of original investigation carried on in the laboratories of the Institute.

All communications concerning the Society of Arts should be addressed to the Secretary of the Society of Arts, Massachusetts Institute of Technology. Contributions for the *Technology Quarterly* and correspondence concerning subscriptions or advertisements may be addressed to the Editor, Room 15, Rogers Building.

Location.—The buildings of the Institute are not only favorably located for accessibility and convenience of students and instructors, but are in close proximity to the chief collections and libraries of Boston, in particular to the Museum of Fine Arts, the Public Library, and the Museum of the Boston Society of Natural History. The free lecture courses of the Lowell Institute are held in the main buildings of the school. Several railroad stations and many street-car lines afford convenient access from the southern and western suburbs. Moreover, the advantages of location in a great manufacturing district, with which the school maintains close relations, are of the greatest value to technological students. Frequent short excursions enable them to make immediate connection between what they learn in the school and what they observe in industrial establishments. The relations between principles and their applications are much better appreciated than if such excursions were reserved for vacation or some subsequent period. The location in a large city brings the school into close contact with men of various professions. The architectural student, for example, not only has at his hand conspicuous examples of the best design and construction, but regularly receives suggestive criticism from eminent men in active practice.

Buildings.—The buildings now occupied are the Rogers Building, on Boylston Street, devoted to instruction in Mining

Engineering and Metallurgy, Mathematics, Literature, History, and Political Science, and containing the administrative offices and the General Library; the Walker Building, on Boylston and Clarendon Streets, devoted to the Departments of Chemistry and Physics; the Engineering Buildings A and B, on Trinity Place, devoted to the Engineering Laboratories, to instruction in Applied Mechanics and Hydraulics, and to the Departments of Civil and Mechanical Engineering; the Engineering Building C, on Trinity Place, devoted to the Departments of Geology and Naval Architecture and to the Research Laboratories of Physical Chemistry; the Henry L. Pierce Building, also on Trinity Place, occupied by the Departments of Architecture, Biology, Geology, and by the Laboratories of Industrial Chemistry and Textile Coloring; the Lowell Building, on Clarendon Street, designed primarily to furnish laboratories for the Department of Electrical Engineering, but occupied also by the Department of Modern Languages; a series of Mechanical Laboratories and a Gymnasium on Garrison Street; and the Sanitary Research Laboratory and Sewage Experiment Station on Albany Street. As soon as a suitable site has been selected, work will be begun on the Walker Memorial Building, a gymnasium and student club-house, the fund for which has been contributed largely by past and present students, in memory of the late President Walker.

Members of the Corporation.

President.

HENRY S. PRITCHETT.

Secretary.[1]

FRANCIS H. WILLIAMS.

Treasurer.

GEORGE WIGGLESWORTH.

WILLIAM ENDICOTT.
HOWARD A. CARSON.
CHARLES J. PAINE.
CHARLES FAIRCHILD.
DAVID R. WHITNEY.
ALEXANDER S. WHEELER.
JAMES P. TOLMAN.
HOWARD STOCKTON.
NATHANIEL THAYER.
CHARLES F. CHOATE.
HIRAM F. MILLS.
PERCIVAL LOWELL.
CHARLES MERRIAM.
THORNTON K. LOTHROP.
CHARLES C. JACKSON.
SAMUEL M. FELTON.
DESMOND FITZGERALD.
SAMUEL CABOT.
FRANCIS BLAKE.
CHARLES W. HUBBARD.

THOMAS L. LIVERMORE.
A. LAWRENCE ROTCH.
JOHN R. FREEMAN.
GEORGE A. GARDNER.
WILLIAM H. LINCOLN.
J. B. SEWALL.
CHARLES L. LOVERING.
A. LAWRENCE LOWELL.
JAMES P. MUNROE.
WILLIAM L. PUTNAM.
CHARLES G. WELD.
EBEN S. DRAPER.
ROBERT S. PEABODY.
ELIHU THOMSON.
ELLIOT C. LEE.
JAMES P. STEARNS.
LUCIUS TUTTLE.
FREDERICK P. FISH.
FRANCIS L. HIGGINSON.
CHARLES A. STONE.

W. MURRAY CRANE.

On the Part of the Commonwealth.

HIS EXCELLENCY, WILLIAM L. DOUGLAS, *Governor.*
HON. MARCUS P. KNOWLTON, *Chief Justice of the Supreme Court.*
HON. GEORGE H. MARTIN, *Secretary of the Board of Education.*

[1] Correspondence should be addressed to Dr. H. W. Tyler, Secretary of the Faculty. (See page 18.)

Committees of the Corporation.

Executive Committee.

HENRY S. PRITCHETT. } *Ex Officiis.*
GEORGE WIGGLESWORTH. }

A. LAWRENCE LOWELL. HOWARD STOCKTON.
FREDERICK P. FISH. FRANCIS H. WILLIAMS.
THOMAS L. LIVERMORE.

Finance Committee.

WILLIAM ENDICOTT. NATHANIEL THAYER.
DAVID R. WHITNEY. CHARLES F. CHOATE.
CHARLES C. JACKSON. JAMES P. STEARNS.

Committee on the Society of Arts.

HOWARD A. CARSON. GEORGE A. GARDNER.
HIRAM F. MILLS.

Auditing Committee.

CHARLES C. JACKSON. JAMES P. TOLMAN.
WILLIAM L. PUTNAM.

Committee on Nominations.

THORNTON K. LOTHROP. GEORGE A. GARDNER.
DAVID R. WHITNEY. HOWARD A. CARSON.
FRANCIS H. WILLIAMS.

Trustees of the Museum of Fine Arts.

HENRY S. PRITCHETT. A. LAWRENCE ROTCH.
FRANCIS BLAKE.

VISITING COMMITTEES.

Department of Civil Engineering.

HOWARD A. CARSON. DESMOND FITZGERALD.
CHARLES F. CHOATE. JOHN R. FREEMAN.
LUCIUS TUTTLE.

Departments of Mechanical Engineering and Applied Mechanics.

HIRAM F. MILLS. JAMES P. TOLMAN.
FRANCIS BLAKE EBEN S. DRAPER.
ELLIOT C. LEE.

Departments of Mining and Geology.

THOMAS L. LIVERMORE. JAMES P. TOLMAN.
CHARLES FAIRCHILD. CHARLES L. LOVERING.
JAMES P. STEARNS.

Department of Architecture.

ROBERT S. PEABODY. ALEXANDER S. WHEELER.
A. LAWRENCE ROTCH. FRANCIS L. HIGGINSON.
JOHN R. FREEMAN.

Department of Physics.

A. LAWRENCE ROTCH. CHARLES W. HUBBARD
FRANCIS BLAKE. ELIHU THOMSON.

Department of Electrical Engineering.

ELIHU THOMSON. FREDERICK P. FISH.
FRANCIS BLAKE. CHARLES A. STONE.
PERCIVAL LOWELL.

Departments of Literature, History, and Political Economy.

GEORGE H. MARTIN. JAMES P. MUNROE.
A. LAWRENCE LOWELL. J. B. SEWALL.
CHARLES L. LOVERING.

Departments of Modern Languages and English.

JAMES P. MUNROE. SAMUEL CABOT.
CHARLES C. JACKSON. J. B. SEWALL.

Department of Mathematics.

PERCIVAL LOWELL. WILLIAM L. PUTNAM.
HOWARD STOCKTON. CHARLES F. CHOATE.

Departments of Chemistry and Chemical Engineering.

SAMUEL CABOT. ELLIOT C. LEE.
HIRAM F. MILLS. CHARLES W. HUBBARD.
ELIHU THOMSON. W. MURRAY CRANE.

Department of Biology.

JOHN R. FREEMAN. GEORGE H. MARTIN.
FRANCIS BLAKE. FRANCIS H. WILLIAMS.

Department of Naval Architecture.

CHARLES G. WELD. HOWARD STOCKTON.
CHARLES J. PAINE. WILLIAM H. LINCOLN.

Officers of Administration.

President	HENRY S. PRITCHETT.
Treasurer	GEORGE WIGGLESWORTH.
Secretary	HARRY W. TYLER.
Dean	ALFRED E. BURTON.
Librarian	ROBERT P. BIGELOW.
Bursar	FRANK H. RAND.
Registrar	WALTER HUMPHREYS.
Recorder	O. F. WELLS.

General correspondence should be addressed to the Secretary.

Officers of Instruction.

Offices or Lecture-rooms.[1]

HENRY S. PRITCHETT, PH.D., LL.D. . . . . 10 Rogers.
President.

GEORGE A. OSBORNE, S.B. . . . . 27 Rogers.
Walker Professor of Mathematics.

ROBERT H. RICHARDS, S.B. . . . . 1 Rogers.
Professor of Mining Engineering and Metallurgy.

WILLIAM H. NILES, S.B., PH.B., A.M., LL.D. . . . . 14 Pierce.
Professor of Geology and Geography, Emeritus.

CHARLES R. CROSS, S.B. . . . . 11 Walker.
Thayer Professor of Physics; Director of the Rogers Laboratory.

GAETANO LANZA, C.E. . . . . 10 Engineering A.
Professor of Theoretical and Applied Mechanics; in charge of the Department of Mechanical Engineering.

GEORGE F. SWAIN, S.B. . . . . 43 Engineering A.
Hayward Professor of Civil Engineering.

FRANCIS W. CHANDLER . . . . . 35 Pierce.
Professor of Architecture.

[1] The numbers of the usual offices or lecture-rooms relate to the following buildings: Rogers Building, 491 Boylston Street; Walker Building, 525 Boylston Street; Engineering Buildings A, B, and C; Henry L. Pierce Building, 18, 24, and 30 Trinity Place; and Lowell Building, Clarendon Street, respectively.

Offices or Lecture-room.

WILLIAM T. SEDGWICK, PH.D. . . . . 26 Pierce.
Professor of Biology; Director of the Sanitary Research Laboratory and Sewage Experiment Station.

DAVIS R. DEWEY, PH.D. . . . . 40 Rogers.
Professor of Economics and Statistics.

WEBSTER WELLS, S.B. . . . . 21 Rogers.
Professor of Mathematics.

CECIL H. PEABODY, S.B. . . . . 31a Engineering C.
Professor of Naval Architecture and Marine Engineering.

HARRY W. TYLER, PH.D. . . . . 11 Rogers.
Professor of Mathematics; Secretary of the Faculty.

ARLO BATES, A.M., LITT.D. . . . . 16 Rogers.
Professor of English.

DESIRÉ DESPRADELLE . . . . . 30 Pierce.
Rotch Professor of Architectural Design.

PETER SCHWAMB, S.B. . . . . 23 Engineering B.
Professor of Machine Design; Director of the Mechanical Laboratories.

C. FRANK ALLEN, S.B. . . . . 51 Engineering B.
Professor of Railroad Engineering.

ALFRED E. BURTON, S.B. (*Absent*).
Professor of Topographical Engineering; Dean.

DWIGHT PORTER, PH.B. . . . . 46 Engineering A.
Professor of Hydraulic Engineering.

HEINRICH O. HOFMAN, E.M., MET.E., PH.D. . . . . 1 Rogers.
Professor of Metallurgy.

HENRY P. TALBOT, PH.D. . . . . 30 Walker.
Professor of Inorganic and Analytical Chemistry.

ARTHUR A. NOYES, PH.D. . . . . 17 Engineering C.
Professor of Theoretical Chemistry; Director of the Research Laboratory of Physical Chemistry.

THOMAS E. POPE, A.M. . . . . 47 Walker.
Professor of Inorganic Chemistry.

CHARLES F. A. CURRIER, A.M. . . . . 31 Rogers.
Professor of History.

WILLIAM HOVGAARD, COMMANDER, DANISH NAVY.
Professor of Naval Design. 33 Engineering C.

FRED WHEELER, MAJOR, U.S.A. . . . . 37 Rogers.
Professor of Military Science.

THOMAS A. JAGGAR, JR., PH.D. . . . . 14 Pierce.
Professor of Geology.

HARRY E. CLIFFORD, S.B. . . . . 16 Lowell.
Professor of Theoretical Electricity; acting in charge of the Department of Electrical Engineering.

JOHN BIGELOW, JR. . . . . 31 Lowell.
Professor of French.

Offices or Lecture-rooms.

FRANK VOGEL, A.M. . . . . 24, 33 Lowell.
Professor of Modern Languages.

DANA P. BARTLETT, S.B. . . . . 20, 26 Rogers.
Professor of Mathematics.

ALLYNE L. MERRILL, S.B. . . . . 30a Engineering A.
Professor of Mechanism.

EDWARD F. MILLER, S.B. . . . . 10 Engineering A.
Professor of Steam Engineering.

WILLIAM H. WALKER, PH.D. . . . . 55 Pierce.
Professor of Industrial Chemistry.

PERCIVAL LOWELL, A.B.
Non-resident[1] *Professor of Astronomy.*

ELIHU THOMSON.
Non-resident Professor of Applied Electricity.

S. HOMER WOODBRIDGE, A.M. . . . . 21 Engineering B.
Associate Professor of Heating and Ventilation.

WILLIAM L. PUFFER, S.B. . . . . 14 Lowell.
Associate Professor of Electrical Engineering.

WILLIAM H. LAWRENCE, S.B. . . . . 41a Pierce.
Associate Professor of Architecture.

WILLIAM O. CROSBY, S.B. . . . . 12 Engineering B.
Associate Professor of Geology.

FREDERICK S. WOODS, PH.D. . . . . 20, 22 Rogers.
Associate Professor of Mathematics.

HARRY M. GOODWIN, PH.D. . . . . 2, 11 Walker.
Associate Professor of Physics and Electro-Chemistry.

JOHN O. SUMNER, A.B. . . . . 41b Pierce.
Associate Professor of History.

FREDERICK H. BAILEY, A.M. . . . . 33 Rogers.
Associate Professor of Mathematics.

LOUIS DERR, M.A., S.B. . . . . 11 Walker.
Associate Professor of Physics.

GEORGE V. WENDELL, PH.D. . . . . 25 Walker.
Associate Professor of Physics.

CHARLES L. ADAMS . . . . . 43c Rogers, 50 Pierce.
Associate Professor of Drawing and Descriptive Geometry.

CHARLES L. NORTON, S.B. . . . . 4a Walker.
Associate Professor of Heat Measurements.

HENRY FAY, PH.D. . . . . 46 Walker.
Associate Professor of Analytical Chemistry.

WILLIAM E. MOTT, S.B. . . . . 41 Engineering B.
Associate Professor of Hydraulic Engineering.

WILLIS R. WHITNEY, PH.D.
Non-resident Associate Professor of Theoretical Chemistry.

[1] Non-resident professors deliver courses of lectures, without stated engagements.

Offices
Lecture-rooms

FRED L. BARDWELL, S.B. . . . . 47a Walker.
Assistant Professor of Inorganic Chemistry.

AUGUSTUS H. GILL, PH.D. . . . . 38 Walker.
Assistant Professor of Technical Analysis.

RICHARD W. LODGE . . . . . 7 Rogers.
Assistant Professor of Mining Engineering and Metallurgy.

ARTHUR G. ROBBINS, S.B. . . . . 50 Engineering A.
Assistant Professor of Highway Engineering.

FRANK A. LAWS, S.B. . . . . 4 Lowell, 10 Walker.
Assistant Professor of Electrical Testing.

HENRY G. PEARSON, A.B. . . . . 12 Rogers.
Assistant Professor of English.

FRANK H. THORP, PH.D. . . . . 50 Engineering B.
Assistant Professor of Industrial Chemistry.

CHARLES E. FULLER, S.B. . . . . 10 Engineering A.
Assistant Professor of Mechanical Engineering.

WILLIAM A. JOHNSTON, S.B. . . . . 10 Engineering A.
Assistant Professor of Mechanical Engineering.

CHARLES F. PARK, S.B. . . . . 20a Engineering A.
Assistant Professor of Mechanical Engineering.

F. JEWETT MOORE, PH.D. . . . . 43 Walker.
Assistant Professor of Organic Chemistry.

HARRY W. GARDNER, S.B. . . . . 44 Pierce.
Assistant Professor of Architecture.

FRANK P. McKIBBEN, S.B. . . . . 40 Engineering B.
Assistant Professor of Civil Engineering.

SAMUEL C. PRESCOTT, S.B. . . . . 28a, 29 Pierce.
Assistant Professor of Industrial Biology.

RALPH R. LAWRENCE, S.B. . . . . 10 Lowell.
Assistant Professor of Electrical Engineering.

CHARLES H. WARREN, PH.D. . . . . 7 Engineering C.
Assistant Professor of Mineralogy.

SAMUEL P. MULLIKEN, PH.D. . . . . 34 Walker.
Assistant Professor of Organic Chemical Research.

GEORGE B. HAVEN, S.B. . . . . 24 Engineering B.
Assistant Professor of Mechanical Engineering.

WALTER S. LELAND, S.B. . . . . 31b Engineering C.
Assistant Professor of Naval Architecture.

WILLIAM J. DRISKO, S.B. . . . . 16 Walker.
Assistant Professor of Physics.

HARRISON W. SMITH, A.B., S.B. . . . . 12 Lowell.
Assistant Professor of Electrical Engineering.

CHARLES-EDWARD A. WINSLOW, S.M. . . . . 28a Pierce.
Assistant Professor of Biology; Biologist in charge of the Sanitary Research Laboratory and Sewage Experiment Station.

Offices or Lecture-rooms.

CARROLL W. DOTEN, A.M. . . . . 40 Rogers.
Assistant Professor of Economics.

DOUGLAS W. JOHNSON, PH.D. . . . . 14 Pierce.
Assistant Professor of Geology.

HENRY K. BURRISON, S.B. . . . . 50b Rogers.
Instructor in Mechanical Drawing and Descriptive Geometry.

ELLEN H. RICHARDS, A.M., S.B. . . . . 36 Walker.
Instructor in Sanitary Chemistry.

PETER S. BURNS, PH.D. . . . . 47a Walker.
Instructor in Inorganic Chemistry.

NATHAN R. GEORGE, JR., A.M. . . . . 11 Rogers.
Instructor in Mathematics.

LEONARD M. PASSANO, A.B. . . . . 48 Engineering A.
Instructor in Mathematics.

JOSEPH BLACHSTEIN . . . . . 22 Lowell.
Instructor in Modern Languages.

ROBERT P. BIGELOW, PH.D. . . . . 15 Rogers.
Instructor in Biology; Librarian.

BENJAMIN E. CARTER, JR., A.M. . . . . 26 Lowell.
Instructor in Mathematics.

GEORGE W. ROLFE, A.M. . . . . 39 Walker.
Instructor in Sugar Analysis.

ERVIN KENISON, S.B. . . . . 50a Rogers.
Instructor in Mechanical Drawing and Descriptive Geometry.

W. FELTON BROWN . . . . . 50 Pierce.
Instructor in Freehand Drawing.

JUSTUS ERHARDT, A.B. . . . . 21 Lowell.
Instructor in Modern Languages.

JOSEPH W. PHELAN, S.B. . . . . 34a Walker.
Instructor in Inorganic Chemistry.

ARCHER T. ROBINSON, A.B. . . . . 13 Rogers.
Instructor in English.

ARTHUR W. WEYSSE, PH.D. . . . . 22 Pierce.
Instructor in Biology.

HARRY C. BRADLEY, S.B. . . . . 50a Rogers.
Instructor in Mechanical Drawing and Descriptive Geometry.

FRANCIS HAROLD DIKE, A.B. . . . . 23 Lowell.
Instructor in Modern Languages.

GEORGE L. HOSMER . . . . . 50 Engineering A.
Instructor in Civil Engineering.

ALPHEUS G. WOODMAN, S.B. . . . . 36 Walker.
Instructor in Sanitary Chemistry.

WILLIAM T. HALL, S.B. . . . . 28 Walker.
Instructor in Analytical Chemistry.

JOSEPH C. RILEY, S.B. . . . . 10 Engineering A.
Instructor in Mechanical Engineering.

	Offices or Lecture-rooms.
CHARLES W. BERRY, S.B.	10 Engineering A.
Instructor in Mechanical Engineering.	
CHARLES B. BREED, S.B.	51 Engineering B.
Instructor in Civil Engineering.	
MAURICE DEK. THOMPSON, JR., PH.D.	2 Walker.
Instructor in Electro-Chemistry.	
CHARLES E. LOCKE, S.B.	1 Rogers.
Instructor in Mining Engineering and Metallurgy.	
HENRY L. SEAVER, A.B.	12 Rogers.
Instructor in English.	
HARRISON W. HAYWARD, S.B.	10 Engineering A.
Instructor in Mechanical Engineering.	
FREDERICK R. KNEELAND, S.B.	46c Walker.
Instructor in Analytical Chemistry.	
HERMAN R. KURRELMEYER, PH.D.	30 Lowell.
Instructor in Modern Languages.	
ERNEST A. MILLER, A.M. (*Absent*).	
Instructor in Mathematics.	
WALTER H. JAMES, S.B.	20 Engineering A.
Instructor in Mechanical Engineering.	
LAWRENCE S. SMITH, S.B.	13 Engineering B.
Instructor in Mechanical Engineering.	
CLIFFORD M. SWAN, S.B.	25 Walker.
Instructor in Physics.	
CHARLES F. WILLARD, S.B.	31c Engineering C.
Instructor in Marine Engineering.	
ARTHUR A. BLANCHARD, PH.D.	34a Walker.
Instructor in Inorganic Chemistry.	
JOHN W. BROWN, PH.D.	20 Engineering C.
Instructor in Theoretical Chemistry.	
WILFRID E. MACDONALD, A.B.	26 Lowell.
Instructor in Mathematics.	
MILES S. SHERRILL, PH.D.	32 Walker.
Instructor in Analytical Chemistry.	
HERVEY W. SHIMER, A.M., PH.D.	14 Pierce.
Instructor in Geology.	
LIVINGSTON W. SMITH, PH.D.	47a Walker.
Instructor in Inorganic Chemistry.	
PERCY G. STILES, PH.D.	21 Pierce.
Instructor in Physiology and Personal Hygiene.	
ROY G. BURNHAM, S.B.	30 Engineering A.
Instructor in Mechanical Engineering.	
CHAUNCY C. BATCHELOR, A.B.	13 Rogers.
Instructor in English.	
NEWELL C. PAGE, S.B.	10 Walker.
Instructor in Physics.	

	Offices or Lecture-rooms.
RICHARD B. EARLE, Sc.D. *Instructor in Organic Chemistry.*	44 Walker.
JAMES A. HARE, A.B. *Instructor in Modern Languages.*	29 Lowell.
GEORGE J. LENZ, A.B. *Instructor in Modern Languages.*	21 Lowell.
CLARENCE L. E. MOORE, PH.D. *Instructor in Mathematics.*	36 Rogers.
STURGIS H. THORNDIKE, A.B., S.B. *Instructor in Civil Engineering.*	44 Engineering A.
WILLIAM H. ROEVER, A.M. *Instructor in Mathematics.*	20 Rogers.
ARTHUR L. GOODRICH, S.B. *Instructor in Mechanical Drawing and Descriptive Geometry.*	50a Rogers.
CHARLES WINTHROP SAWYER *Instructor in Freehand Drawing.*	52 Rogers.
HENRY W. BUHLER, S.B. *Instructor in Heat Measurements.*	4a Walker.
HAROLD A. EVERETT, S.B. *Instructor in Naval Architecture.*	31b Engineering C.
EUGENE D. FORBES, S.B. *Instructor in Physics.*	16 Walker.
EDWARD J. RUXTON, S.B. *Instructor in Mechanical Engineering.*	30 Engineering B.
GEORGE W. SWETT, S.B. *Instructor in Mechanical Engineering.*	31 Engineering B.
THEODORE H. TAFT, S.B. *Instructor in Mechanical Engineering.*	10 Engineering A.
DANIEL F. COMSTOCK, S.B. (*Absent*). *Instructor in Theoretical Physics.*	
JOHN W. HOWARD, S.B. *Instructor in Civil Engineering.*	50 Engineering A.
WALTER J. GILL, JR., S.B. *Instructor in Physics.*	25 Walker.
CHARLES H. PORTER, A.B., S.B. *Instructor in Electrical Engineering.*	7 Lowell.
STEPHEN A. BREED, S.B. *Instructor in Mechanical Drawing and Descriptive Geometry.*	43d Rogers.
SAMUEL E. GIDEON *Instructor in Mechanical Drawing and Descriptive Geometry.*	43d Rogers.
JOHN A. ROSS, JR., S.B. *Instructor in Naval Architecture.*	33 Engineering C.
GEORGE E. RUSSELL, S.B. *Instructor in Civil Engineering.*	46 Engineering A.
CHESTER S. ALDRICH, S.B. *Assistant in Mechanical Engineering.*	10 Engineering A.

Offices or Lecture-rooms.

MOSES BROWN, JR., S.B. . . . . 7 Rogers.
Assistant in Mining Engineering and Metallurgy.

MAURICE W. CARTY, S.B. . . . . 10 Engineering A.
Assistant in Mechanical Engineering.

CLINTON H. COLLESTER, A.M. . . . . 13 Rogers.
Assistant in English.

MYRON W. DOLE, S.B. . . . . 30 Engineering B.
Assistant in Mechanical Engineering.

ROBERT FAULKNER, S.B. . . . . 7 Rogers.
Assistant in Mining Engineering and Metallurgy.

RAYMOND HASKELL, S.B., S.M. . . . . 21 Engineering C.
Assistant in Theoretical Chemistry.

EVERETT O. HILLER, S.B. . . . . 20 Engineering A.
Assistant in Mechanical Engineering.

ADDISON F. HOLMES, S.B. . . . . 10 Engineering A.
Assistant in Mechanical Engineering.

JOHN C. HUDGINS, A.B. . . . . 47a Walker.
Assistant in Inorganic Chemistry.

CARL KING, S.B. . . . . 24 Engineering B.
Assistant in Mechanical Engineering.

ELIOT W. NILES, S.B. . . . . 10 Walker.
Assistant in Physics.

RUFUS C. REED, S.B. . . . . 7 Rogers.
Assistant in Mining Engineering and Metallurgy.

ROBERT B. SOSMAN, B.Sc., S.B. . . . . 10 Engineering C.
Assistant in Theoretical Chemistry.

GEORGE R. TAYLOR, S.B. . . . . 34 Walker.
Assistant in Inorganic Chemistry.

NELSON E. TOUSLEY, A.B. . . . . 28 Walker.
Assistant in Analytical Chemistry.

ARTHUR K. ADAMS, S.B., A.M. . . . . 7 Engineering C.
Assistant in Geology.

JOHN AYER, S.B. . . . . 51 Engineering B.
Assistant in Civil Engineering.

JAMES E. BARLOW, S.B. . . . . 44 Engineering A.
Assistant in Civil Engineering.

GEORGE A. BARNABY, S.B. . . . . 7 Rogers.
Assistant in Mining Engineering and Metallurgy.

EDWARD A. BARRIER, S.B. . . . . 46a Walker.
Assistant in Analytical Chemistry.

CHARLES R. BOGGS, S.B. . . . . 2 Walker.
Assistant in Electro-Chemistry.

IRVING H. COWDREY, S.B. . . . . 30 Engineering A.
Assistant in Mechanical Engineering.

HAROLD G. CRANE, S.B. . . . . G Lowell.
Assistant in Electrical Engineering.

	Offices or Lecture-rooms.
JOHN C. DAMON, S.B.	G Lowell.
Assistant in Electrical Engineering.	
CHARLES J. EMERSON, S.B.	4 Walker.
Assistant in Heat Measurements.	
CLARENCE E. GAGE, S.B.	10 Engineering A.
Assistant in Mechanical Engineering.	
RALPH S. GIFFORD, S.B.	46a Walker.
Assistant in Analytical Chemistry.	
JOHN T. GLIDDEN, S.B.	7 Rogers.
Assistant in Mining Engineering and Metallurgy.	
RALPH HAYDEN	7 Rogers.
Assistant in Mining Engineering and Metallurgy.	
CARL T. HUMPHREY, S.B.	50 Engineering A
Assistant in Civil Engineering.	
HENRY L. JACKSON, S.B.	38 Walker.
Assistant in Technical Analysis.	
WARREN K. LEWIS, S.B.	53 Pierce.
Assistant in Industrial Chemistry.	
WALDO V. LYON, S.B.	8 Lowell.
Assistant in Electrical Engineering.	
HORACE J. MACINTIRE, S.B.	10 Engineering A.
Assistant in Mechanical Engineering.	
ROWERT W. McLEAN, S.B.	10 Engineering A.
Assistant in Mechanical Engineering.	
JOHN H. McMANUS, S.B.	50 Engineering A.
Assistant in Civil Engineering.	
FRANK J. QUINLAN, S.B.	47a Walker.
Assistant in Inorganic Chemistry.	
GEORGE I. RHODES, S.B.	G Lowell.
Assistant in Electrical Engineering.	
GEORGE A. RODENBAECK, S.B.	G Lowell.
Assistant in Electrical Engineering.	
CHESTER R. SHAW, S.B.	25 Walker.
Assistant in Physics.	
WILLARD E. SIMPSON, S.B.	50 Engineering A.
Assistant in Civil Engineering.	
ALBERT H. SMITH, S.B.	10 Engineering A.
Assistant in Mechanical Engineering.	
ALBERT L. SMITH, S.B.	30 Walker.
Assistant in Analytical Chemistry.	
FRANK C. STARR, S.B.	50 Engineering A.
Assistant in Civil Engineering.	
HENRY A. WENTWORTH, S.B.	4 Lowell.
Assistant in Electrical Engineering.	
WILLIAM H. WHITCOMB, S.B.	16 Walker.
Assistant in Physics.	
KILBORN WHITMAN, JR., S.B.	51 Engineering B.
Assistant in Civil Engineering.	

STAFF OF THE RESEARCH LABORATORY OF PHYSICAL CHEMISTRY.

	Offices or Lecture-rooms.
ARTHUR A. NOYES, PH.D. . . . . *Professor of Theoretical Chemistry; Director.*	17 Engineering C.
HARRY M. GOODWIN, PH.D. . . . . *Associate Professor of Physics and Electro-Chemistry.*	2, 11 Walker.
ARTHUR C. MELCHER, S.B. . . . . *Research Associate in Physical Chemistry.*	11 Engineering C.
ROY D. MAILEY, S.B. . . . . *Research Associate in Physical Chemistry.*	26 Engineering C.
WILLIAM C. BRAY, PH.D. . . . . *Research Associate in Physical Chemistry.*	16 Engineering C.
GUY W. EASTMAN, S.B. . . . . *Research Associate in Physical Chemistry.*	12 Engineering C.
GILBERT N. LEWIS, PH.D. . . . . *Research Associate in Physical Chemistry.*	12 Engineering C.
GEORGE A. ABBOTT, A.M. . . . . *Research Assistant in Physical Chemistry.*	14 Engineering C.
CHARLES A. KRAUS, B.S. . . . . *Research Assistant in Physical Chemistry.*	2 Engineering C.
EDWARD W. WASHBURN, S.B. . . . . *Research Assistant in Physical Chemistry.*	26 Engineering C.

STAFF OF THE SANITARY RESEARCH LABORATORY AND SEWAGE EXPERIMENT STATION.

WILLIAM T. SEDGWICK, PH.D. . . . . *Professor of Biology; Director.*	26 Pierce.
CHARLES-EDWARD A. WINSLOW, S.M. . . . . *Assistant Professor of Biology; Biologist in Charge.*	28a Pierce.
EARLE B. PHELPS, S.B. . . . . *Research Chemist and Bacteriologist.*	27 Pierce.
ANNE F. ROGERS . . . . . *Research Assistant.*	23 Pierce.

INSTRUCTORS AND ASSISTANTS IN THE CHANIC ARTS.

	Offices or Lecture-rooms.
THEODORE B. MERRICK *Instructor in Woodwork and Foundry-Work.*	Mech. Lab.
JAMES R. LAMBIRTH *Instructor in Forging.*	Mech. Lab.
ROBERT H. SMITH *Instructor in Machine-Tool Work.*	Mech. Lab.
CHARLES E. LITTLEFIELD *Instructor in Chipping and Filing.*	Mech. Lab.
GEORGE E. BRADLEY *Assistant in Machine-Tool Work.*	Mech. Lab.
FRANK A. BROWN *Assistant in Forging.*	Mech. Lab.
OSCAR W. NORTHRUP *Assistant in Machine-Tool Work.*	Mech. Lab.
MARSHALL G. MERIAM. *Assistant in Chipping and Filing.*	Mech. Lab.
ALBERT L. MOULTON *Assistant in Woodwork and Foundry-Work.*	Mech. Lab.

INSTRUCTOR IN GYMNASTICS.

WINFIELD C. TOWNE, A.B. . . . . Gymnasium.

MEDICAL ADVISER LECTURER ON PERSONAL HYGIENE.

FRANKLIN W. WHITE, S.B., M.D. . . . . 27 Pierce.[1]

TEACHERS AND LECTURERS FOR THE CURRENT YEAR.

HOMER ALBERS, LL.B., *Business Law.*
JOHN ALDEN, S.B., *Textile Printing.*
TRUMAN H. BARTLETT, *Modelling.*
HOWARD L. COBURN, S.B., *Mechanical Engineering of Electric Power Plants.*
ALLEN H. COX, *Architectural Design.*
P. W. DAVIS, *Storage Batteries.*
FRANK F. FOWLE, S.B., *Railway Telephone Systems.*
CHARLES GARRISON, S.B., *Steam Turbines.*
CHARLES M. GREEN, *Electric Arc Lighting.*

[1] Tuesdays and Fridays only, 4–5 P.M.

DAVID A. GREGG, *Pen-and-Ink Drawing.*
ELEAZER B. HOMER, S.B., *Architectural History.*
JOHN GEORGE JACK, *Landscape Horticulture.*
HENRY D. JACKSON, *Electric Railway Systems.*
CHARLES D. JENKINS, S.B., *Illuminating Gas and Pottery.*
FRANK B. JEWETT, PH.D., *Telephone Engineering; Optics.*
MARSHALL O. LEIGHTON, S.B., *the Pollution of Streams.*
ARTHUR D. LITTLE, *Paper.*
JAMES W. LOVELAND, S.B., *the Manufacture of Soaps.*
GUY LOWELL, A.B., S.B., Grad. École des Beaux-Arts, *Landscape Architecture.*
ARTHUR N. MANSFIELD, S.B., *Telephone Line Construction.*
SAMUEL W. MEAD, *Architectural Design.*
ALPHEUS A. PACKARD, S.B., *Yacht Designing.*
F. A. C. PERRINE, *Electric Power Transmission.*
WALTER E. PIPER, S.B., *Rubber.*
THOMAS G. RICHARDS, S.B., *Shop Economy.*
ODIN B. ROBERTS, LL.B., *the Nature and Function of Patents for Inventions.*
ALBERT SAUVEUR, S.B., *Metallography.*
CHARLES F. SCOTT, *Electrical Engineering Development.*
TIMOTHY W. SPRAGUE, S.B., *Electricity in Mining.*
JOHN STONE STONE, *the Application of Electrical Oscillations in Telephony.*
CHARLES P. TOLMAN, S.B., *Brakes and Braking.*
ROSS TURNER, *Water Color.*
GEORGE F. ULMER, S.B., *Sugar.*
W. LYMAN UNDERWOOD, *Biology.*
CHARLES F. WALLACE, S.B., *High Voltage Transmission Lines.*
C. HOWARD WALKER, *History of Ornament.*
HENRY E. WARREN, S.B., *the Governing of Turbines.*
S. W. WILDER, JR., S.B., *Alumina and Alumina Compounds.*
FREDERICK A. WOODS, M.D., *Histology.*

Faculty.

HENRY S. PRITCHETT, *President.*

GEORGE A. OSBORNE.
ROBERT H. RICHARDS.
WILLIAM H. NILES.
CHARLES R. CROSS.
GAETANO LANZA.
GEORGE F. SWAIN.
FRANCIS W. CHANDLER.
WILLIAM T. SEDGWICK.
DAVIS R. DEWEY.
WEBSTER WELLS.
CECIL H. PEABODY.
HARRY W. TYLER, *Secretary.*
ARLO BATES.
D. DESPRADELLE.
PETER SCHWAMB.
C. FRANK ALLEN.
ALFRED E. BURTON, *Dean.*
DWIGHT PORTER.
HEINRICH O. HOFMAN.
HENRY P. TALBOT.
ARTHUR A. NOYES.
THOMAS E. POPE.
CHARLES F. A. CURRIER.
WILLIAM HOVGAARD.
FRED WHEELER.
THOMAS A. JAGGAR.
HARRY E. CLIFFORD.
JOHN BIGELOW, JR.
FRANK VOGEL.
DANA P. BARTLETT.
ALLYNE L. MERRILL.
EDWARD F. MILLER.
WILLIAM H. WALKER.
S. HOMER WOODBRIDGE.
WILLIAM L. PUFFER.
WILLIAM H. LAWRENCE.
WILLIAM O. CROSBY.
FREDERICK S. WOODS.
HARRY M. GOODWIN.
JOHN O. SUMNER.
FREDERICK H. BAILEY.
LOUIS DERR.
GEORGE V. WENDELL.
CHARLES L. ADAMS.
CHARLES L. NORTON.
HENRY FAY.
WILLIAM E. MOTT.
FRED L. BARDWELL.
AUGUSTUS H. GILL.
RICHARD W. LODGE.
ARTHUR G. ROBBINS.
FRANK A. LAWS.
HENRY G. PEARSON.
FRANK H. THORP.
CHARLES E. FULLER.
WILLIAM A. JOHNSTON.
CHARLES F. PARK.
F. JEWETT MOORE.
HARRY W. GARDNER.
FRANK P. McKIBBEN.
SAMUEL C. PRESCOTT.
RALPH R. LAWRENCE.
CHARLES H. WARREN.
SAMUEL P. MULLIKEN.
GEORGE B. HAVEN.
WALTER S. LELAND.
WILLIAM J. DRISKO.
HARRISON W. SMITH.
C.-E. A. WINSLOW.
CARROLL W. DOTEN.

DOUGLAS W. JOHNSON.

Courses of Instruction.

THE Massachusetts Institute of Technology provides instruction in the sciences and their applications to the arts. Its Courses embrace also such general studies as are essential for a liberal education.

The fundamental elements in the curriculum of the school are Mathematics, Chemistry, and Physics. The general training acquired in these introductory studies prepares the student, on the one hand, for more advanced and specialized scientific work, and it constitutes, on the other hand, the foundation for the technical courses in Engineering, Chemistry, and Architecture. Instruction in technical methods is subordinated to the acquisition of principles, and these principles are studied with the predominant purpose of exercising the powers and training the faculties.

The Institute offers thirteen distinct undergraduate Courses, each of four years' duration, as follows:

I. CIVIL ENGINEERING.
II. MECHANICAL ENGINEERING.
III. MINING ENGINEERING AND METALLURGY.
IV. ARCHITECTURE.
V. CHEMISTRY.
VI. ELECTRICAL ENGINEERING.
VII. BIOLOGY.
VIII. PHYSICS.
IX. GENERAL SCIENCE.
X. CHEMICAL ENGINEERING.
XI. SANITARY ENGINEERING.
XII. GEOLOGY AND GEODESY.
XIII. NAVAL ARCHITECTURE.

For the satisfactory completion of any one of these Courses the degree of Bachelor of Science is conferred. Of the thirteen Courses, eight give their students scientific and practical training for the various engineering professions; four others, namely, those in Chemistry, Physics, Biology, and Geology, embrace a larger proportion of pure science and afford preparation either for professional practice, for teaching, or for scientific investigation. While the Institute of Technology is primarily a school of applied science, there has been no time since its foundation when its degree could be attained without a considerable amount of literary, historical, and economic study. All regular students are accordingly required to pursue such studies through at least three years.

The growing appreciation of the value to technological students of a broader training than can be obtained from purely technical courses has led the Faculty to require of regular students, in addition to the general studies of the curriculum, a substantial amount of reading during the summer vacation.

Women may be admitted to any of the Courses of the school.

Descriptions and Schedules of the Professional Courses.— The following pages, 36 to 73, contain schedules showing the distribution of studies throughout each of the regular Four-year Courses. Each schedule is preceded by a brief description of the Course as a whole, while more detailed information is given of subjects taught and of the laboratory facilities on pages 112 to 298.

Choice of Courses.[1]—At the end of the first half-year, up to which time the subjects pursued are the same for all Courses, the student makes a preliminary choice, subject to the approval of the Faculty, of the Course which he will thenceforth pursue. The divergence in the second term of the first year is, however, slight, and a change of choice can usually be made without serious difficulty as late as the beginning of the second year.

[1] A special circular in regard to Choice of Courses will be sent on application.

An idea of the nature and amount of the work to be done in any one of the regular Courses may be obtained by considering, in connection with the schedule of that Course and the number of hours devoted to the various subjects in it (pages 36 to 73), the statements made in regard to these subjects in the description of Subjects of Instruction, pages 112 to 273.

Course Options.—Within most of the regular Courses the student is given, by means of Options, a considerable latitude in the selection of the branch of his intended profession to which he shall specially devote his energies in the later years of his study. Thus in Civil Engineering (page 39) he may elect Sanitary and Hydraulic Engineering, or an advanced course in Railroad Engineering and Management; in Mechanical Engineering (page 41) he may choose either Marine Engineering, Locomotive Construction, Mill Engineering, or Heating and Ventilation; and similarly for other Courses. Inspection of the descriptions and schedules of the Courses (pages 36 to 73) will show the nature and effect of the Options. In cases where numbers are prefixed the selection of later Options is positively determined by that of earlier ones, owing to the requirement of certain subjects as preparation for the former; in others, a wide choice is offered throughout all the years, the difference in this respect arising chiefly from the nature of the topics involved.

Graduate Courses of study may be pursued, either with or without reference to advanced degrees, by graduates of the Institute or by other persons of equivalent training. (See pages 84 to 89.)

Five-Year Courses.—Students purposing to take the degree of the Institute, but for sufficient reasons finding it advantageous to take in any particular year fewer studies than are prescribed in the schedules for the regular Four-year Courses, may arrange to distribute the entire work over five instead of four years.

Such an arrangement will often be of advantage. It makes possible a more thorough mastery of the subjects of the regular Course, or, if preferred, the accomplishment of certain valuable work which is necessarily omitted from the Four-year Courses. Moreover, considerations of health, lack of thorough preparation, or other causes, may in certain cases render it advisable to extend the work over five years. The Five-year Courses, which have been arranged, in most Departments, to meet such demands, contain the same subjects as the corresponding Four-year Courses, and differ from them only in the time over which the work is distributed, and, to a slight extent, in the sequence of studies. They lead respectively to the same degrees as the corresponding Four-year Courses. The standard of scholarship required of the student is in every way the same, and he is classed as a regular student as long as he maintains his standing in the Course which he is pursuing.

Applicants for Five-year Courses should consult the chairman of the Faculty Committee on Five-year Courses as early as possible.

Alternative Studies.—In the case of students passing examinations for advanced standing, the Faculty endeavors to facilitate the substitution of alternative work. A candidate passing more than the required work in Modern Languages may arrange to complete any remainder during his first year. A candidate passing Trigonometry may substitute second-year European History or Mechanic Arts. A candidate who has passed off Descriptive Geometry and Mechanical Drawing[1] may do the same, or, if prepared, 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 be not anticipated, nor Algebra except by a candidate who can pass Analytic Geometry also.

Further suggestions in regard to anticipation of work and ad-

[1] See foot-note, p. 135.

mission with correspondingly advanced standing may be found in the special circulars on Alternative Studies and The Admission of Students from Other Colleges. Anticipation of Institute work should be based on special correspondence and on a study of the definitions of the courses as described under Subjects and Methods of Instruction on pages 112 to 273.

Summer Reading.—All students who are candidates for the degree of the Institute (except college graduates) 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 essential as preparation for the English Literature course 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 have been selected for their value from the point of view of general training, but the attempt has been made to include only readable and attractive works.

Description of Studies.—A description of the character, method of instruction, and scope of every subject offered in the following schedules is given on pages 112 to 273.

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 275 to 303.

SCHEDULES OF THE COURSES.

GENERAL INFORMATION.

The sum of the hours of exercise and of preparation in all Courses does not exceed seven hundred and twenty for each term of fifteen weeks. In the following Course Schedules, the number in the column at the right headed "Hours of Exercise" represents for each particular subject the total for a term of fifteen weeks. The corresponding hours of preparation are given in the Alphabetical Subject Index, pages 114 to 119.

Numbers in parentheses refer to the description of Subjects of Instruction, pages 112 to 273, 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 regular students except college graduates are required to complete assigned courses of reading of a literary, historical, and general scientific character. See page 35.

In the third year, in addition to the other prescribed subjects, all regular students 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. The options offered comprise courses in Economics, English, Modern Languages, and History. For the details of this requirement see page 72.

A statement with regard to the object of the various Course Options will be found on page 33 and further explanations are given in connection with the description accompanying each Course Schedule.

FIRST YEAR.

FIRST TERM.

COMMON TO ALL COURSES.

	Hours of Exercise
Algebra (20)	30
Plane Trigonometry (23)	30
Inorganic Chemistry (550); Chemical Laboratory	105
Descriptive Geometry and Mechanical Drawing (100)	90
Freehand Drawing (110)	15
French II.[1] (221)	45
Rhetoric and English Composition (140)	30
Military Science (990)	45

SECOND TERM.

COURSES I, II, III, VI, VIII$_3$, X, XI, XII, XIII.	Hours of Exercise
Analytic Geometry (28)	60
Inorganic Chemistry (551); Qualitative Analysis; Chemical Laboratory	105
Descriptive Geometry and Mechanical Drawing (101)	90
Freehand Drawing (111)	30
French II.[1] (221)	45
English (140)	30
United States History (170)	30
Military Science (990)	45

COURSE IV.	
Shades and Shadows (470)	15
Analytic Geometry (28)	60
Descriptive Geometry and Mechanical Drawing (103)	135
Modelling (522)	30
Freehand Drawing (112)	45
French II.[1] (221)	45
English (140)	30
United States History (170)	30
Military Science (990)	45

COURSE V.	
Inorganic Chemistry (551); Qualitative Analysis; Chemical Laboratory	150
Elements of Analytic Geometry (27)	45
Descriptive Geometry and Mechanical Drawing (101)	90
Freehand Drawing (111)	30
French II.[1] (221)	45
English (140)	30
United States History (170)	30
Military Science (990)	45

COURSE VII.	Hours of Exercise
Inorganic Chemistry (551); Qualitative Analysis; Chemical Laboratory	150
Industrial Microscopy (708)	30
Analytic Geometry (28)	45
Freehand Drawing (111)	30
French II.[1] (221)	45
English (140)	30
United States History (170)	30
Military Science (990)	45

COURSE VIII$_{1, 2}$.	
Analytic Geometry (28)	60
Inorganic Chemistry (551); Qualitative Analysis; Chemical Laboratory	135
Freehand Drawing (111)	30
Wood and Metal Work (137)	60
French II.[1] (221)	45
English (140)	30
United States History (170)	30
Military Science (990)	45

COURSE IX.

See page 60.

[1]Students who have passed French II. before entrance are advised to take German II. For more advanced elective courses in French and German, see Subjects of Instruction, page 155.

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 comparatively advanced work of the fourth year, the student is offered a choice between two Options or lines of study; namely, a general Option in Civil Engineering, including the study of Sanitary and Hydraulic Engineering in considerable detail, and an Option in which more than usual attention is devoted to highways, railroads, and railroad management. Students desiring to pursue in greater detail the study of Geodesy and Topography are offered opportunity to do so by taking Course XII. and Graduate Courses.

For further details see pages 160 to 173, 276 to 280, and 297.

I.—CIVIL ENGINEERING.

FIRST YEAR. SEE PAGE 37.

SECOND YEAR.

FIRST TERM.	Hours of Exercise	SECOND TERM.	Hours of Exercise
Surveying and Plotting (300)	90	Surveying and Plotting (300)	75
Differential Calculus (34)	45	Topographical Drawing (302)	30
Spherical Trigonometry (24)	10	Integral Calculus (35)	45
Physics: Mechanics, Wave-motion, Electricity (770)	75	Physics: Electricity, Optics (770)	75
Descriptive Geometry (107)	60	Physical Laboratory (773)	30
German (231)	45	Geology (855, 857)	60
English Literature (150)	30	German (231)	45
European History (173)	30	English Literature and Composition (150)	30

SUMMER READING, SEE PAGE 35.

THIRD YEAR.

FIRST TERM.	Hours of Exercise	SECOND TERM.	Hours of Exercise
Railroad Engineering: Field-work and Drawing (313, 315)	90	Railroad and Highway Engineering; Field-work and Drawing (313, 314, 315)	120
Advanced Surveying (303)	30	Advanced Surveying (303)	30
Stereotomy (325)	60	Astronomy (308)	30
Topographical and Field Geology (874)	30	Theory of Structures (345)	30
Physics: Heat (771)	15	Building Stones (895)	15
Physical Laboratory (774)	15	Topographic Geology (874)	15
Dynamo Electric Machinery (661)	30	Mechanism (364)	30
Applied Mechanics: Statics; Kinematics and Dynamics; Strength of Materials (90)	60	Applied Mechanics: Strength of Materials; Theory of Elasticity (91)	50
Political Economy (190)	45	General Studies (see page 72).	
General Studies (see page 72).			

FOURTH YEAR.

FIRST TERM.	Hours of Exercise	SECOND TERM.	Hours of Exercise
Theory of Structures: Bridges and Similar Structures (348)	45	Theory of Structures: Bridges and Similar Structures (348)	45
Bridge Design (355)	90	Advanced Structures (350)	30
Foundations (349)	15	Bridge Design (355)	90
Materials (352)	15	Steam Engineering (387)	30
Theoretical Hydraulics (330)	45	Hydraulic Laboratory (342)	15
Industrial Electricity (663)	15	Thesis.	
Steam Engineering (387)	30		
Options.		*Options.*	
1. Sanitary and Hydraulic Eng. (334)	45	1. Hydraulic Engineering (335)	45
1. Hydraulic Measurements (333)	20	1. Elements of Geodesy (310)	15
1. Practical Astronomy (309)	15	1. Hydraulic and Sanitary Designing (337)	30
2. Railroad Engineering (319)	30	1. Sanitary Science and Public Health (754)	15
2. R.R. & Highway Designing (321)	75	2. Railroad Engineering (319)	45
		2. Economics of Corporations (193)	15
		2. R.R. & Highway Designing (321)	30
		2. Railroad Management (320)	30

II.— MECHANICAL ENGINEERING.

The Course in Mechanical Engineering aims to equip the student to deal with general engineering problems from the most favorable standpoint.

Courses are given in the class-room, in the drawing-room, and in the Engineering Laboratories, the objects being: (1) to give to the student practice in such work as engineers, in the pursuit of their profession, are called upon to perform; (2) to enable him to base all his work upon some principles, and not upon empirical rules; (3) to teach him to perform original investigations; and (4) to enable him, by means of a thorough familiarity with both the theoretical and the practical aspects of his business, to deal intelligently with other men.

Mathematics, Physics, and Applied Mechanics are given outside the Department, the last including the study of the Strength of Materials, with practice in testing.

The recitation-room work of the Department begins with the study of Mechanism, the construction of Gear-teeth, and courses on Valve-gears, and the mechanisms found in Machine-tools and Cotton Machinery. Courses are given on Thermodynamics, Steam Boilers, and the Theory of the Steam-engine; also upon Applied Dynamics, Hydraulics, Hydraulic Motors, Foundations, and Industrial Management, the last involving a study of the organization and the relations of the various departments of an industrial establishment, and the determination of costs.

A course in Machine Design is also given in the fourth year, the main object of which is the application of principles already learned to the solution of problems in design. In the fourth year, also, the student is offered the option of courses in Marine Engineering, Locomotive Construction, Mill Engineering, and Heating and Ventilation. Instruction in drawing extends up to the end of the third year, and its aim is to teach the proper way of making the necessary dimensioned drawings, tracings, and blue prints for use in practice. Instruction is also given in the design of gear-teeth, valve-gears, and other mechanism designs.

The instruction in the Engineering Laboratories in its earlier portions is devoted to giving the student a drill in such experimental work as an engineer has constantly to perform, such as boiler tests, engine tests, etc. The later work and the thesis work take very largely the form of investigation.

See pages 174 to 186 and 276 to 280.

II.—MECHANICAL ENGINEERING.

FIRST YEAR. SEE PAGE 37.

SECOND YEAR.

FIRST TERM.	Hours of Exercise
Mechanism (360)	45
Mechanical Engineering Drawing (372)	30
Carpentry and Wood-turning (120)	60
Differential Calculus (34)	45
Physics: Mechanics, Wave-motion, Electricity (770)	75
Descriptive Geometry (107)	45
German (231)	45
English Literature (150)	15
European History (173)	30

SECOND TERM.	Hours of Exercise
Mechanism and Valve-gears (360)	45
Mechanical Engineering Drawing (373)	90
Pattern Work (122)	30
Foundry (elective) (125)	30
Integral Calculus (35)	45
Physics: Electricity, Optics (770)	75
German (231)	45
English Literature and Composition (150)	30

SUMMER READING, SEE PAGE 35.

THIRD YEAR.

FIRST TERM.	Hours of Exercise
Steam Engineering: Thermodynamics (385)	45
Machine Drawing (377)	90
Forging (127)	60
Elements of Differential Equations (42)	30
Precision of Measurements (772)	15
Physics: Heat (771)	15
Physical Laboratory (773 partial)	15
Applied Mechanics: Statics; Kinematics and Dynamics (70)	30
Electrical Engineering (653)	30
Political Economy (190)	45
General Studies (see page 72).	

SECOND TERM.	Hours of Exercise
Steam Engineering: Boilers (385)	45
Mechanical Engineering Drawing (378), and Boiler Drawing (379)	68
Use of Surveying Instruments (304)	
Engineering Laboratory (396)	15
Electrical Engineering (683)	30
Electrical Engineering Laboratory (690)	30
Forging (127); Chipping and Filing (130)	90
Physical Laboratory (773, 774)	30
Applied Mechanics: Strength of Materials; Graphical Statics (71)	45
Business Law (200)	15
General Studies (see page 72).	

FOURTH YEAR.

FIRST TERM.	Hours of Exercise
Machine Design (404)	135
Theoretical Hydraulics (331)	15
Dynamics of Machines (401)	25
Engineering Laboratory (397) (639)	60
Chipping and Filing (130); Machine-tool Work (132)	90
Applied Mechanics: Strength of Materials; Friction (80)	45
Heating and Ventilation (414)[1]	15
Metallurgy of Iron (441)	15
Options.	
1. Marine Engineering (420)	35
2. Locomotive Construction (421)	35
3. Mill Engineering (422)	35
4. Heating and Ventilating Eng. (423)	30
4. Dynamo-electric Machinery (662)	25
4. Hygiene of Ventilation and Heating (758)	5

SECOND TERM.	Hours of Exercise
Hydraulic Motors (338)	30
Engineering Laboratory (397, 781)	60
Machine-tool Work (132)	90
Applied Mechanics: Strength and Stability of Structures; Theory of Elasticity (81)	45
Foundations (407)	15
Industrial Management (409)	10
Thesis.	
Options.	
1. Marine Engineering (420)	75
2. Locomotive Construction (421)	40
3. Mill Engineering (422)	40
4. Heating and Ventilating Eng. (423)	40

[1] Not taken by Option 4.

III.—MINING ENGINEERING AND METALLURGY.

The demands made upon the mining and metallurgical engineer call of necessity 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 after graduation take up specialized work, with the expectation of carrying it on successfully.

Beginning with the second year, three optional lines of study are open to the student. With the studies included under the first Option the Course is a general one, adapted to the needs of students who prefer not to make an immediate choice between professional specialties. Those who have not a serious reason for doing otherwise are advised to take this Option.

The second group of optional studies is arranged with reference to Mechanism and the Steam-engine, the time necessary being taken from Surveying, Geology, and Mining Engineering. This Option is adapted especially for the iron and steel metallurgist. Option 3 is arranged to meet the needs of students desiring to devote themselves especially to the geological side of Mining Engineering, or to join the National Geological Survey or one of the State Geological Surveys along economic lines.

Valuable opportunities are offered for observation and field work in the Summer Schools of Mining and Metallurgy, and in mineralogical and geological excursions, as well as in the ample laboratories of the Institute. (See pages 78 and 281.)

For students able to devote an additional year to professional study, a definite Graduate Course of one year, which may lead to the degree of Master of Science, has been arranged. (See page 86.) In view of the varied demands likely to be made upon the professional mining engineer, such an extension of the Course offers peculiar advantages, even if taken without the intention of obtaining a higher degree.

For a description of the subjects of instruction, see pages 187 to 193.

III.—MINING ENGINEERING AND METALLURGY.

(*Option 1.*)

FIRST YEAR. SEE PAGE 37.

SECOND YEAR.

FIPST TERM.	Hours of Exercise	SECOND TERM.	Hours of Exercise
Blowpipe Silver Assay (430)	30	Mineralogy (840)	60
Mineralogy (840)	60	Quantitative Analysis (558)	105
Qualitative Analysis (552)	105	Structural and Stratigraphical Geology (858)	60
General Geology (856)	45	Field Geology (870)	20
Surveying and Plotting (300)	90	Surveying and Plotting (300)	60
Differential Calculus (34)	45	Topographical Drawing (302)	30
Physics: Mechanics, Wave-motion, Electricity (770)	75	Integral Calculus (35)	45
English Literature (150)	15	Physics: Electricity, Optics (770)	75
European History (173)	30	English Literature and Composition (150)	30

SUMMER READING, SEE PAGE 35.
SUMMER COURSE IN PRACTICAL MINING OR METALLURGY (ELECTIVE).
FIELD-WORK IN MINERALOGY (ELECTIVE).

THIRD YEAR.

FIRST TERM.	Hours of Exercise	SECOND TERM.	Hours of Exercise
Mining Engineering (458)	45	Mining Engineering (458)	45
Assaying (432)	60	Theoretical Chemistry (618)	30
Quantitative Analysis (559)	90	Quantitative Analysis (559)	150
Economic Geology (859)	60	Physical Laboratory (773, 774)	30
Field Geology (869)	15	Precision of Measurements (772)	15
Physics: Heat (771)	15	Applied Mechanics: Strength of Materials; Kinematics and Dynamics (73)	45
Physical Laboratory (773)	20	German (231)	45
Applied Mechanics: Statics; Stresses in Frames (72)	20	Business Law (200)	15
German (231)	45		
Political Economy (190)	45		

SUMMER COURSE IN PRACTICAL METALLURGY OR MINING (ELECTIVE).

FOURTH YEAR.

FIRST TERM.	Hours of Exercise	SECOND TERM.	Hours of Exercise
Mining Engineering: Ore-dressing (459)	30	Mining Engineering: Mining and Metallurgical Machinery (459)	30
Memoirs (465)	15	Memoirs (465)	15
Laboratory Reports (437)	15	Laboratory Reports (437)	15
Metallurgy (non-ferrous) (442)	30	Metallurgy (non-ferrous) (442)	45
Metallurgy of Iron (441)	15	Metallurgical Laboratory (435)	180
Metallurgical Laboratory (435); Metallography (452)	120	Quantitative Analysis (559)	210
Quantitative Analysis (559)	150	Thesis.	
Heat Measurements (781)	30		
Theoretical Hydraulics (331)	15		
Applied Mechanics: Strength of Materials; Friction (80)	45		

III.—MINING ENGINEERING AND METALLURGY.

(*Option 2.*)

FIRST YEAR. SEE PAGE 37.

SECOND YEAR.

FIRST TERM.	Hours of Exercise	SECOND TERM.	Hours of Exercise
Mineralogy (841)	60	Mineralogy (841)	30
Qualitative Analysis (552)	135	Mechanism and Valve-gears (361)	30
Principles of Mechanism (361)	45	Mechanical Engineering Drawing (373)	45
Descriptive Geometry (107)	45	Theoretical Chemistry (618)	30
Differential Calculus (34)	45	Quantitative Analysis (558)	120
Physics: Mechanics, Wave-motion, Electricity (770)	75	Integral Calculus (35)	45
English Literature (150)	15	Physics: Electricity, Optics (770)	75
European History (173)	30	English Literature and Composition (150)	30

SUMMER READING, SEE PAGE 35.
SUMMER COURSE IN PRACTICAL MINING OR METALLURGY (ELECTIVE).
FIELD-WORK IN MINERALOGY (ELECTIVE).

THIRD YEAR.

FIRST TERM.	Hours of Exercise	SECOND TERM.	Hours of Exercise
Steam Engineering; Thermodynamics (385)	45	Assaying (432)	60
Machine Drawing (377)	90	Steam Engineering: Boilers (385)	45
Quantitative Analysis (559)	120	Engineering Laboratory (396)	15
Physics: Heat (771)	15	Quantitative Analysis (559)	90
Physical Laboratory (773)	20	Physical Laboratory (773, 774)	30
Applied Mechanics: Statics; Stresses in Frames (72)	20	Precision of Measurements (772)	15
German (231)	45	Applied Mechanics: Strength of Materials; Kinematics and Dynamics (73)	45
Political Economy (190)	45	German (231)	45
		Business Law (200)	15

SUMMER COURSE IN PRACTICAL METALLURGY OR MINING (ELECTIVE).

FOURTH YEAR.

FIRST TERM.	Hours of Exercise	SECOND TERM.	Hours of Exercise
Mining Engineering: Ore-dressing (459)	30	Mining Engineering: Mining and Metallurgical Machinery (459)	30
Memoirs (465)	15	Memoirs (465)	15
Laboratory Reports (437)	15	Laboratory Reports (437)	15
Metallurgy (non-ferrous) (442)	30	Metallurgy (non-ferrous)(442)	45
Metallurgy of Iron (441)	15	Metallurgical Laboratory (435)	180
Metallurgical Laboratory (435); Metallography (452)	120	Engineering Laboratory (398)	60
Quantitative Analysis (559)	150	Quantitative Analysis (559)	150
Heat Measurements (781)	30	Thesis.	
Theoretical Hydraulics (331)	15		
Applied Mechanics: Strength of Materials; Friction (80)	45		

III.—MINING ENGINEERING AND METALLURGY.

(*Option 3.*)

FIRST YEAR. SEE PAGE 37.

SECOND YEAR.

FIRST TERM.	Hours of Exercise	SECOND TERM.	Hours of Exercise
Qualitative Analysis (552)	105	Quantitative Analysis (558)	105
Blowpipe Silver Assay (430)	30	Mineralogy (840)	60
Mineralogy (840)	60	Structural and Stratigraphical Geology (858)	60
General Geology (856)	45	Field Geology (870)	20
Differential Calculus (34)	45	Surveying and Plotting (300)	60
Physics: Mechanics, Wave-motion, Electricity (770)	75	Topographical Drawing (302)	30
Surveying and Plotting (300)	90	Integral Calculus (35)	45
English Literature (150)	15	Physics: Electricity, Optics (770)	75
European History (173)	30	English Literature (150)	30

SUMMER READING, SEE PAGE 35.
SUMMER COURSE IN PRACTICAL MINING OR METALLURGY (ELECTIVE).
FIELD-WORK IN MINERALOGY (ELECTIVE).

THIRD YEAR.

FIRST TERM.	Hours of Exercise	SECOND TERM.	Hours of Exercise
Assaying (432)	60	Economic Geology (889)	60
Economic Geology (859)	60	Quantitative Analysis (559)	105
Field Geology (869)	15	Mining Engineering (458)	45
Quantitative Analysis (559)	90	Physical Laboratory (773, 774)	30
Mining Engineering (458)	45	Precision of Measurements (772)	15
Applied Mechanics: Statics; Stresses in Frame (72)	20	Applied Mechanics: Strength of Materials; Kinematics and Dynamics (73)	45
Physics: Heat (771)	15	German (231)	45
Physical Laboratory (773)	20	Business Law (200)	15
German (231)	45	General Studies (see page 72).	
Political Economy (190)	45		
General Studies (see page 72).			

SUMMER COURSE IN PRACTICAL METALLURGY OR MINING (ELECTIVE).

FOURTH YEAR.

FIRST TERM.	Hours of Exercise	SECOND TERM.	Hours of Exercise
Geological Surveying (871)	120	Geological Surveying (871)	60
Economic Geology (860)	60	Petrography (843)	60
Petrography (843)	60	Geology of North America (890)	90
Mining Engineering: Ore-dressing (459)	45	Applied Geology and Reports (896)	15
Laboratory Reports (437)	15	Mining Engineering: Mining and Metallurgical Machinery (459)	45
Metallurgical Laboratory (435)	120	Metallurgy (non-ferrous) (442)	45
Metallurgy (non-ferrous) (442)	30	Theoretical Chemistry (618)	30
Metallurgy of Iron (441)	15	Thesis.	
Theoretical Hydraulics (331)	15		

IV. — ARCHITECTURE.

The Course in Architecture aims to prepare its members not only for their years of work as subordinates, when accuracy, rapidity, and taste in drawing and design, with knowledge of detail, will be the most useful qualifications, but also for their subsequent independent career, when the value of technical knowledge will become most important. The Course embraces three optional lines of study, Option 1, the General Course in Architecture, Option 2, Architectural Engineering, and Option 3, Landscape Architecture.

Opportunities are offered for one or two years of graduate professional work. The value of such continuous and uninterrupted study at a period when the students are best fitted for it cannot be overestimated. See page 86.

Options 1 and 2 are identical to the middle of the third year. The professional work of these Options begins in the second year, with the study of the orders and their applications. The student is made familiar with the materials and principles of construction by lectures and visits to buildings. Specifications are discussed, and sufficient practice in Working Drawings is given to enable the student to be of immediate service on entering an architect's office.

The course in the History of Architecture is carried on for two years, and is followed by a year's course in European History and Art, in recognition of the importance of a broader æsthetic and historical training.

A technical course in Heating and Ventilation is given in the third year, illustrated by the study of important public buildings in the city. In the fourth year Applied Mechanics and Graphical Statics are applied to general practice, and exercise is given in designing trusses and in the various problems occurring in modern construction.

Practice in Architectural Design is continued throughout the Course, and also instruction in drawing from the cast and from life. Facility in rendering is gained by a course in Water-color and Pen-and-ink Drawing.

Option 2 includes, in the second term of the third year and the whole of the fourth year, extended courses in Structures and Structural Design, in place of the purely architectural design and allied work of Option 1.

For the schedule of a Graduate Course in Architecture see page 86.

See also pages 194 to 203.

IV.—ARCHITECTURE.—(*Options 1 and 2*)

(See also page 49.)

FIRST YEAR. SEE PAGE 37.

SECOND YEAR.

FIRST TERM.	Hours of Exercise
Elementary Design and Theory of Architecture (526)	120
Architectural History (490)	15
Specifications and Working Drawings (480)	45
Freehand Drawing (116)	60
Differential Calculus (34)	45
Physics: Mechanics, Wave-motion, Electricity (770)	75
German (231)	45
English Literature (150)	15
European History (173)	30

SECOND TERM.	Hours of Exercise
Design and Theory of Architecture (526)	120
Architectural History (490)	15
Specifications and Working Drawings (480)	45
Freehand Drawing (116)	60
Integral Calculus (35)	45
Physics: Electricity, Optics (770)	75
German (231)	45
English Literature and Composition (150)	30

SUMMER READING, SEE PAGE 35.

THIRD YEAR.

FIRST TERM.	Hours of Exercise
Design (527)	120
Architectural History (491)	30
Stereotomy (472)	30
Freehand Drawing (117)	60
Heating and Ventilation (413)	45
Applied Mechanics: Statics; Stresses in Frames (74)	40
Political Economy (190)	45
General Studies (see page 72).	
Options.	
1. History of Ornament (405)	15
2. History of Construction (486)	15
2. Materials (352)	15

SECOND TERM.	Hours of Exercise
Architectural History (491)	30
Freehand Drawing (117)	60
Pen-and-ink (515)	15
Applied Mechanics: Strength of Materials; Graphical Statics (75) Opt. 1	45
Applied Mechanics: Strength of Materials; Graphical Statics (75) Opt. 2	52
Perspective (471)	15
Building Stones (892)	30
Sanitary Science and Public Health (754)	15
Business Law (200)	15
General Studies (see page 72).	
Options.	
1. Design (527)	225
1. Water Color (520)	30
2. Theory of Structures (346)	30
2. Structural Design (538)	71
2. Heating and Ventilation (413)	30

FOURTH YEAR.

FIRST TERM.	Hours of Exercise
History of Construction (486)	15
European Civilization and Art (180)	60
Pen-and-ink (516)	15
Options.	
1. Design (528)	285
1. Constructive Design (532)	50
1. History of Ornament (495)	15
1. Life Class (118)	60
1. Water-color (520)	30
1. Applied Mechanics: Strength of Materials (85)	20
1. Acoustics (824)	5
2. Theory of Structures (351)	45
2. Structural Design (539)	285
2. Applied Mechanics: Strength of Materials (86)	45

SECOND TERM.	Hours of Exercise
Business Relations (488)	15
European Civilization and Art (180)	45
Sanitary Science and Public Health (754)	15
Design; Thesis (528) Opt. 1	370
Design; Thesis (539) Opt. 2	370
Options.	
1. Life Class (118)	60
1. Modelling (523)	30
1. Pen-and-ink (516)	15
1. Water-color (520)	30
1. Color (814)	5
2. Theory of Structures (351)	45
2. Building Stones (892)	30
2. Laboratory Tests of Building Materials (87)	14

IV.—ARCHITECTURE (*continued*).

* **Option 3, Landscape Architecture.**—This Option meets the demand for trained landscape architects, due to the steadily increasing attention now paid to all questions concerning the designing of public and private grounds. The profession is most closely allied with Architecture and Civil Engineering; and these two Departments are largely drawn on for instruction. The fundamental biological, botanical, and geological subjects are taught in their several Departments.

The professional work of this Option begins in the second year with elementary Architectural Design. Under Horticulture are comprised not only the study at the Arnold Arboretum of all that relates to planting, and the use of plants and trees, but also the lectures on the History of Landscape Architecture. In the third year an extension of the same general line of work is followed. In the fourth year, Landscape Design, lectures on practical work, and Horticulture are the main features.

Practice in Freehand Drawing, Pen-and-ink Drawing, and Water-color extend through the three years, nearly as in the general Course, with the usual requirements in Physics, Languages, and History.

Not only does this Option as a profession in itself offer unusual opportunities, but it gives to both the architect and the civil engineer a chance for special studies which cannot fail to be of the greatest value.

(See pages 194 to 203.)

Persons applying for admission as special students in Architecture must be college graduates, or twenty-one years of age, with not less than two years' office experience. They will be required to pass, before entrance, examinations [1] in Plane and Solid Geometry; and must include in their work at the Institute the regular first-year courses in Freehand Drawing, Descriptive Geometry, and Mechanical Drawing,[2] unless these subjects have been passed at the September examinations for advanced standing.[2]

* For classes entering in 1905 and thereafter, Landscape Architecture will not be offered as an Option in the Four-year Course in Architecture, but will be given instead as a Graduate Course leading to an advanced degree.

[1] See "Advanced Standing Examinations," Calendar, page 2.

[2] See foot-note, pp. 135 and 136.

IV.—ARCHITECTURE.— (*3, Landscape Option.*)

(See also page 47.)

FIRST YEAR. SEE PAGE 37.

SECOND YEAR.

FIRST TERM.	Hours of Exercise
Elementary Design and Theory of Architecture (526)	120
Architectural History (490)	15
Shades and Shadows (470)	15
Landscape Horticulture (500)	30
General Biology (701)	15
Surveying (300)	60
General Geology (856)	30
Freehand Drawing (116)	60
Physics: Mechanics, Wave-motion, Electricity (770)	75
German (231)	45
English Literature (150)	15
European History (173)	30

SECOND TERM.	Hours of Exercise
Design and Theory of Architecture (526)	120
Architectural History (490)	15
Landscape Horticulture (500)	30
Elements of Botany (734)	30
Structural Geology (857)	30
Surveying (300)	60
Freehand Drawing (116)	60
Physics: Electricity, Optics (770)	75
German (231)	45
English Literature and Composition (150)	30

SUMMER READING, SEE PAGE 35.

THIRD YEAR.

FIRST TERM.	Hours of Exercise
Design (527)	120
Architectural History (491)	30
Landscape Horticulture (501)	60
History of Ornament (495)	15
Curves and Earthwork (312)	30
Topographic and Field Geology; Elements of Natural Landscape (874)	30
Structural Geology and Lithology (857)	30
Freehand Drawing (117)	60
Political Economy (190)	45
General Studies (see page 72).	

SECOND TERM.	Hours of Exercise
Landscape Design (540)	195
Landscape Horticulture (501)	60
Perspective (471)	15
Highway Engineering: Field-work and Drawing (314, 316)	60
Architectural History (491)	30
Freehand Drawing (117)	60
Pen-and-ink (515)	15
Water-color (520)	30
Applied Geology; Building Stones (895)	15
Business Law (200)	15
Sanitary Science and Public Health (754)	15
General Studies (see page 72).	

FOURTH YEAR.

FIRST TERM.	Hours of Exercise
Landscape Architecture (542)	15
Landscape Design (541)	210
Horticulture (502)	60
Specifications and Working Drawings; Landscape Gardening (483)	30
Sanitary Engineering; Masonry (336)	30
History of Ornament (495)	10
Life Class (118)	60
Pen-and-ink (516)	15
Water-color (520)	30
European Civilization and Art (180)	60

SECOND TERM.	Hours of Exercise
Landscape Architecture (542)	15
Landscape Design (541): Thesis	275
Horticulture (502)	60
History of Ornament (495)	10
Business Relations (488)	15
Life Class (118)	60
Modelling (523)	30
Pen-and-ink (516)	15
Water-color (520)	30
Sanitary Science and Public Health (754)	15
Photography (815)	15
European Civilization and Art (180)	45

V.—CHEMISTRY.

The Course in Chemistry is designed to prepare students to conduct manufacturing operations based on chemical principles, to act as consulting chemists, to become teachers of Chemistry, or to engage in scientific research.

Three series of optional studies, extending throughout the last three years of the Course, have been established to allow students to elect subjects which will prepare them more thoroughly for certain special lines of work, namely, general analytical practice (Option 2), sanitary or municipal Chemistry (Option 3), or Physical Chemistry (Option 5).[1] This specialization does not, however, preclude a thorough general training in all the important branches of Chemistry.

The class-room work consists of courses of lectures on Inorganic Chemistry, and on Theoretical, Analytical, Industrial, and Organic Chemistry. The non-chemical studies, such as Mathematics, Mechanical Drawing, Physics, Biology, Mineralogy, English, History, Political Economy, and Language, are selected with reference to their bearing on chemical work, or for their general educational value.

The student spends a large part of the four years in the laboratories, the work being arranged as follows: in the first year there is general laboratory practice, in which the student is taught the nature of chemical processes and the use of chemical apparatus, and is drilled in accurate habits of observation. Qualitative Chemical Analysis is begun in the second term of the first year, and is continued through the first term of the second year. Quantitative Analysis follows in the second term of the second year, and continues throughout the Course. Practice in the Industrial, Sanitary, Organic, and Physico-chemical Laboratories follows in the third and fourth years. Effort is made to develop self-reliance in the student, so that he may be fitted to make his way without assistance. To this end he is required to make investigations, involving original research and reference to chemical literature in English, French, and German.

The details of instruction in this Course, for both regular and special students, and the description of the Kidder Laboratories, are given on pages 204 to 219 and 283. For the schedule of a Graduate Course in Chemistry see page 87.

[1] Five series of optional studies have been maintained for some years, but the options numbered 1 and 4 have been discontinued, the change taking effect in the second year, only, in 1905-06. The former Option 1 is now merged with Course X. See page 61.

V.—CHEMISTRY.

First Year. See page 37.

SECOND YEAR.

FIRST TERM.	Hours of Exercise
Qualitative Analysis (552)	165
Mineralogy (840) (841)	60
Physics: Mechanics, Wave-motion, Electricity (770)	75
German (231)	45
English Literature (150)	15
European History (173)	30
Options.	
2, 3. Elements of Differential and Integral Calculus (31)	45
5. Differential Calculus (34)	45

SECOND TERM.	Hours of Exercise
Quantitative Analysis (558) Opts. 2, 3	180
Quantitative Analysis (558) Opt. 5	150
Physics: Electricity, Optics (770)	75
Physical Laboratory (773)	30
Precision of Measurements (772)	15
German (231)	45
English Literature and Composition (150)	30
Options.	
2, 3. Industrial Microscopy (708)	30
2, 3. Mineralogy (840)	60
5. Integral Calculus (35)	45

THIRD YEAR.

FIRST TERM.	Hours of Exercise
Quantitative Analysis (559) Opt. 1	240
Quantitative Analysis (559) Opts. 2, 3	210
Quantitative Analysis (559) Opts. 4, 5	255
Industrial Chemistry (580)	45
Physics: Heat (771)	15
Physical Laboratory (774)	15
Political Economy (190)	45
General Studies (see page 72).	
Options.	
1. Mechanism (362) and Drawing (374)	90
2, 3. Air, Water, and Food Analysis (565)	90
2, 3. Sugar Analysis (573)	20
2, 3. General Biology (701)	15
4. Industrial Chemical Laboratory (582)	90
5. Differential Equations (43)	45

SECOND TERM.	Hours of Exercise
Quantitative Analysis (559) Opt. 1	225
Quantitative Analysis (559) Opts. 2, 3, 5	210
Quantitative Analysis (559) Opt. 4	270
Organic Chemistry (592)	45
Industrial Chemistry (580)	45
Inorganic Chemistry (561)	30
Assaying (433)[1]	30
Business Law (200)	15
General Studies (see page 72).	
Options.	
1. Mechanism (362) and Drawing (381)	45
2. Industrial Chemical Laboratory (582)	90
3. General Bacteriology (744)	60
4. Assaying (432)	60
5. Water Analysis (567)	30
5. Electrical Measurements (782)	15
5. Gas Analysis (638)	20

FOURTH YEAR.

FIRST TERM.	Hours of Exercise
Organic Chemistry (592)	45
Organic Analysis (596)	75
Organic Preparations and Reactions[3] (598)	195
Theoretical Chemistry (611)	30
Theoretical Chemical Laboratory (619)	30
Elements of Non-ferrous Metallurgy[4] (443)	20
Metallurgy of Iron (441)[5]	15
Options.	
1. Drawing[6] (381)	75
2a. Proximate Technical Analysis (629)	90
2b. Textile Coloring (630)	90
3. Bacteriology of Water and Sewage (748)	30
3. Industrial Biology (746)	60
4. Non-ferrous Metallurgy (442)	30
4. Ore-dressing (459)	30
4. Laboratory Reports (437)	15
4. Metallurgical Laboratory (435)	120
5. Electro-chemistry (796)	30
5. Electro-chemical Laboratory (799)	90

SECOND TERM.	Hours of Exercise
Organic Chemistry (592)	45
Gas Analysis (638)	20
Theoretical Chemistry (612)	15
Electro-chemistry (613)[5]	15
Electrical[2] and Heat Measurements (782)	30
History of Chemistry (645)	15
Thesis Reports[1] (647)	15
Thesis.	
Options.	
1. Elements of Engineering (391)	30
2. Physico-chemical Laboratory (803)	30
3. Sanitary Science and Public Health (754)	15
3. Microscopical Analysis of Water and Sewage (711)	30
4. Non-ferrous Metallurgy (442)	45
4. Mining Machinery (459)	30
4. Metallurgical Laboratory (435) (*Thesis*)	180
4. Laboratory Reports (437)	15
5. Energetics (829)	30
5. Physico-chemical Laboratory (803)	15

[1] Omitted by students in Option 4.
[2] Option 5, third year, second term.
[3] 60 hours less for Option 4.
[4] Omitted by Options 4, 5.
[5] Omitted by Option 5.
[6] Industrial Chemical Laboratory in 1906–07.

VI.—ELECTRICAL ENGINEERING.

The Course in Electrical Engineering aims to give a broad knowledge of the Theory of Electricity and of its application to the arts. As the modern development of Electrical Engineering has taken place largely along lines dependent on a sound theoretical knowledge, great importance is attached to the study of the Theory of Electricity, which begins in the second year and continues throughout the remainder of the Course. The electrical engineering lectures of the junior and senior years take on a distinctly professional character, involving the applications of electricity to the various problems in railroad work, station-design, power-transmission, lighting, telegraphy, 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, beginning with work in General Physical Measurements, and followed by General Electrical Measurements. This leads to the work in Electrical Testing and to that in the Laboratory of Electrical Engineering, where distinctly professional engineering problems are attacked. The laboratory work throughout 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 laboratory work is supplemented by a system of conferences in which these matters are especially emphasized.

The Augustus Lowell Laboratories of Electrical Engineering are extensively equipped with apparatus for all lines of work, and particularly for those relating to alternating currents.

The high importance of work of the nature of scientific research is strongly emphasized; and special research-rooms, together with ample facilities for carrying on special investigations, are available.

For further details see pages 222 to 230 and 285 to 288. For the schedule of a Graduate Course in Electrical Engineering see page 87.

VI.—ELECTRICAL ENGINEERING.

First Year. See page 37.

SECOND YEAR.

FIRST TERM.	Hours of Exercise
Physics: Mechanics, Wave-motion, Electricity (770)	75
Acoustics (823)	30
Mechanism (361)	30
Mechanical Engineering Drawing (372)	45
Differential Calculus (34)	45
Descriptive Geometry (107)	45
Joinery and Pattern-work (123) or Metal-turning (134)	60
German (231)	45
English Literature (150)	15
European History (173)	30

SECOND TERM.	Hours of Exercise
Physics: Electricity, Optics (770)	75
Physical Laboratory: Mechanics, Optics (773)	30
Precision of Measurements (772)	15
Theoretical Electricity (786)	15
Mechanism and Valve-gears (361)	30
Mechanical Engineering Drawing (373)	15
Integral Calculus (35)	45
Metal-turning (134) or Joinery and Pattern-work (123)	60
German (231)	45
English Literature and Composition (150)	30

Summer Reading, see page 35.

THIRD YEAR.

FIRST TERM.	Hours of Exercise
Physics: Heat (771)	15
Physical Laboratory: Heat (774)	15
Theoretical Electricity (787)	45
Electrical Measuring Instruments and Methods (778)	10
Direct Current Generators (654)	30
Electrical Laboratory (779)	15
Steam Engineering: Thermodynamics (385)	30
Machine Drawing (377)	40
Differential Equations (43)	45
Applied Mechanics: Statics; Stresses in Frames (72)	20
Political Economy (190)	45
General Studies (see page 72).	

SECOND TERM.	Hours of Exercise
Electrical Laboratory (779)	25
Electrical Engineering Lab. (692)	45
Periodic Currents (788)	45
Technical Electrical Measurements (685)	20
Standardizing Laboratory (681)	20
Steam Engineering: Boilers (385)	45
Machine Drawing (377)	20
Mechanical Engineering Laboratory (396)	14
Applied Mechanics: Kinematics and Dynamics; Strength of Materials (73)	45
Business Law (200)	15
General Studies (see page 72).	

FOURTH YEAR.

FIRST TERM.	Hours of Exercise
Theory of Periodic Currents (650)	30
Electrical Engineering (657)	30
Electrical Measuring Instruments and Testing (685)	20
General Electrical Testing (686)	80
Electrical Engineering Lab. (693)	50
Dynamo Design (667)	20
Theoretical Hydraulics (332)	30
Engineering Laboratory (397) (639)	45
Applied Mechanics: Strength of Materials (82)	24
Surveying (304)	16

SECOND TERM.	Hours of Exercise
Theory of Alternating Current Machinery (651)	30
Electrical Engineering (657)	45
Electrical Engineering Laboratory (693)	25
Telephony (671)	15
Telephone Engineering (672)	10
Electric Railroads (678)	10
Engineering Laboratory (397, 781)	44
Surveying (304)	14
Economics of Corporations (193)	15
Thesis.	

VII.— BIOLOGY.

This Course is designed for students who want a thorough training in the principles of Biology, and desire eventually to become biologists, bacteriologists, investigators, or teachers, or to engage practically in one of the various fermentation industries, or in the public health service, to prepare for studies in forestry, or for entering those higher medical schools which now require, besides the regular bachelor's degree, special preparation in Biology, Physics, Chemistry, and Modern Languages.

In all of these lines, but especially perhaps in Bacteriology, the public health service, forestry and medical science, useful and inviting careers are open to earnest and capable students.

The Course includes a generous allowance of Chemistry, Physics, and Modern Languages, as well as so much of Mechanical and Freehand Drawing as is required of most first-year students, and the same amount of English Literature, History, and Political Economy prescribed for the Engineering Courses. Somewhat more geological instruction is provided than in other Courses, excepting those in Geology and Mining, and the training afforded by the Course in Biology is especially broad and liberal.

The subjects of study and their sequence are shown on the opposite page. Abundant facilities for the practical work are furnished in the various laboratories of the Institute, especially those of Chemistry, Physics, Physiology, and Bacteriology.

A new research laboratory has recently been added to the regular equipment and fitted up with investigators' tables, high-power microscopes, incubators, and the latest appliances for advanced work in Bacteriology and Sanitary Science. Students of Biology have also unusual opportunities for study and research in the Sanitary Research Laboratory and Sewage Experiment Station of the Institute. (See page 290.)

Instruction is provided for advanced workers in General Bacteriology, Industrial Biology, and Sanitary Science; in Physiology, and in some departments of Hygiene. For more detailed information see pages 231 to 242, 289, and the special circular on Biology.

VII.— BIOLOGY.

First Year. See page 37.

SECOND YEAR.

First Term.	Hours of Exercise	Second Term.	Hours of Exercise
General Biology (700)	75	Cryptogamic Botany (735)	90
Qualitative Analysis (552)	120	General Zoölogy (716)	45
Crystallography (841)	15	Quantitative Analysis (558)	120
Diff. and Int. Calculus (31)	45	Precision of Measurement (772)	10
Physics: Mechanics, Wave-motion, Electricity (770)	75	Physical Laboratory (773)	30
German (231)	45	Physics: Electricity, Optics (770)	75
English Literature (150)	15	German (231)	45
European History (173)	30	English Literature and Composition (150)	30

Summer Reading, see page 35.

THIRD YEAR.

First Term.	Hours of Exercise	Second Term.	Hours of Exercise
General Bacteriology (744)	75	Microscopic Anatomy (722)	60
Comparative Anatomy (717)	120	Embryology (717)	75
Anthropology (720)	15	Comparative Physiology (727)	60
Organic Chemistry (590)	30	Physiological Laboratory (728)	45
Air, Water, and Food Analysis (565)	90	Municipal Laboratory Methods (755)	45
Physics: Heat (771)	15	Theoretical Chemistry (618)	30
Physical Laboratory (773) (774)	30	Historical Geology (880)	45
Political Economy (190)	45	Physical Laboratory (773, 774)	15
General Studies (see page 72).		Business Law (200)	15
		General Studies (see page 72).	

FOURTH YEAR.

First Term.	Hours of Exercise	Second Term.	Hours of Exercise
Comparative Physiology (727)	75	Sanitary Science and Public Health (754)	15
Physiological Laboratory (728)	75	Municipal Sanitation (753)	60
Bacteriology of Water and Sewage (748)	30	Microscopical Analysis of Water and Sewage (711)	30
Industrial Biology (746)	60	Theoretical Biology (704)	30
Theoretical Biology (704)	15	Comparative Physiology (727)	75
Muncipal Laboratory Methods (755)	30	Journals (764)	30
Vital Statistics (198)	30	Thesis.	
History of Science (761)	30		
Journals (764)	15		
Options.			
1. Organic Chemical Laboratory (599)	105		
2. { Mammalian Anatomy (719) / Plant Physiology (737)	45 / 30		

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 pure science, whether with a view to its further continuance, or wholly as a matter of training. 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. A large amount of experimental work is 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, especially in quantitative measurement, should be conducted.

The Course is laid out with two Options, so arranged that, in addition to the fundamental work outlined above, the student may specialize in either Chemistry or Mathematics.

The first or chemical Option is intended for students who desire to specialize in experimental Physics or Physical Chemistry, or who expect to teach both Physics and Chemistry. The second Option affords a suitable preparation to students who desire to teach either Physics or Mathematics or who expect to undertake graduate work in Mathematical Physics.

Beyond the particular alternative studies set forth in the Course Scheme, a certain further liberty of substitution may be allowed by the Faculty in the case of students in Course VIII. who are fitting themselves for some special line of work. For further details see pages 243 to 256 and 291 to 294.

VIII.— PHYSICS.— (*Options 1, 2.*) (See also page 59.)

FIRST YEAR. SEE PAGE 37.

SECOND YEAR.

FIRST TERM.	Hours of Exercise
Physics: Mechanics, Wave-motion, Electricity (770)	75
Acoustics (823)	30
Qualitative Analysis (552)	90
Organic Chemistry (590)	30
Differential Calculus (34)	45
German (231)	45
English Literature (150)	15
European History (173)	30
Options.	
1. Qualitative Analysis (552) (additional)	45
2. Determinants (39)	15

SECOND TERM.	Hours of Exercise
Physics: Electricity, Optics (770)	75
Physical Laboratory: Mechanics, Optics (773)	30
Precision of Measurements (772)	10
Theoretical Electricity (786)	15
Quantitative Analysis (558)	145
Integral Calculus (35)	45
German (231)	45
English Literature and Composition (150)	30

SUMMER READING, SEE PAGE 35.

THIRD YEAR.

FIRST TERM.	Hours of Exercise
Physics: Heat (771)	15
Physical Laboratory: Heat (774)	15
Theoretical Electricity (787)	45
Industrial Electricity (663)	15
Optical Measurements (807)	30
Theoretical Chemistry (611)	30
Method of Least Squares (56)	20
Political Economy (190)	45
General Studies (see page 72).	
Options.	
1. Quantitative Analysis (559) + Differential Equations (43)	85
2. Advanced Calculus and Geometry (36)	60

SECOND TERM.	Hours of Exercise
Electrical Measurements (778, 779)	60
Heat Measurements (781)	30
Optical Measurements (807)	30
Periodic Currents (788)	45
Theoretical Chemistry (612)	15
Analytical Mechanics (95)	45
Business Law (200)	15
General Studies (see page 72).	
Options.	
1a. Physico-Chemical Measurements (803) + Gas Analysis (638)	90 + 20
1b. Electrical Engineering Laboratory (692) + Physical Laboratory (776)	45 + 45
2. Differential Equations (44) + Vector Analysis (46)	30 + 15

FOURTH YEAR.

FIRST TERM.	Hours of Exercise
Theory of Periodic Currents (650)	30
Electrical Testing (686)	45
Heat Measurements (781)[1]	30
General Theory of Light (808)	45
Electro-chemistry (796)	30
Fourier's Series; Laplace's Coefficients (52)	30
History of Science (761)	30
Physical Colloquium (838).	
Options.	
1. Advanced Theoretical Chemistry (620) + Organic Laboratory (599)	15 + 90
2. Analytical Mechanics (96)	45

SECOND TERM.	Hours of Exercise
Energetics (829)	30
Kinetic Theory of Gases (830)	15
Theory of Potential (791)	30
Fourier's Series; Laplace's Coefficients (52)	30
Physical Colloquium (838)	15
Principles of Scientific Investigation (837).	
Physical Research: Thesis.	
Options.	
1. Advanced Theoretical Chemistry (620) + Special Work: Chemistry or Physics (832)	15 + 90
2. Analytical Mechanics (96)	45

[1] After 1905 the time given to this subject in the fourth year will be devoted to Astronomy.

VIII.— PHYSICS (*continued*).

Option in Electro-Chemistry.—The schedule of studies in Electro-Chemistry, which has been arranged as an independent Option in the Course in Physics, is intended to meet the wants of those who desire to prepare themselves to enter upon any of the various electro-chemical and electro-metallurgical industries which are being so rapidly developed at the present time.

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 Electro-chemistry, which runs through the fourth year. The electrical studies include courses in Theoretical Electricity, Periodic Currents, and the Theory of Alternating Current Machinery, an extended laboratory course in Electrical Measurements and Testing, and a course in Direct and Alternating Current Generators and Motors and Power Transmission, with practice in the Laboratory of Electrical Engineering. The instruction in Chemistry is devoted chiefly to courses in Analytical, Theoretical, Organic, and Industrial Chemistry. In addition to these subjects shorter courses are included in Gas Analysis, Assaying, Metallurgy, and Metallurgical Laboratory, and courses in Mechanism and the Elements of Engineering.

The work in Electro-chemistry 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 Electro-chemical Measurements. The results obtained in the laboratory are discussed in a series of conferences. In the second term the instruction is continued by courses of lectures on Applied Electro-chemistry, including electro-deposition, accumulators, electric furnaces and their products, electrolytic processes, and electro-metallurgy, and by work in the Laboratory of Applied Electro-chemistry. The current periodical literature of the subject is reviewed in a weekly colloquium. The thesis required is also on some electro-chemical topic.

The instruction given in this Option is of so broad a character that a student completing the Course should be well prepared to undertake various lines of electrical and chemical work other than Electro-chemistry, if he so desires.

VIII.— PHYSICS.— (*Option 3.*)

ELECTRO-CHEMISTRY.

FIRST YEAR. SEE PAGE 37.

SECOND YEAR.

FIRST TERM.	Hours of Exercise
Physics: Mechanics, Wave-motion, Electricity (770)	75
Qualitative Analysis (552)	105
Differential Calculus (34)	45
Descriptive Geometry (107)	45
Mechanical Engineering Drawing (374)	30
Metal-turning (134)	60
German (231)	45
English Literature (150)	15
European History (173)	30

SECOND TERM.	Hours of Exercise
Physics: Electricity, Optics (770)	75
Physical Laboratory: Mechanics, Optics (773)	30
Precision of Measurements (772)	10
Theoretical Electricity (786)	15
Quantitative Analysis (558)	145
Integral Calculus (35)	45
German (231)	45
English Literature and Composition (150)	30

SUMMER READING, SEE PAGE 35.

THIRD YEAR.

FIRST TERM.	Hours of Exercise
Physics: Heat (771)	15
Physical Laboratory: Heat (774)	15
Theoretical Electricity (787)	45
Direct Current Generators (654)	30
Quantitative Analysis (559)	60
Theoretical Chemistry (611)	30
Organic Chemistry (590)	30
Gas Analysis (638)	20
Differential Equations (42)	30
Political Economy (190)	45
General Studies (see page 72).	

SECOND TERM.	Hours of Exercise
Electrical Measurements (779)	45
Technical Electrical Measurements (685)	20
Periodic Currents (788)	45
Electrical Engineering Laboratory (692)	45
Theoretical Chemistry (612)	15
Organic Laboratory (599)	90
Assaying (433)	30
Heat Measurements (781)	30
Mechanism (364)	30
Business Law (200)	15
General Studies (see page 72).	

FOURTH YEAR.

FIRST TERM.	Hours of Exercise
Electro-chemistry (796)	30
Electro-chemical Laboratory (799)	105
Electrical Engineering (657)	30
Electrical Engineering Laboratory (693)	50
Electrical Measuring Instruments and Testing (685)[1]	20
Electrical Testing (686)	15
Theory of Periodic Currents (650)	30
Heat Measurements (781)[1]	30
Industrial Chemistry (580)	45
Non-ferrous Metallurgy (443)	20
Metallurgical Laboratory (436) and Reports (437)	27
Colloquium (838).	

SECOND TERM	Hours of Exercise
Applied Electro-chemistry (797)	20
Electro-chemical Laboratory (800)	45
Electro-metallurgy (446)	15
Electrical Engineering (657)	30
Electrical Engineering Laboratory (693)	25
Elements of Engineering (391)	30
Industrial Chemistry (580)	45
Colloquium (838)	15
Thesis.	
Options.	
1. Industrial Chemical Laboratory (582)	75
2. Theory of Alternating Current Machinery (651)	30

[1] Replaced in the fourth year after 1905–1906 by Steam Engineering.

IX.—GENERAL SCIENCE.

The Corporation has voted to establish, in place of the former Course in General Studies, an elective Course in General Science. The following regulations respecting the Course 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 programme 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.

X.—CHEMICAL ENGINEERING.

The Course in Chemical Engineering is designed to meet the needs of students who desire to obtain a fundamental knowledge of Chemistry and at the same time to become sufficiently familiar with the principles of Mechanical Engineering to enable them to deal with problems of construction, operation and maintenance in connection with manufacturing processes including chemical principles. To this end the course includes a training in Inorganic, Analytical, Theoretical and Organic Chemistry, both in the class-room and in the laboratories, which is nearly identical with that given to students in the Course in Chemistry, with the exception of the amount of time spent in the laboratories, which in this course is necessarily lessened somewhat in order to include such fundamental subjects in Mechanical Engineering as Mechanism and Drawing, Applied Mechanics, Steam Engineering, and Engineering Laboratory. A small amount of instruction in the handling of electrical currents is also included. The instruction in all of these subjects is arranged as far as practicable to bear directly upon the needs of this Course.

The instruction in Technical Chemistry includes lecture and laboratory courses, special attention being devoted to the methods of conducting both the mechanical and the chemical operations involved in various manufacturing processes, while at the same time the chemical principles upon which the operations rest are thoroughly taught. The student is thus enabled to obtain a valuable insight into the problems of Engineering Chemistry.

This Course has been extensively revised by the Faculty during the past year. In the Course, as formerly offered, much the larger proportion of the time was devoted to a training in Mechanical Engineering, while under the present arrangement chemical subjects occupy the larger number of hours and the training is correspondingly more complete on that side. The Mechanical Engineering subjects now included are, however, still treated fundamentally, and afford an excellent foundation for later development through graduate study, or individual effort. The schedule on page 63 presents the entire Course as revised, the second year only of which goes into effect in 1905–06. The last two years of the former schedule are given for the classes of 1906 and 1907 (see page 62).

A description of the subjects of instruction will be found on pages 128 to 133, 174 to 186 and 204 to 219.

X.—CHEMICAL ENGINEERING.

FOR CLASSES OF 1906 AND 1907 ONLY.

THIRD YEAR.

FIRST TERM.	Hours of Exercise
Industrial Chemistry (580)	45
Organic Chemistry (590)	30
Gas Analysis (638)	20
Steam Engineering; Thermodynamics (385)	45
Machine Drawing (377)	90
Elements of Differential Equations (42)	30
Physics: Heat (771)	15
Physical Laboratory (773)	15
Applied Mechanics: Statics, Kinematics and Dynamics (70)	30
English Literature (150)	15
European History (173)	30

SECOND TERM.	Hours of Exercise
Industrial Chemistry (580)	45
Industrial Chemical Laboratory (582)	105
Steam Engineering: Boilers (385)	45
Mechanical Engineering Drawing (378) or Boiler Drawing (379)[1]	30
Engineering Laboratory (396)	15
Physical Laboratory (773, 774)	30
Applied Mechanics: Strength of Materials; Graphical Statics (71)	45
Forging (128)	45
Metal Turning (135)	30
English Literature and Composition (150)	30

FOURTH YEAR.

FIRST TERM.	Hours of Exercise
Applied Chemistry (634)	30
Testing of Oils (628)	25
Chemical Resistance of Materials (636)	15
Engineering Laboratory (397)	50
Steam Engineering (386)[3]	15
Industrial Electricity (663)	15
Metallurgy (441, 443)	35
Applied Mechanics: Strength of Materials; Friction (80)	45
Gas Analysis (638)[2]	20
Dynamics of Machines (402)	15
Political Economy (190)	45
General Studies[4] (see page 72).	
Options.	
1. Textile Coloring (630)	90
2. Heat Measurements (781)	60
3. Organic Chemical Laboratory (599)	90
4. Hydraulics (331) and Hydraulic Measurements (333)	35
5. Machine Design (404)	90

SECOND TERM.	Hours of Exercise
Applied Chemistry: Memoirs (634)	30
Theoretical Chemistry (618)	30
Dynamo Electric Machinery (664)	30
Engineering Laboratory (397)	60
Applied Mechanics: Strength and Stability of Structures; Theory of Elasticity (81)	45
Forging (128) and Metal-turning (135)[2]	75
Business Law (200)	15
General Studies[4] (see page 72).	
Thesis.	

[1] Students who wish to take Machine Design in the fourth year take No. 379.

[2] Taken in third year by class of 1907.

[3] For the class of 1906 only.

[4] Omitted by class of 1906.

X.—CHEMICAL ENGINEERING.

FIRST YEAR. SEE PAGE 37.

SECOND YEAR.

FIRST TERM.	Hours of Exercise	SECOND TERM.	Hours of Exercise
Qualitative Analysis (552)	120	Quantitative Analysis (558)	120
Mechanism (361)	30	Mechanism and Valve-gears (361)	30
Differential Calculus (34)	45	Mechanical Engineering Drawing (373)	30
Physics: Mechanics, Wave-motion, Electricity (770)	75	Integral Calculus (35)	45
Descriptive Geometry (107)	45	Physics: Electricity, Optics (770)	75
German (231)	45	German (231)	45
English Literature (150)	15	English Literature (150)	30
European History (173)	30		

SUMMER READING, SEE PAGE 35.

THIRD YEAR.

FIRST TERM.	Hours of Exercise	SECOND TERM.	Hours of Exercise
Quantitative Analysis (558)	195	Organic Chemistry (592)	45
Steam Engineering: Thermodynamics (385)	45	Organic Chemical Laboratory (598)	105
Machine Drawing (377)	105	Special Analytical Methods (560)	75
Physics: Heat (771)	15	Steam Engineering: Boilers (385)	30
Physical Laboratory (773)	15	Mechanical Engineering Drawing (378)	60
Applied Mechanics: Statics, Kinematics and Dynamics (72)	20	Physical Laboratory (773, 774)	30
Political Economy (190)	45	Applied Mechanics: Strength of Materials; Graphical Statics (73)	45
General Studies (see page 72).		Business Law (200)	15
		General Studies (see page 72).	

FOURTH YEAR.

FIRST TERM.	Hours of Exercise	SECOND TERM.	Hours of Exercise
Organic Chemistry (592)	30	Industrial Chemistry (580)	45
Organic Chemical Laboratory (598)	90	Industrial Chemical Laboratory (582)	105
Industrial Chemistry (580)	45	Theoretical Chemistry (611) (612)	30
Theoretical Chemistry (610) (611)	45	Theoretical Chemical Laboratory (619)	45
Theoretical Chemical Laboratory (619)	45	Electro-chemistry (613)	15
Elements of Electrical Engineering (653)	30	Electrical Engineering Laboratory (691)	45
Applied Mechanics (80)	45	Thesis Reports (647)	15
Hydraulics (331)	15	Thesis.	
Engineering Laboratory (397)	30		
Metal-turning (135)	30		

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 and Biology, 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 39, in the following particulars.

There is a reduction in the time devoted to railroads and bridges, and an entire omission of the Mechanical Engineering subjects of Mechanism and Steam Engineering, and of Astronomy and Historical Geology.

The time thus gained is devoted principally to courses in Chemistry and Biology. 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 and Air 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 the health of communities. In the fourth year, courses of instruction are given also in Heating and Ventilation and in Hydraulic Machinery.

The entire instruction in Sanitary and Hydraulic Engineering now given in the Course in Civil Engineering, a portion of which is there optional, is required in the Course in Sanitary Engineering. (See page 168.)

XI.—SANITARY ENGINEERING.

FIRST YEAR. SEE PAGE 37.

SECOND YEAR.

FIRST TERM.	Hours of Exercise	SECOND TERM.	Hours of Exercise
Surveying and Plotting (300)	90	Surveying and Plotting (300)	75
Qualitative Analysis (552)	60	Quantitative Analysis (558)	45
Differential Calculus (34)	45	Integral Calculus (35)	45
Physics: Mechanics, Wave-motion, Electricity (770)	75	Physics: Electricity, Optics (770)	75
Descriptive Geometry (107)	45	Physical Laboratory (773)	30
German (231)	45	Geology (855, 857)	60
English Literature (150)	30	German (231)	45
European History (173)	30	English Literature and Composition (150)	30

SUMMER READING, SEE PAGE 35.

THIRD YEAR.

FIRST TERM.	Hours of Exercise	SECOND TERM.	Hours of Exercise
Railroad Engineering: Field-work and Drawing (313, 315)	50	Railroad & Highway Engineering: Field-work and Drawing (313, 314, 315)	110
Stereotomy (325)	60	Advanced Surveying (303)	30
Advanced Surveying (303)	30	Theory of Structures (345)	30
Topographical Drawing (302)	30	General Bacteriology (744)	60
Organic Chemistry (590)	30	Applied Mechanics: Strength of Materials; Theory of Elasticity (91)	50
General Biology (701)	15	Mechanism (364)	30
Microscopical Organisms (709)	15	Topographic Geology and Building Stones (874, 895)	30
Topographic and Field Geology (874)	30	Business Law (200)	15
Physics: Heat (771)	15	General Studies (see page 72).	
Physical Laboratory (774)	15		
Applied Mechanics: Statics; Kinematics and Dynamics; Strength of Materials (90)	60		
Political Economy (190)	45		
General Studies (see page 72).			

FOURTH YEAR.

FIRST TERM.	Hours of Exercise	SECOND TERM.	Hours of Exercise
Theory of Structures; Bridges and Similar Structures (348)	45	Theory of Structures; Bridges and Similar Structures (348)	45
Theoretical Hydraulics (330)	45	Hydraulic Engineering (335)	45
Hydraulic Measurements (333)	20	Hydraulic Machinery (339)	30
Sanitary and Hydraulic Engineering (334)	45	Sanitary and Hydraulic Designing (337)	85
Bridge Design (356)	60	Municipal Sanitation (753)	30
Bacteriology of Water and Sewage (748)	30	Air Analysis (569)	15
Chemistry of Water and Sewage (568)	45	Sanitary Science and Public Health (754)	15
Metallurgy of Iron (441)	15	Microscopical Analysis of Water and Sewage (711)	30
Industrial Electricity (663)	15	Hydraulic Laboratory (342)	15
Heating and Ventilation (415)	30	Thesis.	
Pipe-fitting (139)	30		

XII.—GEOLOGY AND GEODESY.

The Course in Geology and Geodesy aims to prepare students for professional work in geologic or geodetic Surveying after a thorough training in Mathematics, Drawing, Physics and Surveying. The plan of the Course admits of specialization in the fourth year in geodetic, geologic, mineralogic, physiographic or paleontologic studies, according to the professional aim of the student.

By combining Geodesy with the Course in Geology, it now becomes possible for a student to take his bachelor's degree for work mainly along the lines of geodetic surveying, and this plan secures a double advantage to Course XII. The graduates in Geodesy will be better trained in earth science than ever before, and the need of such training is much felt by those now employed in the topographic branches of government surveys. On the other hand the graduates in Geology cannot fail to profit by more intimate acquaintance with the precise methods of the topographer, and all students are urged to take part in the Summer Schools of practical Surveying.

Option 1, the Course in Geology, is designed for those who plan to prepare for Civil Service Examinations which lead to work on federal or State geologic surveys. The optional work of the fourth year, however, permits men of exceptional attainment to train as specialists in pure science.

Option 2, Geodesy, differs from Option 1 in that the Summer Schools of Surveying are required, certain mathematical studies and advanced Surveying are taken in the third year, and the thesis and professional work of the fourth year are devoted to Astronomy and Geodesy. This Option is designed to lead to service in the topographic or hydrographic divisions of the United States Geological Survey, or in the United States Coast and Geodetic Survey.

For further details see pages 257 to 266 and 295.

XII.—GEOLOGY AND GEODESY.

FIRST YEAR. SEE PAGE 37.

SECOND YEAR.

FIRST TERM.	Hours of Exercise	SECOND TERM.	Hours of Exercise
Mineralogy (840)	60	Mineralogy (840)	60
General Geology (856)	45	Structural and Stratigraphic Geology (858)	60
Qualitative Analysis (552)	105	Field Geology (870)	20
Physics: Mechanics, Wave-motion, Electricity (770)	75	Quantitative Analysis (558)	135
Differential and Integral Calculus (31)	45	Physics: Electricity, Optics (770)	75
German (231)	45	Physical Laboratory (773)	20
English Literature (150)	15	Precision of Measurements (772)	10
European History (173)	30	German (231)	45
		English Lit. & Composition (150)	30

SUMMER COURSE IN SURVEYING REQUIRED IN OPTION 2, ELECTIVE IN OPTION 1.
SUMMER READING, SEE PAGE 35.

THIRD YEAR.

FIRST TERM.	Hours of Exercise	SECOND TERM.	Hours of Exercise
Economic Geology (859)	60	Economic Geology (889)	60
Topographic Geology (874)	30	Topography of the U.S. (872)	90
Structural Paleontology (878)	45	Topographical Drawing (302)	30
General Biology (701)	15	Astronomy (308)	30
Physics: Heat (771)	15	Zoölogy (716)	45
Physical Laboratory (773, 774)	45	Electrical and Heat Measurements (782)	30
Freehand Drawing (116)	75	Business Law (200)	15
Political Economy (190)	45	General Studies (see page 72).	
General Studies (see page 72).			
Options.		*Options.*	
1. Surveying and Plotting (300)	90	1. Surveying and Plotting (300)	75
1. Geological Surveying (871)	55	1. Historical Geology (880)	90
2. Advanced Surveying (303)	30	2. Advanced Surveying (303)	30
2. Descriptive Geometry (107)	60	2. Historical Geology: Laboratory (880)	60
2. Method of Least Squares (56)	20	2. Geological Surveying (871)	60
2. Spherical Trigonometry (24)	10		

SUMMER SCHOOL OF ADVANCED SURVEYING IN OPTION 1: ELECTIVE, SUBSTITUTE FOR (303) OF FOURTH YEAR; IN OPTION 2, REQUIRED.
SUMMER FIELD-WORK IN MINERALOGY OR GEOLOGY (ELECTIVE).

FOURTH YEAR.

FIRST TERM.	Hours of Exercise	SECOND TERM.	Hours of Exercise
Economic Geology (860)	60	Geological Surveying (871)	60
Glacial Geology (863)	15	Geology of North America (890)	90
Petrography (843)	60	Petrography (843)	60
Mining Engineering (458)	45	Theoretical Chemistry (611, 612)	30
Hydraulic Measurements (333)	20	*Options.*	
Theoretical Chemistry (610, 611)	45	1. Advanced Surveying (303)	30
Options.		1. Geodesy (310)	15
1. Advanced Surveying (303)	30	1. Thesis and professional studies continued from first term	285
1. Professional work leading to a Thesis[1]	145	2. Thesis and professional studies continued from first term	315
2. Geological Surveying (871)	60		
2. Professional work leading to a Thesis[1]	175		

[1] The work is to be chosen, subject to the approval of the Department of Geology, from the following studies:—

Option 1: Advanced Mineralogy, Petrography, Advanced Paleontology, Building Stones, Applied Geology and Reports, Advanced Field-work, Topographic Geology, Experimental Geology, Mining or Metallurgy.

Option 2: Astronomy, Geodesy, Physical Laboratory, Topographic Geology, Experimental Geology.

XIII.—NAVAL ARCHITECTURE.

The Course in Naval Architecture 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. Like all the Courses at the Institute, it gives, in addition to a professional and technical training, a good scientific and liberal education.

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, Steam Engineering, 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.

In the third year of the Course, lectures are given on the methods of building ships of wood and of steel, on the methods of computing the displacement and stability of ships, the theory of waves, the rolling of ships, and on such special problems as launching and docking, and flooding compartments. In the fourth year the lectures treat of the strength of ships, resistance and propulsion, and steering and manœuvring; and also of ventilation and drainage and the adjustment of compasses. The lectures are accompanied by two or three exercises a week in drawing, in which the students learn how to make the calculations and constructions described in the lectures, and apply them to the design of a ship for a special purpose.

The work in Applied Mechanics and Steam Engineering is accompanied by a full course in the Laboratories of Engineering and Applied Mechanics. In the Mechanical Laboratories instruction is given in Forging, Chipping and Filing, and Machine-tool Work. (See also pages 267 to 272 and 298.)

A student who has completed the Course in Mechanical Engineering or an equivalent course at another college will be enabled on application to complete Course XIII. in one year, with opportunity for collateral work in electrical or other lines.

XIII.—NAVAL ARCHITECTURE.

FIRST YEAR. SEE PAGE 37.

SECOND YEAR.

FIRST TERM.	Hours of Exercise	SECOND TERM.	Hours of Exercise
Mechanism (361)	4	Mechanism and Valve-gears (361)	30
Mechanical Engineering Drawing (372)	30	Mechanical Engineering Drawing (373)	75
Forging (127)	60	Forging (127), Chipping, and Filing (130)	90
Differential Calculus (34)	45	Integral Calculus (35)	45
Physics: Mechanics, Wave-motion, Electricity (770)	75	Physics: Electricity, Optics (770)	75
Descriptive Geometry (107)	45	German (231)	45
German (231)	45	English Literature and Composition (150)	30
English Literature (150)	15		
European History (173)	30		

SUMMER READING, SEE PAGE 35.

THIRD YEAR.

FIRST TERM.	Hours of Exercise	SECOND TERM.	Hours of Exercise
Naval Architecture (901)	30	Naval Architecture (901)	30
Ship Construction (900)	30	Ship Construction (900)	15
Ship Drawing (910)	90	Ship Drawing and Design (910)	75
Steam Engineering; Thermodynamics (385)	45	Steam Engineering (385)	45
Elements of Differential Equations (42)	30	Machine Drawing (377)	45
Physics: Heat (771)	15	Engineering Laboratory (396)	15
Physical Laboratory (773)	15	Physical Laboratory (773, 774)	30
Applied Mechanics: Statics; Kinematics and Dynamics (70)	30	Precision of Measurements (772)	15
Political Economy (190)	45	Applied Mechanics: Strength of Materials; Graphical Statics (71)	45
General Studies (see page 72).		Business Law (200)	15
		General Studies (see page 72).	

FOURTH YEAR.

FIRST TERM.	Hours of Exercise	SECOND TERM.	Hours of Exercise
Naval Architecture (902)	30	Naval Architecture (902)	30
Ship Design (911)	105	Ship Design (911)	90
Marine Engines (913)	30	Marine Engines (913)	90
Theoretical Hydraulics (331)	15	Engineering Laboratory (397, 781)	60
Engineering Laboratory (397, 639)	60	Applied Mechanics: Strength and Stability of Structures; Theory of Elasticity (81)	45
Dynamics of Machines (401)	20	Machine-tool Work (133)	60
Applied Mechanics: Strength of Materials; Friction (80)	45	Thesis.	
Chipping and Filing (130); Machine-tool Work (133)	90		
Metallurgy of Iron (441)	15		

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. Other subjects selected from the regular course are Marine Engineering, Steam Engineering, and Applied Mechanics. Throughout the three years instruction is given in War-ship Design by means of lectures and drawing. The Course is broadened and strengthened by courses on Sanitation, Heating and Ventilation, Foundations, Metallurgy, and Metallography. A thorough course is given in Electrical Engineering, with adequate training in physical and electrical engineering laboratories. Lectures and laboratory work are given on paints, oils, and other organic materials used on ships. Lectures will be given from time to time by Naval Constructors and other eminent specialists on subjects pertaining to the practice of ship-building.

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.

FIRST YEAR.[1]

FIRST TERM.	Hours of Exercise	SECOND TERM.	Hours of Exercise
Naval Architecture (901) . . .	30	Naval Architecture (901) . . .	30
Theory of Warship Design (915)	30	Theory of Warship Design (915)	30
Warship Design, preliminary work (920)	120	Warship Design (920)	90
Advanced Calculus and Geometry (36)	60	Differential Equations (44) . .	30
Theoretical Electricity (787) .	45	Applied Mechanics: Strength of Materials; Graphical Statics (71)	30
Technical Chemistry (635) . .	30	Chemical Laboratory (635) . .	90
Hydraulics (340)	15	Precision of Measurements (772)	10
Spanish II. (241)	30	Physical Laboratory (773) (774)	30
		Periodic Currents (788) . . .	45
		Spanish II. (241)	30

SECOND YEAR.

FIRST TERM.	Hours of Exercise	SECOND TERM.	Hours of Exercise
Naval Architecture (902) . . .	30	Naval Architecture (902) . . .	30
Theory of Warship Design (916)	30	Theory of Warship Design (916)	30
Warship Design (921)	90	Warship Design (921)	90
Steam Engineering (386) . . .	30	Steam Engineering (386) . . .	30
Drawing with Steam Engineering (380)	20	Applied Mechanics: Strength and Stability of Structures; Theory of Elasticity (81) . .	45
Applied Mechanics: Strength of Materials; Friction (80) . .	45	Alternating Current Machinery (651)	30
Periodic Currents (650) . . .	30	Electrical Engineering Laboratory (694)	30
Electrical Engineering Laboratory (694)	30	Sanitation of Ships (756) . . .	15
Metallurgy of Iron (441) . . .	15	Foundations (407)	10
Metallography (452)	10	Spanish III. (242)	30
Spanish III. (242)	30		

THIRD YEAR.

FIRST TERM.	Hours of Exercise	SECOND TERM.	Hours of Exercise
Naval Architecture (903) . . .	20	Naval Architecture (903) . . .	15
Theory of Warship Design (917)	30	Theory of Warship Design (917)	30
Warship Design (922)	90	Warship Design (922)	90
Marine Engines (913)	30	Marine Engines (913)	90
Heating and Ventilation (416) .	15	Electrical Engineering (680) .	30
Dynamics of Machines (401) .	20	Electrical Engineering Laboratory (694)	60
Engineering Laboratory (397) .	60	Engineering Laboratory (397) .	60
Theory of Structures (347) . .	60	Thesis.	
Electrical Testing (689) . . .	30		
Electrical Engineering Laboratory (694)	45		

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

OPTIONS IN GENERAL STUDIES.

All regular students in the third year 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.[1] The division of this time between exercise and preparation varies for the different subjects. The choice of subjects is to be made from the following list of options:—

FIRST TERM.	Hours of Exercise	SECOND TERM.	Hours of Exercise
ECONOMICS.			
Economic History (191)	15	Railroad Economics (194)	45
		Banking and Finance (195)	45
		Labor Problems (196)	45
		Organization of Industry (197)	45
ENGLISH.			
Advanced English Composition (143)	15	Contemporary Literature (158)	45
English Literature of the Eighteenth Century (156)	30	English Literature of the Nineteenth Century (157)	45
MODERN LANGUAGES.			
French III. (222)	15	French III. and French Sight Reading (222, 228)	45
German III. (232)	15	German III. and German Sight Reading (232, 238)	45
French Sight Reading (228)	45	Spanish (240)	45
German Sight Reading (238)	45		
Spanish (240)	30		
HISTORY.			
Comparative National Government (209)	15	Municipal Government (208)	30
International Law (201)	15	Colonial Systems (175)	30
History of Science (761)	30	European Civilization and Art (182)	30

Students are allowed to exercise entire freedom of choice between these subjects, except that European Civilization and Art is not counted as an option in Course IV.

[1] Course X. for classes previous to the class of 1908, and Options 1 and 2 of Course III. take this work in the fourth year.

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

Summer Courses.

THE Institute offers summer instruction during the months of June and July, supplementing the work of the regular school year. The requirements for admission, the work performed, and the final examinations are expected to correspond with 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 larger 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. 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 1905.

Mathematics.
- (*a*) Analytic Geometry.
- (*b*) Integral Calculus.

Applied Mechanics.

Mechanical Drawing and Descriptive Geometry.

Mechanic Arts.
- (*a*) Woodwork.
- (*b*) Forging.
- (*c*) Chipping and Filing.
- (*d*) Machine-Tool Work.

Modern Languages.
- (*a*) French I.
- (*b*) French II.
- (*c*) German I.
- (*d*) German II.

Chemistry.
- (*a*) Inorganic and Analytical Chemistry.
- (*b*) Organic Analysis and Preparations.
- (*c*) Air, Water, and Food Analysis.
- (*d*) Industrial Chemistry.
- (*e*) Theoretical Chemistry.
- (*f*) Sugar Analysis.

Physics.
- (*a*) Mechanics, Optics, and Electricity.
- (*b*) Heat.
- (*c*) Physical Laboratory.
- (*d*) Electro-Chemistry.

Civil Engineering.
- (*a*) Surveying.
- (*b*) Geodetic and Hydraulic Surveying.

Mechanical Engineering.
- (*a*) Mechanism and Valve-gears.
- (*b*) Mechanical Engineering Drawing.

Mining Engineering.
- Assaying.

Architecture.
- (*a*) Shades and Shadows.
- (*b*) Design I.
- (*c*) Design II.

Biology.
- (*a*) Sanitary Bacteriology.
- (*b*) Research in Bacteriology and Public Health.
- (*c*) Physiology and Personal Hygiene.

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 112 to 274. 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 Secretary of the Faculty, at a date as early as possible before the beginning of the course. For many of the subjects a final date for applications is fixed.

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. The courses will be given, in general, only when at least six students have applied before June 15.

A fee of $25 for each course (with certain exceptions noted in the special circular) is payable to the Bursar at the time fixed for beginning the course. For the courses in the Chemical Laboratories an additional charge of $10 will be made for 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 services.

A special circular giving full details in regard to dates and subjects will be sent 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, Architecture, Chemistry, and Geology. The students, accompanied by instructors, give their time to field-work or visit and report on mines and industrial establishments.

Summer School of Civil Engineering.—In the vacation following the third year, students in the second and third years are offered in alternate years a course in Geodetic and Topographic Surveying, including Hydraulic Measurements during about four weeks in the early part of the summer. This is held at some convenient point in the country, and its object is to give the students opportunity for more extended and continuous field-practice in these branches than is possible during the term. The work consists of a topographical survey of a certain district, with field-practice in triangulation and base-line measurement, the gauging of streams, and the observation of tidal phenomena. Field-work in Geology is sometimes added. This course is open to all students in the Department who have completed the second year, and to properly qualified students in other Departments. Second-year students taking the course will be excused from field-work in Surveying in the third year, and third-year students taking it will be excused from most of the hydraulic field-work of the fourth year. Persons not connected with the Institute are permitted to attend the Summer School also, upon giving satisfactory evidence of being properly qualified. All persons taking the course are required to pay a tuition fee of $25.

In 1901, this school was held at Machias, Me.; in 1902, at Ellsworth, Me.; and in 1903 and 1905 at East Machias, Me. In 1904 it was not held.

Summer Schools of Mining and Metallurgy.—To bring the mining students into closer acquaintance with their profession, Summer Schools are organized for the study of mines, mills, smelting works, and geological fields. The mining and metallurgical Summer Schools take place in alternate years.

At the Summer School of Mines, the students, with their instructors, establish themselves at a mine, and take up in succession systematic studies in methods of mining and ore-dressing, of underground and surface surveying, doing actual work in all these lines.

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.

In 1904 a change was made in the usual Summer School of Mining of the Institute in that it was held in conjunction with mining students from the Lawrence Scientific School of Harvard University, the Sheffield Scientific School of Yale University, and the School of Mines of Columbia University. Students of the Colorado School of Mines at Golden City were also invited to attend. This plan of a joint Summer School was conceived by Mr. John Hayes Hammond and inaugurated by Mr. George Crocker. The school was held at the Pelican Dives Mine, Silver Plume, Colorado, part of which had been leased for this purpose, and was in charge of Professor Henry S. Munroe of Columbia University. It lasted seven weeks. One week was given to drilling and blasting, one to timbering, and one to mine surveying; half of the fourth week was taken up with mine sampling and the other half with a study of the plant as a whole. Ore-dressing was followed for one and a half weeks at Idaho Springs and hydraulicking and dredging for half a week at Breckenridge.

The last week, left open for optional work, was devoted by students of the Institute to the visiting of metallurgical plants.

In 1905 the Summer School of Metallurgy was held in New Jersey, Maryland and Pennsylvania. It was occupied with the study of some phases of the metallurgy of lead, copper, zinc, silver, gold, the concentration and melting of oxide zinc ores, and the mining of coal and the manufacture of coke. In New Jersey the American Smelting and Refining Company furnished the opportunity of studying the smelting and refining of lead and copper, and the electrolytic parting of doré silver. The other copper plant visited was that of the De Lamar's Copper Refining Company at Chrome. Magnetic and wet concentration of oxide zinc ores, and the production of spelter and of zinc oxide, were taken up at the new plants of the New Jersey Zinc Company at Franklin Furnace and Hazard (Pa.). In Maryland the works of the Maryland Steel Company at Sparrow's Point gave the party every facility to become familiar with coking in retort-ovens, smelting of iron ores, manufacture of slag cement, Bessemerizing and rolling. In Pennsylvania a short stop was made in Philadelphia to study at the United States Mint the electrolytic parting of doré silver and the electrolytic refining of gold. About a fortnight was spent in Pittsburgh to study the mining of coal and the metallurgy of iron and steel. The following plants were visited: the blast furnace and Bessemer departments of the Edgar Thompson works at Braddock, the Isabella blast furnaces at Etna, the open-hearth plant at Homestead, the works of the Crucible Steel Company of America, the National Tube Company, the American Steel and Tin Plate Company, and the Pittsburgh Malleable Iron Company: further, the Saber Iron Works of Zug and Company and the Hazel Mine.

Summer School of Architecture.—The first Summer School was held in 1893 in Chicago, during the World's Fair. In 1894 and 1895 schools were held in Salem and Portsmouth for the study of Colonial Architecture. In 1896 the Institute

took the important initiative of sending the school abroad, and a bicycle tour was made in England and France for the study of architectural styles. In 1897 and 1898 the school made pencil and water-color sketches of the picturesque buildings in and about Quebec. In 1899 the school again studied European Architecture, visiting cities in Northern Italy, and then making a bicycle tour from Genoa to Paris. In 1900 Colonial Architecture was again studied, and measured drawings were made in Providence and Boston. In 1901 and 1902 the demands from architects for draughtsmen's services were so great that the Summer School was omitted. In the summer of 1903 the school was again held abroad, the class making a tour of Italy and France.

Summer School of Industrial Chemistry.—In alternate years opportunity is offered to students of the third and fourth years of the Courses in Chemistry, Chemical Engineering and Electro-chemistry to visit typical chemical or metallurgical manufacturing plants, under the guidance of instructors, and to study and report upon essential features of the industrial processes involved. These excursions occupy about fifteen days and include daily conferences between the instructors and the members of the school.

In 1904 visits were made to North Adams, Mass., Mechanicsville, Glens Falls, Syracuse, Silver Springs, Rochester, Buffalo and Niagara Falls in New York, and Olean in Pennsylvania.

Summer Schools of Geology and Mineralogy.—With a view to emphasize the practical character of the instruction in Geology and Mineralogy, provision is made for Field-work during the summer vacation in districts remote from Boston. Thus the term work in Mineralogy is usually supplemented by an excursion to localities of special mineralogical interest in New England, the Middle States, or Canada; and similar opportunities are offered for the study of Ore-deposits and Mining Geology. Advanced students may secure field experience in connection with the professional work of the instructors.

Requirements for Graduation.

BACHELOR OF SCIENCE.

General Conditions.—To receive the degree of Bachelor of Science the student must have attended the Institute not less than one year, which must be that next 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.

Theses.—The student must, moreover, prepare a dissertation 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 of paper of good quality, 8 × 10½ inches in size, with an inch margin on the inner, and a half-inch margin on the outer edges. Theses must be handed to the Secretary of the Faculty not later than the first annual examination.

All theses and records of work done in preparation of theses are the permanent property of the Institute, and can not 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.

Significance of the Degree.—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 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.

Degrees in Two Courses.—An applicant for the degree of Bachelor of Science in two Courses at the same time must have made application for such candidacy not later than November first next preceding his graduation. Such applications will be granted only in the case of students who have previously anticipated fourth-year subjects in one or both of the Courses in question to such an extent that they have ample time for the work proposed. No student shall be allowed to present two theses in the same term. A student graduating in more than one Course at the same time shall receive but one diploma, which shall, however, state the several Courses in which he graduates.

Degrees in Related Courses.—The continually increasing specialization of the various engineering professions and the upward tendency of the standards of professional attainment render it difficult in a Four-year Course to give much more than a thorough training in the student's chosen specialty. Hence it is frequently of great advantage to a graduate from one of the Engineering Courses to devote an additional year to the professional work of another closely related Course. The student who completes such a double Course has obtained

a broader scientific and professional education, is enabled to investigate a given problem on more than a single side, and is thus more efficient and independent in engineering practice. For the successful completion of such a Course the Institute gives a second degree of Bachelor of Science in the new department of study.

At present the professional work of Course I., Civil Engineering, may be completed in one year by graduates of Course XI., Sanitary Engineering; of Course II., Mechanical Engineering, by graduates of Course XIII., Naval Architecture; of Course XII., Option 1, Geology, by graduates of Course III., Option 3, Mining Engineering; of Course XII., Option 2, Geodesy, by graduates of Course I.; and of Course XIII., Naval Architecture, by graduates of Course II., Mechanical Engineering.

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

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

For requirements for higher degrees, see pages 84 to 89.

Graduate Courses.

GENERAL STATEMENT.

The Institute offers courses of advanced study and research leading to the degrees of Master of Science, Doctor of Philosophy, and Doctor of Engineering.

An applicant for any of these degrees must, except in cases of unusual attainment, have taken his first degree in some scientific school, college, or university of good standing; and his attainments must be substantially equivalent to those required for the Bachelor's degree of the Massachusetts Institute of Technology. He must file with the Secretary, before being accepted as a candidate, a statement of his previous work and present attainments, and of the advanced work which he intends to do at the Institute.

Advanced courses in chosen lines of study, without reference to degrees, may be pursued by graduates of the Institute without preliminary examination, or by graduates of other institutions who satisfy the Faculty that they are qualified to take with advantage the courses proposed.

Further information regarding graduate work may be found in the circular on Advanced Study and Research.

MASTER OF SCIENCE.

The course of study leading to the degree of Master of Science must consist mainly of advanced study and research. The candidate must pursue his course of study continuously, under the direction and oversight of the Faculty, for at least 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.

Such an advanced course serves to supplement the undergraduate work by more thorough instruction in underlying principles and their mathematical development, by a fuller study of special branches of the profession, and by a training in the investigation of scientific or technical problems, which is essential to the highest professional success.

Since the choice of the most advantageous subjects for a Graduate Course will depend more or less upon individual conditions, the Faculty has not attempted to fix absolutely the schedules of topics to be followed in order to obtain the Master's degree. In some cases a general outline only of the Course has been planned, while the details will be filled in to correspond with the requirements of the individual candidate. For instance, in order to provide for the needs of students wishing to pursue graduate work in Civil Engineering, an advanced Course is offered, which includes, besides original work in research and criticism, advanced instruction in the design and construction of bridges, buildings, and other structures, in Theoretical Hydraulics, and in the Theory of Elasticity, with special reference to its applications to the strength of materials, together with experimental work in the Engineering Laboratories. Opportunity is also offered for advanced study in Geodesy, including courses in Geodesy and Astronomy extending throughout the year, with work at the Observatory in Middlesex Fells, and suitable advanced work in the Physical Laboratory.

In other cases somewhat more definite arrangements are proposed, and the following statements of Graduate Courses have been approved by the Faculty; but the schedules below are presented as typical, and not as prescribed Courses. Course XIII.A also leads to the Master's degree, as stated on page 70.

III. G.—MINING ENGINEERING AND METALLURGY.

GRADUATE COURSE.—*(Option 1.)*

FIRST TERM.	Hours of Exercise
Principles of Mechanism (361)[1]	30
Steam Engineering (385)	45
Drawing (377)[1]	90
Electrical Measurements (782)	15
Electrical Engineering (lectures) (658)	30
Electrical Engineering (laboratory) (694)	30
Option A.	
Advanced Surveying (303)	30
Railroad Drawing and Field-work (315)	30
Theory of Structures (348)[2]	45
Ore-dressing (reading) (462)	30
Forging (128)	45
Option B.	
Electro-chemistry (796)	30
Electro-chemical Laboratory (799)	15
Heat Measurements (782)	45
General Metallurgy (lectures; laboratory) (453, 454)	105

SECOND TERM.	Hours of Exercise
Mechanism (361)	30
Steam Engineering (385)	45
Drawing (373) (378)	90
Option A.	
Advanced Surveying (303)	30
Railroad Drawing and Field-work (315)	75
Theory of Structures (348)	45
Ore-dressing Laboratory (463); Thesis	180
Option B.	
Electro-metallurgy (446)	15
Metallurgical and Chemical Laboratory (438); Thesis	245
Gas Analysis (638)	20
Distillation of Fuels (449)	6
Forging (128)	45

[1] Descriptive Geometry (107) must have been completed.
[2] Structures (345) must have been completed.

IV. G.—ARCHITECTURE.

GRADUATE COURSE.

FIRST TERM.	Hours of Exercise
European Civilization and Art (advanced course)[1] (181)	30
Advanced Architectural Design (529); Advanced Composition: Theory and Practice	370
Advanced Constructive Design (533); Building Laws and Contracts	60
Advanced Decorative Design; Life Class (119)	90
Composition in Rendering; Theory and Practice (517)	15
Æsthetics (165)	30

SECOND TERM.	Hours of Exercise
Advanced Architectural Design (529); Thesis; Philosophy of Art (lectures)[2]	465
History and Archæology; Special Research (492)	30
Advanced Decorative Design; Life Class (119)	90
Composition in Rendering; Theory and Practice (517)	15

[1] The History of Greek and Roman Civilization and Art is given in the fourth year.
[2] The History of Ornament is given in the fourth year.
Opportunity will be offered also for graduate work in architectural engineering and landscape architecture.

V. G.—CHEMISTRY.

GRADUATE COURSE.

FIRST TERM.	Hours of Exercise
Advanced Inorganic Chemistry (623)	15
Advanced Theoretical Chemistry (620)	15
Chemical Research.	
Option A.	
Electrical Engineering (lectures) (658)	30
Electrical Engineering (laboratory) (694)	30
Principles of Mechanism (361)	30
Applied Mechanics (Statics; Kinematics and Dynamics) (70)	30
or { Steam Engineering (385)	45
or { Drawing (377)	75
Option B.	
Electro-chemistry (lectures) (796)	30
Electro-chemistry (laboratory) (799)	45
Method of Least Squares (56)	15
Advanced Calculus (36)	60

SECOND TERM.	Hours of Exercise
Advanced Inorganic Chemistry (623)	15
Qualitative Analysis of Rare Metals (553), or	165
Organic Qualitative Analysis (597)	135
Chemical Research.	
Option A.	
Advanced Industrial Chemistry (581)	15
Mechanism (361)	30
Mechanical Engineering Drawing (373)	45
Applied Mechanics (Strength of Materials; Graphical Statics) (71)	45
Steam Engineering (385)	45
Drawing Design (378)	30
Engineering Laboratory (396)	30
Option B.	
Electricity (792)	30
Applications of Polarized Light (813)	15
Kinetic Theory of Gases (830)	15
Energetics (829)	30
Differential Equations (44)	30

Students who have not had the preparation required for particular subjects are advised to consult the instructors in charge regarding the possibility of preparing themselves through summer work preceding the graduate course.

VI. G.—ELECTRICAL ENGINEERING.

GRADUATE COURSE.

FIRST TERM.	Hours of Exercise
Theoretical Electricity (652)	45
Laboratory of Electrical Testing (687)	75
Laboratory of Electrical Engineering (696)	75
Design of Stations and Distribution Systems (679)	120
Dynamo Design (668)	15
Drawing and Machine Design (405)	90

SECOND TERM.	Hours of Exercise
Theoretical Electricity (652)	45
Laboratory of Electrical Engineering (696)	75
Design of Stations and Distribution Systems (679)	75
Machine Design (405)	90
Thesis.	

XIII. G.—NAVAL ARCHITECTURE.

GRADUATE COURSE.[1]

FIRST TERM.	Hours of Exercise	SECOND TERM.	Hours of Exercise
Naval Architecture	15	Naval Architecture	15
War-ship Design	180	War-ship Design	180
Theory of War-ship Design	60	Theory of War-ship Design	60
Advanced Calculus	60	Sanitation of Ships	15
Theoretical Electricity	45	Differential Equations	30
Electrical Engineering	30	Periodic Currents	45
Electrical Testing	30	Electrical Engineering Laboratory	30
		Thesis	135

[1] For graduates of Course XIII. who desire War-ship Design.

DOCTOR OF PHILOSOPHY.

The degree, Doctor of Philosophy, certifies to the creditable completion of an advanced course of study in some branch of science and to the performance of an original research of high grade bearing upon some scientific topic. It will be awarded only to candidates who have exhibited the power of attacking new problems in an independent and efficient manner. The study and research for the degree must be pursued under the direction and oversight of the Faculty for at least two school years. Attendance at the Institute must be continuous, except in cases of absence previously approved by the Faculty.

The courses of study leading to the degree of Doctor of Philosophy are especially valuable to those who wish to engage in original research or in the work of instruction in higher institutions of learning; but a thorough knowledge of scientific facts and principles and a training in methods of investigation are so essential to creative work in any branch of industry that students who are preparing themselves for an industrial career will also derive great profit from such courses.

DOCTOR OF ENGINEERING.

The degree, Doctor of Engineering, certifies to the creditable completion of an advanced course of study in some branch of engineering and to the performance of an original research of high grade bearing upon some engineering topic. Candidates for this degree must be registered in the Graduate School of Engineering Research and work under the direction of its Council for a period of at least two years, during which time attendance must be continuous, except in cases of absence previously approved by the Faculty.

For further information regarding admission to the school see page 90, and also the special Programme of the School for Engineering Research.

Graduate School of Engineering Research.

The Graduate School of Engineering Research is intended to provide facilities for a small number of advanced students who show capacity for research; and it will be the aim of the Faculty to direct the work of those who enter this school toward the solution of problems of practical importance. There will be formed in each department of the school a seminar; and every member of the school will be expected to connect himself with a seminar, and to take part in the presentation of papers. Courses at present are offered by the Departments of Civil, Mechanical, Mining, Electrical, Chemical, and Sanitary Engineering, and Naval Architecture, with the co-operation of the Departments of Mathematics, Physics, Chemistry, Biology, etc.

Candidates for admission will in general be expected to have such training as is represented by the degree of Bachelor of Science of the Massachusetts Institute of Technology or other institutions of corresponding grade. The Council reserves the right, however, to accept or reject, as it may deem wise, candidates of any academic rank. The degree of Doctor of Engineering will be conferred for satisfactory resident work occupying not less than two years. A fee of $25 will be required, and an additional fee of $25 for each full course of 30 hours of class work or 60 hours of laboratory work, but the maximum charge for instruction will be $250 for the year. Two fellowships of $500 each will be available from the beginning of the year 1904–05, and holders of these fellowships will be exempt from tuition fees. A special circular giving detailed information in regard to the school will be mailed on application.

Scientific Research.

In addition to the opportunities for advanced study and investigation connected with the Graduate School of Engineering Research, the Institute offers excellent facilities for purely scientific research in all of its laboratories. For research work in Physical Chemistry and Sanitary Science two new laboratories devoted exclusively to these subjects have been established.

Physico-Chemical Research.—The Research Laboratory of Physical Chemistry offers unusual opportunities for a thorough scientific training in Physical Chemistry to properly prepared students who wish to do research work in this branch of science, either with or without reference to an advanced degree. Researches in this laboratory are carried on in part by a staff of Research Assistants and Associates and in part by graduate students working under the direction of those Professors of the Institute who are connected with the subjects of Theoretical or Physical Chemistry. A number of advanced lecture courses (see page 220) are offered by the members of the laboratory staff, and seminar meetings are conducted by them. These are attended also by advanced students.

A description of the laboratory may be found on page 285.

For additional information the Programme of the Research Laboratory of Physical Chemistry should be consulted.

Sanitary Research.—By the generosity of an anonymous donor the Institute has recently established upon land specially secured for the purpose on the corner of Massachusetts Avenue and Albany Street, and near the City Hospital, a San-

itary Research Laboratory and Sewage Experiment Station, provided with facilities for demonstration of the more important methods employed on a large and a small scale for the purification of sewage and water, and in connection therewith well-equipped sanitary, chemical, and bacteriological laboratories.

The regular students of the Institute in Sanitary Biology, Sanitary Chemistry, and Sanitary Engineering have full access to the privileges offered by the station and the laboratories, and graduate or special students may here carry on individual work with advantage. A description of the laboratory may be found on page 290.

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 or who are engaged in teaching or technical pursuits, and applicants who for satisfactory reasons desire only special courses requiring no previous training may be admitted also, at the discretion of the Faculty, without entrance examinations.

ADMISSION TO THE FIRST YEAR.

The student proposing 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, manual training high schools, and academies will, in general, afford suitable preparation.

The requirements of age and scholarship specified are re-

garded 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 in Boston.—Examinations for admission to the first-year class are held *in Boston only* on the first Wednesday, Thursday, and Friday after June 23, in the Rogers Building, 491 Boylston Street. A second series of examinations for admission, and for applicants conditioned at the first examinations, is held at the same place, on the first Tuesday, Wednesday, and Thursday after September 17. (See Calendar, page 2.)

Applicants for admission after the September examinations will be received only when some good cause, such as illness, has prevented attendance on the days prescribed. A fee of five dollars, payable to the Bursar, may be charged for special examinations, if required in such cases.

Applicants who intend to take their entrance examinations in September are requested to notify the Registrar of such intention not later than September 10.

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

Order of Examinations in Boston.—The order of examinations for June, 1906, will be as follows:—

WEDNESDAY, JUNE 27, 1906.

8.45 A.M. to 9 A.M.	*Registration of Applicants.*
9.00 A.M. to 11.00 A.M.	Solid Geometry.
11.15 A.M. to 1 P.M.	English.
2.00 P.M. to 3.30 P.M.	History.

THURSDAY, JUNE 28, 1906.

9.00 A.M. to 11.00 A.M.	Algebra A.
11.15 A.M. to 1.00 P.M.	Plane Geometry.
2.00 P.M. to 4.00 P.M.	French.

FRIDAY, JUNE 29, 1906.

9.00 A.M. to 11.00 A.M.	German.
11.15 A.M. to 1 P.M.	Algebra B.
2.00 P.M. to 4 P.M.	Physics.

SATURDAY, JUNE 30, 1906.

9 A.M. to 11 A.M.	French II. } for advanced
11 A.M. to 1 P.M.	German II. } standing.

The order of examinations for September, 1906, will be as follows:—

TUESDAY, SEPTEMBER 18, 1906.

9.00 A.M. to 11 A.M.	Solid Geometry.
11.15 A.M. to 1 P.M.	English.
2.00 P.M. to 3.30 P.M.	History.

WEDNESDAY, SEPTEMBER 19, 1906.

9.00 A.M. to 11 A.M.	Algebra A.
11.15 A.M. to 1 P.M.	Plane Geometry.
2.00 P.M. to 4.00 P.M.	French.

THURSDAY, SEPTEMBER 20, 1906.

9.00 A.M. to 11 A.M.	German.
11.15 A.M. to 1.00 P.M.	Algebra B.
2.00 P.M. to 4 P.M.	Physics.

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

Examinations at Other Points.—*Examinations are now held by the Institute in Boston 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 detailed information candidates should address the Secretary of the College Entrance Examination Board, Post-office Sub-station 84, New York, N.Y.

The entrance examinations of the College Entrance Examination Board for 1906 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, Post-office Sub-station 84, New York, N.Y., and must be made upon a blank form to be obtained from the Secretary upon application.

Applications for examination at points in the United States east of the Mississippi River (also at Minneapolis, St. Louis and other points on the Mississippi River) must be received at the office of the Secretary of the Board not later than Monday, June 4, 1906.

Applications for examination elsewhere in the United States or in Canada must be received not later than May 28.

Applications for examination at points outside of the United States and Canada must be received not later than May 15.

Applications received later than the dates named will be accepted when it is practicable to arrange for the examination of the candidates concerned, but only upon the payment of five dollars in addition to the regular examination fee. Candidates filing belated applications do so at their own risk.

The examination fee is five dollars for all candidates examined at points in the United States and Canada, and fifteen dollars for all candidates examined at points outside of the United States and Canada. The fee (which can not be accepted in advance of the application) should be remitted by postal order, express order, or draft on New York, to the order of the College Entrance Examination Board.

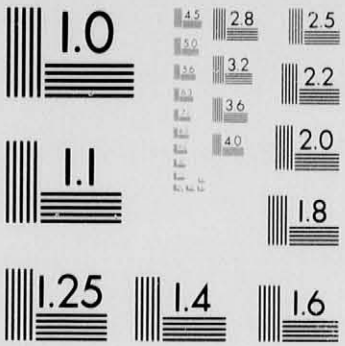
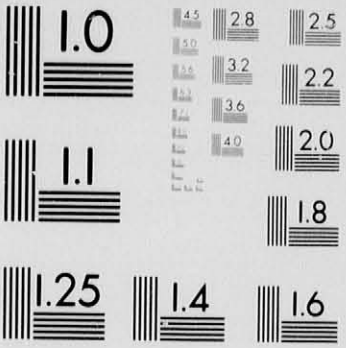
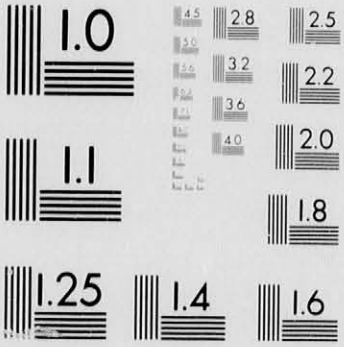
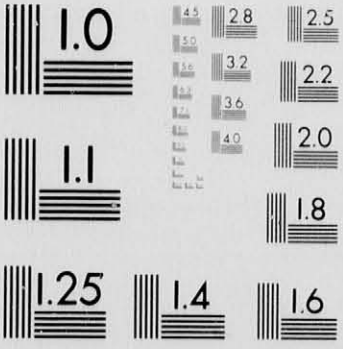
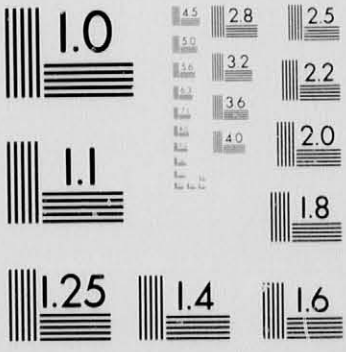
The order of the College Board examinations in subjects required or accepted by the Institute for 1905 is as follows:—

MONDAY, JUNE 18, 1906.

9.30 A.M. to 11.30 A.M.	Mathematics a, i (Algebra to Quadratics).
9.30 A.M. to 11.30 A.M.	Mathematics a, ii (Quadratics and beyond).
9.30 A.M. to 12.30 A.M.	Mathematics a, i and ii (Elementary Algebra, complete).[2]
1.30 P.M. to 3.30 P.M.	History b, d (Mediæval and Modern[1]; American).
3.45 P.M. to 5.45 P.M.	Physics; Botany.[1]

[1] Elective.

[2] See foot-note, p. 97.


1.0
1.1
1.25
1.4
1.6
2.8
2.5
3.2
2.2
3.6
2.0
4.0
1.8

1.0
1.1
1.25
1.4
1.6
2.8
2.5
3.2
2.2
3.6
2.0
4.0
1.8

1.0
1.1
1.25
1.4
1.6
2.8
2.5
3.2
2.2
3.6
2.0
4.0
1.8

1.0
1.1
1.25
1.4
1.6
2.8
2.5
3.2
2.2
3.6
2.0
4.0
1.8

1.0
1.1
1.25
1.4
1.6
2.8
2.5
3.2
2.2
3.6
2.0
4.0
1.8

TUESDAY, JUNE 19, 1906.

9.00 A.M. to 11.00 A.M. . . . . Mathematics c, d (Plane Geometry; Solid Geometry).
9.00 A.M. to 12 M. . . . . Mathematics c and d (Plane and Solid Geometry).
1.30 P.M. to 3.30 P.M. . . . . History a c (Ancient History; English History[1]).
3.45 P.M. to 5.45 P.M. . . . . German a (Elementary).

WEDNESDAY, JUNE 20, 1906.

9.00 A.M. to 10.30 A.M. . . . . Latin b (Cæsar).[1]
1.30 P.M. to 3.30 P.M. . . . . French a (Elementary).
3.45 P.M. to 5.45 P.M. . . . . German b (Intermediate).[1]

THURSDAY, JUNE 21, 1906.

11.15 A.M. to 12.30 P.M. . . . . Latin a (Grammar and Composition).[1]
3.45 P.M. to 5.45 P.M. . . . . French b (Intermediate).[1]

FRIDAY, JUNE 22, 1906.

9.00 A.M. to 11.00 A.M. . . . . English a (Reading).
1.30 A.M. to 3.30 P.M. . . . . English b (Study).
3.45 P.M. to 5.45 P.M. . . . . Chemistry.[1]

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 a, i (Algebra to Quadratics).
ALGEBRA B.	MATHEMATICS a, ii (Quadratics and beyond).[2]
ENGLISH.	ENGLISH a and b.
FRENCH.	FRENCH a (Elementary).
GEOMETRY, PLANE.	MATHEMATICS c (Plane Geometry).
GEOMETRY, SOLID.	MATHEMATICS d (Solid Geometry).
GERMAN.	GERMAN a (Elementary).
HISTORY.	HISTORY a or d.
PHYSICS.	PHYSICS.
ELECTIVE.	HISTORY b or c, LATIN a and b (or equivalent). FRENCH b, GERMAN b CHEMISTRY, or BOTANY.

Records below 60 will not be accepted.

Certificates covering fewer than three of the Institute requirements are accepted only for final candidates.

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

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

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.

[1] Elective.

[2] Records based on the single examination in Mathematics a i and a ii will be accepted for Algebra A only, unless the percentage is 70 or better.

It is accordingly requested that every applicant present from the principal of the school last attended a statement of the duration and extent of his work there. For statements in regard to elective certificates see page 105. For the required certificates for preliminary applicants see below.

Conditions.—A candidate failing in only one or two of the examination subjects may be admitted with "conditions." Conditions incurred in June must be made up in September; those incurred in September must be made up in January.

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 seven subjects, but he will not be entitled to a record for any unless he presents a certificate from his teacher stating that he is qualified in the subjects in which he is examined, and unless he passes at least three (or two in addition to the elective).

Algebra.	Plane Geometry.	Physics.
History.	French.	German.
	English.	

Preliminary candidates are advised not to offer English or the second part of Algebra (see page 100), and Algebra B, if taken, will not be counted as an additional 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 (or two in addition to the elective).

SUBJECTS FOR EXAMINATION.

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

Algebra.	French I.
Plane Geometry.	German I.
Solid Geometry.	English.
Physics.	History.

He must also present satisfactory evidence of preparation in one of the following Electives:—

French or German (additional).	Chemistry.
Latin.	Mechanical Drawing and Mechanic Arts.
English (additional).	Biology.
History (additional).	

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.

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. The use of graphical methods and illustrations, particularly 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. 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, and should be carefully guarded against the tendency to become mechanical in their algebraic work from giving disproportionate attention to mere dexterity in the solution of problems.

French I.—The examination in French is given in two parts, which, however, may not be taken separately. (*a*) Ability to translate simple prose at sight into clear and idiomatic English.

(*b*) Proficiency in elementary Grammar, to be tested by the translation of easy English into French, or by direct questioning on the following topics, or by both: inflection of nouns and adjectives for gender and number, excepting unusual cases; pronominal adjectives; the forms and positions of pronouns, especially the personals; the partitive constructions; the uses of articles; the conjugation of the regular and of the more common irregular verbs, such as *aller*, *dire*, *faire*, and of the classes represented by *ouvrir*, *sentir*, *venir*, *paraître*, *conduire*, and *craindre*. Special attention will be given to the verbs.

NOTE.—Attention should be given from the beginning to the correct pronunciation of the Modern Languages, and teachers in preparatory schools are advised to give this important subject all due consideration.

German I.—The examination in German is given in two parts, which, however, may not be taken separately. (*a*) Ability to translate simple prose at sight into clear and idiomatic English.

(*b*) Proficiency in elementary Grammar, to be tested by the translation of easy English into German or by direct question-

ing on the following topics, or by both: the conjugation of the weak, and of the more usual strong verbs; declension of readily classified nouns, of adjectives, articles, pronouns; comparison of adjectives; 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.

Provision will be made for applicants prepared to pass examinations for advanced standing in French or German.

English.—The examination in English will be as far as possible a test of the candidate's ability to express himself in writing in a manner at once clear and accurate, and of his power to distinguish in a broad sense literary values,—the qualities which mark a work as being Literature. The examination is not divided.

1. The candidate will be required to write upon subjects familiar to him. His composition should be correct in spelling, punctuation, grammar, idiom, and division into paragraphs, and should be plain and natural in style. He will be judged by how well he writes rather than by how much he writes.

2. The candidate is required to have some acquaintance with good Literature. The books adopted by the Commission of Colleges in New England are taught in most secondary schools, and the candidate may, if convenient, use these in his preparation. Any course of equivalent amount, if made up of standard works, will be received; and in any case it is expected that the aim of preparatory study will be to gain a clear perception of what qualities make a work Literature. The examination will be intended as a test rather of the candidate's power of intelligent appreciation than of his knowledge of specific books.

For the convenience of those who may wish to use it the list issued by the Commission of Colleges is given.

The books are divided into two classes.[1] It is the intention of the Commission that those marked (a) shall be read, and

[1] These books may all be had in an inexpensive form. A list of publishers and prices will be sent upon application to the Secretary of the Institute.

the candidate required to show a general knowledge of their subject-matter and of the lives of the authors: that those marked (b) shall be studied thoroughly, so that the candidate shall be able to pass an examination upon their subject-matter and structure.

For **1906, 1907, 1908**: (*a*) Shakespeare's Macbeth and The Merchant of Venice; the Sir Roger de Coverley Papers in The Spectator; Irving's Life of Goldsmith; Coleridge's The Ancient Mariner; Scott's Ivanhoe and The Lady of the Lake; Tennyson's Gareth and Lynette, Lancelot and Elaine, and the Passing of Arthur; Lowell's The Vision of Sir Launfal; George Eliot's Silas Marner.

(*b*) Shakespeare's Julius Cæsar; Milton's L'Allegro, Il Penseroso, Comus, and Lycidas; Burke's Speech on Conciliation with America; Macaulay's Essay on Addison, and Life of Johnson.

NOTE.—It is expected that the paper in History and the translations from French and German 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.

For United States History, either Johnston's High Schoo History of the United States or McLaughlin's History of the American Nation will suggest a satisfactory amount of preparation; for Ancient History, either Botsford's History of Greece or Myers's History of Greece, and either Botsford's History of Rome or Myers's Rome, its Rise and Fall, may serve to indicate the ground covered by the examination.

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 use of judgment on the pupil's part, rather than the mere use of memory. 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, among which may be mentioned those of Wentworth and Hill, Carhart and Chute, Gage, Hall and Bergen. 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.

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.

ELECTIVE SUBJECTS.

The object of the elective requirements is to secure and to recognize greater breadth of preparatory training.

These requirements are to be met by the presentation of certificates made out on forms supplied by the Institute; but an applicant passing an examination for advanced standing in any subject included in the list of electives need not present a certificate.

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, German, 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 Chemical or Chemical Engineering Courses are advised to present Chemistry as an elective subject if practicable. Further information in regard to substitutes for work thus anticipated may be found in the special circular on Alternative Studies, which may be obtained on application to the Secretary of the Faculty.

Elective French or German.[2]— (*a*) Additional French: translation from English into French; review of Grammar, with

[1] See footnote, page 135.

[2] In addition to the uniform requirements stated on page 101.

special reference to the syntax of verbs (modes and tenses); additional and more varied reading.

(*b*) Additional German: translation from English into German; review of Grammar; additional and more varied reading.

The additional reading in French and German may be selected from the list of works read in the Institute classes, but no requirement of particular text-books is intended. Lists may be obtained on application to the Secretary of the Faculty. Applicants passing advanced standing examinations in French or German may count these examinations for the elective.

Elective Latin.—Satisfactory evidence should be presented that the applicant has acquired the elements of Latin Grammar and that he has read four books of Cæsar or an equivalent.

The study of Latin is strongly recommended to persons who purpose to enter the Institute, since in addition to its disciplinary value it gives a better understanding of the various terms used in science, and greatly facilitates the acquisition of the Modern Languages.

Elective English or History.[1]—The work of secondary schools differs 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 102 to 104 may present for approval as his elective a statement of the amount and kind of work done. Such a course can be considered, however, only when the amount of work done in excess of the ordinary requirement has been in time equivalent to the requirement in Latin.

Elective Chemistry.—Applicants must present evidence of familiarity with the rudiments of Chemistry. More impor-

[1] In addition to the uniform requirements stated on pages 102–104.

tance 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 both Inorganic Chemistry and Elementary Qualitative Analysis may substitute more advanced work for the entire Chemistry of the first year.

Elective Mechanical Drawing and Mechanic Arts.—These subjects are to be offered in combination.

In Mechanical Drawing, the applicant must be familiar with the projections of points, lines, planes, and simple solids. Special attention is called to the importance of neatness and accuracy, and to facility in lettering and dimensioning drawings. Plates should be presented, showing the ground covered by the applicant. Applicants are advised in general not to offer Mechanical Drawing and Descriptive Geometry with a view to omitting the course at the Institute.

In Mechanic Arts, the applicant 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.

To be admitted as a regular student in the second, third, or fourth year, the applicant must have attained the age of eighteen, nineteen, or twenty years, respectively, and must in general 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 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 2. (See pages 99 to 104 and pages 36 to 73.)

Graduates of colleges are admitted to the Institute without the usual entrance examination, 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 as regular students, 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 36 to 73, and to the description of Subjects of Instruction, pages 112 to 274. 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 highly desirable that they be familiar with Mechanical Drawing and Descriptive Geometry. For admission to third-year

engineering work, they must be prepared in Mathematics through the Calculus, in Mechanical Drawing, and in Descriptive Geometry. Summer courses of appropriate scope are offered in these subjects. (See page 74.) Applicants desiring excuse from any portion of the physical laboratory work should present their original laboratory records. Those desiring excuse from Mechanical, or Freehand Drawing should submit examples of their work.

Graduates from other technical schools and colleges who have the equivalent of all the other engineering work of the Course in Naval Architecture may take the strictly professional work of that Course, together with Marine Engineering, in one year.

A special circular in regard to Opportunities for College Graduates will be mailed on application, and persons desiring admission with advanced standing are invited to correspond with the Secretary of the Faculty.

ADMISSION OF SPECIAL STUDENTS.

To be admitted to one or more selected subjects in any of the regular Courses,—that is, to a partial or special course,—the applicant must have attained the age of seventeen years, and must give satisfactory evidence, by examination or otherwise, that he is qualified to pursue with advantage the subjects chosen.

By means of the description of Subjects of Instruction, pages 112 to 274, 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 proved his satisfactory knowledge of all subjects required as preparation for it. For requirements regarding special students in Architecture, see page 48.

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.

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 thirteen 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 obtaining 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 for convenience of reference in consulting the various Course Schedules, pages 36 to 73, and the Alphabetical Subject Index, pages 114 to 119. 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 558) is taken 150 hours per term in Course V., Option 5, 145 hours per term in Course VIII., 120 hours per term in Course X., etc. In the above mentioned Course Schedules, however, the number of hours of exercise in each subject is given, while in the Subject Index, pages 114 to 119, both the hours of exercise and the hours of preparation are 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 70 (Applied Mechanics) are 35 and 770; that for 35 is 34; that for 34 is 28; those for 28 are 20 and 23; those for 20 and 23 are 1, 2 and 5 (Algebra, Plane Geometry, and Solid Geometry required for admission, page 99); the requirement for 770 is 28 (or 27, which, again, depends upon 20 and 23). So that to take up 70, Applied Mechanics, the applicant must be prepared to pass, or must have passed, examinations in 20, 23, 28, 34, 35, 770 and in 1, 2, and 5. The reason for this is that in subject 70 use is made of all the subjects referred to; and, to carry on the work, the student must have had suitable training in all of them.

By a 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 special student applies is always subject to the approval of the Faculty.

ALPHABETICAL SUBJECT INDEX.

FIRST TERM.

Numbers immediately following the subjects refer to the Subjects of Instruction, pages 121 to 274.
Numbers 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 823 (2)	30–	—
Acoustics 824 (4)	5–	5
Æsthetics 165 (G)	30–	00
Air, Water & Food Anal. 565 (3)	90–	0
Algebra 20 (1)	30–	60
Analytical Mechanics II 96 (4)	45–	90
Anthropology 720 (3)	15–	15
Applied Chemistry 634 (4)	30–	50
Applied Mechanics 90 (3) (I, XI)	60–	120
Applied Mechanics 70 (3) (II, X, XIII)	30–	60
Applied Mechanics 72 (3) (III, VI)	20–	40
Applied Mechanics 74 ($IV_{1,2}$) (3)	40–	80
Applied Mechanics 80 (4)	45–	90
Applied Mechanics 82 (4) VI	24–	48
Applied Mechanics 85 (4) (IV_1)	20–	40
Applied Mechanics 86 (4) (IV_2)	45–	90
Architectural History 490 (2)	15–	15
Architectural History 491 (3)	30–	60
Architectural History: Research 492 (G)		
Assaying 432 (3) III_1	60–	15
Assaying 432 (3) III_3	60–	0
Astronomy 309 (4)	15–	30
Astronomy, Descriptive 819 (4)	30–	15
Bacteriology 744 (3)	75–	45
Bacteriology of Water & Sewage 748 (4)	30–	15
Biology, General 701 (2, 3) (XI, 15–0)	15–	15
Biology, General 700 (2)	75–	15
Blowpipe Assay, 430 (2)	30–	0
Bridge Design 355 (4)	90–	0
Bridge Design 356 (4)	60–	0
Building Stones 803 (4)	30–	15
Calculating Machines 836 (E)	7–	
Calculus, Advanced and Geometry 36 (3)	60–	120
Carpentry & Wood Turning 120 (2, 4)	60–	0
Chemical Resistance of Materials 636 (4)	15–	
Chemistry of Water and Sewage 568 (4)	15–	15
Chipping and Filing (cont.) 130 (4)	30–	0
Comparative Anatomy 717 (3)	120–	60
Comparative National Government (209) (E) (3)	15–	30
Comparative Physiology 727 (4)	90–	90
Composition in Rendering 517 (G)	15–	0
Constructive Design 532 (4)	56–	9
Constructive Design, Advanced 533 (G)		
Crystallography, Geometry and Physics		
Crystallography 841 (2)	15–	15
Curves and Earthwork 312 (3)	30–	45
Descriptive Geometry and Mechanical Drawing 100 (1)	90–	0
Descriptive Geometry 107 (2) (I, 60–0)	45–	0
Design I 526 (2)	120–	0
Design II 527 (3)	120–	0
Design III 528 (4)	285–	0
Design (Architectural, Advanced) 529 (G)		
Design of Stations and Distribution Systems 679 (G)		
Determinants 39 (2)	15–	30
Differential Calculus 34 (2)	45–	90
Differential and Integral Calculus 31 (2)	45–	90
Diff. Equations 43 (3) ($VIII_1$ 45–60)	45–	75
Differential Equations, Elementary 42 (3)	30–	60
Differential Equations, Partial 60 (E)	30–	60
Diffraction, Theory of 811 (E)		
Direct Current Generators 654	30–	30
Drawing and Machine Design 405 (G)	60–	0
Drawing Design 380 (4)	20–	
Dynamics of Machines 401 (4) (XIII 20–40)	25–	50
Dynamics of Machines 402 (4) X	15–	30
Dynamo Design 667 (4)	20–	20
Dynamo Design 668 (G)	15–	
Dynamo-electric Machinery 662 (4)	25–	0
Dynamo-electric Machinery 661 (3)	30–	30
Economic Geology 859 (3) III_1	60–	15
Economic Geology 859 (3) III_3	60–	0
Economic Geology 859 (3) XII	60–	30
Economic Geology 860 (4)	60–	30
Economic History 191 (E)	15–	30
Electrical Engineering, Elements of 653 (3)	30–	15
Electrical Engineering 657 (4)	30–	30
Electrical Engineering 658 (G)	30–	30
Elect. Eng. Lab. 693 (4)	50–	50
Electrical Engineering Lab. 694 (G)	45–	45
Electrical Engineering Lab. 694 (4)	30–	30
Electrical Engineering Laboratory 696 (G)	75–	
Electrical Laboratory 779 (3)	15–	15
Electrical Measurements 687 (G)	75–	
Elect. Measuring Instruments 685 (4)	20–	20
Electrical Measuring Instruments 778 (3)	10–	10
Electrical Testing 689 (G)	30–	30
Elect. Testing Lab. 686 (4) V	80–	105
Elect. Testing Lab. 686 (4) $VIII_{1,2}$	45–	35
Elect. Testing Lab. 686 (4) $VIII_3$	15–	15
Electro-chem. Lab. 799 (4) (V_3, 90–25)	105–	
Electro-Chemistry 796 (4) V	30–	60
Electro-Chemistry 796 (4) VIII	30–	45
Engineering Laboratory 396	50–	25
Engineering Laboratory 397 (4) II, XIII	60–	30
Engineering Laboratory 397 (4) VI	45–	23
Engineering Laboratory 397 (4) X	50–	25
English 140 (1)	30–	30
English Composition, Adv. 143 (E) (3)	15–	30
English Literature of 18th Century 156 (E) (3)	30–	15
English Literature 150 (2, 3) I, 30–30	15–	5
English Literature 150 (2, 3) XI, 30–20		

Subject.	Hours Ex.	Prep.
European Civilization and Art I 180 (4)	60–	60
European Civilization and Art II, 181 (G)	30–	60
European History 173 (2) (I, 30–30)	30–	10
Experimental Geology 865 (4)	30–	30
Field Geology 869 (3)	15–	0
Field Geology, Advanced 873 (4)	90–	0
Forging 127 (2, 3)	60–	0
Foundations 349 (4)	15–	15
Fourier's Series 52 (4)	30–	60
Freehand Drawing 110 (1)	15–	0
Freehand Drawing 116 (2) (XII, 75–0)	60–	0
Freehand Drawing 117 (3)	60–	0
French I 220 (1)	45–	—
French II 221	45–	90
French III 222 (E) (3)	15–	30
French Sight Reading 228 (E) (3)	45–	0
Gas Analysis 638 (3, 4)	20–	10
Gas and Fuel Analysis 639 (4)	8–	
Geodesy 310 (4)	15–	15
Geological Surveying 871 (3, 4) { XII$_1$	55–	0
Geological Surveying 871 (3, 4) { XII$_2$	60–	30
Geology, Applied and Reports 806 (4)		
Geology, General 856 (2, 3) (III, XII, 45–15)	30–	15
Geology, Glacial 863 (4)	15–	15
Geology, Struct. 857 (3)	30–	15
German I 230 (1)	45–	—
German II 231 (1, 2, 3)	45–	90
German III 232 (E) (3)	15–	30
German, Sight-reading 238 (E) (3)	45–	0
Heating and Ventilation 413 (3)	45–	45
Heating and Ventilation 414 (4)	15–	0
Heating and Ventilation 415 (3) XI	30–	30
Heating and Ventilation 416 XIII A	15–	15
Heating & Ventil. Eng. 423 (4)	30–	55
Heat Meas'ts 781 (4) { III	30–	0
Heat Meas'ts 781 (4) { VIII, XIII$_A$	30–	30
Heat Meas'ts 781 (4) { X	60–	30
History of Construction 486 (3, 4)	15–	15
History of Science 761 (4) (E)	30–	15
History of Ornament 495 (3, 4)	15–	45
Horticulture 500 (2)	30–	0
Horticulture 501 (3)	60–	30
Horticulture 502 (4)	60–	0
Hydraulic Measurements 333 (4) (XII, 20–30)	20–	10
Hydraulics 330 (4) I, XI	45–	90
Hydraulics 340 XIII A	15–	30
Hydraulics 331 (4)	15–	30
Hydraulics 332 VI (4)	30–	45
Hydrodynamics (page 127)	5–	5
Hygiene of Ventilation 758 (4)	15–	30
Hygiology 757 (4)	60–	15
Industrial Biology 746 (4)	90–	0
Industrial Chemical Laboratory 582 (3)	45–	45
Industrial Chemistry 580 (3)	15–	15
Industrial Electricity (663) (3, 4)	105–	90
Inorganic Chemistry 550 (1)	15–	30
International Law 201 (E) (3)	30–	60
Italian 248 (E)	60–	0
Joinery and Pattern Work 123 (2)	15–	15
Journals 764 (4)	15–	15
Laboratory Reports 437 (4) (VIII$_3$ 3– —)	15–	15
Landscape Architecture 542 (4)	210–	0
Landscape Design 541 (4)	20–	30
Least Squares 56 (3)	90–	0
Life Class 118 (4)	90–	0
Life Class and Decorative Design 119 (G)	45–	90
Light, General Theory of 808 (4)	35–	70
Locomotive Engineering 421 (4)	135–	0
Machine Design 404 (4) (X: 90–0)	90–	0
Machine Drawing 377 (3) { II, X	90–	0
Machine Drawing 377 (3) { III	40–	0
Machine Drawing 377 (3) { VI	60–	0
Machine Tool Work 132 (4)		

Subject.	Hours Ex.	Prep.
Machine Tool Work 133 (4) XIII	60–	0
Manmalian Anatomy 719 (4)	45–	30
Marine Engineering 420 (4)	35–	70
Marine Engines 913 (4)	30–	30
Materials 352 (4) I	15–	30
Mech. Eng. Drawing 372 (2) (VI, 45–0)	30–	0
Mechanical Eng. Drawing 374 { (2)	30–	0
Mechanical Eng. Drawing 374 { (3)	60–	0
Mech. Eng. Drawing 381 (4)	90–	0
Mechanism 360 (2, G) II	45–	75
Mechanism 361 (2) { III, XIII	45–	75
Mechanism 361 (2) { VI, X	30–	45
Mechanism 362 (3)	30–	60
Memoirs 465 (4)	15–	15
Metallography 452 (4)	10–	10
Metallurgical Lab. 435 (4)	120–	0
Metallurgical Laboratory 436 (4)	24–	0
Metallurgical Laboratory 438 (G)		
Metallurgy 442 (4)	30–	30
Metallurgy, Elementary 443 (4) (XII, 15–15)	20–	20
Metallurgy, General 453 (G) (E)		
Metallurgy, General 454 (G) (E)		
Metallurgy of Iron 441 (4)	15–	15
Metal Turning 134 (2)	60–	0
Metals and Alloys (G)	8–	
Microscopic Anatomy 722 (4)	45–	30
Microscopical Organisms 709 (3)	15–	0
Military Science 990 (1) { A	45–	0
Military Science 990 (1) { B	30–	15
Mill Engineering 422 (4)	35–	70
Mineralogy 840 (2)	60–	15
Mineralogy 841 (2)	60–	15
Mineralogy Adv. 842 (3, 4)	60–	15
Mining Engineering 458 (3, 4) { III$_1$ (XII)	45–	45
Mining Engineering 458 (3, 4) { III$_3$	45–	30
Mining Engineering 459 (4)	30–	15
Municipal Laboratory Methods 755 (4)	30–	15
Naval Architecture 901 (3)	30–	45
Naval Architecture 902 (4)	30–	60
Naval Architecture 903 (G)	20–	40
Oil Testing 628 (4)	25–	5
Optical Measurements 807 (3)	30–	
Ore-dressing 462 (G)	30–	
Organic Analysis 596 (4)	75–	5
Org. Chem. Lab. 599 (4) { VII	120–	15
Org. Chem. Lab. 599 (4) { VIII$_1$	90–	0
Org. Chem. Lab. 599 (4) { X	90–	0
Org. Chem. 590 (2, 3) { VII, VIII$_{1,2}$, X	30–	30
Org. Chem. 590 (2, 3) { XI	30–	30
Org. Chemistry 592 (4)	45–	45
Organic Chemistry 593 (E)	15–	
Organic Compounds 594 (E)	30–	
Organic Laboratory, Adv. 600 (E)		
Organic Preparations 598 { V$_{1,2,3,5}$	195–	15
Organic Preparations 598 { V$_4$	135–	15
Oxidation and Reduction (G)		
Paleontology, Adv. 884 (4)		
Paleontology, Struct. 878 (3)	45–	30
Pen and Ink 516 (4)	15–	0
Periodic Currents 650 (4)	30–	30
Petrography 843 (4)	60–	15
Physical Colloquium 838 (4)	—–	30
Physical Laboratory 773 (3) (Partial) { II, XIII	15–	10
Physical Laboratory 773 (3) (Partial) { III	20–	20
Physical Laboratory 774 (3) (I, V, VI, VII, VIII, XI)	15–	10
Physical Laboratory 773, 774 (3) (X, XII)	30–	30
Physical Properties of Chemical Substances (G)		
Physico-chemical Research Reports and Reviews (G)		
Physics 770 (2) { 45 } –60 { 30 }		
Physics 771 (3) (Heat)	15–	20
Physiological Laboratory 728 (4)	30–	15

Subject.	Hours Ex.	Hours Prep.
Physiology and Personal Hygiene 726 (E)	30–	
Pipe Fitting 139 (4)	30–	0
Plant Physiology 738 (4)	30–	30
Political Economy 190 (3, 4)	45–	45
Precision of Measurements 772 (3)	15–	—
Propagation of Electric Waves 790 (E) (4)	15–	30
Proximate Technical Analysis 629 (4)	90–	30
Qualitative Analysis 552 (2) $III_{1,3}$	105–	15
Qualitative Analysis 552 (2) $V_{2,3,5}$	165–	15
Qualitative Analysis 552 (2) VII, X	150–	15
Qualitative Analysis 552 (2) III_2, $VIII_1$	135–	15
Qualitative Analysis 552 (2) $VIII_2$	90–	15
Qualitative Analysis 552 (2) $VIII_3$	105–	15
Qualitative Analysis 552 (2) XI	60–	15
Qualitative Analysis 552 (2) XII	105–	15
Qualitative Analysis of Rare Metals 553 (G)		
Quantitative Analysis 559 (3, 4) $III_{1,3}$ (3)	90–	15
Quantitative Analysis 559 (3, 4) III_2 (3)	120–	15
Quantitative Analysis 559 (3, 4) III (4)	150–	45
Quantitative Analysis 559 (3, 4) V_1	240–	45
Quantitative Analysis 559 (3, 4) $V_{2,3}$	210–	45
Quantitative Analysis 559 (3, 4) $V_{4,5}$	255–	45
Quantitative Analysis 559 (3, 4) $VIII_1$	85–	0
Quantitative Analysis 559 (3, 4) $VIII_3$	60–	0
Quantitative Analysis 559 (3, 4) XII	120–	45
R.R. Design 321 (4)	75–	0
R.R. Drawing & Fieldwork 315 (3) I	60–	0
R.R. Drawing & Fieldwork 315 (3) XI	30–	0
Railroad Engineering 313 (3) I	30–	60
Railroad Engineering 313 (3) XI	20–	40
R.R. Engineering 319 (4)	30–	60
Sanitary & Hydraulic Engineering 334 (4)	45–	45
Sanitary Engineering 336 (4)	30–	45
Shades and Shadows 470 (2)	15–	30
Ship Construction 900 (3)	30–	15
Ship Design 911 (4)	105–	0
Ship Drawing 910 (3)	90–	0
Spanish I 240 (E)	30–	15
Spanish II 241 (E)	30–	60
Spanish III 242 (E)	30–	60
Special Composition 141		
Spec. & Work. Drawing 480 (2)	45–	0
Spec. & Work. Drawing 483 (4)	30–	35

Subject.	Hours Ex.	Hours Prep.
Spherical Trigonometry 24 (2, 3)	10–	20
Steam Eng. 385 (3, 4) (VI, 30–60)	45–	90
Steam Engineering 386 XIII A	30–	30
Steam Engineering 386 (4, G)	15–	30
Steam Engineering 387 (4)	30–	60
Stereotomy 325 (3)	60–	0
Stereotomy 472 (3)	30–	15
Structural Design 539 (4)	285–	0
Structures 348 (4)	45–	90
Structures 351 (4) (IV_2)	45–	90
Structures 347 (G)	60–	60
Sugar Analysis 573 (3)	20–	10
Surveying and Plotting 300 (2, 3) (IV_3, 60–15)	90–	15
Surveying, Adv. 303 (3, 4)	30–	0
Surveying, 304 (4)	16–	0
Technical Chemistry 635 (3)	30–	30
Technical Electrical Measurements 685 (4)	20–	20
Textile Coloring 630 (4) (V, 90–30)	90–	0
Theoretical Biology 704 (4)	30–	30
Theoretical Chemistry Laboratory (1) 619 (4)	30–	0
Theoretical Chemistry 610, 611 (4)	45–	75
Theoretical Chemistry 611 (3, 4) (V, 30–45)	30–	60
Theoretical Chemistry Advanced 620	15–	30
Theo. Elect. 787 (3)	45–	60
Theoretical Electricity 652 (G)	45–	90
Theory of Warship Design 915 (3)	30–	30
Theory of Warship Design 916 (4)	30–	30
Theory of Warship Design 917 (G)	30–	30
Topographical Geology 874 (3, 4) (XII, 30–30)	30–	15
Topographical Drawing 302 (3)	30–	
Trigonometry 23 (1)	30–	60
Valve Gears 369 (3) See Thermodynamics		
Valve Gears 370 & Drawing 381 (4)	120–	0
Vital and Sanitary Statistics 198 (4)	30–	30
Warship Design 920 (3)	120–	
Warship Design 921 (4)	90–	
Warship Design 922 (G)	90–	
Water Analysis 568 (4)	15–	30
Water Color 520 (4)	30–	0
Zymology 747 (4)	15–	30

ALPHABETICAL SUBJECT INDEX.

SECOND TERM.

Numbers immediately following the subjects refer to the Subjects of Instruction, pages 121 to 274.
Numbers 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.
Air Analysis 569 (4)	15–	15
Alt. Cur. Machinery, Theory of 651 (4 G) ($VIII_3$, 30–60)	30–	30
Analytical Mechanics 95 (3) I	45–	90
Analytical Mechanics 96 (4) II	45–	90
Analytic Geometry, Elem. 27 (1)	45–	90
Analytic Geometry 28 (1)	60–	120
Applied Chemistry 634 (4)	30–	30
Applied Electro-chemistry 707 (4)	20–	40
Applied Geology and Reports 896 (4)	15–	30
Applied Mechanics 91 (3) (I, XI)	50–	100
Applied Mechanics 73 (3) (III. VI)	45–	90
Applied Mechanics 71 (3) { III. X, XIII / XIIIA	45– / 30–	90 / 60
Applied Mechanics 75 (3) { IV_1 / IV_2	45– / 52–	90 / 132
Applied Mechanics 81 (4)	45–	90
Applied Mechanics (Laboratory) 87 (4)	14–	7
Architectural History 490 (2)	15–	15
Architectural History 491 (3)	30–	30
Architectural History: Special Research 492 (G)		
Assaying 432 (3) V_4. XII (III_2 60–15)	60–	5
Assaying 433 { $V_{1,2,3,5}$ / $VIII_3$	30– / 30–	5 / 5
Astronomy 308 (3)	30–	45
Bacteriology 744 (3) (XI, 60–0)	60–	30
Banking and Finance 105 (E) (3)	45–	30
Boiler Drawing 379 (3)	30–	0
Botany, Cryptogamic 735 (2)	90–	40
Botany, Elementary 734 (2) (IV)	30–	15
Botany, General 733 (2)	15–	0
Bridge Design 355 (4)	90–	0
Building Construction 485	15–	0
Building Stones 892 (3, 4)	30–	15
Building Stones 895 (3)	15–	15
Business Law 200 (3, 4)	15–	15
Business Relations 488 (4)	15–	0
Chemistry or Physics (Adv.) 832 (4)	90–	—
Chipping and Filing 130 (2, 3)	40–	0
Civil Engineering Drawing. See Survey (2)		
Colonial Systems 175 (E) (3)	30–	45
Color 814 (4)	5–	5
Comparative Physiology 727 (4)	75–	60
Composition in Rendering 517 (G)	15–	0
Constitution Inorganic Substances (G)	25–	30
Constructive Design, Advanced 533 (E).	120–	
Contemporary Literature 158 (E) (3)	45–	30
Descriptive Geom. & Mech. Draw. 101 (1)	90–	0
Descriptive Geom. & Mech. Draw. 103 (1)	135–	15
Design (Architectural) 526 (2)	120–	0
Design (Architectural) (3) IV_1 527	225–	0
Design (Architectural) 528 (4)	370–	0
Design (Architectural Advanced) 529 (G)	—	—

Subject.	Hours Ex.	Hours Prep.
Differential Equations 44	30–	60
Differential Equations, Partial 60 (E)	30–	60
Distillation of Fuels 449 (G)	6–	—
Drawing and Machine Design 405 (G)	90–	0
Dynamo Electric Machinery 664 (4)	30–	0
Economics of Corporations 193 (4)	15–	15
Electrical & Heat Measurements 782 (3, 4)	30–	30
Electrical Discharge in Gases 816	10–	
Electrical Engineering 683 (3)	30–	30
Electrical Engineering 680 (G)	30–	30
Electrical Measurements 782 (3)	15–	15
Electrical Engineering 657 (4) { VI / VIII	45– / 30–	45 / 30
Electrical Engin. Laboratory 690 (3)	30–	15
Electrical Engin. Laboratory 691 (4)	45–	45
Electrical Engineering Laboratory 692 (3)	45–	45
Electrical Engineering Laboratory 693 (4)	25–	25
Electrical Engin. Laboratory (4)	30–	30
Electrical Engin. Laboratory 694 (G)	60–	60
Electrical Engineering Laboratory 696 (G)	75–	
Electrical Laboratory 779 (3) { VI / $VIII_{1,2}$ / $VIII_3$	25– / 45– / 45–	25 / 45 / 30
Electrical Measuring Insts. 778 (3) ($VIII_{1,2}$)	15–	15
Electric Railroads 678 (4)	10–	10
Electricity 792 (G)	60–	—
Electro-chemical Laboratory 800 (4)	45–	30
Electro-chemistry 613 (4)	15–	15
Electro-metallurgy 446 (4)	15–	15
Elements of Engineering 391 (4)	30–	30
Embryology 717 (3)	75–	45
Energetics 829 (4) (V_5 30–30)	30–	60
Engineering Lab. 396 (3)	15–	7
Engineering Laboratory 397 (4) (VI. 45–22)	60–	30
Engineering Laboratory 398 (4) (III_2)	60–	30
English 140 (1)	30–	0
English Literature 150 (2)	30–	30
English Literature of 19th Century 157(E)(3)	45–	30
European Civilization and Art 180 (I, 4)	45–	75
European Civilization and Art II. 181 (G)	30–	60
European Civilization and Art in its most famous Epochs 182 (E)	30–	45
Field Geology 870 (2, 3)	20–	10
Field Geology Adv. 873 (4)	90–	
Field-work and Drawing 316 (3)	45–	0
Food Analysis, Advanced 649 (E)	90–	0
Forging 127 (2, 3)	50–	0
Forging 128 (3, 4)	45–	0
Foundations 407 (4) (XIIIA 10–20)	15–	30
Foundry 125 (2)	30–	0
Fourier's Series 52 (4)	30–	60
Freehand Drawing 111 (1)	30–	0
Freehand Drawing 112 (1)	45–	0

Subject.	Hours Ex. Prep.
Freehand Drawing 116 (2)	60– 0
Freehand Drawing 117 (3)	60– 0
French I 220 (1)	45– —
French II 221 (1)	45– 90
French III 222 (E) (3)	15– 30
French Sight Reading 228 (E) (3)	30– 0
Gas Analysis 638 (3, 4)	20– 10
Geodesy 310 (4)	15– 15
Geological Surveying 871 (3)	60– 15
Geological Surveying 871 (4)	60– 30
Geology, Dynamical 855 (2) (XI, 30–0)	30– 15
Geology, Economic 889 (3, 4)	60– 30
Geology of N. A. 890 (4)	90– 45
Geology, Experimental 865 (4)	45– 0
Geology, Historical 880 (3) XII_1	90– 30
Geology, Historical 880 (3) XII_2 (Lab.)	60– 30
Geology (Struct. & Strat.) 858 (2) (III, XII 60–15)	45– 30
Geology, Structural 857 (2) (I, XI, 30–0)	30– 15
German I 230 (1)	45– —
German II 231 (1, 2, 3)	45– 90
German III 232 (E) (3)	15– 30
German Sight Reading 238 (E) (3)	30– 0
Heating and Ventilation 413 (3) (IV_2)	30– 15
Heating and Ventilation Eng. 423 (4)	45– 90
Heat Measurements 781 (3)	30– 15
Highway Engineering 314 (3)	15– 15
History of Chemistry 645 (4)	15– 30
History of Ornament 495 (4)	10– 30
Horticulture 500 (2)	30– 00
Horticulture 501 (3)	60– 30
Horticulture 502 (4)	60– 0
Hydraulic Engineering 335 (4)	45– 90
Hydraulic Lab. 342 (4) (I, XI)	15– 5
Hydraulic Machinery 339 (4)	30– 60
Hydraulic Motors 338 (4)	30– 60
Hydrodynamics (page 127)	
Hygiology 757 (4)	15–
Indust. Chemical Lab. 582 (X (3))	105– 15
Indust. Chemical Lab. 582 (V (3))	90– 0
Indust. Chemical Lab. 582 (VIII (4))	75– 15
Industrial Chemistry 580 (3, 4)	45– 45
Industrial Chemistry, Advanced 581	
Industrial Management 409 (4)	10– 20
Inorganic Chemistry 551 (1) (V, VII 150–60) ($VIII_{1,2}$ 135–60)	105– 60
Inorganic Chemistry 561 (3)	30– 30
Inorganic Chemistry, Adv. 623 (G)	15– 60
Integral Calculus 35 (2)	45– 90
Joinery and Pattern Work 123 (2)	60– 0
Journals 764 (4)	15– 15
Kinetic Theory of Gases 830	15– 30
Labor Problems 196 (E) (3)	45– 30
Laboratory Reports 437 (4)	15– 15
Landscape Architecture 542 (4)	15– 15
Landscape Design 540 (3)	105– 0
Landscape Design 541 (4)	275– 15
Life Class 118 (4)	90– 0
Life Class and Decorative Design 119 (G)	90– 0
Light, Electro-magnetic, Theory of 810 (4)	30–
Locomotive Construction 421 (4)	40– 80
Machine Drawing 377 (3) VI	20– 0
Machine Drawing 377 (3) XIII	45– 0
Machine-tool Work 132 (4)	90– 0
Machine-tool Work 133 (4) XIII	60– 0
Marine Engineering 420 (4)	40– 80
Marine Engines 913 (4 G)	90– 45
Mech. Eng. Draw. 373 (2, 3) II	90– 0
Mech. Eng. Draw. 373 (2, 3) III_2	45– 00
Mech. Eng. Draw. 373 (2, 3) V	30– 0
Mech. Eng. Draw. 373 (2, 3) VI	15– 0
Mech. Eng. Draw. 373 (2, 3) X	30– 0
Mech. Eng. Draw. 373 (2, 3) XIII	75– 0

Subject.	Hours Ex. Prep.
Mech. Eng. Draw. 378 (3) II	38– 0
Mech. Eng. Draw. 378 (3) X	30– 0
Mechanism 364 (3)	30– 60
Mechanism 360 & Valve Gears 369 (2)	45– 90
Mechanism 361 & Valve Gears 369 (2) (III_2, VI, X, XIII)	30– 60
Memoirs 465 (4)	15– 15
Metal Turning 134 (2)	60– 0
Metal Turning 135 (3, 4)	30– 0
Metallurgical Laboratory 435 (4) Thesis	180–30
Metallurgical Laboratory 438 (G)	
Metallurgy 442 (4)	45– 45
Microscopical Anal. of Water and Sewage 711 (4)	30– 15
Microscopic Anatomy 722 (3)	60– 30
Microscopy, Industrial 708 (1, 2) (V, 30–15)	30– 30
Military Science 900 (1) A	45– 0
Military Science 900 (1) B	30– 15
Mill Engineering 422 (4)	40– 80
Mineralogy 840 (2)	60– 15
Mineralogy 841 III_2	30– 0
Mining Engineering 458 (3) III_1	45– 45
Mining Engineering 458 (3) III_3	45– 30
Mining Eng. (or Machinery) 452, 459 (4)	30– 30
Modelling 522 (1)	30– 0
Modelling 523 (4)	30– 0
Municipal Government 208 (E) (3)	30– 45
Municipal Laboratory Methods 755 (3)	45– 15
Municipal Sanitation 753 (4) (VII, 60–30)	30– 15
Naval Architecture 901 (3)	30– 60
Naval Architecture 902 (4)	30– 60
Naval Architecture 903 (G)	15– 30
Optical Measurements 807 (3)	30– —
Organic Chemical Laboratory 599 (3)	90– 0
Organic Chemistry 590 (3)	45– 60
Organic Chemistry 592 (4)	45– 45
Organic Compounds 593 (E)	30–
Organic Laboratory, Adv. 600	
Organic Qualitative Analysis 597 (G)	
Organization of Industry 197 (E) (3)	45– 30
Paleontology, 883 (4) (E)	30– 15
Pattern Work 122 (2)	30– 0
Pen and Ink 515 (3)	15– 0
Pen and Ink 516 (4)	15– 0
Periodic Currents 788 (3)	45– 30
Perspective 471 (3)	15– 30
Personal Hygiene 729 (4)	15– —
Petrography 843 (4)	60– 15
Photography 815 (4)	15– 0
Physical Colloquium 838 (4)	15– 15
Physical Laboratory 773 (2) I, XI, 30–30 / V, 30–20	30–15
Physical Laboratory 773, 774 (3) (III, 30–45)	30– 30
Physical Laboratory (Advanced) 776 (3)	45– —
Physical Properties of Chemical Substances (G)	
Physico-chemical Lab. 803 (4) V_2	30– 30
Physico-chemical Lab. 803 (4) V_3	15– 15
Physico-chemical Lab. 803 (4) $VIII_{1a}$	90– 15
Physics 770 (2) 45 / 30	– 60
Polarized Light 813 (E)	30– —
Potential, Theory of 791 (4)	30– 60
Precision of Measurements 772 (2, 3)	10– 10
Principles of Scientific Investigation 837 (4)	45
Quantitative Analysis 558 (2) $III_{1,3}$	105– 15
Quantitative Analysis 558 (2) III_2 VII	120– 15
Quantitative Analysis 558 (2) $V_{2,3}$	180– 15
Quantitative Analysis 558 (2) V_5	150– 15
Quantitative Analysis 558 (2) VIII	145– 15
Quantitative Analysis 558 (2) X	120– 15
Quantitative Analysis 558 (2) XI	45– 0
Quantitative Analysis 558 (2) XII	135– 15

Subject.	Hours Ex.	Hours Prep.
Quantitative Analysis 559 (3, 4) III_1	150	15
Quantitative Analysis 559 (3, 4) III_2	90	15
Quantitative Analysis 559 (3, 4) III_3	105	15
Quantitative Analysis 559 (3, 4) V_1	225	15
Quantitative Analysis 559 (3, 4) $V_{2\cdot3\cdot5}$	210	15
Quantitative Analysis 559 (3, 4) V_4	270	15
Quantitative Analysis 559 (3, 4) $VIII_1$	90	15
Quantitative Analysis 559 (3, 4) III_1 (4)	210	75
Quantitative Analysis 559 (3, 4) III_2 (4)	150	60
R.R. Design 321 (4)	30	0
R.R. Drawing & Field-work 315 (3) I, XI	75	0
R.R. Economics 104 (E) (3)	45	30
R.R. Engineering 313 (3) (XI, 20–20)	30	30
R.R. Engineering 319 (4)	45	45
Railroad Management 320 (4)	30	30
Sanitary & Hydraulic Design 337 (4) I	30	0
Sanitary & Hydraulic Design 337 (4) XI	85	0
Sanitary Science and Public Health 754 (3, 4) (IV, 15–15)	15	0
Sanitation of Ships 756 (4)	15	15
Shades and Shadows 470 (1)	15	30
Ship Construction 900 (3)	15	0
Ship Design 911 (4)	90	0
Ship Draw. & Design 910 (3)	75	0
Spanish I. 240 (E) (3)	45	30
Spanish II. 241 (E)	30	60
Spanish III. 242 (E)	30	60
Special Composition 141		
Spec. & Work. Drawings 480 (2)	45	—
Spec. & Work. Drawings 482 (2)	45	0
Standardizing Laboratory 681 (3)	20	20
Steam Engineering 385 (3)	45	90
Steam Engineering 386 (4)	30	60
Steam Engineering 387 (4)	30	60
Structural Design 538 (3)	71	0
Structural Design 539 (4)	370	0
Structures, Theory of 345 (3) (I, XI)	30	60
Structures, Theory of 346 (3) (IV)	30	60
Structures, Theory of 348 (4)	45	90
Structures, Theory of (Adv.) 350 (4)	30	60
Structures, Theory of 351 (4) (IV)	45	90
Surveying 300 (2, 3) (III_1 IV_2 60–0)	75	15
Surveying, Adv. (3, 4)	30	0
Surveying Instruments 304 (3, 4)	14	0
Technical Chemistry (Lab.) 635 (3)	90	0
Technical Elect. Measure 685 (3)	20	20
Telegraphy, Methods of 670	15	7
Telephone Engineering 672 (4)	10	10
Telephony 671 (4)	15	15
Theoretical Biology 704 (4)	30	30
Theoretical Chemistry 610 (3)	30	45
Theoretical Chemistry 611, 612 (4)	30	45
Theoretical Chemistry 612 (3, 4)	15	30
Theoretical Chemistry 618 (2, 3, 4)	30	60
Theoretical Chemistry, Adv. 620 (4, G)	15	60
Theoretical Electricity 786 (2)	15	15
Theoretical Electricity 652 (G)	45	90
Theory of Warship Design 915 (3)	30	30
Theory of Warship Design 916 (4)	30	30
Theory of Warship Design 917 (G)	30	30
Thesis Reports 647 (4)	15	30
Topographical Drawing 302 (2, 3)	30	0
Topographical Geology 874 (3)	15	0
Topography of the U.S. 872 (3)	90	0
U.S. History 170 (1)	30	30
Valve Gears 370 (3)	15	30
Vector Analysis 46 (3)	15	30
Warship Design 920 (3)	90	
Warship Design 921 (4)	90	
Warship Design 922 (G)	90	
Water Analysis 567 (3)	30	0
Water Color 520 (3, 4)	30	0
Wave-surface and Polarization, Theory of 812		
Wood & Metal Work 137 (1)	60	0
Zoölogy 716 (2, 3) (XII 45–15)	30	15

The following subjects are the entrance requirements, full statements of which are given on pages 99 to 104:

1. ALGEBRA.
2. PLANE GEOMETRY.
3. ENGLISH.
4. HISTORY.
5. SOLID GEOMETRY.
6. FRENCH I.
7. GERMAN I.
8. PHYSICS.

INDEX TO DESCRIPTION OF SUBJECTS.

Department.	*Subject Numbers.*	*Page.*
MATHEMATICS	20–70	121
ANALYTICAL AND APPLIED MECHANICS	70–100	128
DRAWING AND DESCRIPTIVE GEOMETRY	100–120	134
MECHANIC ARTS	120–140	139
ENGLISH LANGUAGE AND LITERATURE	140–170	144
HISTORY	170–190	148
ECONOMICS	190–210	151
MODERN LANGUAGES	220–250	155
CIVIL ENGINEERING	300–360	160
MECHANICAL ENGINEERING	360–430	174
MINING ENGINEERING AND METALLURGY	430–470	187
ARCHITECTURE	470–550	194
CHEMISTRY AND CHEMICAL ENGINEERING	550–650	204
RESEARCH LABORATORY OF PHYSICAL CHEMISTRY		220
ELECTRICAL ENGINEERING	650–700	222
BIOLOGY	700–770	231
PHYSICS	770–840	243
GEOLOGY	840–900	257
NAVAL ARCHITECTURE	900–930	267
MILITARY SCIENCE	990	273

DEPARTMENT OF MATHEMATICS.

HARRY W. TYLER, PH.D.
Professor of Mathematics.

GEORGE A. OSBORNE, S.B.
Walker Professor of Mathematics.

WEBSTER WELLS, S.B.
Professor of Mathematics.

DANA P. BARTLETT, S.B.
Professor of Mathematics.

FREDERICK S. WOODS, PH.D.
Associate Professor of Mathematics.

FREDERICK H. BAILEY, A.M.
Associate Professor of Mathematics.

Instructors.

NATHAN R. GEORGE, JR., A.M.
LEONARD M. PASSANO, A.B.
BENJAMIN E. CARTER, JR., A.M.
ERNEST A. MILLER, A.M. (absent).
WILFRID E. MACDONALD, A.B.
CLARENCE L. E. MOORE, PH.D.
WILLIAM H. ROEVER, A.M.

Great importance is attached to the study of Mathematics, both as a means of mental discipline and as a necessary basis for further instruction in the engineering and other Courses. Nearly all regular students pursue mathematical courses for two full years, including Algebra, Plane Trigonometry, Plane and Solid Analytic Geometry, Differential and Integral Calculus. Care is taken to present both underlying principles and concrete applications, the latter connecting the mathematical instruction closely with the professional studies. In Analytic Geometry and Calculus the instruction is given in part by lectures, in part by recitations in small sections. The number of students in a recitation section is rarely permitted to exceed twenty-five, thus making possible individual treatment of students who require it. Students having time and interest for the study of Mathematics beyond the prescribed limits are offered opportunity for more advanced work.

20. ALGEBRA.

Professors Tyler, Woods,[1] *Bailey; Messrs. George, Passano, Carter, MacDonald, Moore, Roever.*

PREPARATION: 1; 2.

A course of two recitations a week during the first term, covering the following subjects: undetermined coefficients with applications to series and partial fractions; graphical methods in solving equations; permutations and combinations; and the elements of the theory of equations, including the solution of numerical equations by Horner's method.

[REQUIRED IN ALL COURSES.]

23. PLANE TRIGONOMETRY.

Professors Wells, Woods,[1] *Bailey; Messrs. Passano, Carter, MacDonald, Moore, Roever.*

PREPARATION: 1; 2; 5.

A course of two exercises a week during the first term, covering the following subjects: definitions of the trigonometric functions as ratios; their line representations; proofs of principal formulas; trigonometric transformations; circular measure of angles; inverse trigonometric functions; proofs of formulas of right and of oblique triangles; theory and use of logarithms; and areas and solutions of right and of oblique triangles. The course is fully illustrated by practical problems.

[REQUIRED IN ALL COURSES.]

24. SPHERICAL TRIGONOMETRY.

Mr. George.

PREPARATION: 23.

This course of ten exercises covers the proofs of formulas of right and of oblique spherical triangles, and dependent problems.

[REQUIRED IN COURSE I.]

27. ELEMENTS OF ANALYTIC GEOMETRY.

Professor Woods.

PREPARATION: 20; 23.

This course, of three exercises a week throughout the second term, includes both Plane and Solid Analytic Geometry. The subjects are, in general, the same as those of course 28, but the discussion is necessarily briefer, and is confined to the more fundamental properties of the curves and surfaces. Both rectangular and polar coördinates are used.

[REQUIRED IN COURSE V.]

[1] In charge.

28. ANALYTIC GEOMETRY.

Professors Tyler, Bartlett, Woods, Bailey[1]*; Messrs. George, Passano, Carter, MacDonald, Moore, Roever.*

PREPARATION: 20; 23.

This course, of four exercises a week throughout the second term, divided between lectures and recitations, includes both Plane and Solid Analytic Geometry.

In the Plane Geometry the equation and the plotting of the corresponding locus is first discussed in general, after which a detailed study of the following topics is made: the straight line; transformation of coördinates; the circle; the conic sections as a class of curves; general definitions of tangent, normal, and polar; parabola, ellipse, and hyperbola. Both rectangular and polar coördinates are used.

In the Solid Geometry the subjects are: the interpretation of equations; the plane and the straight line; discussion of central quadric surfaces by means of plane sections.

[REQUIRED IN ALL COURSES EXCEPT V.]

31. ELEMENTS OF DIFFERENTIAL AND INTEGRAL CALCULUS.

Professor Tyler.

PREPARATION 27.

Three recitations a week during the first term. The course differs from courses 34 and 35 in devoting less attention to complicated problems and in omitting methods and applications which are not essential.

[REQUIRED IN COURSE V., OPTIONS 2, 3, VII.]

34. DIFFERENTIAL CALCULUS.

Professors Osborne, Bartlett,[1] *Woods, Bailey; Messrs. George, Passano, Carter, MacDonald, Moore, Roever.*

PREPARATION: 27 or 28.

A course of forty-five exercises in the first term. The aim of this course is to make the student as familiar with the process and meaning of differentiation as he is with the elementary operations of Arithmetic; and with this end in view the exercises consist chiefly of recitations, a comparatively small portion of the time being given to lectures. The formulas or processes of differentiation are deduced by the method of limits, and, after extended practice in obtaining the derivatives of all the common types of expressions, application is made to the expansion of functions in series, the evaluation of indeterminate forms, the partial differentiation of functions of two or more independent variables, the solution of problems in the analytic geometry of plane curves, the determination of maxima and minima values of functions, and to numerous other problems which involve the rate of change of a function with respect to the change in its variable.

[REQUIRED IN ALL COURSES EXCEPT IV., OPTION 3, V., OPTIONS 2, 3, VII.]

[1] In charge.

35. INTEGRAL CALCULUS.

Professors Tyler, Osborne, Bartlett,[1] *Woods, Bailey; Messrs. George, Passano, Carter, MacDonald, Moore, Roever.*

PREPARATION: 34.

A course of forty-five exercises in the second term, partly lectures but chiefly recitations, in continuation of the course in Differential Calculus. Integration is first defined as representing the reversal of the process of differentiation, and then the fundamental integrals are derived. Integration defined as a summation is then considered, and the relation between the two definitions is demonstrated.

Sufficient time is devoted to the formal process of integration to make the student thoroughly familiar with the fundamental integrals and the methods of reduction of all the common types of expressions. Applications of the Integral Calculus are taken up in considerable detail, including the determination of the length of curves, the areas of surfaces, both plane and curved, the volumes of solids, moments of inertia, centers of gravity and pressure, and the solution of numerous problems of the sort that are likely to occur in practice. Particular stress is laid upon the proper determination of the limits or constants of integration in single, double, and triple integrals, and upon the ability of the student to express a stated problem in mathematical form; while the aim throughout is to cultivate the power to use the methods of the Calculus as a convenient tool and not to have the subject regarded as a merely formal manipulation of symbols.

[REQUIRED IN ALL COURSES EXCEPT IV., OPTION 3, V., OPTIONS 2, 3, VII.]

36. ADVANCED CALCULUS AND GEOMETRY.

Professor Woods.

PREPARATION: 35; 39.

This course consists of lectures and recitations four times a week during the first term. Its aim is to extend the knowledge of the Calculus gained in courses 34 and 35 so that the student may read with greater ease the standard treatises on Mathematical Physics or may begin the study of special topics in pure Mathematics.

The subjects treated are as follows: Algebraic Solid Geometry, including the reduction of the general equation of the second order and special properties of the ellipsoid; functions of one variable, including the derivative and the mean value theorems, the definition and properties of definite integrals; application to space curves, including tangent, normal, binormal, osculating plane, curvature, and torsion; functions of two or more variables, including partial differentiation, change of variables, Taylor's theorem, maxima and minima; the differential equation of the first order and the first degree; application to surfaces, including curvature, lines upon surfaces, and curvilinear coördinates; envelopes, including singular solutions of differential equations; double and

[1] In charge.

triple integration; line, surface, and space integrals; infinite series; and the evaluation of standard definite integrals.

[Required in Courses VIII., Option 2, XIII.a Elective in Courses V., Option B, XIII., Graduate Year.]

39. **DETERMINANTS.**

Dr. Moore.

Preparation: 20.

This course consists of fifteen lectures in the first term on the elements of the Theory of Determinants with applications to the solution of linear equations.

[Required in Course VIII., Option 2.]

42. **ELEMENTS OF DIFFERENTIAL EQUATIONS.**

Professor Bartlett; Messrs. MacDonald, Roever.

Preparation: 35.

A course of thirty lectures and recitations in the first term. The topics considered include: the derivation of differential equations from their primitives; differential equations of the first order; singular solutions; linear differential equations; certain special forms of differential equations of orders higher than the first; and applications to problems in Geometry, Mechanics, and Physics.

[Required in Courses II., VIII., Option 3, X., XIII.]

43. **DIFFERENTIAL EQUATIONS.**

Professor Osborne; Mr. MacDonald.

Preparation: 35.

This course, of forty-five lectures and recitations given in the first term, includes the derivation of Differential Equations by the elimination of constants; differential equations of the first order, of first degree and of higher degrees; linear differential equations, including linear equations with constant coefficients, and the homogeneous linear equation; special forms of differential equations of higher orders; ordinary simultaneous differential equations; linear partial differential equations; and applications to Geometry, Mechanics, and Physics.

[Required in Courses V., Option 5, VI., VIII., Option 1.]

44. **DIFFERENTIAL EQUATIONS.**

Professor Woods.

Preparation: 36.

This course of thirty exercises in the second term is a continuation of course 36. It differs from course 43 in the fact that the elements have been given in

course 36 and some attention is paid to functions defined by differential equations and to partial differential equations of higher order than the first.

[Required in Courses VIII., Option 2, XIII.A. Elective in Courses V., Option B., XIII., Graduate Year.]

46. VECTOR ANALYSIS.

Professor Bailey.

Preparation: 36.

In this course of fifteen lectures in the second term the following subjects are discussed: scalars; vectors; multiplication of vectors by scalars; addition of vectors; scalar and vector products of two or more elements; differentiation of vector expressions; the application of operator ∇ to scalar and vector functions of position in space; and applications to Trigonometry, Geometry, and Mechanics.

[Required in Course VIII., Option 2.]

52. FOURIER'S SERIES; LAPLACE'S COEFFICIENTS.

Professor Bailey.

Preparation: 43.

This course consists of a series of lectures and recitations twice a week extending throughout the fourth year. 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 Course VIII., Options 1, 2.]

56. THE THEORY OF PROBABILITY AND METHOD OF LEAST SQUARES.

Professor Bartlett.

Preparation: 35.

This course consists of twenty exercises in the first term, partly lectures and partly recitations, in which, after the fundamental principles that govern the application of the method to the adjustment of observations have been developed, numerous problems are 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.

[Required in Course VIII., Options 1, 2, XII., Option 2. Elective in Course V., Option B, Graduate Year.]

ELECTIVE ADVANCED COURSES.

In addition to the above subjects, opportunity for elective advanced work is given, the topics considered varying from year to year. In 1905–6 the courses offered will be as follows:—

60. PARTIAL DIFFERENTIAL EQUATIONS OF PHYSICS.

Professor Woods.

PREPARATION: 43 or 44.

This course consists of two lectures a week throughout the year. The main emphasis is laid upon the properties of Differential Equations which are important in Mathematical Physics.

[ELECTIVE.]

HYDRODYNAMICS.

Professor Woods.

This course consists of twenty lectures in which the fundamental equations of Hydrodynamics are developed and applied to the solution of particular problems. It forms a required portion of course 903, but is open as an elective to any student with suitable preparation.

[ELECTIVE.]

HISTORY OF THE MATHEMATICAL SCIENCES.

Professor Bartlett.

This course will consist of about ten lectures during the first term and forms a part of course 761 on the History of Science, under which title a more detailed description may be found.

[ELECTIVE.]

DEPARTMENT OF THEORETICAL AND APPLIED MECHANICS.

GAETANO LANZA, C.E.
Professor of Theoretical and Applied Mechanics.

EDWARD F. MILLER, S.B.
Professor of Steam Engineering.

CHARLES E. FULLER, S.B.
Assistant Professor of Mechanical Engineering.

WILLIAM A. JOHNSTON, S.B.
Assistant Professor of Mechanical Engineering.

HARRISON W. HAYWARD, S.B.
Instructor in Mechanical Engineering.

The instruction in Applied Mechanics is given in the third and fourth years, to students of Civil, Mechanical, Mining, Electrical, Chemical, and Sanitary Engineering, Architecture, and Naval Architecture. The fundamental principles of Statics, Dynamics, and the Strength of Materials, are developed in an extended series of lectures and recitations, accompanied by blackboard work and written exercises. The work is so planned as to impart to the student a thorough knowledge of such principles as will be of practical use in engineering work, and also the ability to apply what he has learned, and to perform intelligently the calculations needed, whatever Mathematics they may involve, up to and including the Differential and Integral Calculus.

This instruction is followed by a series of lectures and recitations intended to familiarize the students with such data upon the strength of materials used in construction as have been obtained by means of experiments, especially those made on a practical scale in different parts of the world. 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 of the strength and resisting proper-

ties of materials of construction; especial emphasis being laid upon tests made upon full-sized pieces under the conditions of practice. A considerable amount of original investigation on the behavior of materials under stress has been performed and the results have been published.

The subjects of friction and lubrication, of continuous girders, of stone and iron arches, and of the theory of elasticity, and their applications are also treated at considerable length.

Instruction in Analytical Mechanics is given to students of the Course in Physics, and includes an advanced mathematical treatment of Analytical Statics, of the Dynamics of a Particle, of the Dynamics of Rigid Bodies, etc. It aims to impart a working knowledge of the principles of Analytical Mechanics adapted to the needs of the student of Physics rather than to those of the student of Engineering, and to enable him to read intelligently articles on mathematical Physics involving Mechanics. Not only is an acquaintance with considerable Mathematics beyond the general courses in Calculus a requisite to a successful prosecution of this course, but also considerable mathematical facility.

70 and 71. APPLIED MECHANICS (Statics — Stresses in Frames — Graphical Statics — Kinematics and Dynamics — Strength of Materials).

Professors Fuller, Johnston; Mr. Hayward

PREPARATION: 35; 770.

These courses consist of two lectures (or recitations) per week in the first term of the third year (course 70) and three (two for XIII.A) during the second term (course 71). In the first term the subjects treated are:

(1) *Statics:* consisting of the general methods of Statics with applications, including determination of reactions, stresses in frames, center of gravity, etc.

(2) *Kinematics and Dynamics:* including the equations of rectilinear, curvilinear, uniform, and varying motion; centrifugal force, unresisted projectile, circular, and cycloidal pendulum, harmonic motion, moment of inertia, radius of gyration, and center of percussion of solid bodies, angular momentum, energy, and impact.

In the second term the subjects treated are:

(3) *Strength of Materials* mathematically treated, including the stresses and strains in bodies subjected to tension, to compression, and to shearing; fundamental assumptions of the common theory of beams, distribution of stresses

in beams; shearing forces, bending moments, slopes and deflections of beams; stresses in hooks, in columns whether centrally or eccentrically loaded; torsional stresses; and stresses in springs.

(4) *Graphical Statics:* consisting of presentation of its general methods, involving the Force and Funicular Polygons, followed by a large number and variety of applications to roof-trusses, including the three-hinged arch, to beams, and to masonry arches and abutments.

[Required in Courses II., X., XIII.; XIII.A, in Second Term only; Elective in Course V., Option A, Graduate Year.]

72 and 73. APPLIED MECHANICS (Statics—Stresses in Frames—Kinematics and Dynamics—Strength of Materials).

Professors Fuller, Johnston; Mr. Hayward.

Preparation: 35; 770.

These courses are nearly the same as courses 70 and 71, with the omission of Graphical Statics. Given two hours per week for ten weeks in the first term of the third year (course 72), and three hours per week in the second term (course 73).

[Required in Courses III., VI., X.]

74 and 75. APPLIED MECHANICS (Statics—Stresses in Frames—Graphical Statics—Strength of Materials).

Professors Fuller, Johnston; Mr. Hayward.

Preparation: 35; 770.

These courses of three hours per week in the first term of the third year (course 74) and three hours per week for the first seven weeks (Option 2, one hour additional for the last eight weeks) in the second term (course 75) are nearly the same as courses 70 and 71.

[Required in Course IV., Options 1 and 2.]

80. APPLIED MECHANICS (Strength of Materials—Friction).

Professors Lanza, Miller, Fuller, Johnston.

Preparation: 71, 73.

A course of lectures, recitations, and laboratory work, three hours per week in the first term of the fourth year, forming a continuation of the preceding courses.

The first portion of the course consists of a detailed study of such data on the Strength of Materials as have been obtained by means of experiments, especially those upon full-sized pieces, and under practical conditions, in different parts of the world. Moreover, this work is constantly revised, and brought up to date, as later experiments throwing new light upon the subjects are made. The subjects treated are as follows: *Cast iron*—tensile, compressive, and trans-

verse tests, including tests of full-sized columns, of window lintels, and of pulley arms. *Steel and Wrought Iron*—Specifications in the case of the standard test specimens, and also in the case of large bars; effect of temperature; tests of repeated stresses, including the work of Wöhler, of Bauschinger, and others; tests of full-sized bridge columns, of I-beams, etc.; tests and design of riveted joints; tests of shafting subjected to both twisting and bending; tests of full-sized timber beams and columns; tests of timber framing-joints, headers, etc.; tests of timber in shearing, and when subjected to compression across the grain; tests, specifications, etc., of cement, and of concrete, including tests of concrete beams and columns. The second portion of the course treats of friction, and includes the common laws of friction and the means of making the usual calculations, including those for the work used up in friction in shaft journals, and in pivots, under each of the two assumptions commonly made as to the distribution of the pressure. It also includes an experimental and theoretical study of the transmission of power by belting and by ropes; a study of the experimental work that has been done upon the friction-reducing power of lubricating oils; and the theory of lubrication.

In connection with the work of courses 80 and 81 the students are required to make tests of materials in the Applied Mechanics Laboratory, the tests made by them in 1903–1904 being the following:

A test to determine the modulus of elasticity, the limit of elasticity, and the tensile strength of a wrought-iron, or a steel rod or bar.

A test of the deflections and of the transverse strength of a full-sized iron or steel I-beam, or of a wooden beam subjected to a transverse load.

A test to determine the modulus of elasticity and the tensile strength of annealed or bright iron wire.

A test to determine the shearing modulus of elasticity and torsional strength of 2-inch iron or steel bars.

A test of the tensile strength of hydraulic cement.

Tests of the compressive strength of hydraulic cement.

Tests of the tensile strength of compositions.

Tests of the strength of different kinds and sizes of ropes and of different knots used in fastening ropes.

Tests to determine the ratio of the modulus of rupture to the tensile strength in bars of Bessemer steel of different sections.

The crushing strength of short struts and of wooden columns.

[Required in Courses II., III., X., XIII., XIII.A.]

81. APPLIED MECHANICS (Strength of Materials—Stability of Structures—Theory of Elasticity).

Professors Lanza, Fuller, Johnston.

Preparation: 80.

This course is a continuation of the preceding and is given by lectures, recitations, and laboratory practice three hours per week in the second term of the fourth year. It consists in a mathematical treatment of the continuous girder,

so planned as to apply to beams, and also to parts of machinery where there is a transverse load, and where continuity exists; a graphical treatment of the stone arch; a mathematical treatment of the elastic arch; and a treatment of the theory of elasticity, including the determination of the resultant strains in any direction. The course also includes the determination of the stresses on any plane in both simple and compound stress, the relation between the stresses and the strains, together with a consideration of the Poisson ratio; the determination of the principal stresses; and applications to shafting subjected to twisting and bending combined, hydraulic presses, flat plates, earth-work, etc.

[REQUIRED IN COURSES II., X.]

(All except the stone arch required of Courses XIII. and XIII.A.)

82. APPLIED MECHANICS (Strength of Materials).

Professors Lanza, Fuller, Johnston.

PREPARATION: 73.

This course of three hours per week for eight weeks in the first term of the fourth year is the same as the first portion of course 80: *i.e.*, friction and laboratory work are omitted.

[REQUIRED IN COURSE VI.]

85. APPLIED MECHANICS (Strength of Materials).

Professors Lanza, Fuller, Johnston.

PREPARATION: 74, 75.

This course of three hours per week for the last eight weeks of the second term of the third year is the same as the first portion of course 80: *i.e.*, friction and laboratory work are omitted.

[REQUIRED IN COURSE IV., OPTIONS 1, 2.]

86. APPLIED MECHANICS (Continuous Girders — Elastic Arch — Theory of Elasticity).

Professor Lanza.

PREPARATION: 85.

This course consists of three lectures and recitations per week for eight weeks in the first term of the fourth year, and is somewhat similar to a portion of course 81, though the details are varied to adapt it to the class.

[REQUIRED IN COURSE IV., OPTION 2.]

87. APPLIED MECHANICS (Laboratory).

Professors Miller, Fuller, Johnston; Mr. Hayward.

PREPARATION: 86.

This course, given three hours per week for half the first term of the fourth year, is similar to the laboratory portion of course 81.

[REQUIRED IN COURSE IV., OPTION 2.]

90 and 91. APPLIED MECHANICS (Statics — Stresses in Frames, Kinematics and Dynamics — Strength of Materials; Theory of Elasticity).

Professors Lanza, Miller, Fuller, Johnston.

PREPARATION: 35; 770.

This course is given by lectures, recitations, and laboratory practice, and extends throughout the third year. The portion of the course which is given in the first term (90), four hours per week, is similar to courses 70 and 71, with the omission of Graphical Statics. The portion which is given in the second term (91) is similar to portions of courses 80 and 81, the special details being arranged with reference to the needs of the class.

[REQUIRED IN COURSES I., XI.]

95. ANALYTICAL MECHANICS I.

Professor Lanza.

PREPARATION: 43; 770.

This course is given three hours a week in the second term of the third year, and consists of a treatment of the earlier portions of Analytical Statics, and includes a study of the composition and resolution of forces; virtual work; centers of mass; flexible strings; together with a variety of examples to be solved mathematically, illustrating the subject.

[REQUIRED IN COURSE VIII., OPTIONS 1, 2.]

96. ANALYTICAL MECHANICS II.

Professor Lanza.

PREPARATION: 95.

This course is given three hours a week throughout the fourth year.

The first portion deals with the following subjects, viz.: virtual work of any system of bodies, including the Lagrange equations; equilibrium of strings; theory of attraction, including Laplace's equation; a treatment of the theory of potential, of Green's equation and spherical harmonics. Then follows a treatment of the theory of elasticity, from the point of view of mathematical Physics.

The second portion of the course is devoted to a study of Dynamics, treating of moments of inertia, radius of gyration, center of percussion, etc.; the pendulum, general equations of motion and applications to a variety of problems, momentum and vis viva; the Lagrange and Hamiltonian equations, together with a consideration of other methods, moving axes, Euler's equations, the top, and other portions of rigid Dynamics, which are varied somewhat from year to year.

[REQUIRED IN COURSE VIII., OPTION 2.]

DEPARTMENT OF DRAWING AND DESCRIPTIVE GEOMETRY.

ALFRED E. BURTON, S.B.,
Professor of Topographical Engineering.

CHARLES L. ADAMS,
Associate Professor of Drawing and Descriptive Geometry.

Instructors.

HENRY K. BURRISON, S.B.
ERVIN KENISON, S.B.
W. FELTON BROWN.
HARRY C. BRADLEY, S.B.
ARTHUR L. GOODRICH, S.B.
CHARLES WINTHROP SAWYER.
STEPHEN A. BREED, S.B.
SAMUEL E. GIDEON.

The subjects of Mechanical Drawing, Freehand Drawing, and Descriptive Geometry are presented with the view of preparing the student for his future professional course, on both theoretical and practical lines.

In dealing with the practical side of these subjects it is not the purpose to anticipate the subject-matter of any of the professional courses, but to develop the powers of imagination, judgment, precision, speed, and taste in directions called for in the various branches of Engineering and Architecture, as well as in the natural sciences. While great importance attaches to the study of Descriptive Geometry as a means for training the imagination, it is deemed equally important that the student shall learn, from the very beginning, to use the subject in practical connections; hence varied applications are introduced as often as possible.

The instruction in Freehand Drawing extends through the first year for all Courses, and is presented from an educational and disciplinary point of view; the subject is also arranged to supplement the work in Mechanical Drawing. In the De-

partment of Architecture the methods begun in the first year are extended to the study of ornament, the human figure from the cast and life, and eventually to figure design. Art Anatomy is taken up, and architectural modes of treatment are practised.

Besides the large and well-equipped Freehand Drawing Rooms of the Institute, the Museum of Fine Arts offers excellent opportunities for drawing from the cast, and regular exercises are held in its galleries.

100. DESCRIPTIVE GEOMETRY AND MECHANICAL DRAWING.[1]

Professor Adams; Messrs. Burrison, Kenison, Bradley, Goodrich, Breed, Gideon.

PREPARATION: 2, 5.

A course of six hours per week throughout the first half of the first year. The weekly programme consists of two one-hour lectures, each followed by a one-hour drawing period; and one two-hour drawing period. The subject-matter of the lectures and drawing is as follows:—

Descriptive Geometry with applications; drawing instruments and their use; geometrical construction; mechanical drawing from objects; applied sketching, lettering, and dimensioning; working methods.

[REQUIRED IN ALL COURSES.]

101. DESCRIPTIVE GEOMETRY AND MECHANICAL DRAWING.[1]

Professor Adams; Messrs. Burrison, Kenison, Bradley, Goodrich, Breed, Gideon.

PREPARATION: 100.

A course of six hours per week throughout the second half of the first year. The weekly programme is the same as in course 100. The subject-matter of the lectures and drawing, a continuation of course 100, includes:

Descriptive Geometry with applications; mechanical drawing from objects; applied sketching, lettering, and dimensioning; working methods.

[REQUIRED IN ALL COURSES EXCEPT IV., VII., VIII., OPTIONS 1 AND 2.]

[1] 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.

103. DESCRIPTIVE GEOMETRY AND MECHANICAL DRAWING.[1]

Professor Adams; Messrs. Kenison, Goodrich.

PREPARATION: 100.

A course of nine hours per week throughout the second half of the first year, consisting of lectures and drawing. This course is a continuation of 100 and includes:

Descriptive Geometry, complete (the ground covered by courses 101 and 107) with applications; mechanical drawing from objects; applied sketching, lettering and dimensioning; working methods. The course is open to students not in Course IV. only by special arrangement with Professor Adams.

[REQUIRED IN COURSE IV.]

107. DESCRIPTIVE GEOMETRY.[1]

Professor Adams; Messrs. Kenison, Bradley, Goodrich.

PREPARATION: 101.

A course of three hours[2] per week throughout the first half of the second year, consisting of lectures and drawing. This course is a continuation of the Descriptive Geometry given in course 101.

Descriptive Geometry, completed, with applications.

[REQUIRED IN COURSES I., II., III., OPTION 2, V., OPTION 1, VI., VIII., OPTION 3, X., XI., XIII.]

110. FREEHAND DRAWING.[3]

Professor Adams; Mr. Sawyer.

NO PREPARATION IS REQUIRED.

A course of one hour per week throughout the first half of the first year. The personal powers concerned in Freehand Drawing, such as correct seeing, visual generalization, selection, etc., are considered, and exercises for the development of these powers are indicated for immediate practice. The term work consists largely of the drawing of letters, regarded as an excellent means for teaching general principles and methods, as well as of general application in technical work.

[REQUIRED IN ALL COURSES.]

[1] 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] Four hours for Course I.

[3] All applicants for advanced standing should present themselves for examination and should submit examples of their lettering and object drawing.

111. FREEHAND DRAWING.[1]

Professor Adams; Mr. Sawyer.

PREPARATION: 110.

A course of two hours per week throughout the second half of the first year. The work continues on the lines indicated in course 110, but more attention is given to object drawing and to applications of lettering, such as the construction of titles, dimensioning, and the making of working sketches. In the object drawing, students sketch, according to their professional Course, mechanical subjects, such as details of building construction and machinery, apparatus, natural history specimens, etc. Drawings either in projection or in perspective may be required.

[REQUIRED IN ALL COURSES EXCEPT IV.]

112. FREEHAND DRAWING.[2]

Professor Adams; Mr. Sawyer.

PREPARATION: 110.

This course of three hours per week throughout the second half of the first year is the same as course 111, except that the object drawing includes study from the cast of ornament and of details of the human figure.

[REQUIRED IN COURSE IV.]

116. FREEHAND DRAWING.[3]

Professor Adams; Mr. Brown.

PREPARATION: 112.

A course of two two-hour lecture and drawing periods per week throughout the second year. Students study from the cast of ornament and the human figure, with individual instruction. The drawing-exercises are supplemented by lectures on Art Anatomy, practice in architectural rendering, and memory drawing.

[REQUIRED IN COURSE IV.]

117. FREEHAND DRAWING.[3]

Professor Adams; Mr. Brown.

PREPARATION: 116.

This course, of two two-hour lecture and drawing periods throughout the third year, is a continuation of course 116.

[REQUIRED IN COURSE IV.]

[1] Applicants for advanced standing should present themselves for examination, and should submit examples of their object drawing, lettered titles, and dimensioning.

[2] Applicants for advanced standing should present themselves for examination, and should submit examples of their cast drawing, lettered titles, and dimensioning.

[3] Applicants for advanced standing should present themselves for examination.

118. LIFE CLASS.[1]

Professor Adams; Mr. Brown.

PREPARATION: 117.

A course of two two-hour lecture and drawing periods per week throughout the fourth year, and continuing course 117 in figure drawing and Art Anatomy with work in figure design.

[REQUIRED IN COURSE IV., OPTIONS 1, 3.]

119. LIFE CLASS AND DECORATIVE DESIGN.[1]

Professor Adams; Mr. Brown.

PREPARATION: 118.

A course of three two-hour lecture and drawing periods per week throughout the year. In this course decorative figure design takes the prominent position belonging to it when associated with Architecture in its highest development, and is studied in its varied relation to painting and sculpture.

[ELECTIVE IN COURSE IV., GRADUATE YEAR.]

[1] Candidates for advanced standing should present themselves for examination.

DEPARTMENT OF MECHANIC ARTS.

PETER SCHWAMB, S.B.
Professor of Machine Design; Director of the Mechanical Laboratories.

Instructors.

THEODORE B. MERRICK. ROBERT H. SMITH.
JAMES R. LAMBIRTH. CHARLES E. LITTLEFIELD.

Assistants.

GEORGE E. BRADLEY. OSCAR W. NORTHRUP.
FRANK A. BROWN. MARSHALL G. MERIAM.
ALBERT L. MOULTON.

The aim of the instruction in Mechanic Arts is a systematic training in the fundamental typical operations to be performed with the tools and appliances suited to each art, including instruction in the methods of sharpening and adjusting all edge tools used, with a discussion of the proper cutting angles, speeds, and feeds for the various materials worked. Attention is also given to the principal properties and characteristics of the materials used in each art.

Instruction in each course is given by means of a series of projects or models in which the systematic training and advance of the student, precision, the cultivation of the powers of observation, judgment, and foresight, and orderly habits are the main ends sought. The instruction is mainly oral, each new operation being described and discussed just before the work is to be undertaken. As a rule the entire class is engaged upon the same or similar projects, and all work is executed from suitable working drawings. Sufficient practice is given to enable the student to do good work.

The most complete course is given to students in Mechanical Engineering, and consists of Carpentry and Wood-turning, Pattern-work, Foundry-work (optional), Forging, Chipping and Filing, and Machine-tool Work. Briefer courses, covering only a part of the ground outlined above, are given to stu-

dents in Naval Architecture, Electrical and Chemical Engineering, Chemistry, and Physics. A short course in Pipe Fitting, including some plumbing, is given to students in Sanitary Engineering.

120. CARPENTRY AND WOOD-TURNING.

Mr. Merrick and assistant.

PREPARATION: 100, 110, completed or taken simultaneously.

This course consists of thirty two-hour exercises, two each week of the first term. 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 sand paper. 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.

[REQUIRED IN COURSES II., X.]

122. PATTERN-WORK.

Mr. Merrick and assistant.

PREPARATION: 120.

This course consists of fifteen two-hour exercises, one each week of the second term of the second year. The course includes some additional instruction in Wood-turning having special application to Pattern-work, an illustrated discussion of the principles of moulding to explain clearly and show reasons for "draft" on patterns and methods of allowing it, instruction in the use and making of core-boxes, and methods of building up patterns. The projects in this course include patterns of pipe-fittings, valves, pulleys, gears, hangers, machine parts, etc.

[REQUIRED IN COURSE II.]

123. JOINERY AND PATTERN-WORK.

Mr. Merrick and assistant.

PREPARATION: 100 or 101, 110 or 111, completed or taken simultaneously.

This course consists of thirty two-hour exercises, two each week, and is given each term of the second year. It aims to give as much training in simple pat-

tern making as the time will allow, and covers, though less thoroughly, the ground of courses 120 and 122. To this end the work begins with a short course in Carpentry and Wood-turning, which is followed as soon as practicable by instruction in Pattern-work.

[Required in Course VI.]

125. FOUNDRY WORK.

Mr. Merrick; special instructor and assistant.

Preparation: 101, 111 completed or taken simultaneously.

The course consists of fifteen two-hour exercises, one each week during the second term of the second year. It begins with instruction in tempering the sand and making green sand moulds for small work. Following this come exercises in core-making and an explanation of loam work. Machine, floor, and sweep moulding are briefly described. Castings are first made in white metal for practice, then in cast iron, when the students are taught to attend the cupola furnace in small sections.

[Optional in Course II.]

127. FORGING.

Mr. Lambirth and assistant.

Preparation: 100 or 101, 110 or 111, completed or taken simultaneously.

This course consists of fifty-four two-hour exercises, two per week during the first, and three per week for eight weeks of the second term. The 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, chamfering, welding, including careful instruction in scarfing for the various welds, the making and use of heading tools, chain making, the making and fitting of braces, the construction of hooks and ring bolts, riveting, and the use of threading tools. Training is also given in the use of the power hammer. The work in steel includes drawing, forming, welding, refining and tempering, and spring and tool making.

[Required in Courses II., XIII.]

128. FORGING.

Mr. Lambirth and assistant.

Preparation: 101, 111, completed or taken simultaneously.

This course consists of fifteen three-hour exercises, given once a week during the second term. It covers nearly the same ground as that of course 127, but in a much less thorough manner.

[Required in Course X. Elective in Course III., Option B, Graduate Year.]

130. CHIPPING AND FILING.

Messrs. Smith, Littlefield, and assistant.

PREPARATION: 101, 111, completed or taken simultaneously.

The course consists of thirty-three two-hour exercises, twenty-one in the second term and twelve in the first term of the following year. 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, keyways, and "chipping to shoulder." The exercises in Filing begin with a study of the names and classification of files, a discussion of the "cut," tooth angles, and uses of each form, and methods of holding and operating. The instruction covers methods of holding and "laying out" work, cross filing, draw filing, free-hand filing, production of flat surfaces, surfaces at right angles, parallel surfaces, chamfering, filing to template, use of hack-saw, fitting, including parallel, drive, and slide fits, finishing and polishing. The course concludes with exercises in the construction, care, and use of scraping tools, and the production of flat surfaces, each student making a pair of small surface plates.

[REQUIRED IN COURSES II., XIII.]

132. MACHINE-TOOL WORK.

Mr. Smith and assistants.

PREPARATION: 130.

This course consists of seventy-eight two-hour exercises, three each week during the last eleven weeks of the first term, and during the entire second term of the fourth year. When necessary, instruction is given 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. Instruction is given also in steam-pipe fitting.

[REQUIRED IN COURSE II.]

133. MACHINE-TOOL WORK.

Mr. Smith and assistants.

PREPARATION: 130.

This course consists of the first sixty exercises of course 132, three each week during the last ten weeks of the first term of the fourth year, and two each week during the second term.

[REQUIRED IN COURSE XIII.]

134. METAL TURNING.

Mr. Smith and assistants.

PREPARATION: 100 or 101, 110 or 111, completed or taken simultaneously.

This course consists of thirty two-hour exercises, two each week, and is given in both terms of the second year. A brief course in Chipping and Filing precedes a course in Machine-tool work, special attention being given to brass work. The course includes lathe work, drilling, planing, and milling, the object being to give students a training sufficient to enable them to construct experimental apparatus.

[REQUIRED IN COURSES VI., VIII., OPTION 3.]

135. METAL TURNING.

Mr. Smith and assistants.

PREPARATION: 101, 111, completed or taken simultaneously.

This course consists of fifteen two-hour exercises, one each week during the second term of the fourth year. The course begins with exercises in elementary Chipping and Filing, which are followed by instruction in lathe-work, covering centering, straight and taper turning, screw cutting, chucking, finishing and polishing, drilling, and tapping.

[REQUIRED IN COURSE X.]

137. WOOD AND METAL WORK.

Messrs. Merrick, Smith, and assistants.

PREPARATION: 101, 111, completed or taken simultaneously.

This course of thirty two-hour exercises is given during the second term of the first year, and consists of the first twenty-four exercises of course 134, followed by six exercises in Wood-turning.

[REQUIRED IN COURSE VIII., OPTIONS 1, 2.]

139. PIPE FITTING.

Mr. Smith and assistants.

PREPARATION: 334, taken simultaneously.

This course consists of fifteen two-hour exercises, one each week of the first term of the fourth year. Instruction is first given in elementary Chipping and Filing; following this the use of tools required in brass and iron piping is taught by means of exercises planned to give practice in the ordinary combinations of pipes and fittings; finally practice is given in the making of soil-pipe joints and wiped joints for lead pipe.

[REQUIRED IN COURSE XI.]

DEPARTMENT OF ENGLISH COMPOSITION AND LITERATURE.

ARLO BATES, A.M., LITT.D.
Professor of English.

HENRY G. PEARSON, A.B.
Assistant Professor of English.

Instructors.

ARCHER T. ROBINSON, A.B. HENRY L. SEAVER, A.B.
CHAUNCY C. BATCHELOR, A.B.

Assistant.

CLINTON H. COLLESTER, A.M.

English Composition at the Institute is taught as an essential part of the training of every educated man, but especial emphasis is laid upon its importance in technical work. While attention is given to its place in general cultivation and to its æsthetic side, the greater stress is placed upon the absolute necessity that every professional man should be able to express his thought with clearness and accuracy. The work is therefore continued, so far as is possible, throughout the four years. In the first year is given a systematic course in Composition, and translations from the classes in language are corrected by the English Department; in the second year themes are written in connection with the study of Literature; in the third and fourth years written work is now arranged in most of the professional Courses in connection with regular professional work. At any time in the four years, if a student shows marked deficiencies in English, he is given special work in Composition to be done with criticism and consultation.

English Literature is required throughout the second year of all students. It is designed not only to give the history of Literature, but so far as is practicable to cultivate an understanding and appreciation of what is best. As much stress as

possible is laid on the enjoyment and comprehension of masterpieces; and the assigned readings are treated as not only illustrative, but essential.

The same principle is observed in the higher courses of Literature which belong to the third and fourth year. Literature is regarded and treated as of value, not simply as a study, but as a part of life.

140. RHETORIC AND ENGLISH COMPOSITION.

Professors Bates, Pearson; Messrs. Robinson, Seaver, Batchelor.

PREPARATION: 3, 4.

The first-year English Composition is conducted by means of class-room exercises, written work, and consultations; it occupies two hours per week in the first term and one in the second. The chief object is to enable the student to write correct, clear, and easy business English, to express himself with accuracy and precision, and to realize that the secret of clear writing is clear thinking. Effort is made to do what is possible in fitting students for receiving instruction by lectures and to train them in the art of taking notes. In the second term, preparation is made for the second-year work by attention to the proper treatment of Literature: in reading intelligently and in understanding the relation of such reading to composition.

[REQUIRED IN ALL COURSES.]

141. SPECIAL COMPOSITION.

Professors Bates, Pearson; Messrs. Robinson, Seaver, Batchelor.

This course is supplementary to course 140, and 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.

143. ADVANCED ENGLISH COMPOSITION.

Professor Bates.

PREPARATION: 140.

The course in Advanced Composition is given one hour a week during the first term of the third year. It is given by lectures, written work, and consultation. This is a continuation of course 140, and aims to take advantage of the increased development of the mind of the student in carrying him further in the appreciation and practice of literary expression.

[ELECTIVE.]

150. ENGLISH LITERATURE.

Professors Bates, Pearson; Messrs. Robinson, Seaver, Batchelor.

PREPARATION: 140.

In the English Literature of the second year fifteen lectures are given in the first term and thirty in the second. Readings are assigned in the more important authors, and written work with personal consultation is required in each term. The year's work is designed to give an outline of the formation of the language, and of the rise and development of Literature in England and America to the close of the Nineteenth Century. This survey is necessarily general, but the effort is to make it sufficiently definite to serve as a reliable framework for any later and more detailed study.

[REQUIRED IN ALL COURSES.]

156. ENGLISH LITERATURE: 1660-1780.

Professor Bates.

PREPARATION: 150.

The course in Eighteenth Century Literature—1660 to 1780—is offered in the first term of the third year. This course is given in thirty lectures, with assigned readings and notebooks.

[ELECTIVE.]

157. ENGLISH LITERATURE: 1780-1860.

Professor Bates.

PREPARATION: 156.

The course in Nineteenth Century Literature—1780-1860—is offered in the second term. It is a continuation of course 156: the method of conducting the course is the same in both. The number of lectures is forty-five.

[ELECTIVE.]

158. CONTEMPORARY ENGLISH AND AMERICAN LITERATURE.

Professor Bates.

PREPARATION: 150.

The course in Contemporary Literature covers the period from 1860 to the present, and so is in reality a continuation of course 157, although it is given in the same term. It consists of forty-five lectures, with illustrative readings and critical note-books as in the other courses.

[ELECTIVE.]

165. ÆSTHETICS.

Professor Bates.

The course in Æsthetics covers the first term, and is given in thirty lectures, with some illustrative assigned reading. It is devoted to the consideration of the nature and effects of the fine arts in general, and to the bringing out of the practical application of the principles developed.

[Elective in Course IV., Graduate Year.]

DEPARTMENT OF HISTORY.

CHARLES F. A. CURRIER, A.M.
Professor of History.

JOHN O. SUMNER, A.B.
Associate Professor of History.

The courses in History naturally divide themselves into three groups: (1) those taken by all regular students; (2) those required in Course IV.; and (3) elective courses.

The courses taken by all regular students 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 to-day, 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 72.)

170. UNITED STATES HISTORY.

Professor Currier.

PREPARATION: 4.

This course comprises two lectures a week in the second term of the first year. 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 forty 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.]

173. EUROPEAN HISTORY SINCE 1815.

Professor Currier.

PREPARATION: 170.

This course, of two lectures a week, given in the first term of the second year, is largely a study of contemporary European governments 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.]

175. COLONIAL SYSTEMS.

Professor Currier.

PREPARATION: 173.

A course of two hours a week, lectures and recitations, during the second term of the third year. The colonial systems of the leading countries of the world will be studied, and special attention will be given to the recent territorial acquisitions of the United States.

[ELECTIVE. MAY BE OMITTED IN 1905–06.]

180. HISTORY OF EUROPEAN CIVILIZATION AND ART:
I. The Ancient and Early Mediæval Periods.

Professor Sumner.

PREPARATION: 4.

Four hours a week during the first term of the fourth year and three hours a week during the second term.

This course treats of the rise and growth of European civilization and of its gradual westward expansion through the Mediterranean basin and thence into central and northwestern Europe. 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. As the students in Course IV. have already taken a more specialized course in the History of Architecture, attention is now particularly directed to works of sculpture and painting. The lectures are very fully illustrated by lantern slides, supplemented by collections of photographs and by reference to the casts and original works contained in the Boston Museum of Fine Arts.

[REQUIRED IN COURSE IV.]

181. **HISTORY OF EUROPEAN CIVILIZATION AND ART:**
II. The Later Middle Ages and the Period of the Italian Renaissance.

Professor Sumner.

PREPARATION: 180.

Two hours a week, throughout the year. This course is a continuation of the foregoing, but the training of the previous year and the narrower field now surveyed permit of work somewhat more advanced in character. The illustrative material is similar to that of the former course.

[ELECTIVE IN COURSE IV., GRADUATE YEAR.]

182. **EUROPEAN CIVILIZATION AND ART IN ITS MOST FAMOUS EPOCHS.**

Professor Sumner.

Two lectures a week during the second term of the third year. After a brief discussion of the origins of European civilization, the broad features of the political and social life of each epoch will be surveyed and characteristic examples shown of its architecture and art. A syllabus will provide historical summaries connecting together the periods to be discussed, and the lectures will be supplemented by reference reading.

[ELECTIVE.]

DEPARTMENT OF ECONOMICS, STATISTICS, AND POLITICAL SCIENCE.

DAVIS R. DEWEY, PH.D.,
Professor of Economics and Statistics.

CARROLL W. DOTEN, A.M.,
Assistant Professor of Economics.

---

190. POLITICAL ECONOMY.

Professors Dewey, Doten.

PREPARATION: 173.

A course of three hours a week in the first term of the third year, involving lectures, discussions, and written work. The course is elementary, with special emphasis upon Descriptive Economics.

[REQUIRED IN ALL COURSES.]

191. ECONOMIC HISTORY.

Professor Doten.

PREPARATION: 173.

A course of one hour a week in the first term of the third year. This is designed for students who wish to secure a broader course in Economics than is provided by course 190. The industrial history of England and the United States is reviewed, showing the historical origins of present economic conditions.

[ELECTIVE.]

193. ECONOMICS OF CORPORATIONS.

Professor Dewey.

PREPARATION: 190.

A course of one lecture a week in the second term of the fourth year, with a printed syllabus. It 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 COURSES I., OPTION 2. VI.]

194. RAILROAD ECONOMICS.

Professor Doten.

PREPARATION: 190.

This is a course of three hours a week in the second term of the third year. Two hours are devoted to lectures and recitations and the third hour to special investigations under the supervision of the instructor. 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 construction 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.]

195. BANKING AND FINANCE.

Professor Dewey.

PREPARATION: 190.

A course of three hours a week in the second term of the third year. 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.]

196. LABOR PROBLEMS.

Professor Doten.

PREPARATION: 190.

This course consists of two hours a week in the second term of the third year, occupied with lectures and discussions and a third hour to be used at the option of the instructor in special investigation work. The ground covered 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: the "open" and "closed" shop; effect of labor organizations on output; position of unions in the matter of apprentices and

the introduction of new methods and machinery; immigration; convict labor; arbitration; profit-sharing; collective bargaining; employers' liability; strikes and lockouts; injunctions; factory legislation; railroad relief associations and welfare schemes in manufacturing establishments.

[ELECTIVE. May be omitted in 1905–6.]

197. ORGANIZATION OF INDUSTRY.

Professor Dewey.

PREPARATION: 190.

This course consists of two hours a week in the second term of the third year, with lectures and discussion and a third hour to be used at the option of the instructor in special investigation work. The course embraces a general survey of industry in the United States under agriculture, mining, manufactures, commerce, trade, banking and insurance; including the growth and importance of each as measured by the capital invested, number of laborers employed, and the products. The movement toward concentration and combination will be described, involving a history of trusts with an analysis of their advantages and evils. Among special topics discussed are partnership and incorporation, the patent system, monopolies, wholesale and retail trade, jobbing, marketing of goods, produce exchanges, credit system, and bankruptcy and receiverships.

[ELECTIVE. May be omitted in 1905–6.]

198. VITAL AND SANITARY STATISTICS.

Professor Dewey.

PREPARATION: 190.

A course of thirty exercises in the first term of the fourth year. The work includes the collection of Vital Statistics, the consideration of errors, and the analysis of mortality and morbidity reports, with special reference to determining the health of communities.

[REQUIRED IN COURSE VII.]

200. BUSINESS LAW.

Mr. Albers.

A course of one lecture a week throughout the second term of the third or fourth year.

[REQUIRED IN ALL COURSES.]

201. INTERNATIONAL LAW.

Professor Currier.

PREPARATION: 173.

A course of one exercise a week during the first term of the third year, including the study of a text-book, together with references to current international relations and to the history of diplomacy.

[ELECTIVE.]

208. MUNICIPAL GOVERNMENT.

Professor Currier.

PREPARATION: 173.

A course of two exercises a week, with assigned reading, during the second term of the third year. 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.]

209. COMPARATIVE NATIONAL GOVERNMENT.

Professor Currier.

PREPARATION: 173.

A course of one hour a week, lectures and recitations, during the first term of the third year. The principal countries studied are England, France, Germany, Switzerland and the United States

[ELECTIVE.]

DEPARTMENT OF MODERN LANGUAGES.

JOHN BIGELOW, JR.
Professor of French.

FRANK VOGEL, A.M.
Professor of Modern Languages.

Instructors.

JOSEPH BLACHSTEIN.
JUSTUS ERHARDT, A.B.
FRANCIS H. DIKE, A.B.
HERMAN R. KURRELMEYER, PH.D.
JAMES A. HARE, A.B.
GEORGE J. LENZ, A.B.

The study of Modern Languages at the Institute has two objects: that of giving the student general training and culture, and that of enabling him to make use of the languages as instruments in scientific research. It aims to give him sufficient facility with modern texts so that he may use them without the necessity of translating, and as much familiarity with the spoken language as his individual aptitudes and the time available permit. As much of the class-room work as possible is carried on in the language taught. Occasional talks therein are given by the instructor. Writing from dictation and conversation are frequently practised.

A sound knowledge of Grammar is attained by 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 from the beginning through constant practice in the class-room.

220. FRENCH I.

Messrs. Erhardt, Dike.

This course consists of three exercises a week throughout the year. The work is intended to prepare students who have failed to do so to meet the entrance requirements in French. The course will be discontinued after the year 1906–1907. The books used are:—

François. Beginner's French.
Bruno. Le Tour de la France (American Book Company).

[ELECTIVE.]

221. FRENCH II.

Professor Bigelow; Messrs. Blachstein, Erhardt, Dike.

PREPARATION: 6.

This course consists of three exercises a week. The books used are:—

Cameron. Tales of France.
François. Introductory French Prose Composition.
Herdler. Scientific French Reader.
Marion. Le Verbe en quatre Tableaux synoptiques.

The work in this course, during the first term, will drill the student in the irregular verbs and in all irregular forms of adjectives and nouns, and will give him practice in the use of the more common idiomatic expressions of the language. It is expected that by the beginning of the second term the student will be able to read ordinary French without difficulty, and have sufficient knowledge of the spoken language to understand it when it is pronounced slowly. The object of the work in this course will be the understanding of a text without the medium of translation.

[REQUIRED IN ALL COURSES.]

222. FRENCH III.

Professor Bigelow.

PREPARATION: 221.

This course is of one hour a week throughout the year. It presupposes a thorough knowledge of Grammar. The work will consist principally of composition, dictation, and conversation. The books used are:—

François. Advanced French Prose Composition.
Monsanto. Manual of Commercial Correspondence.

The course will be conducted almost wholly in French.

[ELECTIVE.]

228. FRENCH SIGHT READING.

Mr. Blachstein.

PREPARATION: 221, together with which it may be taken by consent of the instructor.

This course is given three times a week during the first term and twice a week during the second term. The object of the course is to give the student greater facility in the understanding of the language without the medium of translation. The books used are:—

Sainte-Beuve. Seven of the Causeries du Lundi. Edited by G. M. Harper.
Monsanto. Commercial Correspondence in French.

[ELECTIVE]

230. GERMAN I.

Messrs. Kurrelmeyer, Hare.

This course consists of three exercises a week throughout the year. The work is intended to prepare students who have failed to do so to meet the entrance requirements in German. The course will be discontinued after the year 1906–1907. The books used are:—

Vos. Essentials of German.
Storm. Geschichten aus der Tonne.
Dippold. Scientific German Reader.

[ELECTIVE.]

231. GERMAN II.

Professor Vogel; Messrs. Blachstein, Kurrelmeyer, Hare, Lenz.

PREPARATION: 7.

This course consists of three exercises a week throughout the year. The Grammar is reviewed, and the study of it completed. 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 scientific nature, and to understand the simple spoken language. Opportunity for speaking German is offered in the discussion of subjects suggested by the reading.

The work in this course is based upon the following books:—

Dippold. A Scientific German Reader.
Hauff. Lichtenstein. (Heath edition.)
Prehn. Journalistic German.
Schiller. Gustav Adolf in Deutschland.
Wesselhoeft. German Composition.

[REQUIRED IN ALL COURSES.]

232. GERMAN III.

Professor Vogel.

PREPARATION: 231.

This course forms an introduction to the German Literature of the Eighteenth and Nineteenth Centuries, and consists of one exercise a week throughout the year. Occasionally, during the first term, lectures are given in German. In the second term the course will be conducted mainly in German. Practice in writing German forms part of the work. Opportunity for speaking German and for foreign correspondence is also offered.

The work in this course is based upon the following books:—

Biedermann. Deutsche Bildungszustände in 18ten Jahrhundert.
Keller. Bilder aus der deutschen Literatur.
Paskowski. Lehrbuch zur Einführung in die Kenntnis Deutschlands und seines geistigen Lebens.

Whitney's A Compendious German Grammar is used as a reference book.

[ELECTIVE.]

238. GERMAN SIGHT READING.

Professor Vogel.

PREPARATION: 231, with which it may be taken by consent of the instructor.

This course is given three times a week during the first term and twice a week during the second term. It is open to qualified students in all Courses. Its object is to facilitate by rapid reading an extensive knowledge and appreciative understanding of the language without the medium of translation. The books used are:—

Kron. German Daily Life.
Kutner. Commercial German.
Seidel. Der Tausendmarkschein.

[ELECTIVE.]

240. SPANISH I.

Professor Bigelow; Messrs. Erhardt, Lenz.

This course is given twice a week during the first term and three times a week during the second term. The work includes the study of the elements of Spanish Grammar; regular verbs and all common irregular verbs; composition exercises, reading of easy Spanish texts, practice in conversation. The following books will form the basis of the work :

Altamira. Eco de Madrid
Howland. Zaragüeta.
Loiseaux. Elementary Spanish Reader.
Ramsey. A Text-Book of Modern Spanish.

[ELECTIVE.]

241. SPANISH II.

Mr. Erhardt.

PREPARATION: 240.

The work in this course covers two exercises a week throughout the year and continues the study of Spanish Grammar, including all the irregular verbs. Composition exercises are required, and more difficult Spanish texts are read. Opportunity for conversation and for practice in writing letters and short essays on topics connected with the regular class work is also offered. The following books will form the basis of this course:—

Altamira. Eco de Madrid.
Fernán Caballero. La Familia de Alvareda.
Ramsey. A Text-Book of Modern Spanish.

[REQUIRED IN COURSE XIII.A; ELECTIVE.]

242. SPANISH III.

Mr. Erhardt.

PREPARATION: 241.

This course of two exercises a week throughout the year completes the study of Spanish Grammar, treating especially the syntax. Composition exercises are required and difficult Spanish texts are read. Practice in conversation and in writing letters and short essays on topics connected with the regular class work is also required. This course is carried on mainly in Spanish. The following books form the basis of the work:—

Altamira. Eco de Madrid.
Cervantes. Don Quijote.
Fernádez y Rodriguez. Lecciones de construcción naval.
Galdos. Electra.
Ramsey. A Text-Book of Modern Spanish.

[REQUIRED IN COURSE XIII.A; ELECTIVE.]

248. ITALIAN.

Mr. Erhardt.

This course, of two exercises a week throughout the year, includes the study of the elements of Italian Grammar; regular verbs and all common irregular verbs; composition exercises; reading of easy Italian texts; and some practice in conversation.

The following books form the basis of this course:—

Bowen. Italian Reader.
Goldoni. La locandiera.
Grandgent. Italian Composition.
Motti. Italian Grammar.

[ELECTIVE.]

DEPARTMENT OF CIVIL AND SANITARY ENGINEERING.

GEORGE F. SWAIN, S.B.
Hayward Professor of Civil Engineering.

C. FRANK ALLEN, S.B.
Professor of Railroad Engineering.

ALFRED E. BURTON, S.B. (*Absent*).
Professor of Topographical Engineering.

DWIGHT PORTER, PH.B.
Professor of Hydraulic and Sanitary Engineering.

WILLIAM E. MOTT, S.B.
Associate Professor of Hydraulic Engineering.

ARTHUR G. ROBBINS, S.B.
Assistant Professor of Highway Engineering.

FRANK P. MCKIBBEN, S.B.
Assistant Professor of Civil Engineering.

Instructors.

GEORGE L. HOSMER.
CHARLES B. BREED, S.B.
STURGIS H. THORNDIKE, A.B., S.B.
JOHN W. HOWARD, S.B.
GEORGE E. RUSSELL, S.B.

Assistants.

JOHN AYER, S.B.
JOHN E. BARLOW, S.B.
CARL T. HUMPHREYS, S.B.
JOHN H. MCMANUS, S.B.
WILLARD E. SIMPSON, S.B.
FRANK C. STARR, S.B.
KILBORN WHITMAN, JR., S.B.

The instruction in Civil Engineering is given by means of lectures and recitations, and by practice in the field, the drawing-room, and the laboratory. The professional work begins in the second year, in which the courses in Surveying and Topographical Drawing are given. In these courses the student is taught the use of the instruments, their adjustments, and the principal operations involved in land, topographical, hydrographical, railroad, city, and underground surveying

with actual work in the field, accompanied by work in the drawing-room in which the field surveys are plotted.

In the third year the professional work includes the courses in Railroad Engineering, Advanced Surveying, Stereotomy, and the Elements of Structures, in which the student is taught to apply what he has learned 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.

300. SURVEYING AND PLOTTING.

Professor Robbins; Messrs. Hosmer, Breed, Howard and assistants.

PREPARATION: 28; 100.

This course consists of a series of lectures, supplemented by exercises in the field and the drawing-room, continuing through the second year. The time required is from four to six hours per week according to the Course. During the first term the student is taught the use of the chain, tape, compass, solar compass, and transit, and in the second term the use of various forms of levelling instruments. The work in the drawing-room consists in making the computations which arise in the work of the surveyor, in making scale drawings, profiles, and contour maps from notes taken in the field, and in studying the application of contour maps in the solution of problems of drainage, road location, Landscape Engineering, etc. The text-book used is a set of printed notes prepared by Professor Robbins.

[REQUIRED IN COURSES I., III., OPTIONS 1, 3, IV., OPTION 3, XI., XII., OPTION 1.]

302. TOPOGRAPHICAL DRAWING.

Professors Burton, Robbins; Messrs. Hosmer, Howard and assistants.

PREPARATION: 100; 111.

This course consists of two hours per week in the drawing-room, during the second term, and 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 o such maps. Particular attention is given to the study of contour maps, and the solution of problems relating thereto.

[Required in Courses I., III., Options 1, 3, XI.]

303. ADVANCED SURVEYING.

Professor Robbins; Messrs. Hosmer, Howard and assistants.

Preparation: 300; 770.

This course of thirty hours in each term of the third year consists of lectures and work in the field and the drawing-room. The instruction includes the use of the stadia and plane table in topographic surveys, of the sextant in hydrographic and astronomical work, of the barometer for determining differences of elevation, of the slide rule for computations, the construction of stadia diagrams, and the making of topographic maps from surveys made with the camera. The text-book used is Wilson's Topographic Surveying.

[Required in Courses I., XI., XII. Elective in Course III., Option A, Graduate Year.]

304. SURVEYING INSTRUMENTS.

Professor Robbins; Messrs Hosmer, Howard and assistants.

Preparation: 377.

This very brief course, in the first and second terms, consists of two lectures and ten hours in the field, illustrating the use of the compass, transit, and level. No text-book is used.

[Required in Course II., as a Part of Course 377. A slightly longer course is given to students in Electrical Engineering.]

308. ASTRONOMY.

Messrs. Hosmer, Howard.

Preparation: 24; 303, taken simultaneously.

This course consists of thirty lectures in the second term of the third year. Fifteen of these are devoted to the elementary principles of practical Astronomy, illustrated by the lantern, and supplemented by practical problems. Special attention is paid to the observations which may be needed in the practice of the engineer, such as those for latitude, time, and azimuth. The remaining fifteen hours are divided between lectures and field-wo[illegible] Obser-

vations are made with the engineer's transit for latitude, longitude, time, and azimuth; and at the Geodetic Observatory in Middlesex Fells use is made of the astronomical transit, the equatorial telescope, and the chronograph. The text-books are printed notes by Mr. Hosmer, and Young's General Astronomy.

[Required in Course I.]

309. PRACTICAL ASTRONOMY (To be given after 1905-6 as part of course 308).

Mr. Hosmer.

Preparation: 308.

This course is a continuation of course 308, and consists of fifteen hours during the first term of the fourth year, divided between lectures and field-work. Observations are made with the engineer's transit for latitude, longitude, time, and azimuth; and at the Geodetic Observatory in Middlesex Fells use is made of the astronomical transit and the chronograph. The text-book is printed notes by Mr. Hosmer.

[Required in Course I., Option 1.]

310. ELEMENTS OF GEODESY.

Mr. Hosmer.

Preparation: 35; 303; 308.

A course of fifteen exercises, mainly lectures, in the second term of the fourth year, giving an outline and a historical sketch of the methods of determining the form of the earth, and the results obtained, both by arc measurements and by the pendulum. The methods of conducting a geodetic survey, the measurement of base lines, and precise levelling, are discussed more in detail.

[Required in Course I., Option 1.]

312. CURVES AND EARTHWORK.

Mr. Breed.

Preparation: 300.

This is a short course, similar in character to course 313, but extending through only one term of the third year, with two hours per week. It consists mainly of recitations, with problems, and is designed to give the students in Landscape Architecture sufficient knowledge of curves and earthwork to enable them to solve the problems they are likely to meet relating to the laying out of roads and the estimate of quantities and costs of earthwork. It is supplemented by course 316. The text-books used are Professor Allen's works on Railroad Curves and Earthwork, and Field and Office Tables.

[Required in Course IV., Option 3.]

313. RAILROAD ENGINEERING.

Professor Allen.

PREPARATION: 35; 300; 315, taken simultaneously.

This course, of two hours per week in the first term of the third year and three hours per week for ten weeks in the second, consists of a thorough study of curves and earthwork and their application in location and construction. 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. 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 enforced by course 315. The text-books used are Professor Allen's works on Railroad Curves and Earthwork, and Field and Office Tables.

So much of this course as relates specifically to railroads is omitted by students in Course XI.

[REQUIRED IN COURSES I., XI.]

314. HIGHWAY ENGINEERING.

Professor Robbins.

PREPARATION: 312 or 313, taken simultaneously.

This course consists of fifteen lectures given during the second term of the third year. It comprises an outline of the principles governing the location, construction, and maintenance of roads, and the construction and maintenance of the various kinds of pavements for city streets. The text-book used is Baker's work on Roads and Pavements.

[REQUIRED IN COURSES I., IV., OPTION 3, XI.]

315. RAILROAD DRAWING AND FIELD-WORK.

Professor Allen; Messrs. Breed, Thorndike, Russell and assistants.

PREPARATION: 300; 313, taken simultaneously.

This course supplements course 313, and extends throughout the third year, practically one day per week being given to it together with course 303. In the first term a survey is made for a railroad some two miles in length. The reconnaissance is followed by the preliminary survey and the location, and the work is conducted according to the methods of modern practice in laying out railroads. Upon the completion of the field-work, the line is plotted from the notes taken. In the second term, the field-work consists in laying out curves of various kinds and in staking out earthwork; while the drawing consists in the construction of the profile of the line surveyed, and of practice in adjusting a line of railroad upon a contour map, with computation of the

earthwork and the preparation of a "mass diagram" for the determination of questions of "haul" and of "borrow and waste."

[Required in Courses I., XI. Elective in Course III., Option A, Graduate Year.]

316. FIELD-WORK AND DRAWING.

Professor Allen, Mr. Breed.

Preparation: 312.

This course supplements course 312, and consists of a series of exercises occupying three hours per week during the second term of the third year, devoted to the laying out of curves and the staking out of earthwork, specially adapted for students in Landscape Architecture. The work in the drawing-room consists of adjusting the line of a highway upon a contour map, plotting the cross-sections, and computing the earthwork, with special reference to the balancing of cut and fill.

[Required in Course IV., Option 3.]

319. RAILROAD ENGINEERING.

Professor Allen.

Preparation: 91; 313.

The course consists of a series of two lectures or recitations a week during the first term and three during the second term of the fourth year. 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; rolling stock and motive power; brakes; signals; yards and stations; tunnels; and street railroads. The object is to give the student a comprehensive knowledge of Railroad and Street Railway Engineering. The text-books used are Track and Track-work, by Tratman; Economics of Railroad Location, by Wellington; and cyclostyled notes by Professor Allen.

[Required in Course I., Option 2.]

320. RAILROAD MANAGEMENT.

Professor Allen.

Preparation: 190; 313.

This is a course of thirty lectures in the second term of the fourth year, designed to acquaint the student with the organization and management of railroads, and especially with the way in which business is conducted in the departments which are not engineering departments. The general questions of railroad policy are also discussed, such as rates, government ownership,

railroad accounts, etc. The course is intended to give a general view of the subject. No text-book is used.

[REQUIRED IN COURSE I., OPTION 2.]

321. RAILROAD AND HIGHWAY DESIGNING.

Professor Allen, Mr. Breed.

PREPARATION: 319, taken simultaneously.

A course of one hundred and five hours in the drawing-room, extending through both terms of the fourth year, including problems in contour location; the proportioning of culverts and water ways; the design of track-work, yards, station grounds, interlocking signals, and other practical railroad problems involving the application of the principles taught in courses 313 and 319. Each student is given a different problem to solve, and the work is critically corrected and discussed in detail.

[REQUIRED IN COURSE I., OPTION 2.]

325. STEREOTOMY.

Messrs. Thorndike, Russell and assistants.

PREPARATION: 107.

A series of thirty exercises of two hours each in the first term of the third year, in the applications of Descriptive Geometry to the making of drawings for masonry structures, such as intersecting arches and walls, abutments, piers, and culverts. It includes the study of warped surfaces, and the making of drawings for the helicoidal arch. The time is nearly all spent at the drawing board, but a moderate amount is assigned to outside preparation. The text-book used is a set of notes on Stereotomy and on Warped Surfaces, lithographed, and specially prepared for the use of students in this course by Professor Porter.

[REQUIRED IN COURSES I., XI.]

330. THEORETICAL HYDRAULICS.

Professor Porter, Mr. Russell.

PREPARATION: 90.

A course of forty-five text-book exercises given in the first term of the fourth year, with the solution of numerous problems, 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. The student is made acquainted with the best experimental results, and the course is supplemented by exercises in the labora-

tory for both Options and in the field for Option 1 (courses 333 and 342). Merriman's Treatise on Hydraulics is used as a text-book.

[Required in Courses I., XI.]

331. THEORETICAL HYDRAULICS.

Professor Mott, Mr. Russell.

Preparation: 71 or 73.

A brief course of fifteen text-book exercises taking up selected portions of the work given in course 330. Given in the first term of the fourth year.

[Required in Courses II., III., XIII.; Optional in Course X.]

332. THEORETICAL HYDRAULICS.

Professor Mott, Mr. Russell.

Preparation: 73.

A course of thirty text-book exercises, dealing with selected portions of the work given in course 330, especially with flow through pipes. Given in the first term of the fourth year.

[Required in Course VI.]

333. HYDRAULIC MEASUREMENTS.

Professors Porter, Mott; Mr. Russell.

Preparation: For Courses I., Option 1, and XI., 303; 330. For Course X. 331. For Course XII., 303.

A course of thirty hours, given in the first term of the fourth year, and designed to teach the methods of measuring the volume of water flowing in open channels, by means of floats and current meters, such as are required when water in large quantities is to be sold, as for power or irrigation, and in other hydraulic investigations involving large volumes of water. The principles governing the measurement of small or medium quantities, as by orifices, weirs, or nozzles, are taught and illustrated in courses 330 and 342. In the class-room, the student is taught the laws governing the distribution of velocity in the cross-section of flowing water, and the construction and use of the instruments used for measuring the velocity, together with the methods of computing the discharge. Each student also spends three afternoons in the field, as a member of a small party, in active gaugings with tubes and current meters; either in the hydraulic canals at Lowell, where, through the courtesy of the Proprietors of Locks and Canals on Merrimack River, such work is permitted to our students, and where quantities of from 1000 to 1500 cubic feet per second are usually found; or in a measuring flume in the Charles River at Newton Upper Falls, where a smaller volume of flow is found, and where a very convenient

gauging station has been constructed for this purpose. The remaining time of the course is given to the graphical work and computing required in finding the discharge from the measurements made in the field. The text-book used is a set of lithographed notes by Professor Porter.

[Required in Courses I., Option 1, XI., XII.; Optional in Course X.]

334. SANITARY AND HYDRAULIC ENGINEERING.

Professor Porter.

Preparation: 330, taken simultaneously.

A course of three exercises a week in the first term. This course and that in Hydraulic Engineering, 335, form a continuous series of exercises, three a week, extending throughout the fourth year, and treating of the application of the principles of Hydraulics to engineering, especially to what is classed as sanitary work. It is to a considerable extent descriptive, and consists of lectures and recitations, with the use of notes and text-books. The ordinary class-room work is supplemented by occasional lectures by practising engineers, by visits to works in construction or operation, by the study of working drawings, by many problems, and by work in design (course 337). The course in the first term, specified above, treats of the drainage of buildings and lands, the treatment and disposal of sewage, and the sewerage of cities and towns; followed by a course in irrigation, in which are studied the constructions and methods employed in this and other countries, including the arrangement and proportioning of diversion weirs, canals, distributaries, falls, regulators, and other special works, and modes of applying water to the soil. The text-books used are Gerhard's House Drainage, Elliott's Engineering for Land Drainage, Folwell's Sewerage, and Wilson's Irrigation Engineering.

[Required in Courses I., Option 1, XI.]

335. HYDRAULIC ENGINEERING.

Professor Porter.

Preparation: 334.

This course of three hours per week in the second term of the fourth year is a continuation of course 334, and is partially described under that head. The subject of water supply is first taken up, and embraces 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 designing of dams, 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 next taken up, partly by lectures and partly by text-book, and embraces a study of 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. The text-book used is Turneaure and Russel's Public Water Supplies.

[Required in Courses I., Option 1, XI.]

336. SANITARY ENGINEERING AND DRAINAGE: MASONRY.

Professor Porter; Messrs. Thorndike, Russell.

Preparation: 103; 312; 770.

This is a brief course, comprising thirty hours during the first term of the fourth year, arranged for the students in Landscape Architecture, and designed to give them some familiarity with the simple problems of drainage and of masonry construction, such as they may require in their professional practice. First are given fifteen exercises, based mainly upon text-book preparation, on the drainage of buildings and lands, and the water supply and sewage disposal of estates. These are followed by about six exercises in the simple problems of Stereotomy, and by nine exercises in the computation and design of retaining walls and the estimation of earth pressure, with some simple considerations respecting foundations.

[Required in Course IV., Option 3.]

337. SANITARY AND HYDRAULIC DESIGNING.

Professors Porter, Mott; Mr. Russell.

Preparation: 334; 335, taken simultaneously.

In this course of six hours a week (two hours for Course I.), in the second term, typical subjects for design are assigned, the data seldom being the same for any two students, and are worked out in detail in the drawing-room, subject to the criticism and suggestions of the instructor in charge. Problems commonly taken up are: the preliminary design of a system of sewers or of a water-supply distribution system for a small town, the design of 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 stand-pipe, for a bell-mouth junction of large sewers, or for a high masonry dam.

[Required in Courses I., Option 1, XI.]

338. HYDRAULIC MOTORS.

Professor Porter.

Preparation: 331.

A series of thirty exercises during the second term of the fourth year, mainly recitations based upon a text-book, and to some extent a continuation of the brief course in Theoretical Hydraulics (331), so as to embrace the laws of

flow in open channels and of the dynamic pressure and work of water flowing over curved surfaces. The time is principally given, however, to a study of impulse wheels and reaction turbines, with reference to their proper construction, regulation, and testing, and to the various sources of loss of energy in their operation. Lectures on speed regulation are given by a specialist in that line of work. Bodmer's work on Hydraulic Motors is used.

[Required in Course II.]

330. HYDRAULIC MACHINERY.

Professor Mott.

Preparation: 335.

This is a course of thirty exercises in the second term of the fourth year, dealing with the general principles governing the operation of pumps, rams, presses, accumulators, lifts, engines, buffers, and various other types of hydraulic machinery, with appropriate problems. Blaine's work on Hydraulic Machinery is used as a text-book.

[Required in Course XI.]

340. THEORETICAL HYDRAULICS.

Professor Mott.

Preparation: 71 or 73.

A brief course of fifteen text-book exercises in the first term of the third year, taking up portions of the work given in course 330, selected with special reference to the needs of Naval Constructors.

[Required in Course XIII.A.]

342. HYDRAULIC LABORATORY.

Professor Miller.

Preparation: 330.

A course of eight laboratory exercises of two hours each in the second term of the fourth year. The time is devoted to testing pumps, ejectors, pulsometers, etc.; to measuring water by means of weirs, meters, nozzles, and orifices; and to making efficiency tests of water wheels.

[Required in Courses I., XI.]

345. THEORY OF STRUCTURES.

Professor McKibben.

Preparation: 90.

This course consists of twenty-five class-room exercises in the second term of the third year, and is devoted to a study of the loads, reactions, shears, and

moments acting upon structures of various kinds, principally roofs and bridges. The practical designing of beams is also taken up. The text-book is a set of notes prepared by Professor Swain, with a set of examples collected by Professor McKibben.

[Required in Courses I., XI.]

346. THEORY OF STRUCTURES.

Professor McKibben.

Preparation: 75, taken simultaneously.

This course of two exercises a week in the second term of the third year is essentially identical with course 345, except that somewhat greater attention is given to the conditions and structures met with in the practice of the architect. The text-book is the same as in course 345.

[Required in Course IV., Option 2.]

347. THEORY OF STRUCTURES.

Professor Swain.

Preparation: 81.

This is a specialized course arranged for the Naval Constructors, and consists of thirty lectures during the first term of the graduate year together with about thirty hours in the drawing-room. 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 structural problems arising in the design of ships. The text-books are the same as in courses 345, 348, and 350.

[Required in Course XIII.a.]

348. THEORY OF STRUCTURES; BRIDGES AND SIMILAR STRUCTURES.

Professor Swain.

Preparation: 345.

This is an extended course consisting of three exercises a week throughout the fourth year, in continuation of course 345. It treats of the computation and design of structures of wood, steel, and masonry, by analytical and by graphical methods. The subjects considered are: the simple beam, the plate girder, roof and bridge trusses of various forms, trestles of wood or steel, earth pressure, retaining walls, masonry dams, arches of metal, stone, or concrete, and concrete-steel structures. The object is to train the student thoroughly in the application of the principles of Mechanics and the strength of materials to the design of structures. The text-books are printed notes by Professor Swain, and Baker's Masonry Structures.

[Required in Courses I., XI. Elective in Course III., Option A, Graduate Year.]

349. FOUNDATIONS.

Professor McKibben.

PREPARATION: 348, taken simultaneously

A course of fifteen exercises in the first term of the fourth year, devoted to the study of the methods of constructing foundations for bridges, buildings, and other structures, and to a study of the properties, manufacture, and methods of use of cements and concrete. Baker's Masonry Construction is used as a text-book.

[REQUIRED IN COURSE I.]

350. ADVANCED STRUCTURES.

Professor Swain.

PREPARATION: 348.

This course consists of thirty class-room exercises in the second term of the fourth year, in continuation of course 348. It treats of the computation and design of cantilevers, continuous girders, movable bridges, metal arches, and skeleton frames for buildings. Only the more simple cases are considered, leaving the complex structures to be studied in graduate courses or in the School of Engineering Research. The text-book is printed notes by Professor Swain.

[REQUIRED IN COURSE I.]

351. THEORY OF STRUCTURES.

Professor Swain.

PREPARATION: 346; 85, taken simultaneously.

A course of three hours per week, extending throughout the fourth year, essentially similar to course 348, except that it is more specifically adapted for students in Architectural Engineering.

[REQUIRED IN COURSE IV., OPTION 2.]

352. MATERIALS.

Professor Swain.

PREPARATION: 313.

This is a short course of fifteen exercises in the first term, 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. The text-book used is Johnson's Materials of Engineering.

[REQUIRED IN COURSE I.]

355. BRIDGE DESIGN.

Professors Swain, McKibben; Mr. Thorndike and assistants.

PREPARATION: 348, taken simultaneously.

A course of six hours a week throughout the fourth year in the drawing-room, with occasional lectures, in which the students are instructed in the design of structures of wood, stone, and metal. Each student is given a different set of data, and is required to perform all the computations and to make designs and working drawings for several structures, such as a plate girder bridge, a wooden roof truss, and a riveted or pin bridge. His work is criticised as it progresses, and his design is compared with those made by other students.

[REQUIRED IN COURSE I.]

356. BRIDGE DESIGN.

Professors Swain, McKibben; Mr. Thorndike and assistants.

PREPARATION: 348, taken simultaneously.

This is a course similar in character to course 355, but much shorter, consisting of sixty hours, in the first term of the fourth year, and intended to give only an outline of the subject.

[REQUIRED IN COURSE XI.]

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.

DEPARTMENT OF MECHANICAL ENGINEERING.

GAETANO LANZA, C.E.
Professor of Theoretical and Applied Mechanics.

CECIL H. PEABODY, S.B.
Professor of Naval Architecture and Marine Engineering.

PETER SCHWAMB, S.B.
Professor of Machine Design.

ALLYNE L. MERRILL, S.B.
Professor of Mechanism.

EDWARD F. MILLER, S.B.
Professor of Steam Engineering.

S. HOMER WOODBRIDGE, A.M.
Associate Professor of Heating and Ventilation.

CHARLES E. FULLER, S.B.
Assistant Professor of Mechanical Engineering.

WILLIAM A. JOHNSTON, S.B.
Assistant Professor of Mechanical Engineering.

CHARLES F. PARK, S.B.
Assistant Professor of Mechanical Engineering.

GEORGE B. HAVEN, S.B.
Assistant Professor of Mechanical Engineering.

Instructors.

JOSEPH C. RILEY, S.B.
CHARLES W. BERRY, S.B.
HARRISON W. HAYWARD, S.B.
WALTER H. JAMES, S.B.
LAWRENCE S. SMITH, S.B.
ROY G. BURNHAM, S.B.
EDWARD J. RUXTON, S.B.
GEORGE W. SWETT, S.B.
THEODORE H. TAFT, S.B.

Assistants.

CHESTER S. ALDRICH, S.B.
MAURICE W. CARTY, S.B.
MYRON W. DOLE, S.B.
EVERETT O. HILLER, S.B.
ADDISON F. HOLMES, S.B.
CARL KING, S.B.
IRVING H. COWDREY, S.B.
CLARENCE E. GAGE, S.B.
HORACE J. MACINTIRE, S.B.
ROBERT W. MCLEAN, S.B.
ALBERT H. SMITH, S.B.

The chief purpose of the instruction in the Department of Mechanical Engineering is to enable the student to deal intelligently with general engineering problems; hence a large portion of the instruction is given not only to students of Mechanical Engineering, but also to students in other Courses, including Electrical Engineering, Chemical Engineering, Naval Architecture, Mining Engineering (Option 2), and Civil Engineering, and to a small extent in certain Options in the Courses in Chemistry and in Physics. The instruction includes courses in such fundamental subjects as Mechanism, Valve-gears, Thermodynamics, Steam Engineering, Mechanical Engineering Drawing, and work in the Engineering Laboratory. In all of these the work is so planned as to furnish a drill in the fundamental principles of Engineering, which shall serve as a foundation for the future work of the student, whatever his special line may be.

Of the subjects taken exclusively, or mainly, by students of Mechanical Engineering, the following special features may be noted.

(*a*) In the instruction in Machine Design, the student is required to make all his calculations in the light of the principles he has learned in the other portions of the work, and not by means of empirical rules.

(*b*) The course in Industrial Management is designed to enable the student to deal intelligently with the business principles of a manufacturing establishment, so that he may understand this side of his profession as well as the engineering side proper.

(*c*) The four Options offered in the fourth year are so planned as to oblige the student to take up some one line of his profession, to apply his knowledge to one special class of problems, and to choose this special line with some reference to his individual tastes.

In the Engineering Laboratory, the experiments are made upon a practical scale, so that they may give results of value, and accuracy is insisted upon throughout.

In this work, as well as in the thesis work, the element of original research is insisted upon, and a considerable amount of investigation of important engineering problems is thus carried on.

360. MECHANISM.

Professor Merrill.

PREPARATION: 34, 107, 770, which may be taken simultaneously; 372, 373, taken simultaneously.

This course consists of ninety lectures and recitations during the first and second terms of the second year. It 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 study of the mechanisms found in modern American machine-tools, and in cotton machinery. The course also includes 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 COURSE II.]

361. MECHANISM.

Professors Merrill, Park, Haven; Mr. James.

PREPARATION: as for 360.

This course consists of seventy-five lectures and recitations (sixty in Course VI.), extending throughout the year, and is very similar to course 360 with the exception of the mechanism of cotton machinery.

[REQUIRED IN COURSES III., OPTION 2, VI., X., XIII., ELECTIVE IN COURSES III. AND V., OPTION A, GRADUATE YEAR.]

362. MECHANISM.

Professor Merrill; Mr. Burnham.

PREPARATION: 34; 107; 770; 374, taken simultaneously.

Forty-five exercises during the first and second terms of the third year. Similar to course 361, but much briefer.

[REQUIRED IN COURSE V., OPTION 1.]

364. MECHANISM.

Professor Merrill.

PREPARATION: 34; 107; 770, which may be taken simultaneously.

Two exercises a week in the second term of the third year. A brief course, omitting valve-gears.

[REQUIRED IN COURSES I., VIII., OPTION 3.]

372. MECHANICAL ENGINEERING DRAWING.

Professor Park; Mr. Ruxton and assistants.

PREPARATION: 360 or 361, 362, taken simultaneously.

This course consists of drawing-room exercises of two to three hours a week during the first term of the second year. The instruction includes the drawing of simple machine details, such as bolts and nuts, screws, springs, keys, flanges, pipe fittings, etc.; teaching systems of dimensioning, conventional representations, and blue-printing; and the drawing necessary in connection with the course in Mechanism.

[REQUIRED IN COURSES II., VI., XIII.]

373. MECHANICAL ENGINEERING DRAWING.

Professor Park; Mr. Ruxton and assistants.

PREPARATION: 360 or 361, 362, taken simultaneously.

A course of drawing-room exercises of from two to six hours a week during the second term of the second year. It consists of drawing illustrating the class-room work in connection with the courses in Mechanism and Valve-gears, including problems in belting, the design of cams, quick-return motions, gear-teeth, slide-valves, double valves, etc. The amount and arrangement of the work vary for the different professional Courses.

[REQUIRED IN COURSES II., III., OPTION 2, VI., X., XIII., ELECTIVE IN COURSES III., V., OPTION A, GRADUATE YEAR.]

374. MECHANICAL ENGINEERING DRAWING.

Professor Park; Mr. Swett.

PREPARATION: 107, which may be taken simultaneously.

A course of fifteen two or four-hour drawing-room exercises in the first term, devoted to the making of dimensioned working drawings of simple machines from measurements. The instruction includes conventional representations and the process of blue-printing.

[REQUIRED IN COURSES V., OPTION 1, VIII., OPTION 3.]

377. MACHINE DRAWING.

Professor Park; Messrs. James, Burnham, Swett and assistants.

PREPARATION: 360 or 361; 373.

This course consists of drawing-room exercises of from two to six hours a week during the first and second terms. The aim of the course is to teach the proper way of making the necessary dimensioned drawings for use in practice, good shop systems being adopted. The instruction includes the making of working detail and assembly drawings of machinery from measurements. The amount and the arrangement of the work are varied for the different professional Courses. Course VI. takes a part of this work, and Course XIII. the whole of it in the second term.

[REQUIRED IN COURSES II., III., OPTION 2, VI., X., XIII., ELECTIVE IN COURSES III., V., OPTION A, GRADUATE YEAR.]

378. MECHANICAL ENGINEERING DRAWING.

Professor Park; Mr. James and assistants.

PREPARATION: 71 or 73, taken simultaneously; 377.

This course consists of drawing-room exercises of from two to five hours a week during the second term of the third year. The course gives practice in the solution of problems in the design of valve-gears, the Stephenson link, quick-return motions, and other mechanism designs. Some time is also spent in the determination of velocity diagrams for special engine or other linkages. The amount and arrangement of the work are varied for the different professional Courses.

[REQUIRED IN COURSES II., X., ELECTIVE IN COURSES III., V., OPTION A, GRADUATE YEAR.]

379. BOILER DRAWING.

Professor Park; Mr. James and assistants.

PREPARATION: 377; 385, taken simultaneously.

A course of thirty hours of drawing-room exercises during the second term of the third year. The course is given in connection with the class-room work in boilers, and is intended not only to teach the method of drawing boilers, but to give the students more familiarity with the construction and details of steam boilers. It is also preparatory to the course in Machine Design.

[REQUIRED IN COURSES II., X., OPTION 5.]

380. DRAWING DESIGN.

Professor Park; Mr. Swett.

PREPARATION: 385, taken simultaneously.

A course of twenty hours of drawing-room exercises during the first term, given in connection with the class-room work in the mechanism of the steam engine. It includes problems in slide-valves, and the Stephenson link.

[REQUIRED IN COURSE XIII.A.]

381. MECHANICAL ENGINEERING DRAWING.

Professor Park; Mr. Swett.

PREPARATION: 362, taken simultaneously.

This course consists of ninety hours of drawing-room exercises during the first term of the fourth year. The course includes the making of working assembly drawings of machinery, and the drawing illustrating the class-room work in connection with the courses in Mechanism and Valve-gears. It includes problems in belting, the design of cams, slide-valves, double valves, etc.

[REQUIRED IN COURSE V., OPTION 1.]

385. STEAM ENGINEERING.

Professor Miller; Messrs. Riley, Berry.

PREPARATION: 35; 369; 70, 71, 377, 771 or 72, 73, 377, 771 taken simultaneously.

The course consists of three lectures or recitations per week throughout the year. It includes a detailed study of the principles of Thermodynamics, mathematically treated; a discussion of the properties of gases and vapors, especially steam; of the flow of steam and other fluids; of the steam injector; and of the hot-air engine, and gas-engine. All these topics are treated in such a way as to give the student a good foundation in the principles of Thermodynamics, especially as they apply to the steam-engine and steam turbine. This is followed by a study of the steam-engine itself, of the compound and multiple expansion engine, and of the mode of testing steam-engines, of compressed air and of refrigerating machines. A careful study is made of such data as have been based on reliable tests made on large, single, compound, and multiple expansion reciprocating engines, and on the steam turbines. The subject of steam boilers is treated at considerable length. Several lectures are given on condensers, air pumps, and the various accessories of a steam plant. Course VI. omits one exercise per week during the first term of the present year.

[REQUIRED IN COURSES II., III., OPTION 2, VI., X., XIII., ELECTIVE IN COURSES III., V., OPTION A, GRADUATE YEAR.]

386. **STEAM ENGINEERING.**

Professor Peabody.

A course of sixty lectures extending through the year on Thermodynamics and the mechanism of the steam-engine, similar to the preceding course, but specially adapted to the needs of students taking Course XIII.A.

[REQUIRED IN COURSE XIII.A.]

387. **STEAM ENGINEERING.**

Professor Peabody.

PREPARATION: 35; 364; 771.

A course of two lectures and recitations a week, extending throughout the fourth year, on valve-gears, steam-engines, and steam boilers, differing from course 385 mainly in that it is briefer, and is intended for those who expect rather to use than to design and to build steam-engines.

[REQUIRED IN COURSE I.]

391. **ELEMENTS OF ENGINEERING.**

Professor Miller.

PREPARATION: 370 or 381.

A course of thirty lectures in the second term of the fourth year, on engines, boilers, boiler accessories, pumps, condensers, etc., pneumatic machinery, and labor-saving devices.

[REQUIRED IN COURSES V., OPTION 1, VIII., OPTION 3.]

396. **ENGINEERING LABORATORY.**

Professor Miller; Mr. Taft and assistants.

PREPARATION: 385.

The work in the Engineering Laboratory begins in the second term of the third year, and consists of a series of seven two-hour exercises, devoted to drill in steam-engine tests, for which the 9-inch, 16-inch, and 24-inch by 30-inch triple expansion engine, and also the 11-inch and 19-inch by 15-inch tandem compound engines are used. In these engine tests the water consumption is determined by condensing and weighing the steam after it has passed through the engine.

[REQUIRED IN COURSES II., III., OPTION 2, X., XIII., ELECTIVE IN COURSE V., OPTION A, GRADUATE YEAR.]

397. ENGINEERING LABORATORY.

Professors Miller, Johnston, Fuller; Messrs. Riley, Berry, Taft, and assistants.

PREPARATION: 369; 385; 396; also for Courses II. and XIII. 331, 401 or 402, taken simultaneously; for Courses X. and XIII.A 402, taken simultaneously.

This course of four hours a week throughout the fourth year is a continuation of the preceding. The work can best be illustrated by the following list of tests made by the students during the past two years:

Tests to determine the efficiency of chain drives.
Tests of the transmission of power by belting.
Tests of the performance of a surface condenser.
Tests of a duplex steam pump, 16, 10½ x 12.
Tests to determine the accuracy of planimeters.
Tests to determine the accuracy of indicator springs.
Tests of a 36-horse-power gas-engine.
Tests to determine the efficiency of pulley blocks.
Tests of the flow of steam.
Valve setting (plain slide-valve).
Tests of a pulsometer.
Calibration of orifices for the flow of water.
Determination of the clearance of an engine.
The use of the Emerson power scale.
Valve setting (double valve).
Tests of gauges, steam and vacuum.
Test of a 400-horse-power battery of boilers, the test continuing for 104 hours, each man working eight hours.
Tests of the steam injector.
The use of three different kinds of calorimeters.
Tests of a Swain turbine.
Tests of a rotary pump of a capacity of 1,000 gallons per minute.
Measurements of the flow of air.
Test of the steam ejector.
Tests of the water ejector.
Tests of 36-inch American impulse wheel.
Tests of an air-pump.
Tests on coefficient of friction.
Moment of inertia of connecting rod.
Tests of three-stage air-compressor, 2,500 lbs.
High temperature measurements.
Heat of combustion of coal.
Measurement of the flow of water by means of orifices and weirs.
Test of a 48-inch Pelton water wheel.
Tests of a Rider hot-air engine.

Valve setting (Harris-Corliss engine).

Analysis of chimney gas.

Explosive force and time of reaching maximum pressure of different mixtures of gas and air.

Ratio of specific heats of air.

Tests of a hydraulic ram.

Tests of a piston water motor.

A 120-hour plant test on engines and boilers at the Institute.

The method of conducting the laboratory tests is as follows: tests are made under the direction of seven instructors, three students generally working together on one test. As the students are applying in their laboratory work knowledge they have already gained in the class-room, it is necessary only for the instructors to explain the arrangements of piping and connections for any piece of apparatus before beginning work. This makes it possible for a great deal of valuable laboratory work to be done in a period of two hours. The observations taken on every test are returned to the instructor, who works up the test and critically compares the student's computation with his own. Course VI. omits seven exercises, and Course X. five exercises in the first term, the omissions being tests depending on theoretical work not covered. Course XIII.A. omits five exercises in the first term and four exercises in the second term. Course 639 is a part of Course 397.

[REQUIRED IN COURSES II., VI., X., XIII., XIII.A.]

398. ENGINEERING LABORATORY.

Professor Miller.

PREPARATION: 80; 385; 396.

Four hours a week during the second term of the fourth year. See course 397.

[REQUIRED IN COURSE III., OPTION 2.]

401. DYNAMICS OF MACHINES.

Professors Lanza, Merrill.

PREPARATION: 385; 80, taken simultaneously.

A course of lectures and recitations given three hours a week for nine weeks in the first term. The courses in Dynamics of Machines include a number of the principal applications of Dynamics to moving machinery, such as governors, fly-wheels, the action of the reciprocating parts of the steam-engine, etc.

The various subjects are treated in such a manner that the results are suitable for practical use in designing, and also in making experimental investigations.

[REQUIRED IN COURSES II., XIII., XIII.A.]

402. DYNAMICS OF MACHINES.

Professors Lanza, Merrill.

PREPARATION: 385; 80, taken simultaneously.

A course of three hours a week for five weeks during the first term of the fourth year. See course 401.

[REQUIRED IN COURSE X.]

404. MACHINE DESIGN.

Professors Schwamb, Haven.

PREPARATION: 80; 379; 401, taken simultaneously

To this work are devoted, including all time used for lectures, calculations, and drawings, nine hours per week during the first term of the fourth year. The main object of the course is the application of principles already learned to the solution of problems in design. Each student makes a number of complete designs, such as a boiler, a large shaft with pulleys and gears, a set of couplings, etc. For each design the constructive details are carefully discussed; each student then makes all the necessary calculations to determine the dimensions of every part, not by the use of empirical formulæ, but by means of principles already acquired, and finally he completes the working drawings. The scope of the designs is such as to include most of the elementary principles of design, and yet is sufficiently limited to enable the student to complete every detail, as it is believed that only by such thorough work can real benefit be obtained.

[REQUIRED IN COURSE II.]

(A course of 90 hours is given to Course X., Option 5.)

405. DRAWING AND MACHINE DESIGN.

Professor Schwamb.

PREPARATION: 377; 386; 92, taken simultaneously.

Four hours a week in the first term and six in the second are devoted to this work. After some preparatory instruction in drawing, mainly boiler drawing (as in course 379), the student proceeds upon a course in design similar to course 404, and finally applies the principles thus acquired to the solution of problems in the design of electrical machinery.

[ELECTIVE IN COURSE VI., GRADUATE YEAR.]

407. FOUNDATIONS.

Professor Lanza.

PREPARATION: 81, taken simultaneously.

A course of fifteen lectures given in the second term. The subjects treated in this course are as follows: building stones and concrete, bearing power of

different kinds of soil, examination of the site, designing the footings, whether of masonry or of steel and concrete, independent piers, pile foundations, compressed air processes, freezing processes, retaining walls.

[REQUIRED IN COURSES II., XIII.A.]

400. INDUSTRIAL MANAGEMENT.

Professor Schwamb.

PREPARATION: 420, 421, 422, or 423, taken simultaneously.

This course of ten lectures in the second term of the fourth year includes a study of the organization and relations of the various departments of an industrial establishment, both in the office and in the workshop, the conduct of accounts, the methods of superintendence and of compensating labor, the determination of costs of production, and a careful discussion of the effect on costs of different systems of distributing indirect expenses.

[REQUIRED IN COURSE II.]

413. HEATING AND VENTILATION.

Professor Woodbridge.

PREPARATION: 770.

This course consists of forty-five lectures in the first term of the third year, followed by thirty in the second. The course is planned to acquaint the student with the fundamental principles of the subject, and the proper application of these principles to practice in the solution of a considerable range of problems in this field of Engineering. The practical side of the subject is treated with as much thoroughness and fulness as is consistent with the primal aim of the course.

[REQUIRED IN COURSE IV., OPTIONS 1 AND 2 (OPTION 1 omits second-term work).]

414. HEATING AND VENTILATION.

Professor Woodbridge.

PREPARATION: 771.

A course of fifteen lectures, given in the first term of the fourth year, on the fundamental features and principles of the subject. See course 413.

[REQUIRED IN COURSE II., OPTIONS 1, 2, 3.]

415. HEATING AND VENTILATION.

Professor Woodbridge.

PREPARATION: 771.

A course of thirty lectures given in the first term of the fourth year, including the subjects given in course 414 and also a study of Heating and Ventilation from the standpoint of hygiene.

[REQUIRED IN COURSE XI.]

416. HEATING AND VENTILATION.

Professor Woodbridge.

PREPARATION: 771.

A course of fifteen lectures given in the first term similar to course 414, but more technical.

[REQUIRED IN COURSE XIII.A.]

420. MARINE ENGINEERING.

Professor Peabody.

PREPARATION: 80, 331, 401, taken simultaneously.

A course of lectures, recitations, and drawing exercises given thirty-five hours in the first term of the fourth year and forty hours in the second.

The Option in Marine Engineering begins with a thorough study of the problems of the resistance and propulsion of ships, leading to the determination of the power required for a certain speed, and the methods of designing and proportioning paddle-wheels and screw propellers. A description is given of marine engines in all their details, together with methods of determining dimensions and proportions of parts and the stresses due to steam pressure and dynamical actions.

A discussion is given of vibrations of ships and balancing engines. Each student makes a preliminary design of a marine engine and the design for propellers suitable for such an engine.

[REQUIRED IN COURSE II., OPTION 1.]

421. LOCOMOTIVE ENGINEERING.

Professor Lanza.

PREPARATION: 80, 331, 401, taken simultaneously.

A course of lectures and recitations given thirty-five hours in the first term of the fourth year and forty hours in the second.

The Option in Locomotive Construction begins with a careful 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. While most of these are American, nevertheless consideration is given also to those of foreign construction. 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 heating cars by steam from the locomotive, 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 COURSE II., OPTION 2.]

422. MILL ENGINEERING.

Professor Schwamb.

PREPARATION: 80, 331, 401, taken simultaneously.

A course of lectures and recitations given thirty-five hours in the first term of the fourth year and forty hours in the second.

The Option in Mill Engineering includes the study of mill and building construction and stability, chimney construction and design; the calculation of stresses in an existing modern mill building from working drawings; a discussion of cotton-mill organization and equipment, including the economical arrangement and methods of driving machinery; a study of the different methods of distributing power, the design of the power plant, and determination of cost of power; all leading up to the solution of a problem involving the design of a complete mill plant.

[REQUIRED IN COURSE II., OPTION 3.]

423. HEATING AND VENTILATING ENGINEERING.

Professors Woodbridge, Park.

PREPARATION: 80, 331, 401, taken simultaneously.

A course of lectures and recitations given thirty hours in the first term of the fourth year and forty hours in the second.

The Option in Heating and Ventilation includes studies relating to the hygiene, the economics, and the methods of ventilation; the treatment of air preparatory to its use in ventilating work; the mechanics of ventilation; the mechanism for ventilating work, including electric generators, electric, steam, water, and other motors, and blowers; air analysis and its use in testing ventilating work; the relation of fuels, chimneys, and the various types of furnaces to heat production and utilization; the determination of the calorific power of fuels; the rates of heat-loss by buildings; the methods of warming buildings by hot air, water, and steam; and the various types of buildings, with reference to the most effective methods of warming and ventilation.

[REQUIRED IN COURSE II., OPTION 4.]

SPECIAL LECTURES.

Besides the teaching by the regular corps of instructors, lectures upon special subjects are given by gentlemen actively engaged in the profession.

During the past school year lectures were given by Mr. J. R. Worcester, on Foundations; by Mr. Odin B. Roberts, on the Relation of Patent Law to Engineering; and by Mr. L. R. Greene, of the Walworth Manufacturing Co., on the Piping of Large Power Plants.

DEPARTMENT OF MINING ENGINEERING AND METALLURGY.

ROBERT H. RICHARDS, S.B.
Professor of Mining Engineering and Metallurgy.

HEINRICH O. HOFMAN, E.M., MET.E., PH.D.
Professor of Metallurgy.

RICHARD W. LODGE.
Assistant Professor of Mining and Metallurgy.

Instructor.

CHARLES E. LOCKE, S.B.

Assistants.

MOSES BROWN, JR., S.B
ROBERT FAULKNER, S.B.
RUFUS C. REED, S.B.
GEORGE A. BARNABY, S.B.
JOHN T. GLIDDEN, S.B.
RALPH HAYDEN.

Instruction in Mining and Metallurgy is given by lectures and recitations, by laboratory work, and in the Summer School. This work presupposes that the preparatory courses in Mineralogy, Geology, and Surveying, given in preceding years, have been taken. Chemical studies begun in the first year are carried on during the entire course. Work in the Department, begun in the second year with Plattner's blowpipe assay of silver, is followed in the third year by a course of lectures on methods of mining, including prospecting, sinking, stoping, hoisting, pumping, and ventilating, the location of mining claims, and mine surveying. Ore-dressing in the fourth year is taught by lectures and by extended laboratory work. The student is given a wide experience in actual metallurgical work, and checks his results by assays and chemical analyses at the appropriate stages of the process. In addition, he receives lectures and laboratory instruction in the

heat treatment and microscopical examination of metals and alloys. A circular of the Department will be sent on application to the Secretary of the Faculty.

430. BLOW-PIPE SILVER ASSAY.

Professor Richards and assistants.

PREPARATION: 5[illegible]1.

A series of fifteen two-hour laboratory exercises in the first term of the second year, devoted to the Plattner assay of silver by the blow-pipe. This is a rapid method of making an approximate valuation of an ore of silver with small portable tools. It is applied to a variety of ores to give the students practice in overcoming the various difficulties that may arise, and forms a good introduction to the professional studies of the Course in Mining Engineering. The text-book is Richards, Notes on Blow-Piping.

[REQUIRED IN COURSE III., OPTIONS 1, 3.]

432. ASSAYING.

Professor Lodge and assistants.

PREPARATION: 840.

This course consists of lectures and laboratory exercises extending through one term of the third year, four hours per week. It is taken the first term by Course III., Options 1, 3, and the second term by Courses III., Option 2, and V., Option 4. The student takes up the crushing and sampling of ores and the assay of ores for silver, gold, lead, copper, and tin; also the assay of base and doré bullion, the assay of solutions, and all work related to the carrying on of a reguiar assay office in connection with a mine or smelter. The text-book is Lodge, Notes on Assaying and Metallurgical Laboratory Experiments.

[REQUIRED IN COURSES III., V., OPTION 4.]

433. ASSAYING.

Professor Lodge and assistants.

PREPARATION: 840 or 841.

This is a shorter course of fifteen two-hour exercises in the second term of the third year, which covers only the sampling of ores and the assay of ores for silver, gold, and lead. The text-book is Lodge, Notes on Assaying and Metallurgical Laboratory Experiments.

[REQUIRED IN COURSES V., OPTIONS 1, 2, 3, 5, VIII., OPTION 3.]

435. METALLURGICAL LABORATORY.

Professors Richards, Hofman, Lodge; Mr. Locke and assistants.

PREPARATION: 770; 432; 437, 441, 442, 559, taken simultaneously.

A course of laboratory work, eight hours per week during the first term of the fourth year, 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. The work in the Metallurgical Laboratory includes roasting, smelting, amalgamating, leaching, and the electrolytic treatment of copper, lead, silver and gold ores. In the second term twelve hours per week are devoted to a thesis involving special study of some particular line of work.

[REQUIRED IN COURSES III., V., OPTION 4.]

436. METALLURGICAL LABORATORY.

Professor Hofman and assistants.

PREPARATION: 433; 559; 437, 443, taken simultaneously.

In this course given eight hours a week for three weeks in the first term of the fourth year the work is identical with the purely metallurgical work of course 435.

[REQUIRED IN COURSE VIII., OPTION 3.]

437. LABORATORY REPORTS.

Professors Richards, Hofman, Lodge; Mr. Locke.

PREPARATION: 435 or 436, taken simultaneously.

A seminar accompanying courses 435 and 436, held one hour per week during the fourth year, in which the students and instructors meet and discuss the various points brought out by the week's work. Students in Course VIII. attend only those seminars which are connected with the work of course 436.

[REQUIRED IN COURSES III., V., OPTION 4, VIII., OPTION 3.]

438. METALLURGICAL LABORATORY.

Professors Richards, Hofman, Lodge.

PREPARATION: 435.

A course of laboratory investigation.

[ELECTIVE IN COURSE III., OPTION B, GRADUATE YEAR.]

441. METALLURGY OF IRON.

Professor Hofman.

PREPARATION: 551.

A series of fifteen lectures in the first term of the fourth year, in which is given a general review of the Metallurgy of iron and steel. The introductory part is devoted to a discussion of the physical and chemical properties, and the constitution of cast iron, wrought iron, and steel. This is followed by a more extended treatment of the production of cast iron, wrought iron, Bessemer, open-hearth, cement, and crucible steel, and of foundry work. In the discussion of the different processes, principles of manufacture are made prominent; details of practice are given in printed notes. The text-book is Hofman, Outline of the Metallurgy of Iron and Steel.

[REQUIRED IN COURSES II., III., V., OPTIONS 1, 2, 3, 4, X., XI., XIII., XIII.A.]

442. METALLURGY OF NON-FERROUS METALS; GENERAL METALLURGY.

Professor Hofman.

PREPARATION: 551; 432; 435, taken simultaneously.

This course of seventy-five lectures extends throughout the fourth year. In the first term, thirty lectures are devoted to the Metallurgy of lead and copper, and of silver as far as it is related to these metals. The processes for extracting lead and copper from their ores and for refining them are treated in detail. At the same time particular attention is paid to the principles on which are based the operations of roasting, smelting, leaching and electro-deposition. Work in the Metallurgical Laboratory (course 435) supplements the class-room exercises. In the forty-five lectures of the second term Non-ferrous Metallurgy is concluded and General Metallurgy is taken up. Gold, silver, zinc, and aluminum are discussed in detail, and the remaining minor metals, nickel, cobalt, arsenic, antimony, tin, quicksilver, and bismuth, are reviewed briefly. 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., are given in connection with the several metals. The text-book is Hofman, Metallurgy of Lead and the Desilverization of Base Bullion.

[REQUIRED IN COURSES III., V., OPTION 4.]

443. ELEMENTS OF NON-FERROUS METALLURGY.

Professor Hofman.

PREPARATION: 551.

A course of twenty lectures, given the last ten weeks of the first term of the fourth year. The subject treated is the Metallurgy of lead, copper, silver, and

gold as a branch of chemical technology. The different processes are discussed mainly in their chemical bearings; the principal features of General Metallurgy are taken up as far as is necessary.

[Required in Courses V., Options 1, 2, 3, VIII., Option 3, X.]

446. ELECTRO-METALLURGY.

Professor Hofman.

Preparation: 796; 442 or 443.

This course of fifteen lectures, given in the second term of the fourth year, discusses the present state of the application of the electric current to the treatment of ores and metallurgical products. The established processes relating to the treatment of copper, gold, aluminum, zinc, nickel, and tin are taken up in detail; others are outlined.

[Required in Course VIII., Option 3. Elective in Course III., Option B, Graduate Year.]

449. DISTILLATION OF FUELS.

Professor Gill.

Preparation: 442.

A course of six lectures in the second term, which treats of the chemical processes that take place in the manufacture of charcoal and coke, and in the distillation of oils. The leading principles of the organic processes involved in the operations are made clear to a student versed only in Inorganic Chemistry.

[Elective in Course III., Option B, Graduate Year.]

452. METALLOGRAPHY.

Mr. Sauveur and assistants.

Preparation: 771; 441, 442, which may be taken simultaneously.

A course of six lectures in the first term of the fourth year, descriptive of the constitution and microstructure of metals and alloys and of the relations between their properties, chemical and mechanical treatment and structure. The application of the microscope to the study of alloys is taken up in eight laboratory exercises.

[Required in Courses III., Options 1, 2, XIII.A.]

453. GENERAL METALLURGY.

Professor Hofman.

PREPARATION: 452.

A course of fifteen lectures, given in the first term, treating of the physical and chemical properties of metals and their compounds.

[ELECTIVE IN COURSE III., OPTION B, GRADUATE YEAR.]

454. GENERAL METALLURGY.

Professor Hofman.

PREPARATION: 453, taken simultaneously.

A laboratory course of ninety hours in the first term, embodying mostly research-work in the study of the behavior of metals and their compounds when subjected to heating.

[ELECTIVE IN COURSE III., OPTION B, GRADUATE YEAR.]

458. MINING ENGINEERING.

Professor Richards; Mr. Locke.

PREPARATION: 300; 770; 840; 72, 771, taken simultaneously.

A course of ninety lectures, three hours per week through the third year. In the first term are discussed the mechanism and 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.

In the second term the subjects considered are hydraulicking, tramming, hoisting ore, coal, and men, pumping, ventilating, lighting, explosions, fires, mining law, underground surveying, and the handling of men. The text-book is Richards, Mining Notes.

[REQUIRED IN COURSE III., OPTIONS 1, 3.]

459. MINING ENGINEERING.

Professor Richards; Mr. Locke.

PREPARATION: 770; 771; 840; also for Course III. 72; 80, taken simultaneously.

This course of lectures, two hours per week, is a continuation of the preceding, and extends through the fourth year. In the first term Ore-dressing, including the various methods of crushing and concentration of ores, is discussed. In the second term the course is concluded with the consideration of various motors or sources of power used in mining work. Part of this course in the second term is given by Professor Miller (391).

[REQUIRED IN COURSES III., V., OPTION 4.]

462. ORE-DRESSING.

Professor Richards.

PREPARATION: 459.

A seminar of thirty hours, in the first term, in which the student presents the results of his reading on assigned topics. The text-book is Richards, Ore-Dressing.

[ELECTIVE IN COURSE III., OPTION A, GRADUATE YEAR.]

463. ORE-DRESSING.

Professor Richards.

PREPARATION: 462, taken simultaneously.

A course of one hundred and eighty hours in the second term, devoted to the laboratory investigation of ore-dressing problems.

[ELECTIVE IN COURSE III., OPTION A, GRADUATE YEAR.]

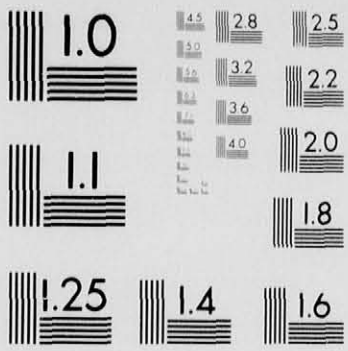
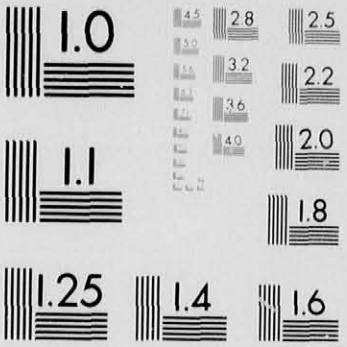
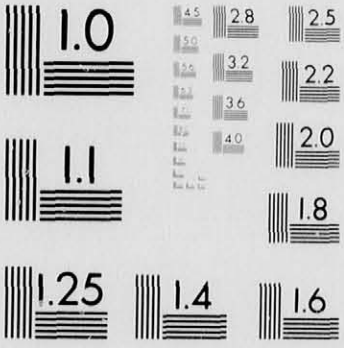
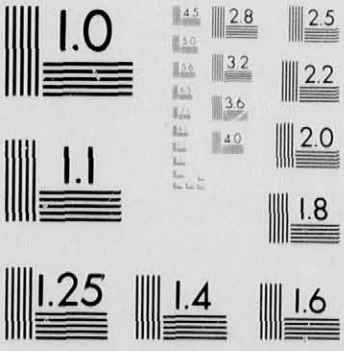
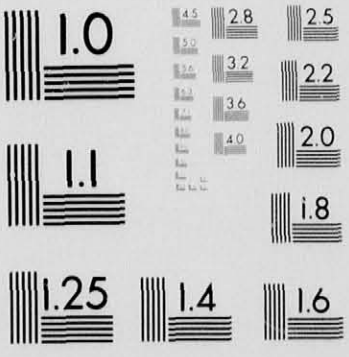
465. MEMOIRS.

Professor Hofman.

PREPARATION: 221; 231; 442, which may be taken simultaneously.

A series of exercises held one hour a week throughout the fourth year. The aim of this course is to start the students in the reading of French and German technical literature, and to make them familiar with technical terms. The work consists in transcribing into English articles from standard foreign books and periodicals, and reading them before the assembled class. The papers are reviewed from a technical point of view directly after they have been read, and are later criticised by the Department of English as to their literary character.

[REQUIRED IN COURSE III.]


1.0
1.1
1.25
1.4
1.6
2.8
2.5
3.2
2.2
3.6
2.0
4.0
1.8

1.0
1.1
1.25
1.4
1.6
2.8
2.5
3.2
2.2
3.6
2.0
4.0
1.8

1.0
1.1
1.25
1.4
1.6
2.8
2.5
3.2
2.2
3.6
2.0
4.0
1.8

1.0
1.1
1.25
1.4
1.6
2.8
2.5
3.2
2.2
3.6
2.0
4.0
1.8

1.0
1.1
1.25
1.4
1.6
2.8
2.5
3.2
2.2
3.6
2.0
4.0
1.8

DEPARTMENT OF ARCHITECTURE.

FRANCIS W. CHANDLER.
Professor of Architecture.

DESIRÉ DESPRADELLE.
Rotch Professor of Architectural Design.

WILLIAM H. LAWRENCE, S.B.
Associate Professor of Architecture.

HARRY W. GARDNER, S.B.
Assistant Professor of Architecture.

Special Teachers and Lecturers.

TRUMAN H. BARTLETT.
ALLEN H. COX.
DAVID A. GREGG.
ELEAZER B. HOMER, S.B.
JOHN G. JACK.
GUY LOWELL, A.B., S.B.
SAMUEL W. MEAD.
ROSS TURNER.
C. HOWARD WALKER.

The instruction offered at the Institute is intended to supply the preliminary training required for the practice of Architecture. It recognizes that Architecture is a fine art, and that its practice must be based on a broad training in design, and on the principles underlying sound construction.

The studies begin with Freehand and Mechanical Drawing, and the Descriptive Geometry which later is to aid in solving the problems of Shades and Shadows, Stereotomy, Perspective, etc. Courses in Applied Mechanics, Graphical Statics, and Strength of Materials prepare the way for professional work in constructive design, which teaches the application of the principles already learned to the solution of structural problems likely to occur in modern practice.

The studies of materials used in building, and of working drawings and specifications, are carried far enough to enable the student to take immediate advantage of office opportunities on graduation.

The History of Construction explains the influences of the building material used, and the constructive principles involved,

in the growth of the great architectural styles. History of Architecture instructs in the principles governing design in the Classic, Mediæval, and Renaissance work, and the proper use to be made of precedent. The importance of a broader æsthetic and historical training is also recognized, and amply provided for in the history course on European Civilization and Art; and the historical development of ornament and a consideration of the motives influencing architectural composition are given in the course on the History of Ornament.

Four years' instruction in Freehand Drawing, from the cast and the living model; a year's course in modelling; and extended courses in water color, and pen-and-ink drawing, based as much as possible upon architectural subjects, enable the student to associate at once the principles of draughtsmanship with architectural form. The courses in Freehand Drawing are described under the Department of Drawing, page 134.

The instruction in Option 2, a specialized course in Architectural Engineering, includes advanced courses relating to Applied Mechanics, the Theory of Structures, and practical problems in Structural Design.

The instruction in Landscape Architecture, offered as a Graduate Course, is mainly devoted to Architectural and Landscape Design, Landscape Horticulture, History, and to the necessary branches of Civil Engineering, Geology, and Biology.

The department offers opportunities for one or more graduate years of advanced study, to be spent in professional work, and leading to the Master's degree.

The student is strongly advised to spend part of the summer vacation in an architect's office, for this practical experience is a great aid to him in the clearer understanding of his school work.

The Bachelor's degree of the Institute admits the holder to candidacy for membership in the American Institute of Architects, without the examination ordinarily required of candidates for membership.

A circular of the Department will be sent on application.

470. SHADES AND SHADOWS.

Professor Gardner.

PREPARATION: 103, 112, taken simultaneously.

A course of fifteen drawing-room exercises during eight weeks in the second term of the first year. Each of the exercises is in the nature of an examination. They include the methods of Descriptive Geometry in casting shadows, and also the shorter ones for determining the shadows in architectural drawings.

[REQUIRED IN COURSE IV.]

471. PERSPECTIVE.

Professor Lawrence.

PREPARATION: 107; 470.

A series of fifteen one-hour exercises in the second term of the third year, consisting of lectures, recitations, and class-room work. Each 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 perspective plan, curves, shadows, and apparent distortion.

[REQUIRED IN COURSE IV.]

472. STEREOTOMY.

Professor Gardner.

PREPARATION: 103.

A course of fifteen two-hour drawing-room exercises in the first term of the third year, each in the nature of an examination. The work begins by making the student familiar with the common building stones and their properties; with the methods of quarrying, and the principles of stone construction. Later the student works out the most common forms of construction in stone.

[REQUIRED IN COURSE IV., OPTIONS 1, 2.]

480. SPECIFICATIONS AND WORKING DRAWINGS.

Professors Chandler, Gardner.

PREPARATION: 100.

A course of forty-five hours in each term of the second year, divided between lectures and drawing-room exercises. The various materials of modern construction, such as cement, lime, mortar, brick, wood, stone, concrete, metal, etc., are discussed, and their uses by the mason, the carpenter, the roofer, and the plumber, are explained. This work in the lecture-room is supplemented by practical instruction in laying out quarter-scale plans and elevations from sketches, and in making the framing plans and working drawings of various kinds necessary in actual practice. Careful instruction is also given in the writing of specifications.

[REQUIRED IN COURSE IV., OPTIONS 1, 2.]

483. SPECIFICATIONS AND WORKING DRAWINGS.

Mr. Lowell.

PREPARATION: 541, taken simultaneously.

A course of lectures and exercises in the first term of the fourth year, for the purpose of showing the student how the more simple specifications and working drawings should be prepared in connection with the problems in Landscape Design.

[REQUIRED IN COURSE IV., OPTION 3.].

486. HISTORY OF CONSTRUCTION.

Professor Chandler.

PREPARATION: 482.

A course of fifteen one-hour lectures in the first term of the third year, given with the aid of the stereopticon. It deals with the highly developed methods used by the Greek, Roman and Mediæval builders, and explains how the growth of their architectural styles was due to these causes. Themes are required.

[REQUIRED IN COURSE IV., OPTION 2.]

488. BUSINESS RELATIONS, CONTRACTS, ETC.

Professor Chandler.

PREPARATION: 482.

A course of fifteen one-hour lectures in the second term of the fourth year, relating to contracts, competitions, the employment by the architect of engineers, clerks of the work, etc., the relations of architect to client, contractor, and draughtsman; special classes of building, and such related topics as may arise in current work.

[REQUIRED IN COURSE IV.]

490. ARCHITECTURAL HISTORY.

Mr. Homer.

PREPARATION: 526, taken simultaneously.

A course of fifteen one-hour lectures in each term of the second year, given with the aid of the stereopticon.

The first term is devoted to Egyptian, Assyrian, Persian, and Greek architecture, and the second, to Roman, Byzantine, and Early Romanesque. Abstracts and themes are required.

[REQUIRED IN COURSE IV.]

491. ARCHITECTURAL HISTORY.

Mr. Homer.

PREPARATION: 490; 526.

A course of thirty one-hour lectures in each term of the third year, given with the aid of the stereopticon.

The first term is devoted to Romanesque and Gothic architecture, and the second, to Renaissance. Abstracts and themes are required.

[REQUIRED IN COURSE IV.]

492. SPECIAL RESEARCH; ARCHITECTURAL HISTORY.

Professor Chandler; Mr. Homer.

PREPARATION: 491.

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.

[ELECTIVE IN COURSE IV., GRADUATE YEAR.]

495. HISTORY OF ORNAMENT.

Mr. Walker.

PREPARATION: 117; 527

A course of fifteen one-hour exercises. 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 the problems are designed and rendered in color.

[REQUIRED IN COURSE IV., OPTIONS 1, 3.]

500. LANDSCAPE HORTICULTURE.

Mr. Jack.

PREPARATION: 701, taken simultaneously.

A course of fifteen two-hour exercises of lectures, laboratory and field work extending throughout the second year. The student is expected to give attention to the identification of the most important trees and shrubs used in landscape design in north temperate America. Instruction is also given concerning the propagation, cultivation, and values of these trees and shrubs for special purposes in landscape design.

[REQUIRED IN COURSE IV., OPTION 3.]

501. LANDSCAPE HORTICULTURE.

Mr. Jack.

PREPARATION: 733.

A course of thirty two-hour exercises including lectures, field exercises, and the making of planting designs extending throughout the third year.

In the third year instruction in Dendrology is continued in the first half-year, followed by instruction in herbaceous plants used in landscape work, their identification, propagation, culture, and values for special purposes.

[REQUIRED IN COURSE IV., OPTION 3.]

502. LANDSCAPE HORTICULTURE.

Mr. Jack.

PREPARATION: 501.

A course of thirty two-hour lectures and field exercises extending throughout the fourth year.

This course is a continuation of courses 500 and 501. Further instruction in herbaceous plants is given in the first half-year. Much attention is given to the making of planting plans, so that the student may become familiarized with the proper arranging or grouping of plants in designs. The field exercises include a study of gardens and planting designs.

[REQUIRED IN COURSE IV., OPTION 3.]

515. PEN AND INK.

Mr. Gregg.

PREPARATION: 116.

A course to ensure facility of rendering in pen-and-ink of architectural subjects. Instruction is given in fifteen one-hour periods in the second term of the third year. Each week the work of the previous week is criticised before the class.

[REQUIRED IN COURSE IV.]

516. PEN AND INK.

Mr. Gregg.

PREPARATION: 515.

This course of fifteen one-hour periods extends through the fourth year. It continues course 515, and instruction is given in the same way.

[REQUIRED IN COURSE IV.; OPTION 2 OMITS SECOND-TERM WORK.]

517. COMPOSITION IN RENDERING.

Mr. Gregg.

PREPARATION: 516.

A continuation of course 516. The course of fifteen one-hour periods is mainly devoted to rendering architectural subjects and perspectives in black and white, color, ink and pencil, and to the study of effects desirable to obtain in the presentation of detail.

[ELECTIVE IN COURSE IV., GRADUATE YEAR.]

520. WATER COLOR.

Mr. Turner.

PREPARATION: 117, taken simultaneously.

This course begins with the second term of the third year, and continues through thirty weeks, with one two-hour exercise per week. Its purpose is to give a good knowledge of the brush and color, primarily with the view of rendering architectural detail and decoration. The instruction begins with study from still life in the studio. As the work progresses opportunity is given for out-of-door sketching and during the summer vacation which intervenes between the two terms of the course, students are expected to make sketches to present for criticism.

Lectures on the physical theory of color are given in a special course, 814.

[REQUIRED IN COURSE IV., OPTIONS 1, 3.]

522. MODELLING.

Mr. Bartlett.

NO PREPARATION REQUIRED.

A course of fifteen two-hour exercises in clay modelling in the second term of the first year. The purpose of the course is to teach the student the value of the third dimension, which he needs to recognize for the proper understanding of architectural detail. He is taught the manipulation of clay, and its practical use as an aid in design.

[REQUIRED IN COURSE IV.]

523. MODELLING.

Mr. Bartlett.

PREPARATION: 117; 522.

A course of fifteen two-hour exercises in clay modelling, given in the second term of the fourth year. It is an extension of the first-year course, but, as it comes after an experience gained in three years of architectural design and line drawing, its value as an important means in design is made more evident.

[REQUIRED IN COURSE IV., OPTIONS 1, 3.]

526. DESIGN I. AND THEORY OF ARCHITECTURE.

Professors Despradelle, Gardner.

PREPARATION: 100; 470; 116, taken simultaneously.

A course of eight hours per week through the first term of the second year, for all students of the Department. In the second term the course is eight hours per week for Options 1 and 2, and seven hours per week for Option 3.

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. At the same time the fundamental principles of Architecture are inculcated, and the influences governing composition are explained and discussed. Continued practice in drawing and academic rendering afford the training necessary for the hand and eye. The course is given by means of individual instruction in the class-room, and by lectures.

[REQUIRED IN COURSE IV.]

527. DESIGN II.

Professor Despradelle; Messrs. Mead, Cox.

PREPARATION: 526; 117, 118, taken simultaneously.

A continuation of course 526, given 120 hours during the first term of the third year to Options 1 and 2, and eight hours per week to Option 3. In the second term the course is fifteen hours per week and is given only to Option 1.

The entire course is devoted to problems in design, and sketch problems.

[REQUIRED IN COURSE IV.]

528. DESIGN III.

Professor Despradelle; Mr. Cox.

PREPARATION: 527; 118, 495, taken simultaneously.

A course of nineteen hours per week during the first term of the fourth year, and twenty-four hours per week during the second term, forming a continuation of the preceding course 527. The second term is largely devoted to the preparation of the graduating theses.

[REQUIRED IN COURSE IV., OPTION 1.]

529. ADVANCED ARCHITECTURAL DESIGN.

Professor Despradelle; Mr. Cox.

PREPARATION: 528.

A course devoted to advanced academic training in designing the most important and monumental classes of buildings. The time also allows of an exhaustive study of some archæological problem consisting of the restoration of Greek and Roman remains or an important study in Mediæval Gothic.

Lectures are given in the French language on theory and practice.

[ELECTIVE IN COURSE IV., GRADUATE YEAR.]

532. CONSTRUCTIVE DESIGN.

Professor Lawrence.

PREPARATION: 85, taken simultaneously.

A course in elementary architectural construction of seven hours per week during eight weeks of the first term of the fourth year. 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 drawing.

[REQUIRED IN COURSE IV., OPTION 1.]

533. ADVANCED CONSTRUCTIVE DESIGN.

Professor Lawrence.

PREPARATION: 532.

This course is a continuation of the course in Constructive Design, 532. It consists of a series of lectures and problems in practical design, occupying eight hours per week for fifteen weeks. 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 COURSE IV., GRADUATE YEAR.]

538. STRUCTURAL DESIGN.

Professors Swain, Lawrence.

PREPARATION: 346, taken simultaneously.

A course of four two-hour exercises per week during eight weeks of the second term of the third year. The time is devoted to the careful consideration of architectural loads, building laws, and practical problems in the design of elementary structures in wood, cast iron, and steel.

[REQUIRED IN COURSE IV., OPTION 2.]

539. STRUCTURAL DESIGN.

Professors Swain, Lawrence.

PREPARATION: 538; 351, taken simultaneously.

A course of nineteen hours per week during the first term and twenty-five hours per week during the second term of the fourth year, a part of the time during the second term being devoted to thesis work. Practical problems in architectural construction are given, including general framing in steel, plate and box girders, and riveted and pin trusses. Great importance is placed upon the study of the details of design, and in each problem carefully worked out and dimensioned drawings are made.

[REQUIRED IN COURSE IV., OPTION 2.]

540. LANDSCAPE DESIGN.

Mr. Lowell.

PREPARATION: 527.

A course of lectures on the principles of Landscape Design, combined with exercises in the drawing-room, where simple problems in laying out landscape work are taken up. Thirteen hours a week during the second term of the third year.

[REQUIRED IN COURSE IV., OPTION 3.]

541. LANDSCAPE DESIGN.

Mr. Lowell.

PREPARATION: 540.

Exercises in the drawing-room in the more complicated problems of designing and laying out public and private work. In connection with these designs planting plans are made. Students in this course are required to do one or more of the regular architectural problems given out in Option 1. Fourteen hours a week in the first term of the fourth year and eighteen in the second.

[REQUIRED IN COURSE IV., OPTION 3.]

542. LANDSCAPE ARCHITECTURE.

Mr. Lowell.

PREPARATION: 540.

One hour a week through the fourth year. Lectures and problems in Landscape Design, with special reference to the intimate association of architectural and landscape problems.

[REQUIRED IN COURSE IV., OPTION 3.]

DEPARTMENT OF CHEMISTRY AND CHEMICAL ENGINEERING.

HENRY P. TALBOT, PH.D.,
Professor of Inorganic and Analytical Chemistry.

ARTHUR A. NOYES, PH.D.,
Professor of Theoretical Chemistry.

THOMAS E. POPE, A.M.,
Professor of Inorganic Chemistry.

WILLIAM H. WALKER, PH.D.,
Professor of Industrial Chemistry.

HENRY FAY, PH.D.,
Associate Professor of Analytical Chemistry.

WILLIS R. WHITNEY, PH.D.,
Non-resident Associate Professor of Theoretical Chemistry.

FRED L. BARDWELL, S.B.,
Assistant Professor of Inorganic Chemistry.

AUGUSTUS H. GILL, PH.D.,
Assistant Professor of Technical Analysis.

FRANK H. THORP, PH.D.,
Assistant Professor of Industrial Chemistry.

F. JEWETT MOORE, PH.D.,
Assistant Professor of Organic Chemistry.

SAMUEL P. MULLIKEN, PH.D.
Assistant Professor of Inorganic Chemistry.

Instructors.

ELLEN H. RICHARDS, A.M., S.B.
PETER S. BURNS, PH.D.
GEORGE W. ROLFE, A.M.
JOSEPH W. PHELAN, S.B.
ALPHEUS G. WOODMAN, S.B.
WILLIAM T. HALL, S.B.
FREDERICK R. KNEELAND, S.B.
ARTHUR A. BLANCHARD, PH.D.
JOHN W. BROWN, PH.D.
MILES S. SHERRILL, PH.D.
LIVINGSTON W. SMITH, PH.D.
RICHARD B. EARLE, S.D.

Assistants.

GEORGE R. TAYLOR, S.B.
NELSON E. TOUSLEY, A.B.
RAYMOND HASKELL, S.B.
ROBERT B. SOSMAN, S.B.
EDWARD A. BARRIER, S.B.
RALPH S. GIFFORD, S.B.
HENRY L. JACKSON, S.B.
WARREN K. LEWIS, S.B.
FRANK J. QUINLAN, S.B.
ALBERT L. SMITH, S.B.

Instruction in general Inorganic Chemistry is given to all regular students 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 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, and Textile Coloring. In all of these subjects class-room instruction is combined with laboratory work. Students in the Course in Chemistry 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 and of the conditions for admission will be found in the circulars relating to the Courses in Chemistry and Chemical Engineering and in that 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. A circular of the department will be sent on application to the Secretary of the Faculty.

550. INORGANIC CHEMISTRY.

Professors Talbot, Pope, Bardwell; Messrs. Burns, Phelan, Blanchard, Smith, and assistants.

PREPARATION: 1, 2, 3, 4.

This course comprises two lectures, accompanied by one recitation and four hours of laboratory work per week during the first term of the first year. 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 Course in Chemistry 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.

As text-books, the following are freely consulted: Remsen, College Chemistry; Holleman-Cooper, Text-book of Inorganic Chemistry; Jones, Principles of Inorganic Chemistry; Talbot and Blanchard, Electrolytic Dissociation Theory; Smith, A Laboratory Outline of General Chemistry.

[REQUIRED IN ALL COURSES.]

551. INORGANIC CHEMISTRY, QUALITATIVE ANALYSIS.

Professors Talbot, Pope, Bardwell; Messrs. Burns, Phelan, Blanchard, Smith, and assistants.

PREPARATION: 550.

This course, which comprises two lectures, one recitation, and four hours of laboratory work per week in the second term of the first year, is a continuation of the preceding and deals with the Chemistry of the metallic elements and the principles of Qualitative Chemical Analysis. Students in the Courses in Chemistry and Biology devote three extra laboratory hours per week to the subject, and students in the Course in Physics, Options 1 and 2, two extra hours per week.

Text-book: A. A. Noyes, Qualitative Chemical Analysis, and others mentioned under course 550.

[REQUIRED IN ALL COURSES EXCEPT IV.]

552. QUALITATIVE ANALYSIS.

Professor Fay; Messrs. Hall, Kneeland, and assistants.

PREPARATION: 220, 230, 551.

The course includes class-room instruction (one hour per week), laboratory practice, and individual conference with instructors in the laboratory. The student is required to analyze alloys, minerals, rocks, pigments, slags, mattes, and industrial products of various sorts and complexity, the assignments differing according to the Course which he is pursuing, the substances being chosen with respect to some point of special interest, either in composition, source, or the purpose for which they are employed. The use of the spectroscope and a study of the reactions of the rarer elements are included in the course so far as time will permit. The amount of time devoted to this subject, which is given in the first term of the second year, varies in the different Courses.

Text-books: A. A. Noyes, Qualitative Chemical Analysis; Treadwell-Hall, Analytical Chemistry, Vol. I.

[REQUIRED IN COURSES III., V., VII., VIII., X., XI., XII.]

553. QUALITATIVE ANALYSIS OF RARE METALS.

Professor Noyes.

PREPARATION: 559; 623, taken simultaneously.

A course of laboratory practice for advanced students, in the first term, including the testing of recently developed methods and the investigation of new procedures for the separation and detection of the rare metals.

[ELECTIVE IN COURSE V., GRADUATE YEAR.]

558. QUANTITATIVE ANALYSIS.

Professor Fay; Messrs. Hall, Kneeland, and assistants.

PREPARATION: 552.

The course, given in the second term of the second year, consists of one hour per week of class-room instruction, and, in addition, laboratory practice, with individual conferences, one-half of the term being 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 subdivisions 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. Students of Course XI. take a course in Volumetric Analysis only.

Text-books: Talbot, Quantitative Chemical Analysis; Treadwell-Hall, Analytical Chemistry, Vol. II.

[Required in Courses III., V., VII., VIII., X., XI., XII.]

559. QUANTITATIVE ANALYSIS.

Professors Talbot, Fay; Dr. Sherrill, and assistants.

Preparation: 558; 221 or 231, taken simultaneously.

The class-room instruction of this course consists of one lecture and two recitations per week during the first term of the third year, and one lecture and recitation per week during the second term, in which methods of analysis, including those carried out in the Quantitative Laboratory, are discussed. Of these exercises fifteen are devoted to the study of text-books or journals in French or German, to enable the student to acquire facility in the use of such works; and, in this connection, a compilation of references to the journal literature upon a definite chemical topic is required of each member of the class.

The laboratory work of this course includes the analysis of silicates, minerals, and ores in the first term, and of industrial products in the second term, with special attention to the methods employed in the examination of irons and steels, the last being studied as typical technical procedures. The instruction of this year 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.

[Required in Courses III., V., VIII., Options 1, 3.]

561. INORGANIC CHEMISTRY.

Professor Fay.

Preparation: 558.

In this course of thirty lectures, given in the second term of the third year, the metals and non-metals are discussed from the general standpoint of Mendelejeff's Periodic System, special emphasis being laid upon the analogies and contrasts to which the system gives prominence. In this connection proper attention is paid to the elements of less common occurrence, although no attempt is made to treat them exhaustively. The composition of complex salts and of salts in solution also receives attention, including the results of recent investigations in this field. The course is illustrated by experiments.

[Required in Course V.]

565. AIR, WATER, AND FOOD ANALYSIS.

Mrs. Richards, Mr. Woodman.

PREPARATION: 558.

This course of six hours per week in the first term of the third year includes lectures and laboratory practice and is intended to illustrate the application of Chemistry to problems of modern municipal and domestic sanitation and the examination of food supplies,—as, for example, the chemical analysis of potable waters, tests of methods for sewage purification, the examination of the air of public buildings, and the determination of the character, purity, and nutritive value of such food-materials as milk, butter, and the cereals. The text-book is Richards and Woodman, Air, Water and Food from a Sanitary Standpoint.

[REQUIRED IN COURSES V., OPTIONS 2, 3, VII.]

567. WATER ANALYSIS.

Mrs. Richards, Mr. Woodman.

PREPARATION: 558.

A portion of the work of course 565, given two hours per week in the second term of the third year.

[REQUIRED IN COURSE V., OPTION 5.]

568. WATER ANALYSIS AND WATER SUPPLIES.

Mrs. Richards.

PREPARATION: 558.

A course in the first term of the fourth year, consisting of fifteen lectures upon the chemical problems connected with public water supplies, accompanied by thirty hours of laboratory practice in the methods of water analysis.

[REQUIRED IN COURSE XI.]

569. AIR ANALYSIS.

Mrs. Richards.

PREPARATION: 558.

A fifteen-hour course of laboratory instruction given in the second term of the fourth year upon the methods employed to test the air of public buildings to determine the efficiency of ventilation systems.

[REQUIRED IN COURSE XI.]

573. SUGAR ANALYSIS.

Mr. Rolfe.

PREPARATION: 558.

This laboratory course, given two hours per week for ten weeks in the first term of the third year, comprises standardization comparisons by quartz-plate

readings, polarizations of sugars by commercial methods, determinations of specific rotary powers, double polarization, determinations of the quotient of purity, the calibration of saccharimeters, and practice in the calculations of optical analysis, as applied to sugars, starches, and the like. About five hours of the time allotted to the course is devoted to class-room discussion of methods.

[Required in Course V., Options 2, 3.]

580. INDUSTRIAL CHEMISTRY.

Professor Thorp.

Preparation: 551; 590, which may be taken simultaneously.

This course consists of a series of forty-five lectures and recitations in each term upon the more important technical chemical processes, exclusive of those of Metallurgy. Much attention is given to the general operations common to many industries, such as crushing, grinding, lixiviation, filtration, evaporation, distillation, crystallization, etc., and to the details of various types of apparatus used for carrying on these processes. Some of the more important manufacturing industries, such as the production of alkali, fertilizers, glass, pigments, cement, soap, explosives, paper, as well as wood distillation, the refining of petroleum, etc., are also considered in detail. Charts, models, lantern slides, and a large collection of samples are employed as aids to instruction in this course, and in this connection visits are made by the class to various factories in the neighborhood of Boston. The text-book is Thorp, Outlines of Industrial Chemistry.

[Required in Courses V., VIII., Option 3, X.]

581. ADVANCED INDUSTRIAL CHEMISTRY.

Professors Walker, Thorp.

Preparation: 580; 592.

A course of fifteen lectures and conferences in the second term for advanced students, upon the applications of Chemistry to special lines of technical work. In connection with this course the student is expected to make an extended report upon some topic selected by the instructors.

[Elective in Course V., Graduate Year.]

582. INDUSTRIAL CHEMICAL LABORATORY.

Professors Walker, Thorp, and assistants.

Preparation: 558; 580, which may be taken simultaneously.

A course of ninety hours' laboratory practice (one hundred and five for Course X.), given in the first or second term, in the preparation and purification of chemical products on a sufficiently large scale to afford data for determining

with considerable accuracy the factors and conditions underlying the economy of the process employed. Each series of preparations made by the students involves a problem of practical importance, for the solution of which each member of the class furnishes a part of the necessary data as a result of experiments with such typical forms of apparatus as the filter-press, suction- and bag-filter, centrifugal machine, or various types of furnaces, electrolytic cells, steam-heated kettles and coils, crushers, grinders, etc. The student thus obtains some insight, through the work of the class, into the method of attacking industrial chemical problems, and acquires a knowledge of the chemical and physical properties of the substances he handles, and of the difficulties of manipulation in large-scale work. Reports and estimates upon apparatus and plant for the production of some particular product are required of each student, while the important questions of factory costs and distribution of expense are discussed, and, as far as possible, involved in the students' reports.

[Required in Courses V., Options 2, 4, X. Optional in Course VIII., Option 3.]

590. ORGANIC CHEMISTRY (Brief Course).

Professor Moore.

Preparation: 551.

This course of thirty exercises in the first term is designed for students who will not pursue the study of Organic Chemistry farther, 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 Courses VII., VIII., X., XI.]

592. ORGANIC CHEMISTRY.

Professor Mulliken.

Preparation: 590.

A course of three lectures a week throughout the fourth year, 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. For the class of 1907 and thereafter this course will begin in the second term of the third year, and end at the close of the first term of the fourth year.

[Required in Course V.]

593. RECENT DEVELOPMENTS IN ORGANIC CHEMISTRY.

Professor Moore.

This course of lectures (one hour per week) 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 fluorescence to chemical constitution, and other topics of general chemical interest will be discussed.

[ELECTIVE.]

594. CHEMISTRY OF THE TECHNICALLY IMPORTANT ORGANIC COMPOUNDS.

Professor Moore.

PREPARATION: 592 and 598 or equivalent.

This course is designed for advanced and graduate students who either desire to pursue the study of special branches of Organic Chemistry further than can be done in course 592, or expect to specialize professionally in some of the technical applications of this branch of the science. The course will consist of two lectures or conferences per week throughout the year, and the work will be divided as follows. One term will be devoted to the artificial dyes and allied coal-tar products, and the other term to those technically important organic compounds which are not obtained from coal-tar. The work of the two terms will not be interdependent, and one may be taken without the other. In general, the chemical character and behavior of the compounds concerned will be studied rather than their technology, though the latter subject will not be neglected.

[ELECTIVE.]

596. ORGANIC ANALYSIS.

Professor Moore; Dr. Earle.

PREPARATION: 559.

A course of five hours a week in the first term of the fourth year, consisting of work in the laboratory supplemented by a number of class-room exercises. The instruction in this course includes qualitative tests for all the important elements occurring in organic compounds, and quantitative determinations of carbon, hydrogen, nitrogen, and the halogens.

[REQUIRED IN COURSE V.]

597. ORGANIC QUALITATIVE ANALYSIS.

Professor Mulliken.

PREPARATION: 592; 598.

A course of laboratory practice, for advanced students, in systematic methods for the identification of organic compounds. Nine hours per week in the second term.

[ELECTIVE IN COURSE V., GRADUATE YEAR.]

598. ORGANIC PREPARATIONS AND REACTIONS.

Professor Moore; Dr. Earle.

PREPARATION: 590 or 591; 592, taken simultaneously.

In this course, given thirteen hours a week in the first term of the fourth year, 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 nitrobenzene, aniline, ethers, phenol, dyestuffs, and other products of synthetic and commercial interest. In connection with this work the student attends a course of ten lectures in which the general methods employed in his preparative work are discussed from the standpoint of efficiency and applicability in laboratory practice.

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. Beginning in 1906 this laboratory course will be divided between the second term of the third year and the first term of the fourth.

[REQUIRED IN COURSE V. (nine hours per week only required of Option 4).]

599. ORGANIC CHEMICAL LABORATORY.

Professor Moore; Dr. Earle.

PREPARATION: 590; 558.

This course includes a portion of the instruction described under course 598, the time devoted to the work varying somewhat with the professional Course.

[REQUIRED IN COURSES VII., OPTION 1, VIII., OPTIONS 1, 3, X., OPTION 3.]

600. ADVANCED ORGANIC LABORATORY.

Professors Moore, Mulliken.

PREPARATION: 592 and 598 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.]

610. THEORETICAL CHEMISTRY: (Energetics, Atomic Theory).

Professor Noyes.

PREPARATION: 31; 552; 770, which may be taken simultaneously.

A course of thirty exercises in the second term. During the first half of the term the important principles of physical science which underlie the subject of Theoretical Chemistry, especially the general laws relating to matter and energy, are reviewed, in a series of recitations and discussions. The text-book used is Noyes' Principles of Physical Science. During the second half of the term, in a course of lectures, the atomic theory is developed through a detailed consideration of the properties upon which molecular and atomic-weight determinations are based; and the periodic law, the subject of valence, and the foundations of the structure theory are discussed. In 1906–1907, courses 610, 611, and 612 will be combined into two courses, to be given in one year, forty-five exercises in each term, with accompanying laboratory practice. This course is omitted in 1905–1906.

[REQUIRED IN COURSES V., VIII., XII.]

611. THEORETICAL CHEMISTRY: (Ionic Theory, Reaction Velocity, Isothermal Chemical Equilibrium).

Professor Noyes.

PREPARATION: 610.

A course of thirty lectures given in the first term in continuation of the preceding course. In this course the properties of solutions dependent on the molecular weight of the dissolved substance are first discussed; then the ionic theory is developed through a consideration of the electrical properties of solutions; next the principles relating to the rate of chemical reactions are taken up; and finally the laws of chemical equilibrium in both homogeneous and heterogeneous systems at constant temperature are presented. The lectures are illustrated with numerous experiments.

[REQUIRED IN COURSES V., VIII., XII.]

612. THEORETICAL CHEMISTRY: (Thermochemistry).

Professor Noyes.

PREPARATION: 611.

Fifteen lectures during the second term are devoted to the effect of temperature on chemical equilibrium, to the phase rule, and to the heat-effects attending chemical changes.

[REQUIRED IN COURSES V., VIII., XII.]

613. ELECTRO-CHEMISTRY.

Professor Goodwin.

PREPARATION: 611; 612, taken simultaneously.

This course of fifteen lectures given in the second term of the fourth year treats of those parts of the subject not previously discussed in course 611, es-

pecially of the production of electrical energy by chemical processes, of the electro-motive force of voltaic cells, of the separate potential differences, of decomposition potentials; and other related subjects. The lectures are illustrated by experiments.

[REQUIRED IN COURSE V., OPTIONS 1, 2, 3, 4.]

618. THEORETICAL CHEMISTRY (Brief Course).

Dr. Brown.

PREPARATION: 551; 770, which may be taken simultaneously.

In this course of thirty lectures in the second term the subject of Theoretical Chemistry is presented in a much briefer form than in the courses above described (610–613). Only the more important principles, and especially those which have direct application to laboratory and industrial work, are considered; but these are so thoroughly discussed and exemplified that more than a superficial knowledge is obtained. Walker's Introduction to Physical Chemistry is used as a text-book. The lectures are illustrated by experiments.

[REQUIRED IN COURSES III., VII., X.]

619. THEORETICAL CHEMISTRY (Laboratory).

Professor Noyes; Dr. Brown and assistants.

PREPARATION: 611, taken simultaneously.

This course consists of a series of laboratory exercises held in connection with lecture course 611, and intended to illustrate the important properties of solutions and the application of the principles relating to chemical reaction-velocity and equilibrium. The methods of determining molecular weight and degree of ionization and the exemplification of the mass-action law receive especial attention. In 1906–1907 this course will be extended, and will accompany the lectures in both terms. (See course 610.)

[REQUIRED IN COURSE V.]

620. ADVANCED THEORETICAL CHEMISTRY.

Professor Noyes.

PREPARATION: 612; 613.

This course is intended for graduate students, and is of the nature of a seminar. The members of the class read Nernst's Theoretische Chemie, and meet once a week for an informal discussion of the subject as it is there presented. The course extends through two years, but any student having the required preparation may join the class at the beginning of any term.

[REQUIRED IN COURSE VIII., OPTION 1. ELECTIVE IN COURSE V., GRADUATE YEAR.]

623. ADVANCED INORGANIC CHEMISTRY.

Professor Talbot.

PREPARATION: 559; 612; 771.

A course of the same general character as course 620, in which the subject for discussion is Inorganic Chemistry.

[ELECTIVE IN COURSE V., GRADUATE YEAR.]

628. TESTING OF OILS.

Professor Gill and assistants.

PREPARATION: 558; 590.

A lecture and laboratory course of twenty exercises, 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. Given in the first term of the fourth year.

The text-book is Gill, Handbook of Oil Analysis.

[REQUIRED IN COURSE X.]

629. PROXIMATE TECHNICAL ANALYSIS.

Professor Gill and assistants.

PREPARATION: 221 or 231; 559; 580; 590.

A course of fifteen six-hour exercises of conference and laboratory work given in the first term of the fourth year 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 COURSE V., OPTION 2A.]

630. TEXTILE COLORING.

Professor Thorp and assistants.

PREPARATION: 590.

The work of this course, given in the first term of the fourth year, comprises about twenty lectures upon the general operations of bleaching and dyeing as applied to textiles, and seventy hours' practice in the laboratory. The dyeing of wool and cotton is studied, and the student becomes familiar with the use of mordants, the detection of dyestuffs present upon fibres, the principles of color matching, and the testing of commercial samples. Some acquaintance with the principles of calico printing is also acquired.

[REQUIRED IN COURSES V., OPTION 2b, X., OPTION 1.]

634. APPLIED CHEMISTRY.

Professors Walker, Gill.

PREPARATION: 221 or 231; 558; 580; 590.

A course of two lectures and class-room exercises a week throughout the fourth year, devoted to the discussion of topics relating to various phases of Chemical Engineering, such as the planning of chemical works or laboratories, the nature of the materials used in the construction of manufacturing plants, as well as the processes and machinery involved in their operation. The instruction includes the use of text-books and journals, in French and German as well as English, and each student is required to prepare a memoir upon one or more assigned topics, the material for which is gathered from a careful search through the recent literature upon the subject. These memoirs are read by the student and are discussed by the class.

[REQUIRED IN COURSE X.]

635. ANALYTICAL AND TECHNICAL CHEMISTRY.

Professors Gill, Moore and assistants.

PREPARATION: 551.

This course comprises thirty lectures during the first term, and seven hours per week of laboratory exercises during the second term, covering the principles of Organic, Analytical, and Technical Chemistry, with particular reference to the needs of Naval Constructors.

[REQUIRED IN COURSE XIII.A.]

636. CHEMICAL RESISTANCE OF MATERIALS.

Professor Walker.

PREPARATION: 580; 582; 590.

This course of fifteen lectures is intended to supplement the general course in Strength of Materials. The more important materials of construction are studied with reference to their chemical composition and general suitability for the construction of maufacturing plants exposed to corrosive or other destructive agents. Methods of preserving and fireproofing timber, the protection of iron and steel by special paints, and the application of peculiar alloys to specific uses, are among the topics discussed in the course. (Included in Applied Chemistry for the year 1905–6.)

[REQUIRED IN COURSE X.]

638. GAS ANALYSIS.

Professor Gill and assistants.

PREPARATION: 558; 771.

A course of five lectures and fifteen hours of laboratory work, embracing the qualitative and quantitative analysis of the various gases, the technical analy-

sis 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. The text-book is Gill, Gas and Fuel Analysis for Engineers.

[REQUIRED IN COURSES V., VIII., OPTIONS 1a, 3, X. ELECTIVE IN COURSE III., OPTION B, GRADUATE YEAR.]

639. GAS AND FUEL ANALYSIS.

Professor Gill and assistants.

PREPARATION: 551; 771.

An eight-hour lecture and laboratory course in the first term of the fourth year, 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.

[REQUIRED IN COURSES II., VI., XIII.]

645. HISTORY OF CHEMISTRY.

Professor Moore.

PREPARATION: 591; 611.

In this course of fifteen exercises given in the second term of the fourth year the 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 COURSE V.]

647. THESIS REPORTS.

Professor Noyes.

PREPARATION: 559; 592.

A series of weekly class-room exercises in the second term of the fourth year 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 COURSE V.]

649. ADVANCED FOOD ANALYSIS.

Mr. Woodman.

PREPARATION: 558, 565.

A course of ninety hours of laboratory work and class-room exercises, which is 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.

[ELECTIVE.]

SPECIAL LECTURES.

During the past year, in addition to the regular courses, special lectures have been given by the persons named below.

Mr. John Alden, chemist of the Pacific Mills, upon Textile Printing; Mr. Charles D. Jenkins, State Inspector of Gas and Gas Meters, upon the Manufacture of Illuminating Gas; Mr. Arthur D. Little, consulting chemist, upon the Manufacture of Paper; Mr. James W. Loveland, superintendent with Curtis Davis & Co., upon the Manufacture of Soap and Glycerine; Mr. S. W. Wilder, Jr., General Manager of the Merrimac Chemical Company, upon Alumina and Alumina Compounds; Mr. W. E. Piper, assistant superintendent with the Boston Rubber Shoe Company, upon Rubber; Mr. Albert E. Leach, chemist to the State Board of Health, on Food Inspection and State Control.

RESEARCH LABORATORY OF PHYSICAL CHEMISTRY.

ARTHUR A. NOYES, PH.D.
Professor of Theoretical Chemistry; Director of the Research Laboratory of Physical Chemistry.

HARRY M. GOODWIN, PH.D.
Associate Professor of Physics and Electro-chemistry.

Research Associates.

ARTHUR C. MELCHER, S.B. WILLIAM C. BRAY, PH.D.
ROY D. MAILEY, S.B. GUY W. EASTMAN, S.B.
GILBERT N. LEWIS, PH.D.

Research Assistants.

GEORGE A. ABBOTT, A.M. CHARLES A. KRAUS, S.B.
EDWARD W. WASHBURN, S.B.

Most of the courses in Physico-chemical and related subjects are given in the Chemical and Physical Departments and will be found described under Nos. 610, 611, 612, 613, 618, 619, 620, 796, 799, 803, 813, 829, and 830. Attention may be called especially to the courses on the Kinetic Theory of Gases (830), on Polarized Light and its Applications (813), and on the History of Science (761), which are given this year in a revised and extended form. A number of special courses are also given each year in connection with the Research Laboratory of Physical Chemistry. These courses are open to graduate students and others who have the requisite preparation. Those offered in 1905–1906 are described below.

THE HISTORICAL DEVELOPMENT OF CHEMISTRY. (Six Lectures.)

Professor Wilhelm Ostwald.

The fundamental conceptions and laws of Chemistry will be considered from a historical standpoint in these lectures. All graduate and third and fourth-year students in the Courses in Chemistry and Physics are invited to attend.

THE PHYSICAL PROPERTIES OF CHEMICAL SUBSTANCES (Seminar).

Professor Noyes.

In this course will be discussed the more important properties of chemical substances and of solutions of them. The principles of the methods employed for the determination of these properties, their variation with physical conditions, such as temperature, pressure, and concentration, and the relations to chemical composition and constitution will be considered. Weekly meetings of the Seminar will be held throughout the year.

GEOMETRICAL AND PHYSICAL CRYSTALLOGRAPHY. (Fifteen Lectures and Seven Laboratory Exercises.)

Professor Warren.

The earlier lectures of this course will deal with the geometric properties of the more important classes of crystals and will be accompanied by laboratory practice in the study of crystals and crystal models. The remaining time will be devoted to certain phases of theoretical and physical Crystallography, such as the theories of crystal structure, the growth and solution of crystals, the thermal, magnetic, electrical, and cohesive properties of crystals. The subject of Optical Crystallography, which will be more fully treated in the course on Polarized Light, will here be taken up only in so far as it has connection with the other physical properties of crystals or with the subject of crystal structure.

PHYSICO-CHEMICAL RESEARCH REPORTS AND REVIEWS.

Professor Noyes; Mr. Melcher.

All those engaged in Physico-chemical Research will meet once a week for the discussion of the researches in progress in the laboratory and for the consideration of recent articles on the subject.

OXIDATION AND REDUCTION (Eight Lectures).

Dr. Blanchard.

In this course, given during the first term, will be considered the state of oxidation of elements in relation to the periodic system, the equilibrium, velocity, and catalysis of oxidation reactions, and the relations to the electrical potential of oxidation cells.

GLASS-BLOWING.

Mr. Kraus.

Students are given an opportunity of familiarizing themselves with some of the more common manipulations before the blast-lamp under the personal supervision of the instructor.

DEPARTMENT OF ELECTRICAL ENGINEERING.

HARRY E. CLIFFORD, S.B.
Professor of Theoretical Electricity; acting in charge of the Department.

WILLIAM L. PUFFER, S.B.
Associate Professor of Electrical Engineering.

FRANK A. LAWS, S.B.
Assistant Professor of Electrical Testing.

RALPH R. LAWRENCE, S.B.
Assistant Professor of Electrical Engineering.

HARRISON W. SMITH, A.B., S.B.
Assistant Professor of Electrical Engineering.

Instructor.

CHARLES H. PORTER, A.B., S.B.

Assistants.

HAROLD G. CRANE, S.B.
JOHN C. DAMON, S.B.
WALDO V. LYON, S.B.
GEORGE I. RHODES, S.B.
GEORGE A. RODENBAECK, S.B.
HENRY A. WENTWORTH, S.B.

The instruction in Electrical Engineering aims to give a broad foundation in those general theoretical principles of Electricity upon which the development and advancement of the electrical art, in all its various phases, have been shown to rest. Co-ordinated with this instruction in the theory of Electricity 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 electrical apparatus of modern practice, in both direct and alternating current work, special emphasis being laid throughs out on a careful 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 intimate contact in his later professional work, and also to carry out original investigation, for which special rooms are provided.

A series of Journal Meetings, in which abstracts of important engineering papers are presented by the students and then discussed, keeps the students in touch with present practice in electrical work.

In both the undergraduate and the graduate Courses the work of the Department is supplemented with lectures by distinguished engineers not connected with the Institute.

650. THEORY OF PERIODIC CURRENTS.

Professor Clifford.

PREPARATION: 788.

This course of thirty lectures given in the first term of the fourth year is based on the third-year courses 787 and 788 in Theoretical Electricity and is devoted to a detailed discussion of the alternator and transformer and their relation to the other parts of a system for the electrical generation and distribution of power. Questions of efficiency, regulation, and the calculation of the performance under various conditions of load are discussed in considerable detail.

[REQUIRED IN COURSES VI., VIII., XIII.A.]

651. THEORY OF ALTERNATING CURRENT MACHINERY.

Professor Clifford.

PREPARATION: 650.

This course of thirty lectures in the second term of the fourth year, which forms a continuation of the preceding, is devoted to the theory of generators, motors, and rotary converters, both as to their qualities as individual machines and when used as a part of any electrical system. The special properties of each machine are considered in detail and calculations are made as to its performance under varying conditions of operation. A brief discussion of some of the fundamental considerations involved in long-distance electrical transmission is also included.

[REQUIRED IN COURSES VI., XIII.A. OPTIONAL IN COURSE VIII., OPTION 3.]

652. THEORETICAL ELECTRICITY.

Professor Clifford.

The work of this graduate course, three hours per week during the year, is concerned chiefly with the theory of the transmission of electrical energy,

more particularly with reference to power work. The questions of capacity and inductance as affecting transmission lines are considered in great detail, and the constants of various types of lines are worked out. There is also some discussion of the general principles of the inductively loaded line as applied to both Telephony and power work.

[ELECTIVE IN COURSE VI., GRADUATE YEAR.]

653. ELEMENTS OF ELECTRICAL ENGINEERING.

Professor Smith.

PREPARATION: 770.

A course of thirty lectures during the first term in which are considered the fundamental principles of the generation, distribution, and utilization of electrical energy.

[REQUIRED IN COURSES II., X.]

654. DIRECT CURRENT GENERATORS.

Professor Smith.

PREPARATION: 786.

A course of thirty lectures in the first term of the third year, devoted to the discussion of the theory of direct current machines, both generators and motors, including a study of the characteristics of the various types, series, shunt, and compound, a consideration of commutation, and of parallel running, together with the general principles involved in the testing of such machines. This course is given as introductory to the work in the Electrical Engineering Laboratory.

[REQUIRED IN COURSES VI., VIII., OPTION 3.]

657. ELECTRICAL ENGINEERING.

Professors Puffer, Lawrence.

PREPARATION: 650; 654; 651, taken simultaneously.

This course of sixty lectures, extending throughout the fourth year, is a general discussion of electrical distribution for light and power. It is intended to familiarize the student with the many ways in which dynamos, motors, and transformers are used collectively for commercial distribution. The course includes a general consideration of the use, maintenance, and care of storage batteries, and also a brief discussion of engineering specifications.

[REQUIRED IN COURSES VI., VIII., OPTION 3.]

658. ELECTRICAL ENGINEERING.

Professor Smith.

A course of lectures, recitations, and reading, two hours per week during the first term, in which the various types of direct and alternating current machinery are discussed with special reference to their uses in power work and industrial processes.

[ELECTIVE IN COURSES III., V., GRADUATE YEAR.]

661. DYNAMO-ELECTRIC MACHINERY.

Professor Smith.

PREPARATION: 770.

A course of thirty experimental lectures, in the first term of the third year, designed as an introduction to the study of the utilization of electricity for power purposes. The course begins with a brief discussion of the ordinary types of electrical measuring instruments, after which the action and application of direct and alternating current machinery are considered.

[REQUIRED IN COURSE I.]

662. DYNAMO-ELECTRIC MACHINERY.

Professor Puffer.

PREPARATION: 423, taken simultaneously.

A laboratory course of twenty-five hours, in the first term of the fourth year, on the management and testing of dynamos and motors. The work covers the ordinary tests of heating, efficiency, and speed regulation of motors.

[REQUIRED IN COURSE II., OPTION 4.]

663. INDUSTRIAL ELECTRICITY.

Professor Lawrence.

PREPARATION: 770.

A course of fifteen experimentally illustrated lectures in the first term, devoted to the consideration of the various types of commercial measuring instruments, for both direct and alternating currents. The general principles of direct current generators and motors, a study of their characteristics, a brief discussion of arc and incandescent lighting, and something of the various types of alternating current apparatus used in power distribution are included.

[REQUIRED IN COURSES VIII., OPTIONS 1, 2, XI.]

667. PRINCIPLES OF DYNAMO DESIGN.

Professor Derr.

PREPARATION: 650; 657.

A course of twenty exercises in the first term of the fourth year. A short discussion of the materials of construction and methods of armature winding is followed by the complete electrical and magnetic calculations for a direct-current compound dynamo and a transformer.

[REQUIRED IN COURSE VI.]

668. DYNAMO DESIGN (Advanced).

Professor Derr.

A course of fifteen exercises, forming a continuation of the preceding course and devoted to the design of alternating current machinery, including the electrical and magnetic calculations for a constant-potential alternator, a rotary converter, and an induction motor.

[ELECTIVE IN COURSE VI., GRADUATE YEAR.]

671. TELEPHONY.

Professor Cross.

PREPARATION: 787; 823.

This course of fifteen lectures in the second term of the fourth year is devoted to a somewhat minute discussion of the physical theory and operation of the various forms of telephonic transmitting and receiving apparatus, together with a consideration of the methods which have been employed in its experimental study.

[REQUIRED IN COURSE VI.]

672. TELEPHONE ENGINEERING.

PREPARATION: 671.

A course of ten lectures in the second term of the fourth year, discussing the design and construction of transmission lines, for both telephonic and power systems.

[REQUIRED IN COURSE VI.]

678. ELECTRIC RAILROADS.

PREPARATION: 657, taken simultaneously.

A course of ten lectures in the second term of the fourth year, including a discussion of the construction, equipment, and operation of different types of electric roads, together with related problems in power transmission and the mechanical engineering of electric power stations.

[REQUIRED IN COURSE VI.]

679. DESIGN OF STATIONS AND DISTRIBUTION SYSTEMS.

Professor Puffer.

This course includes the design of a small isolated plant and of a large lighting or traction station, with the calculations for the necessary distributing systems.

[ELECTIVE IN COURSE VI., GRADUATE YEAR.]

680. ELECTRICAL ENGINEERING.

Professor Puffer.

A course of thirty lectures in the second term of the graduate year, devoted to the discussion of electric installations, with special reference to navy yards and warships.

[REQUIRED IN COURSE XIII.A.]

681. STANDARDIZING LABORATORY.

Professor Laws.

PREPARATION: 788, 685 taken simultaneously.

In this laboratory course of three hours per week particular attention is given to tests to determine the character and behavior of the materials of Electrical Engineering under various circumstances and to the study of measuring instruments. In addition to these matters a considerable amount of time in the latter part of the course is devoted to work supplementary to the lectures on Periodic Currents.

[REQUIRED IN COURSES VI., VIII., CLASS OF 1907.]

683. ELEMENTS OF ELECTRICAL ENGINEERING.

Professors Puffer, Laws.

PREPARATION: 653.

A course of thirty lectures and recitations in the second term of the third year, on technical electrical measurements and methods, followed by a discussion of the salient features of electric installations.

[REQUIRED IN COURSE II.]

685. TECHNICAL ELECTRICAL MEASUREMENTS.

Professor Laws.

PREPARATION: 778; 686, taken simultaneously.

This course of twenty lectures in the first term is devoted to a detailed study of the various measuring instruments used in technical work, especial attention being given to questions of accuracy and possible sources of error. The class of 1907 takes this work in the second term of the third year.

[REQUIRED IN COURSES VI., VIII., OPTION 3; ELECTIVE IN COURSE XIII., GRADUATE YEAR.]

686. GENERAL ELECTRICAL TESTING.

Professor Laws.

PREPARATION: 779; 685, taken simultaneously.

In this laboratory course of five hours per week during the first term (three hours for Course VIII.), the work in Electrical Measurements (see 779) is extended to the more technical problems and to the employment of special methods. Forming a part of this course is a series of conferences in which the methods used in the laboratory are thoroughly discussed.

[REQUIRED IN COURSES VI., VIII.]

687. ELECTRICAL MEASUREMENTS (Advanced).

Professor Laws.

This is an advanced laboratory course of five hours per week during the first term 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 COURSE VI., GRADUATE YEAR.]

689. ELECTRICAL TESTING.

Professor Laws.

PREPARATION: 779.

A laboratory course of two hours per week in which special attention is given to the calibration of instruments and to the tests concerned in the acceptance of electrical material.

[REQUIRED IN COURSE XIII.A. ELECTIVE IN COURSE XIII., GRADUATE YEAR.]

690. ELECTRICAL ENGINEERING LABORATORY.

Professors Laws, Smith.

PREPARATION: 653; 683, taken simultaneously.

A course of fifteen laboratory exercises in the second term of the third year, designed to familiarize the student with the elements of technical Electrical Measurements and the operation of various types of electrical machinery.

[REQUIRED IN COURSE II.]

691. ELECTRICAL ENGINEERING LABORATORY.

Professors Clifford, Lawrence, Smith.

PREPARATION: 653.

A laboratory course of three hours per week during the second term of the fourth year, devoted to the illustration of the characteristics and operation of the ordinary types of electrical machinery. The work in the laboratory is supplemented by frequent conferences.

[REQUIRED IN COURSE X.]

692. ELECTRICAL ENGINEERING LABORATORY.

Professors Clifford, Puffer, Lawrence, Smith.

PREPARATION: 654; 778, 779, taken simultaneously.

A course of three hours per week in the second term of the third year, devoted to the study of Direct-current Machinery. The tests include the determination of characteristics, efficiency, regulation, and heating, and are supplemented by laboratory conferences in which the bearing of the work on engineering practice is discussed.

[REQUIRED IN COURSES VI., VIII., OPTIONS 1b, 3.]

693. ELECTRICAL ENGINEERING LABORATORY.

Professors Clifford, Puffer, Lawrence, Smith.

PREPARATION: 650; 651; 657, taken simultaneously.

The work of this course is a continuation of that of course 692, and occupies five hours per week for fifteen weeks during the fourth year. It includes such tests as efficiency, heating, regulation, and determination of characteristics for alternating current machinery. The work in the laboratory is supplemented by conferences in which the relation of this work to engineering practice is discussed.

[REQUIRED IN COURSES VI., VIII., OPTION 3.]

694. ELECTRICAL ENGINEERING LABORATORY.

Professors Clifford, Puffer, Lawrence, Smith.

The work in this course is arranged each year in accordance with the requirements of the individual student. Two hours per week during the first term are devoted to the work by Courses III. and V.A. Course XIII.A devotes two hours per week during the senior year, and three hours per week during the first term of the graduate year, and four during the second.

[Required in Course XIII.A. Elective in Courses III., V., Option A, Graduate Year.]

696. ELECTRICAL ENGINEERING LABORATORY.

Professors Clifford, Puffer, Lawrence, Smith.

The work of this course, five hours per week throughout the year, is specially arranged for each student, and deals particularly with the more advanced problems of Alternating Currents.

[Elective in Course VI., Graduate Year.]

SPECIAL LECTURES.

In addition to the above regular courses of instruction, occasional lectures are given by engineers, in active practice in their profession, upon subjects with which they are especially familiar. During the past year lectures have been given by Mr. H. L. Coburn, on Mechanical Engineering of Electric Power Plants; Mr. P. W. Davis, engineer of the Electric Storage Battery Company, on the Use of Storage Batteries; Mr. Charles M. Green, of the General Electric Company, on Arc Lighting; Mr. Henry D. Jackson, on Electric Railroads; Mr. A. N. Mansfield, engineer of the American Bell Telephone Company, on Telephone Line Construction; Mr. Clarence Renshaw, engineer of the Westinghouse Company, on the Single Phase Railway Motor; Mr. T. G. Richards, of the Boston Woven Hose and Rubber Company, on Shop Economy; Mr. Odin Roberts, on the Nature and Function of Patents for Invention; Mr. C. P. Tolman, chief engineer of the National Electric Company, on Brakes and Braking.

DEPARTMENT OF BIOLOGY.

WILLIAM T. SEDGWICK, PH.D.
Professor of Biology.

SAMUEL C. PRESCOTT, S.B.
Assistant Professor of Industrial Biology.

CHARLES-EDWARD A. WINSLOW, S.M.
Assistant Professor of Biology.

Instructors.

ROBERT P. BIGELOW, PH.D. ARTHUR W. WEYSSE, PH.D.
PERCY G. STILES, PH.D.

In most of the work of this Department some knowledge of Chemistry and Physics is indispensable by way of preparation, although teachers and special students of mature age are sometimes admitted to some of the lower classes in Biology with only an elementary knowledge of these subjects.

The only course open to first-year students is Industrial Microscopy. In the second year, various courses in General Biology are provided for students of Biology, Chemistry, Landscape Architecture, General Science, Sanitary Engineering, and Geology, and in the elements of Botany and Zoölogy for those intending to become biologists or geologists, or to follow the Course in General Science. In the third and fourth years instruction in more advanced or professional biological subjects is provided for students of Biology, Chemistry, Sanitary Engineering, Civil Engineering, Architecture, Geology, and General Science,—as is described in detail below.

The use of the microscope is taught in Industrial Microscopy and in the several classes in General or Elementary Biology, and the third-year laboratory work in Comparative Anatomy gives practice in the dissection of the lower animals. More exact and more minute laboratory practice is obtained

in the course in Bacteriology in the third year, and in Industrial Biology, Mammalian Anatomy, and Comparative Physiology in the fourth year.

Botany receives considerable attention in the second year, and in this year also is given a general elementary course in Zoölogy, but no attempt is made to teach either advanced Botany or higher Zoölogy, the aim being rather to lay a solid foundation in the elements of these subjects and upon this to build such professional attainment in Bacteriology, Industrial Biology, Physiology, Sanitary Biology and public health subjects, as the time allows. A special circular of the Department will be sent on application to the Secretary of the Faculty.

700. GENERAL BIOLOGY.

Professor Sedgwick.

PREPARATION: 550.

Every student doing work in the Biological Department is expected to take at the outset a course in General Biology. The course here described is the most complete and thorough of those offered in this subject, covering three hours of laboratory and two hours of lecture or recitation each week for the first half of the second year, and bears somewhat the same relation to the study of living things as the elements of Chemistry and Physics bear to the study of lifeless things. It consists essentially of a general discussion of the fundamental facts and principles common to all the biological sciences, and is illustrated and made real by careful laboratory examination of selected and typical plants and animals. It includes a consideration of such topics as organisms, organs, tissues, cells, protoplasms, metabolism, growth, reproduction, and fermentations, with special reference to the physical and chemical basis of living matter; and, while elementary and preparatory in character and aim, it opens up to the thoughtful student many practical problems and philosophical questions of the highest interest, relating to life, growth, foods, heredity, evolution, environment, disease, etc

[REQUIRED IN COURSE VII.]

701. GENERAL BIOLOGY.

Professor Sedgwick.

PREPARATION: 550.

A briefer course, fifteen hours, in the first term, but of the same general character as course 700, intended to give, as far as the time allows, an outline of some of the more important facts and principles, and arranged for the benefit of students of Landscape Architecture and Geology.

[REQUIRED IN COURSE IV. OPTION 3, V., OPTIONS 2, 3, XI., XII.]

704. THEORETICAL BIOLOGY.

Dr. Bigelow.

PREPARATION: 716; 717.

An advanced course in General Biology, of thirty lectures in each term of the fourth year, treating of the history and significance of the more comprehensive theories, such as those in regard to the structure and reproduction of organisms in general, the effect of external conditions upon development, heredity, variation, evolution, natural selection, and the like.

[REQUIRED IN COURSE VII.]

708 INDUSTRIAL MICROSCOPY.

Professor Winslow.

PREPARATION: 550.

An elementary course of thirty exercises, including lectures, recitation, and laboratory practice, given in the second term of the first or second year.

The aim of this course is to teach the student the practical use of the microscope and to familiarize him with the common fibres, starches, spices, yeasts, and similar articles of economic importance, as well as with the substances used in their adulteration. In recent years the importance of the microscope in chemical and geological investigations has been more and more widely recognized, and a wide field has been opened for its technical application to the arts and industries, in the examination of foods and drugs, in the study of the textile fibres, and in Metallography.

[REQUIRED IN COURSES V., OPTIONS 2, 3, VII.]

709. MICROSCOPICAL ORGANISMS.

Professor Winslow.

PREPARATION: 701.

A fifteen-hour course of lectures and laboratory practice in the first term of the third year.

For students who intend to become sanitary engineers or students of public health problems, and who lack the necessary time to follow more lengthy courses in Botany and Zoölogy, a short course is devoted to a practical study of the various groups of microscopic organisms, both plants and animals, especially such as occur in reservoirs or other portions of public water supplies. This work is in Course XI. a prerequisite for the fourth-year course in the Microscopical Analysis of Water and Sewage (711).

[REQUIRED IN COURSE XI.]

711. MICROSCOPICAL ANALYSIS OF WATER AND SEWAGE.

Professor Winslow.

PREPARATION: 701; 709 or 716.

This course of two exercises per week in the second term of the fourth year is taught by lectures accompanied by recitations and laboratory practice.

The study of microscopic plants and animals other than bacteria is of interest from an economic standpoint, since these organisms are the chief factors in the food of many fishes, while as the controlling cause of the tastes and odors which so often make water supplies unpalatable, they are of very great practical importance to the engineer and the sanitary biologist. The modern methods for the microscopical analysis of water and sewage have in the main been developed in the laboratories of the Institute, and the opportunities for learning them, and for gaining a familiarity with the commoner forms of life which actually infest water supplies, are probably unique.

[REQUIRED IN COURSES V., OPTION 3, VII., XI.]

716. GENERAL ZOÖLOGY.

Dr. Weysse.

PREPARATION: 700.

A synoptic course of two hours per week in the second term, the time being divided about equally between lectures or recitations, and laboratory work. The course covers the whole animal kingdom, and is adapted to the needs of beginners in Biology, of teachers, and of students preparing for Forestry or Horticulture or any other branch of more advanced or applied Biology. An unusually rich collection of charts and specimens enables the student to obtain in a comparatively short time a comprehensive survey of all animal life. Special stress is laid upon the economic aspects of the subject, and parasites, shell fish, and other food animals, etc., receive much attention. The course is supplementary in character to that in General Biology (700); in the former a few animals are studied in great detail, in the latter, a large number of forms are briefly considered. The two courses taken together—especially if that in General Botany (733) be added—furnish a sound elementary knowledge of the principal representatives of the living world.

[REQUIRED IN COURSES VII., XII.]

717. COMPARATIVE ANATOMY AND EMBRYOLOGY.

Dr. Woods.

PREPARATION: 700.

Following course 716, students of Biology have in Comparative Anatomy an opportunity to make a careful study, with abundant dissections and drawings, of the principal groups of animals. Stress is laid on Vertebrate Anatomy in particular, and this is succeeded by a brief course in Embryology, especially that of the frog and the chick. Students looking forward to medical

studies or to teaching science in secondary schools will find this course especially useful. It consists of two lectures accompanied by seven laboratory hours a week in the first term of the third year and two lectures and four laboratory hours in the second term.

[REQUIRED IN COURSE VII.]

719. MAMMALIAN ANATOMY.

Dr. Weysse.

PREPARATION: 717.

A lecture and laboratory course of three hours a week in the first term of the fourth year. This is the most advanced course offered in Anatomy, and consists of the careful dissection of all the systems of organs of the cat, with lectures on the anatomy of the cat and on human anatomy. The course is especially designed for students who intend to study medicine, or to become biologists, and for teachers of Biology.

[REQUIRED IN COURSE VII., OPTION 2.]

720. ANTHROPOLOGY.

Professor Winslow.

PREPARATION: 716.

This course consists of fifteen lectures in the first term, with readings and recitations, and forms an introduction to the advanced study of Biology, History, Sociology, Comparative Politics, and similar economic and sociologic subjects. The place of man in nature, the physical characters of man, the races of man, the evidences of early human life upon the earth, the beginnings of primitive culture, and the historic development of the dominant peoples of modern times are briefly considered.

[REQUIRED IN COURSE VII.]

722. MICROSCOPIC ANATOMY.

Dr. Woods.

PREPARATION: 717, taken simultaneously.

A course of lectures and recitations, one hour a week, accompanied by three hours of laboratory practice, and extending through the second term of the third year.

Many of the details of anatomical structure can be studied only by the microscope, and Microscopic Anatomy or Histology is therefore an indispensable adjunct of Comparative Anatomy and Embryology. The minute structure of muscles, nerves, glands, and other organs of the animal body is worked out by means of microscopic examinations, and especially by sections, accompanied by abundant drawings and laboratory practice.

[REQUIRED IN COURSE VII.]

726. PHYSIOLOGY AND PERSONAL HYGIENE.

Dr. Stiles.

PREPARATION: 700.

This lecture course of thirty hours in the first term is intended to give a general but accurate idea of the operation and care of the human mechanism. It begins with an exercise in Mammalian Anatomy, which is followed by a discussion of the functions and workings of the various systems and their coördinated activity At every point emphasis is placed upon the hygienic aspects of the subject,—the right use of the body, and the maintenance of its highest efficiency through proper feeding, exercise, rest, clothing, bathing, etc. The lectures are freely illustrated by demonstrations and experiments.

[ELECTIVE.]

727. COMPARATIVE PHYSIOLOGY.

Dr. Stiles.

PREPARATION: 717.

A course of five hours per week throughout the fourth year, consisting of lectures, conferences, and demonstrations, and covering the whole subject of Physiology in great detail. It is supplemented by the laboratory course 728, and the two are made parallel as far as convenient. It is not intended, however, to make it impossible to take one without the other.

[REQUIRED IN COURSE VII.]

728. PHYSIOLOGICAL LABORATORY.

Dr. Stiles.

PREPARATION: 717.

A course of seventy-five hours of laboratory work in the first term of the fourth year in which experiments are performed by the students, and notes and records submitted. It includes chemical work illustrative of the methods used for separating and identifying substances of physiological interest. A large part of the time is devoted to experiments upon muscle and nerve in order to demonstrate some important properties of living matter, and to teach the methods of modern physiological investigation. Besides serving this purpose, all such work is calculated to train the student in the use of delicate apparatus and to cultivate neatness, dexterity, and despatch; a training which will be of advantage to him in whatever field of work he may afterwards enter.

[REQUIRED IN COURSE VII.]

729. PERSONAL HYGIENE.

Dr. Stiles.

PREPARATION: 727.

Lectures, one hour a week during the second term of the fourth year, designed to give an accurate idea of the operation and care of the human mechanism.

The course includes a thorough discussion of such topics as the choice of foods, the effects of good and bad air upon the body, muscular exertion, fatigue, sleep, rest, recreation, the care of the eyes and other sense organs, bathing and baths, and similar subjects.

[Required in Course VII.

733. GENERAL BOTANY.

Professor Prescott.

Preparation: 700.

A course of fifteen hours in the second term of the second year, the time being about equally divided between lectures, recitations, and laboratory work.

A short survey of the entire vegetable kingdom, covering the plant world in much the same way as course 716, General Zoölogy, is intended to cover the animal kingdom. It is adapted to beginners, teachers, and others desiring a brief general introduction to the vegetable kingdom and the life-histories of plants

734. ELEMENTS OF BOTANY.

Professor Prescott.

Preparation: 701.

A course of thirty hours in the second term of the second year, divided equally between lectures and laboratory work, designed to meet the needs of students of Landscape Architecture, and as a preparation for the several courses in Horticulture. A rapid survey is made of the whole vegetable kingdom, but the time is too brief for more than an elementary consideration of the subject.

[Required in Course IV., Option 3.]

735. CRYPTOGAMIC BOTANY.

Professor Prescott.

Preparation: 700.

A course of two hours lectures and four hours laboratory exercises a week in the second term of the second year. The time assigned allows a thorough treatment of the elements of the subject, with abundant laboratory work, lectures, recitations, dissections, drawings, and the like. Beginning with the lowest forms of vegetable life, the slime-moulds, bacteria, seaweeds, and other algæ, rusts, smuts, and various fungi are studied, and afterwards typical liverworts, mosses, ferns, and higher cryptogams. Some attention is also paid to the structure and development of the flowering plants. The instruction throughout, though elementary, is comprehensive, giving such an equipment as teachers of elementary Botany and professional biologists or bacteriologists should have

[Required in Course VII.]

738. PLANT PHYSIOLOGY.

Dr. Stiles.

PREPARATION: 735.

A series of lectures and demonstrations, one hour a week during the first term of the fourth year, upon the fundamental physiological phenomena of vegetable cells, tissues, organs, and organisms. The instruction goes hand in hand with that in Animal Physiology (727), 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 COURSE VII., OPTION 2.]

744. GENERAL BACTERIOLOGY.

Professor Prescott.

PREPARATION: 700 or 701.

A thorough course, four exercises a week (five for Course VII.) during one term, in General Bacteriology, for students of Biology and public health problems, and for others who desire to take up sanitary or industrial matters depending upon the activity of micro-organisms. The instruction consists of lectures, recitations (one hour a week), and extensive laboratory work, in which bacteria are considered for the most part from the standpoint of pure science, but also somewhat from the sanitary, industrial, or agricultural side. The medical aspects of the subject are for the most part omitted. The course is a prerequisite for Industrial Biology (746) and for all work upon sewage disposal, water supply, and other municipal problems in the Biological Department of the Institute.

[REQUIRED IN COURSES V., OPTION 3, VII., XI.]

746. INDUSTRIAL BIOLOGY.

Professor Prescott.

PREPARATION: 590; 744.

A course of four hours per week in the first term of the fourth year, consisting of lectures (one hour per week) and laboratory work, and dealing 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, dairying, and the preservation of foods, are considered in detail. The course includes a study of enzymes, their actions and applications; and the theory and practice of the general phenomena of fermentation are fully discussed.

[REQUIRED IN COURSES V., OPTION 3, VII.]

747. ZYMOLOGY.

Professor Prescott.

PREPARATION: 746.

A course of fifteen lectures in the first term of the fourth year, consisting of an extended discussion of the fundamental principles of the various fermentations and theories of fermentation and the bearing of these theories upon practical problems in Chemistry, Biology and Hygiene.

[REQUIRED IN COURSE VII.]

748. BACTERIOLOGY OF WATER AND SEWAGE.

Professors Sedgwick, Winslow.

PREPARATION: 744.

A course of two hours per week in the first term of the fourth year, divided equally between lectures, recitations, and laboratory practice.

The course in General Bacteriology (744) may be here supplemented for those students of Biology, Chemistry, and Engineering who intend to work along sanitary lines, by a more detailed study of the principles and methods of Water and Sewage Bacteriology. The laws which govern the distribution of bacteria in nature, the origin and fate of disease germs in sewage and water supplies, and the agency of bacteria in the purification of sewage and water are treated in detail. Special training is given in the latest methods and interpretations of bacteriological analysis.

[REQUIRED IN COURSES V., OPTION 3, VII., XI.]

753. MUNICIPAL SANITATION.

Professors Sedgwick, Winslow.

This course, given in the second term of the fourth year, two lectures a week, for students in the Course in Sanitary Engineering and four hours for others, will review the most recent progress in water supply, sewage disposal, and public health work by means of lectures, informal discussions, and visits to public works of interest and importance. The problems of the municipality are among the most important of modern life, and some of the most difficult are those which concern the public health. In this course detailed consideration is given to the principles of water supply, the disposal of sewage and garbage, and heating, plumbing, ventilation, milk and meat supply, disinfection, the control of contagious diseases by sanitation and other non-medical departments of the work of a municipal board of health or department of public works. The Sanitary Research Laboratory and Sewage Experiment Station furnishes unusual opportunities for research and demonstration in connection with this course.

[REQUIRED IN COURSES VII., XI.]

754. PRINCIPLES OF SANITARY SCIENCE AND PUBLIC HEALTH.

Professor Sedgwick.

Fifteen elementary lectures (illustrated with stereopticon) in the second term, on health and disease, the germ theory, dust and its dangers, infection and contagion, drinking water and sewage as vehicles of disease, the purification of water and sewage, public supplies of water, milk, gas, ice, food, etc., and other problems of public health and sanitation. No special preparation is necessary.

[REQUIRED IN COURSES I., OPTION 1, IV., V., OPTION 3, VII., XI.]

755. MUNICIPAL LABORATORY METHODS.

Professor Winslow.

PREPARATION: 744.

In order to enable young men and women to meet the increasing demand for qualified assistants in the various State and municipal laboratories already established, or rapidly coming into existence in American cities, instruction is supplied in some of the more important methods employed in such laboratories. The course, given in the second term of the third year, consists of one hour lecture a week on the etiology of the more important infectious diseases and two hours of laboratory work in which are taken up the practical methods in use for the cultural diagnosis of diphtheria, and tuberculosis, the Widal serum reaction in typhoid fever, and the microscopical diagnosis of malaria. Some time is also devoted to the theory of immunity and the practice of serum-therapy and vaccination.

[REQUIRED IN COURSE VII.]

756. SANITATION OF SHIPS.

Professor Winslow.

For certain students of Naval Architecture a short course of fifteen lectures is offered, in the second term, in the Sanitation of Ships. Arrangements have been made by which the first half of the course is identical with that in Sanitary Science (754) and consists 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.; while the last half deals directly with the sanitary aspects of the heating and ventilation of ships, their plumbing, lighting, ventilation, sewage disposal, and the like.

[REQUIRED IN COURSE XIII.A. ELECTIVE IN COURSE XIII., GRADUATE YEAR.]

757. HYGIOLOGY.

Professor Sedgwick.

PREPARATION: 755.

Thirty lectures, given once a week throughout the year to advanced students of Bacteriology and Sanitation. The course is essentially one in the theories of Hygiene and Sanitation, with discussions of the origin and trend of the underlying principles of Sanitary Science, Public Health and Vital Statistics.

[REQUIRED IN COURSE VII.)

758. HYGIENE OF VENTILATION AND HEATING.

Professor Sedgwick.

PREPARATION: 423, taken simultaneously.

Five lectures (with readings), arranged for fourth-year students of Mechanical Engineering specializing in Heating and Ventilation. The lectures consist chiefly in considerations of health and disease, their conditions and causes, the physiological regulation of the body temperature, and the sources and remedies of discomfort in private rooms and public halls, due to bad air, overheating, overcrowding, etc.

[REQUIRED IN COURSE II., OPTION 4.]

761. HISTORY OF SCIENCE.

Professors Sedgwick, Bartlett.

A course of thirty lectures, two hours a week throughout the first term of the third year. A majority of the lectures will correspond closely to those heretofore given by Professor Sedgwick in the course on the History of the Inductive Sciences. The remainder, devoted chiefly to the History of Mathematics and its applications to Physics, Astronomy, etc., will be given by Professor Bartlett. The complete course will consist of a rapid survey of the beginnings of science, especially 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. Brief biographical sketches will also be given of some of the greater workers—such as Pythagoras, Aristotle, Euclid, Roger Bacon, Leonardo, Copernicus, Galileo, Newton, Laplace, Lyell, Darwin and Pasteur—in connection with the consideration of their work. The aim of the course will be to make those who follow it acquainted with the sources of the broad stream of scientific knowledge as it exists to-day. The instruction will be given wholly by lectures, in the course of which considerable illustrative material will be used.

[REQUIRED IN COURSE VIII., OPTIONS 1, 2. ELECTIVE.]

764. JOURNALS.

Professors Sedgwick, Prescott.

PREPARATION: 717; 744.

A weekly meeting of the officers and fourth-year and graduate students of the Biological Department at which each member is expected to report from time to time upon his own investigations, or those of others as found in current periodicals, and is subjected to friendly criticism as to his conclusions, or his methods of presentation, or both. The meetings extend throughout the year.

[REQUIRED IN COURSE VII.]

DEPARTMENT OF PHYSICS.

CHARLES R. CROSS, S.B.
Thayer Professor of Physics and Director of the Rogers Laboratory.

HARRY M. GOODWIN, PH.D.
Associate Professor of Physics and Electro-Chemistry.

LOUIS DERR, M.A., S.B.
Associate Professor of Physics.

GEORGE V. WENDELL, PH.D.
Associate Professor of Physics.

CHARLES L. NORTON, S.B.
Associate Professor of Heat Measurements.

WILLIAM J. DRISKO, S.B.
Assistant Professor of Physics.

Instructors.

MAURICE DEK. THOMPSON, JR., PH.D. HENRY W. BUHLER, S.B.
CLIFFORD M. SWAN, S.B. EUGENE D. FORBES, S.B.
NEWELL C. PAGE, S.B. DANIEL F. COMSTOCK, S.B. (*absent*).
WALTER J. GILL, JR., S.B.

Assistants.

ELIOT W. NILES, S.B. CHARLES J. EMERSON, S.B.
CHARLES R. BOGGS, S.B. CHESTER R. SHAW, S.B.
WILLIAM H. WHITCOMB, S.B.

The instruction in General Physics extends through the second, and the first half of the third year, and is common to all Courses. The fundamental principles of the subject are developed in an extended course of very fully illustrated lectures, supplemented by recitations.

Prior to the conclusion of the lecture course the student enters the Physical Laboratory, where 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 gives 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, and Electrical, Mechanical, Chemical, and Mining Engineering, work 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 electro-chemical 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 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.

A circular of the department will be sent on application.

770. PHYSICS (Mechanics, Electricity, Optics).

Professors Cross, Wendell; Messrs. Swan, Gill.

PREPARATION: 27 or 28.

This course consists of three lectures accompanied by two recitations per week throughout the second year. The subjects considered are mechanics of solids, liquids, and gases, molecular mechanics, wave-motion, electricity and optics, which topics are discussed both mathematically and experimentally. It is the purpose of the course to lay a thorough foundation for subsequent study of theoretical, experimental, and technical Physics. Hence it is planned with immediate reference to familiarizing the pupil with the fundamental principles of the science. The lectures are very fully illustrated by suitable experiments.

As text-books, the following are used: Watson, Text-book of Physics, Thompson, Elementary Lessons in Electricity and Magnetism, and printed Notes on Mechanics and Optics.

[REQUIRED IN ALL COURSES.]

771. PHYSICS (Heat).

Professor Norton.

PREPARATION: 770.

This course of experimental lectures, given two hours per week during the first eight weeks of the third year, is a continuation of course 770, and is devoted to the consideration of the phenomena and laws of heat. Watson's Text-book of Physics is used in connection with the lectures.

[REQUIRED IN ALL COURSES EXCEPT IV.]

772. PRECISION OF MEASUREMENTS.

Professors Goodwin, Drisko; Messrs. Swan, Forbes.

PREPARATION: 31 or 34; 773, taken simultaneously.

A course of lectures and recitations, given in both terms of the third year in connection with the laboratory course in General Physical Measurements. The work includes a discussion of the nature and methods of elimination of errors and the application of the Calculus to the solution of precision problems in direct and indirect measurements. These problems are selected from cases which arise in connection with the laboratory work of courses 773 and 774, a fact which adds to their practical interest. Graphical methods of treating observations are also discussed. Notes on Graphical Methods and on the Precision of Measurements, prepared by Professor Goodwin, are used as a basis for the course.

[REQUIRED IN COURSES II., III., V., VI., VII., VIII., XII., XIII.A.]

773. PHYSICAL LABORATORY (General Physical Measurements, Mechanics, Optics).

Professors Goodwin, Derr, Drisko; Messrs. Swan, Forbes, and assistants.

PREPARATION: 770, completed or taken simultaneously.

A series of fifteen two-hour exercises in the third year, laid out individually for each student, according to the Course he is pursuing. The use of the various instruments of precision is taught, so far as may be, in connection with experiments each of which illustrates some different method or principle. The earlier experiments relate to the mechanics of solids, liquids, and gases; these are followed by experiments in optics, including focal length of lenses, gas photometry, indices of refraction, and elementary spectrum analysis. The work is wholly quantitative, and the attention of the student is

especially directed to the precision discussion of his results. The laboratory manual used is: Notes on Physical Laboratory Experiments, prepared by Professor Goodwin.

[REQUIRED IN ALL COURSES EXCEPT IV.]

774. PHYSICAL LABORATORY (Heat).

Professors Goodwin, Derr, Drisko; Messrs. Swan, Forbes, and assistants.

PREPARATION: 773; 771, completed or taken simultaneously.

This course is a continuation of the preceding, and consists of seven two-hour exercises in heat measurements, including exact measurements in mercurial and air thermometry and calorimetry, the determination of the mechanical equivalent of heat by electrical methods, continuous calorimetry, coefficients of expansion, and vapor pressure. Particular attention is directed to the elimination and correction of errors peculiar to heat measurements and to the precision discussion of the results. More advanced instruction in heat measurements is given in course 781. The laboratory manual used is: Notes on Physical Laboratory Experiments, Heat, prepared by Professor Goodwin.

[REQUIRED IN ALL COURSES EXCEPT IV.]

776. PHYSICAL LABORATORY (Advanced).

Professors Goodwin, Wendell.

PREPARATION: 774.

This course in the second term of the third year is open to students who have completed the general laboratory courses in Physics (773 and 774). The work is laid out for each student individually, and involves considerable collateral reading in French and German. The course provides for work with apparatus of high precision, comprehending measuring machines and comparators, prism and grating spectrometer, two Michelson interferometers, an Echelon spectroscope, an Abbé dilatometer, and various instruments for the exact determination of physical constants.

[REQUIRED IN COURSE VIII., OPTION 1b.]

778. ELECTRICAL MEASURING INSTRUMENTS AND METHODS.

Professor Laws.

PREPARATION: 772; 779, 786, taken simultaneously.

A series of lectures given in connection with the laboratory course in Electrical Measurements (779) in which the various instruments used in measuring electrical quantities are discussed. Attention is first directed to the theory of the instrument, after which its mechanical construction is studied, particular atten-

tion being given to questions of precision, and possible sources of error. The lectures are illustrated by the very extensive collection of apparatus possessed by the Department.

[Required in Course VI.]

779. GENERAL ELECTRICAL MEASUREMENTS (Laboratory).

Professor Laws; Mr. Page and assistants.

Preparation: 772; 773; 778, 786, taken simultaneously for Course VI.

An extended course of laboratory practice, beginning with the simpler measurements, such as the determination of resistance, current, and electromotive force, and leading up to alternating current measurements. Throughout the course the student is guided by printed notes which have been especially prepared for use in the Rogers Laboratory. For students of Course VIII., options 1 and 2, the work is supplemented by a series of fifteen conferences in which the various instruments are discussed.

[Required in Courses VI., VIII., XIII.a. Elective in Course XIII., Graduate Year.]

781. HEAT MEASUREMENTS.

Professor Norton; Mr. Buhler and assistants.

Preparation: 774.

This course consists of lectures and laboratory exercises in the measurement of high temperatures, in precise thermometry, the efficiency of fuels, and determinations of thermal properties of engineering materials. Especial attention is given to the study of such temperatures 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 thermometers of the highest precision is required of students in Physics and Chemistry. The time devoted to the work varies in different Courses.

[Required in Courses II., III., VI., VIII., X., XIII., XIII.a.]

782. ELECTRICAL AND HEAT MEASUREMENTS.

Professors Laws, Norton; Mr. Page and assistants.

Preparation: 774.

A thirty-hour course in laboratory practice prefaced by lectures. It covers the more elementary electrical and technical heat measurements which are of fundamental importance to the chemist. The work includes measurements of resistance, current, potential, and power, the thermal conductivity of various materials, the calorific power of fuels, and pyrometry.

[Required in Course V. Elective in Course III., Graduate Year.]

786. THEORETICAL ELECTRICITY.

PREPARATION: 770, completed or taken simultaneously.

A course of fifteen exercises in the second term of the second year, in which many problems are assigned for solution. The work begins with the discussion of resistance and shunt circuits, and leads up to Kirchoff's laws and the general subject of a network of conductors conveying direct currents. Beginning with the Biot-Savart law, the subject of Electrodynamics is developed so far as the field due to various circuits is concerned, and a general discussion of the theory of various types of measuring instruments is given. This is followed by the theory of electrodynamic induction, the principles of generator and motor, and the laws of the magnetic circuit. The course is intended more particularly to enforce the applications of Ohm's law in its various forms on the minds of the students.

[REQUIRED IN COURSES VI., VIII.]

787. THEORETICAL ELECTRICITY.

Professor Clifford.

PREPARATION: 34; 35; 786.

This course of thirty exercises in the first term of the third year is a continuation of 786, and embraces a discussion of the elements of the Theory of Potential, the theorems of Poisson, Laplace, and Gauss, together with their simpler applications to problems in attraction and the calculation of capacity. The relation of the electrostatic and electromagnetic units is discussed, and also a somewhat full treatment is given of the general principles of Magnetism with the relations of the magnetic shell and the voltaic circuit. The general energy relations for the magnetic field are taken up in considerable detail.

[REQUIRED IN COURSES VI., VIII., XIII.A.]

788. PERIODIC CURRENTS.

Professor Clifford.

PREPARATION: 787.

This course of thirty exercises in the second term of the third year begins with a treatment of the subject of variable currents by the differential equation method, and leads up to the general problems connected with circuits conveying periodic currents. In the greater part of the work the vector method is adopted, running parallel with the analytical treatment according to the method of complex quantities. Various types of circuit, consisting of impedances in series and parallel, are discussed in detail, followed by a complete discussion of the analytical theory of the transformer. Considerable emphasis is laid on the solution of illustrative problems.

[REQUIRED IN COURSES VI., VIII., XIII.A.]

790. PROPAGATION OF ELECTRIC WAVES.

PREPARATION: 787.

This course of fifteen lectures given in the first term embraces a discussion of the principles of electrical oscillations, together with their application to wireless telegraphy. This is followed by the general treatment of electrical wave propagation in circuits containing negligible inductance, but definite resistance and capacity, which leads up to the general telegraphic equation and signalling through cables. There is also an extended discussion of the general subject of wave propagation through a periodically varying medium, leading up to the problem of the loaded line as presented by Pupin and Campbell.

[ELECTIVE.]

791. THEORY OF POTENTIAL.

PREPARATION: 787.

This course of thirty lectures in the second term of the fourth year treats of the general properties of the potential function, with applications to various problems in attraction, together with a discussion of the theorems of Poisson, Laplace, and Gauss. An extended treatment is given of Green's theorem, together with its applications, and the method of electrical images is applied to various problems in Electrostatics. The subject of conjugate functions and conformal representation is taken up, so far as is essential for the solution of certain capacity problems in Electrostatics.

[REQUIRED IN COURSE VIII., OPTIONS 1, 2.]

792. ELECTRICITY.

Professor Derr.

In this course of sixty exercises in the second term the option is offered of a study of the newer theories dealing with the relations between electricity and matter, or of a mathematical treatment of the subject along established lines.

[ELECTIVE IN COURSE V., GRADUATE YEAR.]

796. ELECTRO-CHEMISTRY.

Professor Goodwin.

PREPARATION: 610, 611, completed or taken simultaneously.

A course of thirty lectures in the first term, in which the subject is very fully discussed from the theoretical side. A knowledge of the modern theory of solutions is assumed. The principal topics treated are the theories of electrolytic conduction, polarization and electrolysis, the osmotic theory of 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 Courses V., Option 5, VIII. Elective in Courses III., Option B, V., Option B, Graduate Year.]

797. APPLIED ELECTRO-CHEMISTRY.

Dr. Thompson.

Preparation: 796.

A series of twenty lectures in the second term of the fourth year on the technical applications of Electro-chemistry. The subjects discussed include accumulators, electro-deposition of metals, electric furnaces and their products, and electrolytic processes for the preparation of organic and inorganic compounds. The subject of Electro-metallurgy is discussed in a separate fifteen-hour course (446).

[Required in Course VIII., Option 3.]

799. ELECTRO-CHEMICAL LABORATORY.

Professor Goodwin, Dr. Thompson.

Preparation: 796, taken simultaneously.

This course, given in the first term, is carried on in conjunction with the lecture course on Theoretical Electro-chemistry. The work is devoted to exact electro-chemical measurements of all kinds, such as measurements of electrical conductivity, transference numbers and ionic velocities, single potentials, decomposition voltages, polarization, etc. Each student is given a desk completely equipped with electro-chemical apparatus (see page 292) and is thus enabled to calibrate his own set of instruments which he retains for his use throughout the whole course.

[Required in Courses V., Option 5, VIII., Option 3 Elective in Courses III., Option B, V., Option B, Graduate Year.]

800. ELECTRO-CHEMICAL LABORATORY.

Professor Goodwin, Dr. Thompson.

Preparation: 797, taken simultaneously.

This course is given in the second term of the fourth year, in conjunction with course 797 on Technical Electro-chemistry. Each student makes a study on a fairly large scale of various technical electro-chemical processes, such as electrolytic reductions and oxidations of organic and inorganic substances, electro-plating, efficiency tests of alkali processes, and electric furnace processes. For this work the laboratory is equipped with unusual facilities for both direct

and alternating current work (see page 293). The results obtained in the laboratory are discussed by the class in a series of conferences.

[Required in Course VIII., Option 3.]

803. PHYSICO-CHEMICAL LABORATORY.

Professor Goodwin, Dr. Thompson.

Preparation: 612 or 613, completed or taken simultaneously.

This laboratory course is taken in conjunction with the lecture courses (612 and 613) on Theoretical Chemistry, and the experiments are designed to illustrate the principles there taught, as well as to give practice in quantitative physico-chemical methods. The work includes experiments in Thermo-chemistry, velocity of chemical reactions, chemical equilibrium, and Electro-chemistry. The character of the work is similar to that given in Ostwald-Luther's Physico-chemisches Praktikum, this manual being used as a basis for procedure.

[Required in Courses V., Options 2, 5, VIII., Option 1a.]

807. OPTICAL MEASUREMENTS.

Professor Wendell.

Preparation: 770; 773.

A lecture and laboratory course of two hours per week throughout the third year on photometry and lenses. The treatment of lenses and lens systems is by the cardinal point method, and embraces a detailed study of the various aberrations, with special reference to photographic and microscopic combinations. A thorough experimental study is made of optical questions connected with the modern Zeiss compound microscope. Experimental work is also carried out with the Weber, Munsell, Bunsen, Lummer Brodhun Contrast, and Flicker photometers, the König spectro-photometer, and the Abbé focometer.

[Required in Course VIII., Options 1, 2.]

808. GENERAL THEORY OF LIGHT.

Dr. Jewett.

Preparation: 35; 770.

This course of three hours per week in the first term of the fourth year is of a general rather than a distinctly analytic nature. It presupposes a knowledge of the fundamental principles of Optics, and, while sufficient time is devoted to geometrical Optics to give the student a clear insight into the methods of attacking problems from the standpoint of ray propagation, stress is laid mainly on the phenomena of physical Optics and the conditions requisite to their production. No text-book is used, the work consisting principally of lectures and recitations, together with collateral reading. In addition to the

purely theoretical discussions, the methods and instruments used in various optical measurements are discussed at some length. Preston's theory of Light is used as a text-book, in connection with which considerable collateral reading is required.

[Required in Course VIII., Options 1, 2.]

810. ELECTRO-MAGNETIC THEORY OF LIGHT.

A course of thirty lectures in the second term. The work of this course begins with a deduction of the general equations of the electromagnetic field according to the method of Maxwell and subsequent investigators, as Heaviside, Hertz, and others, and shows the development of the wave-surface as a consequence of these equations. The application of the electromagnetic theory to the explanation of the known phenomena in Optics is taken up in considerable detail, and a brief discussion is given of the general subject of radiation.

[Elective.]

811. THEORY OF DIFFRACTION.

Preparation: This and the following course (812) are offered in alternate years. A thorough knowledge of Advanced Calculus and of the general theory of light is essential.

Beginning with the general discussion of wave propagation in an elastic medium, the simpler problems in diffraction are first discussed, leading up to the general theory of the grating, both plane and concave. The questions of resolving power are considered at length, together with the subject of ghosts, and a historical account of the development and use of the grating.

[Elective.]

812. THEORY OF WAVE-SURFACE AND POLARIZATION.

Preparation: see 811.

Beginning with the general discussion of displacements in an elastic medium, the development of the Fresnel wave-surface is given in considerable detail, the subject of conical refraction and the conical points receiving special consideration. Some discussion is also given of the general subject of the propagation of light waves. The treatment of questions of polarization is wholly analytical, and in character follows the work of Fresnel very closely.

[Elective.]

813. POLARIZED LIGHT AND ITS APPLICATIONS.

Professor Wendell.

PREPARATION: 770.

An experimental course of thirty lectures given in the second term on polarized light, the general phenomena, laws, and theories of rotatory polarization and electromagnetic rotation of light, with special reference to their application in Physics and Chemistry. The course includes a discussion of the theory and precision of the best forms of polariscopes and saccharimeters.

[ELECTIVE.]

814. COLOR.

Professor Cross.

PREPARATION: 770.

A course of five lectures given in the second term of the fourth year. In these lectures are discussed the principles of color-sensation, color mixture, successive and simultaneous contrast, and their relation to phenomena in nature and art.

[REQUIRED IN COURSE IV., OPTION 1.]

815. PHOTOGRAPHY.

Professor Derr.

PREPARATION: 550; 770.

A course of fifteen lectures in the second term of the fourth year, very fully illustrated by experiments, on the principles and processes of photography with dry plates. An outline of photographic Optics, including the testing of lenses, is followed by a study of the theories of the latent image and its development, and the general treatment of dry plates. Orthochromatism and the various processes of color photography are explained in detail. Attention is also given to the use of the copying camera and the projection lantern; and the more important printing processes are illustrated.

[REQUIRED IN COURSE IV., OPTION 3; ELECTIVE IN OTHER COURSES.]

816. THE ELECTRICAL DISCHARGE IN GASES.

Professor Cross.

This course consists of ten lectures. It 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 all students desiring to do so can attend without interference with other studies.

[ELECTIVE.]

810. DESCRIPTIVE ASTRONOMY.

Professor Drisko.

PREPARATION: 28; 770, taken simultaneously.

A course of thirty lectures and recitations in the first term on the main facts and principles of Descriptive Astronomy, accompanied by a discussion of astronomical instruments and their uses. The scope of the course is about that covered in Young's General Astronomy. The lectures are illustrated by numerous lantern slides.

[REQUIRED IN COURSE VIII., OPTIONS 1, 2.]

823. ACOUSTICS.

Professor Cross.

PREPARATION: 28; 770, taken simultaneously.

This course, given in the first term of the second year, is devoted to a consideration of the general phenomena and laws of sound, and in particular to those portions of the subject which relate to speech and hearing. It is laid out with special reference to the relations of acoustics to telephony and other applications of electric undulations.

[REQUIRED IN COURSES VI., VIII., OPTIONS 1, 2.]

824. ACOUSTICS.

Professor Cross.

PREPARATION: 770.

This course of five lectures in the first term of the fourth year is intended to give tc the student a knowledge of such acoustic principles as are of importance in Architecture.

[REQUIRED IN COURSE IV., OPTION 1.]

820. ENERGETICS.

Professor Goodwin.

PREPARATION: 35; 612, completed or taken simultaneously.

This course of thirty lectures and recitations given in the second term of the fourth year assumes a knowledge of Theoretical Chemistry and of the fundamental principles of Thermodynamics. It is intended as an introduction to such works on modern Thermodynamics as those of Duhem and Gibbs. The

subjects discussed include the properties of entropy, free energy, and of the various thermodynamic potential functions, the phase rule, and the thermodynamic theory of gases and of dilute solutions.

[REQUIRED IN COURSES V., OPTION 5, VIII., OPTIONS 1, 2. ELECTIVE IN COURSE V., OPTION B, GRADUATE YEAR.]

830. KINETIC THEORY OF GASES.

Professor Goodwin.

PREPARATION: 35; 771.

A course of fifteen exercises in the second term of the fourth year on the mathematical theory of the subject, with collateral reading in Meyer's Kinetic Theory of Gases, Nernst's Theoretische Chemie, and Preston's Theory of Heat. The subjects discussed are Joule's, Clausius' and Maxwell's theories, the law of the distribution of velocities, mean free path, viscosity and molecular dimensions, Van der Waal's equation, and the theory of corresponding states.

[REQUIRED IN COURSE VIII., OPTIONS 1, 2. ELECTIVE IN COURSE V., OPTION B, GRADUATE YEAR.]

832. ADVANCED CHEMISTRY OR PHYSICS.

Professors Noyes, Goodwin, Wendell.

This option in the Course in Physics is intended to allow the student considerable latitude in the choice of the special work he desires to pursue in the last term of his Course. Advanced work in Physical Chemistry, Electro-Chemistry, or Optics may be arranged with the professor in charge.

[REQUIRED IN COURSE VIII., OPTION 1.]

836. CALCULATING MACHINES.

Professor Derr.

An elective course, in the first term, of seven exercises devoted chiefly to practice with the slide rule in solving arithmetical problems taken from Engineering and Physics. The precision attainable with slide rules is carefully studied, and other forms of calculating machines are discussed.

[ELECTIVE.]

837. PRINCIPLES OF SCIENTIFIC INVESTIGATION.

Professor Cross.

The object of the readings constituting this course is to impart to the student some knowledge of the logical principles which underlie processes of scientific reasoning. Jevons's work is used as a text-book.

[REQUIRED IN COURSE VIII., OPTIONS 1, 2.]

838. **PHYSICAL COLLOQUIUM.**

Professor Goodwin.

These exercises are prefaced by several lectures on physical and chemical periodical literature and reference books, and on the use of a reference library. Each student is required to compile the literature of one physical and one physico-chemical or electro-chemical subject. At the weekly colloquium meetings held during the second term of the fourth year the students present before the class for informal discussion reviews of assigned articles appearing in English, French, and German scientific journals. The reviews are submitted to the Department of English for criticism as to their literary character.

[REQUIRED IN COURSE VIII.]

DEPARTMENT OF GEOLOGY.

THOMAS A. JAGGAR, JR., PH.D.
Professor of Geology.

WILLIAM O. CROSBY, S.B.
Associate Professor of Geology.

CHARLES H. WARREN, PH.D.
Assistant Professor of Mineralogy.

DOUGLAS W. JOHNSON, PH.D.
Assistant Professor of Geology.

Instructor.

HERVEY W. SHIMER, PH.D.

Assistant.

ARTHUR K. ADAMS, S.B., A.M.

The geological subjects taught are as follows: Mineralogy, Dynamical and Structural Geology, Field Geology, Topographic Geology, Historical Geology and Paleontology, and Economic Geology. In the descriptions of the subjects those of each group are usually arranged chronologically, so far as they are taken by the same students, the more clearly to express their sequence and logical relations: the subjects without descriptive text are not given in 1905–6.

Elementary Mineralogy is a required preparation for nearly all subsequent work in Geology, and is followed by Petrography.

General Geology affords an introduction to Structural and Historical Geology. The courses in Structural Geology in-

clude also laboratory work in elementary Lithology; and the courses in Economic Geology and Ore-deposits offer more advanced work in both Dynamic and Structural Geology. Glacial and Experimental Geology are special courses, chiefly dynamic in character.

The courses in Field Geology extend through three years, and are designed to afford practice in research and the various methods of geological surveying, including the construction of maps and sections; they are of first importance for all students of Geology.

Structural Paleontology prepares for Historical Geology. The principles of Paleontology are set forth in a later course, and the course on the Geology of North America includes a systematic application to this continent of the principles of Historical Geology.

The courses in Economic and Applied Geology are adapted to meet the needs of mining engineers and geologists, civil, sanitary, and landscape engineers and architects.

Observation and comparison are the foundation of nearly all the work in Geology, and investigation is encouraged, leading frequently, especially in thesis studies, to publication.

840. MINERALOGY.

Professor War .

PREPARATION: 551.

This course, occupying four hours a week during the second year, includes descriptive and determinative Mineralogy and Crystallography. The instruction in Crystallography consists of a short series of lectures supplemented by laboratory practice with natural crystals and models. Its aim is to familiarize the student with the principles of the subject and to enable him to identify the more common crystallographic forms and combinations. The time given to descriptive and determinative Mineralogy is devoted largely to laboratory work, supplemented by informal lectures and recitations. The aim of this course is to train the student to determine minerals accurately and rapidly by their physical and chemical properties, to make him thoroughly familiar with the appearance, properties, uses, and associations of the more important mineral species, and to give him some insight into the practical and scientific problems directly connected with Mineralogy.

[REQUIRED IN COURSES III., OPTIONS 1, 3, V., OPTIONS 2, 3, XII.]

841. MINERALOGY.

Professor Warren.

PREPARATION: 551.

This is a shorter course of sixty hours, given in the second year, and is similar in plan to course 840.

[REQUIRED IN COURSES III., OPTION 2, V., OPTION 5, VII.]

842. ADVANCED MINERALOGY.

Professor Warren.

PREPARATION: 770; 840.

[REQUIRED IN COURSE XII.]

843. PETROGRAPHY.

Professor Warren.

PREPARATION: 770; 841; 858.

This course begins with the study of the optical properties of the important rock-forming minerals as shown by the examination of thin sections under the polarizing microscope. The work in Petrography proper is intended to afford the student an opportunity to become thoroughly familiar with the macroscopic and microscopic characteristics of the principal rock types, and the methods of petrographical study, and to enable him to gain some acquaintance with the theories of modern Petrography and its relation to certain problems in Mining Geology. The work occupies four hours a week through the year and consists largely of a laboratory study of rock specimens and microscopic sections. The laboratory work is supplemented by lectures and assigned reading.

[REQUIRED IN COURSES III., OPTION 3, XII.]

855. DYNAMICAL GEOLOGY.

Professor Jaggar.

PREPARATION: 551, 770, taken simultaneously.

This course of thirty hours in the second term of the second year introduces students of Civil Engineering and related subjects to earth movements and the various terrestrial applications of solar energy. The greater geological processes, erosion, sedimentation, deformation and eruption are discussed in order by means of lectures, illustrated by maps, diagrams, specimens and stereopticon.

[REQUIRED IN COURSES I., XI.]

856. GENERAL GEOLOGY.

Professor Jaggar.

PREPARATION: 551; 770, taken simultaneously.

This course of forty-five hours in the first term of the second year, designed as a preparation for the more special courses in Geology which follow, is largely dynamic and physiographic in scope, treating of earth processes and the development of the topographic and hydrographic features of the earth's surface. In the lectures, in part illustrated by lantern views, the illustrations are drawn largely from North America; and, while the student becomes familiar with the geological work of the atmosphere, of streams, the sea, and the earth's interior heat, he does not discuss the topics without considering the limitations imposed upon works constructed to utilize, resist, or evade the power of these agencies.

[REQUIRED IN COURSES III., OPTIONS 1, 3, IV., OPTION 3, XII.]

857. STRUCTURAL GEOLOGY.

Professor Johnson and assistant.

PREPARATION: 856.

Two hours a week, throughout the second term of the second year. This course consists of fifteen lectures on the broader structural features of the earth's crust, and the application of the principles of Structural Geology to practical engineering problems; and fifteen laboratory exercises in the study of the more common rocks composing the earth's crust. The work is especially adapted to the needs of civil engineers. The lectures are illustrated with specimens, charts, and lantern views.

[REQUIRED IN COURSES I., IV., OPTION 3, XI.]

858. STRUCTURAL AND STRATIGRAPHIC GEOLOGY.

Professor Johnson; Dr. Shimer.

PREPARATION: 840; 856.

Sixty hours in the second term of the second year. This is a composite course, consisting of fifteen lectures on the principles of Structural Geology and their application to practical mining problems, together with fifteen laboratory exercises in the study of the more common rocks; and fifteen lectures on the chronologic succession and geographic distribution of the different geological formations, with fifteen laboratory exercises in the study of the fossils which serve to identify those formations. Special emphasis is laid upon those features of Structural and Stratigraphic Geology which will prove of most service to the practical mining engineer.

[REQUIRED IN COURSES III., OPTIONS 1, 3, XII.]

859. ECONOMIC GEOLOGY.

Professor Johnson.

PREPARATION: 840; 858; 870.

A course of sixty lectures in the first term of the third year, illustrated by specimens and lantern views, presenting such general considerations as are of importance in connection with economic deposits, together with a more detailed discussion of those localities in the United States producing metallic and non-metallic minerals. The structural features of veins and other deposits are reviewed, the methods of classifying ore-deposits stated, and the theories as to origin explained. Particular attention is given to the methods of occurrence, geological relations, and origin of the more important deposits in this country.

[REQUIRED IN COURSES III., OPTIONS 1, 3, XII.]

860. ECONOMIC GEOLOGY (Non-metallic).

Professor Crosby.

PREPARATION: 859.

Sixty hours in the first term of the fourth year. This course is essentially a continuation of course 859 and the methods are the same. It is, however, restricted to the non-metallic minerals of economic interest, including hydrocarbons, and including also building and decorative stones and the quarry industry.

[REQUIRED IN COURSES III., OPTION 3, XII.]

863. GLACIAL GEOLOGY.

Professor Crosby.

PREPARATION: 858.

This course of fifteen hours in the first term of the fourth year is devoted especially to the study and interpretation of the various types of drift deposits left by the Pleistocene ice sheet. The field-work affords practice in the determination and mapping of glacial deposits.

[REQUIRED IN COURSE XII.]

865. EXPERIMENTAL GEOLOGY.

Professors Jaggar, Crosby.

PREPARATION: 843.

This course of research for fourth-year students of Geology or Geodesy deals with special problems of Dynamical Geology which are subject to labora-

tory experimentation or field measurement. Among the topics considered are rill erosion, delta sedimentation, stream flow, folding and faulting as illustrated by subjecting small models to compression, and the synthesis of minerals and rocks.

[Optional in Course XII.]

869. FIELD GEOLOGY.

Professors Jaggar, Johnson; Dr. Shimer, Mr. Adams.

Preparation: 870.

This course of fifteen hours in the first eight weeks of the third year is designed to introduce the student to practical methods of mapping in the field. Small square areas are assigned to each student, and the results of his field work are plotted in colors on the map. The combined work of the class is discussed at the weekly meeting.

[Required in Course III., Options 1, 3.]

870. FIELD GEOLOGY.

Professors Jaggar, Johnson; Dr. Shimer.

Preparation: 858, taken simultaneously.

This course of twenty hours in the second term supplements the courses in Structural Geology. The field-work embraces the study of actual examples of the principal kinds of rocks and of rock-structures, both original and secondary. When the weather is unfavorable for field-work, laboratory exercises for the study of specimens, models, and photographs are substituted; and in both field and laboratory attention is given to practice in the construction of geological maps and sections, the measurement of the thickness of strata, and the determination of the relative ages of geological formations.

[Required in Courses III., Options 1, 3, XII.]

871. GEOLOGICAL SURVEYING.

Professors Jaggar, Crosby, Johnson; Dr. Shimer.

Preparation: 858; 870.

This course, extending throughout the year, affords systematic training in the methods and practice of Geological Surveying and the construction of geological maps and sections. It includes reconnoissance, general and economic surveys, with the methods appropriate for each on areas of contrasted physiographic and geological character, attention being given to glacial and other superficial deposits as well as to the lithified formations, igneous and sedimentary. The course includes also conferences, the elaboration of notes, and the construction of maps and sections based upon field-work.

[Required in Courses III., Option 3, XII.]

872. TOPOGRAPHIC FEATURES OF THE UNITED STATES.

Professor Johnson.

PREPARATION: 874.

An advanced course in the second term of the third year devoted to the detailed study of topographic forms, the literature dealing with their origin, and the maps which represent them, with special investigation into some of the problems suggested by such study.

[REQUIRED IN COURSE XII.]

873. FIELD GEOLOGY (Advanced).

Professors Jaggar, Crosby, Johnson.

PREPARATION: 870.

This is a research course and occupies six hours a week throughout the fourth year. Special problems,—areal, stratigraphic, structural, petrographic, physiographic, etc.,—are assigned for investigation. The problems assigned for the winter months are those requiring chiefly laboratory work, which may be chemical, mineralogic, petrographic, paleontologic, or bibliographic in character.

[OPTIONAL IN COURSE XII.]

874. TOPOGRAPHIC GEOLOGY.

Professor Johnson; Dr. Shimer.

PREPARATION: 857.

A course of thirty hours in the first term of the third year and fifteen hours in the second. The work consists of lectures, laboratory and field work, devoted to the study of the relation of geologic processes and structures to topographic form. During the first part of the term excursions are made to localities of physiographic interest, in order that the student may learn to interpret contour maps in terms of the natural features thus artificially represented. A systematic classification of topographic forms is presented in the lectures, together with a discussion of the origin of the forms. In the laboratory work with contour maps the student becomes familiar with topographic features all over the United States, and with the structures or processes which produced them. The chief aim of the course is to give the student an intelligent appreciation of topographic forms as they are represented by contours, in order that he may correctly interpret contour maps, and be able to sketch topography with precision and with understanding of the structure and geologic history of the region.

[REQUIRED IN COURSES I, IV., OPTION 3, XI.]

878. STRUCTURAL PALEONTOLOGY.

Dr. Shimer.

PREPARATION: 716.

This course of sixty hours in the first term of the third year (or thirty hours for Course VII.) is a continuation of the course in Zoölogy and a preparation for Historical Geology, the main purpose being to make the student acquainted with the structure (anatomy) and relationships of the principal types of fossil invertebrates. The instruction consists of laboratory work with specimens, supplemented by lectures.

[REQUIRED IN COURSE XII.]

880. HISTORICAL GEOLOGY.

Dr. Shimer.

PREPARATION: 857 or 858.

A course of three lectures per week in the second term of the third year and, for Course XII., sixty hours of laboratory work. This course includes a study of the chronologic and geographic distribution of the strata of the earth's crust, their lithological character, and the physical conditions under which they were formed, together with the organic forms or fossils characteristic of each period. The lectures are supplemented, for students in Geology, by four hours per week of laboratory work in Stratigraphic Paleontology to extend the student's acquaintance with the fossils most useful in the identification and correlation of the successive geological formations. Emphasis is also placed upon the origin, occurrence, and distribution of materials of special economic interest, such as coal, petroleum, salt, iron ores, etc.

[REQUIRED IN COURSES VII., XII.]

883. PRINCIPLES OF PALEONTOLOGY.

Dr. Shimer.

PREPARATION: 880.

This course of two hours a week in the second term consists of lectures and reading on the broader aspects and the philosophy of Paleontology. It treats of the development of life on the earth, the life history of the individual (ontogeny), and of the group to which it belongs (phylogeny), and the problems of faunas, including their rise, culmination and decadence, the relations of fossils to sediments and to littoral, deep sea, and abyssal conditions, the cause of the varying stability and persistence of types, and their relative stratigraphic values.

[OPTIONAL IN COURSE XII.]

889. ECONOMIC GEOLOGY (Metallic).

Professor Crosby.

PREPARATION: 859.

Sixty hours in the second term of the third year. This is an advanced course in the study of Ore-deposits, based upon an outline of Chemical Geology. The students become acquainted with the literature, study extensive series of illustrative specimens, and gain some field experience.

[REQUIRED IN COURSES III., OPTION 3, XII.]

890. GEOLOGY OF NORTH AMERICA.

Professors Jaggar, Crosby; Dr. Shimer.

PREPARATION: 859.

Ninety hours in the second term of the fourth year. This course embraces the Stratigraphy, the general geologic structure and the Economic Geology of North America. The first part is devoted to the succession and character of the sedimentary formations in the various geologic provinces of the continent. This is supplemented in the second part by the history of geologic surveys and the general structure and Areal Geology of the country. In the third part the student becomes acquainted with the economic geologic resources of the principal political divisions.

[REQUIRED IN COURSES III., OPTION 3, XII.]

892. BUILDING STONES.

Professor Crosby.

PREPARATION: 550.

Two hours a week, throughout the second term of the third year. This is a short course in Economic Geology specially designed to meet the needs of students of Architecture. The principal varieties of stones used for building and decoration are described and discussed with the aid of numerous dressed specimens, especial stress being laid upon the distinguishing features, adaptation to use in various situations, strength and durability, occurrence and distribution, and important instances of use. This work is followed by illustrated lectures on the methods of quarrying and dressing, the weathering and climatic relations, and the selection and testing of stones. Excursions are made to granite and other quarries in the vicinity of Boston. This course is adapted to the needs of students who have done no previous work in Geology.

[REQUIRED IN COURSE IV., OPTIONS 1, 2.]

893. BUILDING STONES (XII.).

Professor Crosby.

PREPARATION: 843.

In comparison with course 892 this longer course of thirty hours given in the first term of the fourth year is a more systematic and complete study of building

stones; and it includes acquaintance with the literature, laboratory work in the testing of stones, and visits to stone yards and structures and to some of the quarry districts in other parts of New England.

[Optional in Course XII.]

895. BUILDING STONES.

Professor Crosby.

Preparation: 857.

Fifteen hours in the second term of the third year. This course differs from course 892, inasmuch as the students come to it with a better preparation, and less attention is paid to the decorative stones; special emphasis being laid upon the materials employed in engineering works, including the quarrying, dressing, weathering, selection and testing of stones.

[Required in Courses I., IV., Option 3, XI.]

896. APPLIED GEOLOGY AND REPORTS.

Professor Crosby.

Preparation: 859.

In this course of fifteen hours in the second term of the fourth year the instruction in Applied Geology parallels somewhat that given in course 895, but with particular attention to the influence of geologic structures on mining operations. This work is supplemented by lectures and reading on the methods of economic examinations, and a study of professional reports. In this connection excursions are made to mines and quarries, and each student submits a report upon some property which he has examined, the report including, where needful, microscopic and chemical analyses and assays, as well as plans and sections.

[Required in Courses III., Option 3; Optional in Course XII.]

DEPARTMENT OF NAVAL ARCHITECTURE.

CECIL H. PEABODY, S.B.
Professor of Naval Architecture and Marine Engineering.

WILLIAM HOVGAARD, COMMANDER IN THE DANISH NAVY.
Professor of Naval Design.

WALTER S. LELAND, S.B.
Assistant Professor of Naval Architecture.

Instructors.
CHARLES F. WILLARD, S.B.
HAROLD A. EVERETT, S.B.
JOHN A. ROSS, JR., S.B.

The instruction in Naval Architecture is intended for those who expect to be ship-designers, ship-builders, ship-managers, or marine engine builders. The special work of the regular Course is given in the form of lectures and recitations, and drawing and computation, during the 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 at the Navy Yard, at the yard of the Fore River Ship and Engine Company, and at several other ship- and engine-works, and to visit ships of all types. This location has made it possible to arrange for progressive speed-trials, tests of engines and boilers, and tests for determining the center of gravity of ships.

For information regarding graduate work and the admission of graduates in the Department of Mechanical Engineering to professional work of the Department of Naval Architecture, see pages 83 and 84 to 88.

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 70.

A circular of the Department of Naval Architecture will be sent on application to the Secretary of the Institute.

900. **SHIP CONSTRUCTION.**

Professor Leland.

PREPARATION: 372; 901, 910, taken simultaneously.

This is a course of thirty lectures in the first term giving a description of building steel, wooden, and composite ships, including general construction and methods of work, and fifteen lectures in the second term dealing with details. Students are supplied with lithograph plates and typewritten notes.

[REQUIRED IN COURSE XIII.]

901. **NAVAL ARCHITECTURE.**

Professor Peabody.

PREPARATION: 35; 70, 71, 910, taken simultaneously.

A continuous series of lectures and recitations, thirty in each term, on the statics of Naval Architecture. The course opens with methods of computation and the use of integrating instruments, and proceeds with the methods of computing the displacement and stability of ships; it includes a discussion of surfaces of buoyancy and of water lines, and concludes with a consideration of the effects of adding weights, flooding compartments, grounding, docking, and launching.

[REQUIRED IN COURSES XIII., XIII.A.]

902. **NAVAL ARCHITECTURE.**

Professor Peabody.

PREPARATION: 901; 80, 911, 913, taken simultaneously.

This course of sixty lectures, extending two hours a week throughout the year, is a continuation of the preceding course, and treats of the dynamics of Naval Architecture. A simple form of modern hydrodynamics is developed and applied to the study of waves and their influence on the rolling of ships, and also to the investigation of stream lines about ships. A discussion is given of the resistance of ships and of propulsion by paddle wheels, screw propellers, and sail; also of methods of making progressive speed trials, and of steering and manœuvring.

[REQUIRED IN COURSES XIII., XIII.A.]

903. NAVAL ARCHITECTURE.

Professors Peabody, Woods.

PREPARATION: 902.

This course of thirty lectures, extending throughout the year, is given to students taking the Course for Naval Constructors, and is intended to form a continuation of the undergraduate courses of lectures on Naval Architecture. It gives advanced and more extended treatment of the theory of Naval Architecture, including the discussion of some problems in Hydrodynamics, certain subjects that relate more especially tc war-ships, and investigation of original memoirs and other literature of the profession.

[REQUIRED IN COURSE XIII.A, GRADUATE YEAR. ELECTIVE IN COURSE XIII., GRADUATE YEAR.]

910. SHIP DRAWING AND DESIGN.

Professors Peabody, Leland; Mr. Everett.

PREPARATION: 372; 900, 901, taken simultaneously.

The work in drawing for naval architects begins with fairing the lines for a steamship, and is followed by the design of a sailing vessel or yacht, including the sail plan and determination of stability. Afterwards each student individually takes up the design of a steamship for a specific purpose and determines the form, displacement, and power required. The time allotted to this work in the third year is six hours per week.

[REQUIRED IN COURSE XIII.]

911. SHIP DESIGN.

Professors Peabody, Leland.

PREPARATION: 901; 910; 902, taken simultaneously.

The drawing for naval architects is continued throughout the fourth year, with seven hours per week the first term and six hours the second term. The design begun by each student in the third year is carried to completion, including framing, general arrangement, and specifications, together with calculations of weight, displacement, stability, and strain in the hull when in still water and when among waves. Calculations are made for launching.

[REQUIRED IN COURSE XIII.]

913. MARINE ENGINES.

Professor Peabody, Mr. Willard.

PREPARATION: 401; 385; 80, 911 or 920, taken simultaneously.

A course of fourteen lectures in the first term and thirty in the second term, together with four hours of drawing per week.

Instruction in Marine Engineering is an integral part of the Course in Naval Architecture and is an Option in the Course in Mechanical Engineering (see course 420). It gives a description of marine engines and their adjuncts, together with methods of determining dimensions and proportions of parts and strain in them due to steam pressure and dynamical actions. A discussion is given of vibrations of ships and balancing engines. Each student makes a preliminary design of a marine engine adapted to the ship which he is designing in course 910, 911, or 920.

[REQUIRED IN COURSES XIII., XIII.A.]

915. THEORY OF WAR-SHIP DESIGN.

Professor Hovgaard.

PREPARATION: 901, taken simultaneously.

A series of thirty lectures during the first term of the junior year, giving a historical account of the development of war-ships, dealing separately with each of the more important classes: seagoing battleships, coast defence ships, cruisers, gunboats, torpedo vessels and submarine boats.

The attention of the student is particularly directed to an appreciation of the causes which have led to the various steps in the development, the chief object of these lectures being to broaden the view of the students and to afford a basis for the full understanding of the following lectures of this course.

Thirty lectures during the second term, being the first part of a course of practical and theoretical nature relating directly to the design and construction of war-ships. The course of this term comprises a discussion of the principles which govern the choice of the elements of the design of the hull and the general arrangements of its main features: principal dimensions, distribution of weights, stability, seaworthiness, watertight subdivision and strength. It contains also practical rules for working out a preliminary design and for the performance of weight calculations.

These lectures as well as the following lectures on this subject are accompanied by numerous compilations, directly useful in naval design work.

[REQUIRED IN COURSE XIII.A.]

916. THEORY OF WAR-SHIP DESIGN.

Professor Hovgaard.

PREPARATION: 915; 901, taken simultaneously.

A course of thirty lectures extending throughout the first term of the senior year, being a continuation of the lectures described under 915 and comprising a discussion of the structural arrangements of war-ships, including also the theory of riveted joints as applied to shipbuilding, calculation of strength of shell plating, rudder, and bulkheads. Special attention is given to methods

of construction used in the United States Navy and comparisons are made with methods used in other navies.

Thirty lectures during the second term, comprising a discussion of drainage and ventilation, coal stowage and coaling, the installation and design of propelling machinery, so far as these questions concern the naval architect. A discussion is given of the question of liquid fuel and the marine steam turbine.

[Required in Course XIII.a.]

917. THEORY OF WAR-SHIP DESIGN.

Professor Hovgaard.

Preparation: 915, 916; 902, taken simultaneously.

A course of sixty lectures extending throughout the graduate year, dealing with the installation of anchors and chain-cables, steering gear, boats, etc., and the arrangement of living spaces. Finally a discussion of the military elements, armament and protection, is given. The disposition and the various installations of guns and torpedoes, as well as ammunition handling and stowage and the design of magazines, are discussed. The lectures on protection comprise the effect of gunfire, the resistance of armor, and the distribution of armor on hull and guns.

The lectures during the entire three years are accompanied by descriptions of methods and installations used in the United States Navy and other navies, together with explanations and study of plans and working drawings, by which the students are also made familiar with the interpretation of such drawings.

[Required in Course XIII.a.]

920. WAR-SHIP DESIGN.

Professors Hovgaard, Leland.

Preparation: 901; 910 (partly), 915, taken simultaneously.

The total time allotted to the subject of war-ship design is three three-hour exercises per week during the first term of the junior year, followed by two three-hour exercises in the second term and throughout the senior and graduate years; of this time, however, the first term of the junior year is taken up by introductory work like that of course 910.

The work consists in the design of a war-ship, each student being as far as possible given a separate design. In working out the general arrangement plan, particular attention is given to the disposition of ordnance, ammunition, and armor; and the problems of ammunition transport, coal-stowage and transport, drainage, and ventilation are studied. Special plans are worked out, showing structural arrangements, drainage and ventilation, and sketches of structural details are prepared. Detailed calculations are performed for the determination of displacement, weight distribution, stability, and strength, and the usual diagrams accompanying such calculations are prepared. The methods of calculations are those used by the Bureau of Construction and Repair.

The horse-power and coal capacity is determined, the principal dimensions of boilers, engines, and propellers are fixed, and the general arrangement of the machinery is studied. A partial specification is worked out.

A half-block model of the design is made by each student, and on this model the plating, longitudinals, etc. are laid off.

[REQUIRED IN COURSE XIII.A.]

921. WAR-SHIP DESIGN.

Professor Hovgaard.

PREPARATION: 915; 916; 920.

This course is given in the senior year, and is a continuation of the subject described under course 920.

[REQUIRED IN COURSE XIII.A.]

922. WAR-SHIP DESIGN.

Professor Hovgaard.

PREPARATION: 915; 916; 917; 921.

This course is given throughout the graduate year and forms a continuation of course 921.

[REQUIRED IN COURSE XIII.A.]

DEPARTMENT OF MILITARY SCIENCE AND TACTICS.

FRED WHEELER, MAJOR, U.S.A.
Professor of Military Science.

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 time of their entrance*, 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 satisfactory evidence of physical disability may be excused from the prescribed drill exercises, and in lieu thereof will be

[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. The names of the three most distinguished students in Military Science and Tactics will, when graduated, be inserted in the United States Army Register.

required to attend a course of theoretical studies in Military Science and Tactics (Course B). All medical certificates intended to show physical disability must be presented *within ten days after entrance.*

All first-year students are required to fill out blanks stating their previous military experience, and no student to whom the military requirement applies may omit military exercises unless he has also appeared before the committee of the Faculty and received his excuse in writing from the Secretary.

In the permanent organization of the battalion, cadet officers are appointed by the Professor of Military Science, subject to the approval of the Faculty.

990. MILITARY SCIENCE A.

Professor Wheeler.

A course of one hour of lectures, recitations, and instruction in making out military rolls and returns, accompanied by two hours of drill per week throughout the first year. Target practice is held in suitable weather, and is open to students of all classes.

[REQUIRED IN ALL COURSES.]

991. MILITARY SCIENCE B.

Professor Wheeler.

A course of two hours per week.

992. TARGET PRACTICE.

Professor Wheeler.

This course is held in suitable weather when practicable. It is open to students of all classes.

[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 the proper function of such instruction are of comparatively recent origin, dating only from the latter half of the last century. Such instruction has formed a very important feature 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 Applied Mechanics, the Steam Laboratory, and the Hydraulic Laboratory.

The John Cummings Laboratory of Mining Engineering and Metallurgy.

The Kidder Chemical Laboratories.

The Research Laboratory of Physical Chemistry.

The Augustus Lowell Laboratories of Electrical Engineering.
The Biological Laboratories.
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 Electro-Chemistry.
The Geological and Mineralogical Laboratories.
The Mechanical Laboratories.
The Geodetic Observatory.

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 Geodetic Observatory in 1898; and the Research Laboratory of Physical Chemistry and the Sanitary Research Laboratory and Sewage Experiment Station in 1903.

Work in the Institute laboratories is effectively supplemented by visits to engineering and industrial establishments, and by vacation excursions under the direction of members of the Faculty.

The Engineering Laboratories.— These laboratories are situated in the building on Trinity Place, and occupy a floor

area of about 23,500 square feet. The very extensive equipment of these laboratories has been chosen with the following objects in view: first, to give the students practice in such experimental work as engineers in the pursuit of their profession are called upon to perform; and, second, to provide ample facilities for the carrying on of original investigations in engineering subjects. The result has been the publication of a large amount of important engineering data. The various special laboratories, together with their equipment, are described below.

The Applied Mechanics Laboratory is furnished with the following apparatus: three testing-machines of one hundred thousand pounds capacity and one of fifty thousand pounds capacity for determining tensile strength, elasticity, and compressive strength; a testing-machine of one hundred thousand pounds capacity for determining the transverse strength and stiffness of beams up to twenty-five feet in length, of framing-joints used in practice, and of other structures subjected to a transverse load; a rope and chain testing-machine of one hundred and fifty thousand pounds capacity; a testing-machine of eighteen thousand pounds capacity for determining the transverse strength and stiffness of beams up to fourteen feet in length; apparatus of thirty thousand pounds capacity for making time-tests of full-sized timber beams; a kiln for drying lumber; apparatus for testing the strength of full-sized masonry arches; a machine for testing the torsional strength and stiffness of shafting up to three inches in diameter and to twenty-one feet in length; a torsion machine of sixty thousand inch-pounds capacity; a small torsion machine of six thousand inch-pounds capacity, for very delicate work; machinery for the measurement of the twist of shafting; for testing the tensile strength of mortars and cements, and of ropes; for testing the effect of repeated stresses upon the elasticity and strength of iron and steel; for determining the strength and elasticity of wire; for determining the strength and elasticity of cloth; for testing the strength of pipe and pipe-fittings under hydraulic pressure; and also accessory

apparatus for measuring stretch, deflection, and twist. Besides the above-stated apparatus, a horizontal Emery testing-machine of three hundred thousand pounds capacity forms a part of the equipment of this laboratory. It contains all the essential features of the eight hundred thousand pound testing-machine built by Lieutenant Albert H. Emery at the Watertown arsenal, and is suitable for testing a compression specimen eighteen feet long, and a tension specimen twelve feet long.

The Hydraulic Laboratory contains a closed steel tank five feet in diameter and over twenty-seven feet high, arranged for the insertion of orifices, mouth-pieces, and other special pieces of apparatus, with gates for controlling the discharge, and with connections for supplying water, in experiments upon pipes and motors. This tank is connected with a ten-inch stand-pipe over seventy feet high, so arranged that a constant head may be maintained at any desired level. Two steel tanks, each of about two hundred and eighty cubic feet capacity, give opportunity for the accurate measurement of larger quantities of water than can be weighed directly during experiments. A system of pipes connected both with the main tank and with the pumps is arranged for the insertion of diaphragms, branches, and other apparatus for studying loss of head and the laws of discharge. An attachment has been fitted to the main tank, containing a Pitot tube for studying the laws of velocity in jets, and adjustable points for accurate measurement of the cross-section of jets.

The laboratory is further equipped with a forty-eight-inch Pelton wheel, of thirty horse-power; a three-foot American impulse wheel; a Venturi meter; an eight-inch, a twelve-inch, and two forty-eight-inch weirs, and an orifice tank for measuring water; a centrifugal pump; a rotary pump; a plunger pump; a pulsometer; a three-inch water meter and others of smaller size, and a variety of mercury gauges, standard orifices, mouth-pieces, diaphragms, branches, nozzles, etc., for experiments with flowing water under all conditions.

A six-inch turbine is arranged to be run under various conditions of head and gate opening in tests for efficiency. There is also a hydraulic ram with a two-and-one-half-inch drive-pipe and a double-acting Rife hydraulic engine. The laboratory also contains a steel weir-box, the weir having a standard crest adjustable as to length from zero to five feet, and a seconds pendulum, with chronograph for exact determination of time in experimental work. Water is directly supplied for experiment by the various pumps. The laboratory also contains apparatus by which the suitability of various materials for the construction of roads or pavements may be ascertained.

The Steam Laboratory contains a triple-expansion engine, with cylinders of nine inches, sixteen inches, and twenty-four inches diameter respectively, and thirty inches stroke, arranged in such a way as to be run single, compound, or triple, as desired for purposes of experiment. This engine is of the Corliss type, and has a capacity of about one hundred and fifty horse-power when running triple, with an initial pressure of one hundred and fifty pounds in the high-pressure cylinder. It is connected with a surface condenser and the other apparatus necessary to adapt it to the purposes of accurate experiment. A tandem compound, high-speed engine of about two hundred and twenty-five horse-power, having cylinders eleven and nineteen inches in diameter by fifteen inches stroke, is similarly provided with surface condenser, air pump, and other apparatus needed for testing. This engine transmits its power through a rope drive.

This laboratory also contains a three-stage air-compressor adapted to compress one hundred cubic feet of free air per minute to twenty-five hundred pounds pressure per square inch, connected with storage tubes of about fifty-eight cubic feet capacity; a plant for making liquid air; a sixteen horse-power engine, and an eight horse-power engine, used for giving instruction in valve setting, etc., also a thirty-six horse-power gas-engine, and a small gas-engine. It is equipped with several surface condensers, steam-pumps, injectors and ejectors, calorimeters,

mercurial pressure and vacuum columns; apparatus for determining the quantity of steam or air issuing from a given orifice or through a short tube under a given difference of pressure; apparatus for testing steam-engine indicators; apparatus for testing injectors; and indicators, planimeters, gauges, thermometers, anemometers, and other accessory apparatus.

The Engineering Laboratories are provided with a number of friction brakes; with machinery for determining the tension required in a belt or rope to enable it to carry a given power at a given speed, with no more than a given amount of slip; with four transmission dynamometers; with two machines for determining the coefficient of friction of lubricating oils; with a pendulum governor arranged for experimental purposes; with a complete set of Westinghouse air-brake apparatus, including the parts belonging to the car and to the locomotive, and with a complete brake outfit for an electric car; with the pump and engineer's valve of the New York air-brake; with a locomotive link model; with two hot-air engines; and with cotton machinery as follows: — two cards, a drawing-frame, a speeder, a fly-frame, a ring spinning-frame, and a mule, as well as accessory apparatus.

There are available for purposes of experiment in connection with the work of these laboratories four horizontal tubular boilers in a boiler-house near the Engineering Building, with a wrought-iron stack, three feet in diameter and one hundred feet high, fitted with the apparatus necessary to make experiments on the draughts of chimneys; two large sectional boilers situated in the Rogers Building with a masonry stack three feet square and one hundred feet high; two 250-horse-power Babcock and Wilcox boilers and a steel stack four feet in diameter and one hundred feet in height, as well as the engines and cooling tower in the Electrical Engineering Laboratory; and also another boiler, a forty horse-power engine, a number of looms, and other apparatus in the mechanical laboratories on Garrison Street.

The John Cummings Laboratories of Mining Engineering and Metallurgy.— These laboratories are designed to furnish students the means for experimental study of the various processes of ore-dressing and smelting, and at the same time to give them the mental training needful for professional practice. The apparatus has been chosen with a view to illustrating, as far as possible, the principles of the more important machines and furnaces actually used in mines, mills, and smelting works.

The crushing, concentration, and smelting of ores of lead, copper, gold, and silver furnish the best field for this laboratory work. The production of iron and steel in quantity is precluded by the size of the plant required, and by the large amount of ores and fluxes needed; the microscopical study of the structural changes that occur under heat treatment takes its place.

The experimental work of the laboratory is carried on by the students, under the immediate charge of an instructor. A sufficiently large quantity of ore is assigned to each student, who first examines it for its component minerals, sorts and samples it, determines its character and value by analysis and assay, and makes such other preliminary examinations as may serve to indicate the proper method of treatment. He then treats the given quantity, makes a careful examination of the products of each step of the process, ascertains, wherever practicable, the amount of power, water, chemicals, fuel, and labor expended, and thus learns approximately the effectiveness and economy of the method adopted. He learns also the value of chemistry as a check upon metallurgical work. Each student in working his ore is assisted by his classmates, who have opportunity in turn to manage the machines and furnaces.

It is not considered that the instruction given in this laboratory is in any sense a substitute for the experience gained in large works. It is believed, however, that it prepares students to enter works and to be almost immediately useful in them.

The spirit of investigation which is developed by the work, as well as the experience of comparing processes actually carried out with the same processes as described in books, is of great advantage.

The laboratories include five parts: concentration and plate amalgamation, lixiviation and pan amalgamation, roasting and smelting, assaying, and heat treatment and microscopical examination of metals and alloys.

In the Concentrating Laboratory the effects of different combinations and adjustments of machines upon the saving of losses in slimes and included grains, in order to produce the best scientific result or the greatest commercial profit, can be tested under the very best conditions. Among these combinations are graded crushing, graded sizing, graded jigging; hydraulic classifying as a preparation for jigging and the slime table; jigging with much or little suction; the variations of the slope, the quantity of water, and the roughness of the surfaces of slime tables; and the adjustments of the gravity stamps, the amalgamated plates, the belt vanners, Wilfley tables, and magnetic concentrators.

In the Lixiviating and Amalgamating Laboratory the effects of varying the sizes of grains, the strength of solution, and the time of treatment may be tried; suitable variations may be made in the cyanide process, the hyposulphite process, and, either by vat or by revolving barrel, in the chlorination process; in the amalgamating-pan the temperature, the chemicals, and the time of exposure can all be studied for the production of the best results.

The Smelting Laboratory is provided with furnaces for roasting, smelting, and refining copper; for roasting, smelting, and cupelling lead; and for chloridizing roasting preparatory to pan amalgamation or lixiviation. The smelting of a ton or two of ore cannot in the nature of things produce results which approach as nearly to the economy of practice on a large scale as is done in the other experimental lines, but the experience which the students gain throws more light

upon the meaning of the lectures than any other work performed in these laboratories.

The Assaying Laboratory is provided with furnaces for crucible work, scorification, cupellation, and all the usual accompanying operations. Near by are rooms for fine balances and for supplies. This laboratory not only provides for the regular course in assaying which is taken by all the students in Mining Engineering and Chemistry, but it furnishes a means of testing and checking the work of the other three laboratories. A laboratory with chemical desks is provided for conducting small lixiviation tests and such wet work as is necessary in connection with the smelting and lixiviation of ores. The blow-pipe laboratory of the Geological Department is used for blow-pipe silver assay.

The Metallographical Laboratory is furnished with the necessary apparatus for heating, grinding, and polishing specimens of metals and alloys, for examining them microscopically, and for taking micrographs.

A museum of ores, products, and models of mining engineering and metallurgy serves to illustrate the lectures.

The Kidder Laboratories of Chemistry afford accommodations for more than nine hundred students. The Chemical Department occupies twenty-five laboratories, four lecture-rooms, a reading-room and library, three balance-rooms, offices, and supply-rooms,—in all forty-five rooms. The laboratory for inorganic chemistry has places for six hundred students, and is completely equipped for instruction in elementary chemistry. The analytical laboratories can accommodate two hundred and thirty students, and possess every convenience for accurate and rapid analytical work. The main organic laboratory has places for thirty-six students and is provided with appliances for vacuum, steam, and fractional distillation, with suction pumps for filtration, with electrolysis circuits, filter-presses, etc. Adjoining it is a laboratory arranged for organic combustions, and on the roof is an enclosed room, in which

chemical operations of a dangerous or noxious character can be performed. The laboratory of water, air, and food analysis contains places for sixteen students, and possesses a complete outfit for the analysis of air and water, and for the investigation of sanitary problems. The laboratories of industrial chemistry accommodate forty-eight students. They comprise a series of rooms in the Pierce Building fitted with the needful apparatus for the preparation of chemicals on a considerable scale. The main laboratory contains kettles of various patterns, stills, presses, tanks, centrifugal dryers, crystal dryers, a filter-press, a furnace, and a variety of other forms of apparatus. The laboratory devoted to textile coloring contains numerous jacketed kettles, baths, and dye-tubs, squeeze-rolls, a steamer, an ager, and a dryer. Two laboratories for undergraduate and graduate students respectively, adjoining the Research Laboratory of Physical Chemistry, are devoted to work in theoretical chemistry. These are equipped with electric circuits, thermostats, and standard physico-chemical instruments, as well as with all the facilities for ordinary chemical work. The laboratory for proximate technical analysis accommodates thirty-six 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 flash-point apparatus, and other instruments employed in this special line of work, in addition to which are to be found the needful apparatus for the analytical examination of rubber, paper, tanning materials, and other substances of commercial importance. A special laboratory is equipped for the study of methods of optical analysis of sugars, starches, and allied products. The main lecture hall has a seating capacity of three hundred, and is arranged with special reference to the delivery of lectures illustrated by experiment. In addition there are three lecture-rooms, seating respectively forty eight, eighty, and one hundred

and twenty-five students. The lecture-rooms contain valuable cabinets of specimens for purposes of illustration. The balance-rooms are supplied with thirty analytical balances.

The Research Laboratory of Physical Chemistry.— The Research Laboratory occupies one floor of the new building on the corner of Trinity Place and Stanhope Street. It consists mainly of a series of small laboratories, each of which affords ample accommodation for two workers. 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 laboratories are rooms for special purposes,— weighing, photographic work, optical measurements, glass-blowing, pure-water distillation, the storage of apparatus, and the holding of lectures and seminar meetings. Each laboratory is connected with a 220-volt, direct current circuit, and with systems for supplying ordinary and distilled water, gas, steam, and compressed air ; and each is provided with a large thermostat. The laboratory affords abundant room for eighteen research workers.

The Augustus Lowell Laboratories of Electrical Engineering.— These laboratories embrace the Standardizing Laboratory, the Laboratory of Dynamo-electric Machinery, and various rooms devoted to photometric measurements and to special research.

The Standardizing Laboratory furnishes facilities for making tests and for giving instruction in the measurements arising in technical work. It is provided with circuits furnishing alternating current at 25 and 60 cycles, both three-phase and quarter-phase, and also direct current. 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 as regards 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. The laboratory is provided with sets of standard resistances, certified by the Reichsanstalt, all necessary apparatus for measuring both high and low resistances and for calibrating resistance boxes, and also with standards of capacity and inductance, with the necessary auxiliary apparatus.

The Laboratory of Dynamo-electric Machinery is equipped with a complete electric lighting and power plant available for testing purposes, as well as a very extensive collection of alternating and direct current machinery. The power plant consists in part of a battery of two 250-horse-power Babcock and Wilcox boilers, built for a working pressure of 250 lbs., but running normally at 160 lbs., with foundations and space provided for three boilers; a 750-horse-power, horizontal, cross-compound Russell engine, direct-connected to a 480-kilowatt, double-current General Electric generator; and a 250-horse-power, horizontal, tandem-compound Ridgway engine, direct-connected to a 230-volt, 60-cycle, four-phase General Electric alternator. These engines exhaust into a Worthington surface-condenser, provided with steam-driven air and circulating pumps. The circulating water is cooled by

a Worthington cooling tower. The condensed steam from the engine is purified and returned to the boiler through a Cochrane feed water-heater. The output of these generators is delivered to a large switchboard of modern construction, from which light and power feeders are taken, and connections are made to the special mains about the laboratory.

The equipment includes also two 75-kilowatt, 230-volt, three-wire Westinghouse generators, each connected to a 125-horse-power Westinghouse compound engine; a special testing set, consisting of two similar 25-kilowatt General Electric generators belted to a 100-horse-power Westinghouse compound engine, this set being specially fitted with electrical instruments, engine-indicating apparatus, and surface-condenser for instruction in various methods of plant-testing; a motor-generator set, consisting of a 150-horse-power, 230-volt, direct current motor, driving a 100-kilowatt, 230-volt, 60-cycle, three-phase generator and a 50-kilowatt, 230-volt, 25-cycle, three-phase generator; a motor-driven pair of series-boosters suitable for raising the potential of an 800-ampere, three-wire feeder 10 per cent.; a 100-kilowatt set of 60-cycle phasing transformers for change from three-phase to two-phase, or the reverse; a 50-kilowatt, 25-cycle rotary transformer, having compounded field-windings with a variable reactance, provided with screw adjustments, giving a maximum reactance of 50 per cent. of the rotary capacity, together with a field rheostat, a speed-limiting device, circuit-breakers, a starting compensator, and a neutral connection from the transformers, so that this combination can be used as commercially installed, for central-station, railway, power, or lighting service; a 150-horse-power, direct current motor; two 30-horse-power, one 20-horse-power, and two 15-horse-power, 230-volt, direct current motors; and two 15-kilowatt, 60-cycle, three-phase machines, which can be operated at any frequency between 25 and 75 cycles per second, and can be used as generators or synchronous motors. There is a similar though somewhat smaller pair of 25-cycle machines; a number of induction

motors from 30-horse-power down; a 2-kilowatt, alternating current generator, capable of giving any frequency up to 10,000 cycles; a 12-kilowatt Edison generator; a 13½-kilowatt, Thomson-Houston, inclined-coil generator; a 20-kilowatt Westinghouse compound generator; a United States 40-kilowatt compound generator; transformers of various patterns and designs; a 37-kilowatt, Mordey inductor, 1100-volt, alternating current generator; a Brush 30-arc-light generator; an experimental 15-kilowatt, 440-volt, three-phase generator, with Scott transformers of 10-kilowatt capacity; a 25-cycle set, illustrating the problems of long distance transmission, consisting of three 30-kilowatt, 25-cycle, step-up transformers; a single 55-kilowatt, three-phase transformer, with a 145-volt secondary; three 20-kilowatt, 60 cycle, and four 15-kilowatt, 60-cycle, transformers of standard voltages for general use about the laboratory; a pair of 60-cycle testing transformers, stepping up from 230 volts to 100,000 volts; and a 10-ton, electrically-driven, overhead crane, which traverses the entire length of the laboratory. There is also a large number of direct current dynamos and motors, alternating current dynamos and transformers, under 10-horse-power capacity, together with inductances and condensers. The ventilating fans of the building and the fan for the cooling tower are driven by one 15-horse-power and two 10-horse-power motors, especially arranged for such work, and are available for instruction in connection with electrically-driven, variable-speed fans.

Of the four dark rooms provided, one is equipped with a special photometer, designed by the department, for use in testing arc lights; one is used for special testing; and one as a photographic room, with ample accommodations for developing, printing, and washing.

The laboratory possesses a large and representative collection of arc lamps, suitable for use on alternate and direct current circuits, both constant potential and constant current.

The shop of the department is well supplied with machine-

tools, among which are a 24-inch planer, with a six-foot bed, two gear-cutting engine lathes, 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.

The Biological Laboratories, which were opened in 1883 in the Rogers Building, are now located in the Henry L. Pierce Building. They comprise four well-equipped laboratories for undergraduates, with smaller rooms for special lines of work, and a laboratory devoted to more advanced or special investigation. In connection with these there is a well-appointed library and reading-room, centrally placed, and containing more than two thousand volumes and monographs.

A large laboratory of general biology and microscopy 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, somewhat smaller, furnishes opportunities for the practical work of the classes in comparative anatomy, embryology, cryptogamic botany, and histology. It is equipped with Thoma and Minot 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, and with desks for work in physiological chemistry. Adjoining this is a workshop, with lathe and tools, as well as a dark-room for work in physiological optics.

The laboratory of bacteriology and industrial and sanitary biology is 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 culture-room and a room for chemical work and the preparation of nutrient media.

Finally, there is a research laboratory for the use of graduate students and special investigators. This is fitted with incubators, autoclaves, and other apparatus for the study of problems connected especially with the sanitary and industrial applications of biology.

This whole series of laboratories is organized for work directed chiefly towards the microscopical, hygienic, and industrial side of biology, and offers special opportunities for those desiring to fit themselves for teaching or for medical study or for practical work in applied biology.

The Sanitary Research Laboratory and Sewage Experiment Station.— This laboratory was recently established by the generosity of an anonymous donor for the benefit of Institute investigators and students in Sanitary Engineering, Sanitary Chemistry, and Sanitary Biology, upon land specially secured for the purpose on Albany Street opposite the South Department of the Boston City Hospital. Here are provided not only demonstrations of the more important methods employed in the purification of sewage and water but also well-equipped chemical and bacteriological laboratories for the use of investigators and students.

The site of the laboratory borders upon one of the largest of the trunk sewers of the Boston main drainage system, and with this sewer connections have been made, so that raw sewage may be pumped in abundance at any hour of the day or night, as may be required for demonstrations or experi-

ments. The Sewage Experiment Station is in a two-story building, well equipped for the purpose, in which a number of large wooden tanks have been installed for experimental purposes. Some of these contain sand, some coke, and some small stones, for experiments upon filtration, while others are reserved for "septic tank" studies and the like. The equipment of the station, together with the chemical and bacteriological laboratories in a small building adjoining, furnishes, it is believed, exceptional facilities for work of this character bearing upon subjects of practical importance in Sanitary Biology, Sanitary Engineering, Sanitary Chemistry and public health problems, especially the purification of water and sewage.

The Rogers Laboratory of Physics is located in the Walker Building, and occupies sixteen rooms. Of these, two are lecture-rooms: the general physical lecture-room, seating three hundred students; and a smaller one seating two hundred and thirty. Both are fitted with appliances for physical experimentation and for the use of the lantern. The Rogers Laboratory has an exceedingly extensive equipment of apparatus for both demonstration and physical measurements, and large additions are made to it every year.

The several laboratories are as follows: —

The Laboratory of General Physics, which is devoted to instruction in general physical measurements, including mechanics of solids, liquids and gases, light and heat. The equipment consists entirely of instruments of a high grade, and corresponding precision is required in the work of the student. Among the more novel pieces of apparatus in general use may be mentioned a Zeiss comparator, spherometer, and thickness micrometer, a fine Zeiss spectrometer, and a comparator from the Société Genevoise.

For advanced work, provision is made in the following special laboratories: —

The Electrical Laboratory is provided with electric cir-

cuits for both direct and alternating currents. It 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 apparatus has been selected with a view to instruction in measurements of fundamental importance and approved value. The equipment includes such apparatus as ammeters and voltmeters of the best design with standard cells and other apparatus necessary for their verification, Wheatstone bridges of precision, a Thomson low resistance bridge, a Carey-Foster bridge for the determination of temperature coefficients, standard condensers, a standard of self-induction and secohmmeter, a small alternating current dynamo of high periodicity, apparatus for the recording of wave-forms by the Braun's tube, and a Thompson permeameter.

The Physico-chemical Laboratory is fully equipped to give instruction in physico-chemical methods and for research work in chemical physics. Among the special pieces of apparatus may be mentioned a Berthelot platinum calorimeter, a large Landolt-Lippich polarimeter, an Abbé dilatometer and heater, with complete quartz accessories, a Zeiss refractometer and comparison spectroscope, and Nernst's and Drude's apparatus for dielectric constants. A large electrically heated thermostat, the temperature of which can be maintained constant to within a few thousandths of a degree, is provided for work in chemical statics and chemical dynamics. Work in thermo-chemistry, chemical statics, and chemical dynamics, is required in connection with the lectures on these subjects.

The Electro-chemical Laboratory provides for instruction both in electro-chemical measurements and in applied electro-chemistry. The laboratory for the former work has been equipped with every convenience and facility for carrying on electro-chemical experiments. Each student is given a large desk provided with four circuits of 2, 12½, 25, and 110 volts from each of which currents up to 10 amperes can be taken at all times. An adjustable rheostat of corresponding ca-

pacity is also provided and wired directly to terminals on the switch-board at the front of each desk. Water, gas, and suction are provided at one end of each desk, and a large electrically heated and regulated thermostat at the other. In addition to the usual apparatus required for chemical work, each student is given a very complete equipment of electro-chemical apparatus. This includes a three-scale Weston portable voltmeter reading to 3, 15, and 150 volts, a Weston milli-voltmeter with adjustable shunt for reading amperes, a potential box, Lippman electrometer, complete conductivity apparatus, transference apparatus, copper, silver, and gas voltmeters, normal and half electrodes, etc. At present ten desks have been thus equipped. The laboratory is also provided with a balance room, a special still for conductivity water, hoods, a drying closet, and special constant temperature closets, provided with circuits of variable voltage, for electro-chemical analysis.

The work in applied electro-chemistry is intended to illustrate, on a fairly large scale, the more important industrial processes involving the mutual transformations of electrical and chemical energy. For this work a special laboratory adjoining the preceding has been equipped with a 25-kilowatt, double-current motor generator, which may be connected to give 1,000 amperes at 25 volts or 2,000 amperes at 12½ volts. This generator supplies the students' desks with 12½ and 25 volts, and also the electric furnaces for electrolytic reductions on a large scale. For electric furnace work requiring heat alone the laboratory is also provided with alternating current at 1,000 volts, which, by means of a special 50-kilowatt transformer designed in the department, is stepped down first to 160 volts and then in steps of ten volts each to ten volts. The secondary is wound in sections to permit a number of furnaces being run simultaneously, at voltages equal to any multiple of ten volts.

Furnaces of a number of different types are provided, including those of Moissan, Borchers, and others especially con-

structed at the Institute for experimental work. A storage battery of large capacity has also been installed for processes requiring large currents at low constant voltage.

The Laboratory of Heat Measurements is devoted to the study of accurate thermometry, the measurement of high temperatures, the determination of the efficiency of fuels, and the study of intense sources of heat, such as the electric furnace. It is well equipped with standard apparatus for these purposes, and contains also much original apparatus, especially that in use for the technical measurement of thermal conductivity and for the regulation and control of high temperatures. There is also apparatus for the determination of the mechanical efficiency of explosions and for the study of the velocity of propagation of explosions. A specially designed transformer of 50 kilowatts capacity is provided for work in connection with electric furnaces. The increased space now available has made it possible to add largely to the present equipment for research, especially in the line of electric furnaces, for the study of the various modern processes in which their use is involved. The increased electrical supply makes possible a much more complete study and use of the methods and apparatus for the maintenance and measurement of very high temperatures, such as are now reached in many technical processes.

The Laboratory of Acoustics is especially designed for experimentation and research on sound and its applications, including the acoustic side of telephony. It contains an excellent collection of standard forks and other acoustic apparatus.

The Optical Laboratory provides facilities for students to familiarize themselves with the more important optical methods and instruments now in use. The equipment includes an Abbé focometer, a Zeiss microscope with very complete accessories for the study of the optical theory of the microscope, a Pulfrich refractometer; and, for spectroscopic researches, a number of spectrometers, together with concave

and plane Rowland gratings, an echelon spectroscope, and two Michelson interferometers. Facilities are also offered for advanced work in spectro-photometry, and for work in photography, for which special dark rooms are provided.

Provision is made for research in all the special laboratories.

The Geological and Mineralogical Laboratories.— These laboratories now occupy six rooms on the first and second floors of the buildings on Trinity Place.

The laboratory of dynamic and experimental geology, recently established, contains a machine for the cutting and polishing of minerals, rocks, and fossils, apparatus for the mechanical analysis of detrital materials, etc.; besides an extended series of illustrations in chemical geology. The equipment of this laboratory is supplemented by the laboratories of mechanical engineering, metallurgy, chemistry, and physics.

The laboratory of structural geology contains, first, a cabinet collection of rocks, and an extensive series of trays especially arranged for the laboratory work in lithology; second, an exceptionally complete series of illustrations in geotectology; and, third, facilities for the work in petrography.

The laboratory of economic and applied geology contains extensive collections of ores and other economic minerals and of building stones. Directly connected with each of the rooms is the general lecture-room, which is equipped with an electric light lantern.

The laboratory of mineralogy is equipped for work in both descriptive and determinative mineralogy and contains collections of minerals arranged for class work in these subjects; and a spectroscope, a Westphal specific gravity balance, a chemical balance, and other apparatus for the chemical investigation of minerals. The instruction in crystallography is also given here, the equipment including natural crystals, models and drawings, a reflection goniometer, axial angle apparatus, and a polariscope.

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, wood-turning, 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, located on Garrison Street, 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 carpentry, wood-turning, and pattern-making laboratories contain forty carpenter's benches, two circular-saw benches, a swing-saw, a band-saw, two jig-saws, a buzz-planer, thirty-six wood-lathes, a large pattern-maker's lathe, and thirty-six pattern-maker's benches. The founding laboratory contains a cupola furnace for melting iron, two brass furnaces, a core oven, and thirty-two moulder's benches. The forging laboratory contains a power-hammer, thirty-three forges, seven blacksmith's vises, one blacksmith's hand-drill, and a power-shear. The machine-tool laboratory contains thirty-one engine-lathes and seventeen hand-lathes of approved patterns, a twenty-four-inch turret-lathe, two machine-drills, a centering-machine, four planers, a shaping-machine, two universal milling-machines furnished with spiral and gear-cutting attachments, a plain milling machine, a universal grinding-machine, 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, and a fully equipped tool-room. The Filing Laboratory contains thirty-two vise

benches arranged for instruction in vise work and a tool grinder.

Equipment for Civil Engineering: Geodetic Observatory.— 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 single and double floats of various patterns, loaded tubes, and five current meters of different kinds; 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 and mouthpieces, over weirs, through pipes, etc., 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.

An observatory in the Middlesex Fells, within easy access of Boston, is devoted to instruction in geodesy and astronomy. It is a stone building, fifteen feet square, and contains at present the following apparatus: a transit instrument of 2½-inch aperture, 27-inch focus, with micrometer eye-piece for latitude observations; a sidereal chronometer, a chronograph, a magnetometer, a dip circle, an altazimuth instrument, and various other smaller appliances, such as level triers, mercury horizons, etc. This observatory enables the Institute to offer excellent facilities for instruction in geodesy.

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. During the past year special courtesies have been shown by Mr. Lucius Tuttle, President of the Boston & Maine Railroad, and by Mr. Edgar Van Etten, Vice-President of the New York Central Railroad.

Equipment for Naval Architecture.—The Department of Naval Architecture, though relatively new, is already well grounded and established, and has an adequate equipment. The department owns a large collection of standard and recent works on naval architecture and marine engineering, including technical periodicals, and has 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 war-ships, 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 a calculating machine 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, in which instruction is given, at suitable times, in making ships' models, use being made of lines constructed by the student in his ship design, to the end that he may learn to appreciate and correctly judge forms as represented by ships' lines.

Libraries.

The libraries of the Institute contain more than seventy thousand volumes and more than eighteen thousand pamphlets, while nearly a thousand periodicals are received regularly. The General Library of the Institute occupies a spacious and well-lighted room on the first floor of the Rogers Building. In it are to be found more than three thousand volumes in English literature, biography, history, and kindred subjects; works on education and military science, proceedings of learned societies that are of general character, and a complete set of the publications of the Institute and its officers—besides encyclopædias, dictionaries, catalogues of other libraries, and other books of reference. All students have access in this library to a hundred current periodicals, many of which are of a general or popular character. The Librarian of the Institute has his office here.

A collection of about four hundred volumes, chiefly on athletics, sports, and personal hygiene, has been given by a graduate of the Institute to be placed in the Walker Memorial when that building is completed. In the mean time these books are stored in the General Library. There is also a small library of about six hundred volumes in the Margaret Cheney Reading-room for the use of women students of the Institute.

Students have full use of the valuable library of the Boston Society of Natural History, and of the extensive collections of the Boston Public Library, comprising more than six hundred and fifty thousand volumes in all departments of knowledge; and also have the privilege of consulting some libraries of scientific societies, of individuals, and of private

corporations containing complete sets of scientific periodicals, which supplement the rich collections of serial publications in the Libraries of the Institute.

The greater part of the books belonging to the Institute is distributed to twelve departmental libraries, where they are easily accessible to all students. These libraries contain a careful selection of special treatises, monographs, text-books, etc., and of periodical publications germane to the work of the respective Departments. They are thus working libraries, and valuable experience in the use of them is acquired before the completion of the regular Courses, either incidentally to the preparation of theses, or in connection with lectures or recitations. This division of the library enables each student with the least possible inconvenience to consult the works needed. The departmental libraries are described in detail below.

The Library of Mathematics.—This library, called the Runkle Mathematical Library in honor of the late Professor John D. Runkle, who some time previous to his death presented the Institute with his private library of mathematical works, contains a carefully selected collection of about fourteen hundred books in all branches of Mathematics; and new publications of value are added as soon as issued. The more important journals devoted to the subject of Mathematics are received regularly.

An extensive collection of models, which are of special interest and value in connection with the courses on Analytic Geometry of Three Dimensions, the Theory of Surfaces, and the Theory of Functions, is arranged in cases in this library.

The mathematical library is open to advanced students, who must obtain permission to use it from the professor in charge.

The Library of History and Economics.—This library comprises eleven thousand selected volumes and several thousand pamphlets. Every student enjoys unrestricted access to the

shelves, and the reading-room contains reference books, a large number of such magazines and newspapers as are useful in historical and political study, reading-tables, and work-tables for the preparation of maps, charts, diagrams, and especially for statistical work. There is a good collection of maps and diagrams, particularly serviceable for the illustration of industrial and political History. A good working library in Statistics has been gathered, and the library of the American Statistical Association, deposited with the Boston Public Library and easily accessible, affords special advantages.

The Library of Modern Languages.—Conveniently situated near the rooms where instruction in the Modern Languages is given, is a collection of about eleven hundred volumes of works in modern European Literature and Philology, chiefly French and German, together with dictionaries, works on Grammar, etc. Twenty French and German periodicals are taken.

The Engineering Library.—The libraries of the Departments of Civil, Mechanical, and Sanitary Engineering are united into a single library. This library contains about twelve thousand volumes and four thousand pamphlets. It is especially rich in journals and transactions of societies dealing with the various branches of Engineering. Two hundred and nine publications of this kind are received annually.

The Library of Mining and Metallurgy.—The library of the Department of Mining Engineering and Metallurgy contains over thirty-six hundred volumes, and receives annually seventy-eight periodicals.

The Architectural Library.—The Architectural Library contains over thirty-five hundred volumes of technical works, and the leading American and foreign periodicals. The Royal Institute of British Architects presents its publications to the

library, and many richly illustrated and costly books have been added as gifts from friends of the Institute.

By means of a special fund raised for the purpose, several thousand photographs, prints, drawings, and casts were originally collected for the Department. To these collections large additions have been made by regular appropriations and by gifts; so that now there is deposited in the library a carefully selected collection of fifteen thousand photographs and ten thousand five hundred lantern slides. Models and illustrations of architectural detail and materials are arranged in the rooms of the Department. The students of the Department have free access to the Museum of Fine Arts at all times.

The Chemical Library.—The William Ripley Nichols Chemical Library is named in honor of Professor Nichols, whose private library, bequeathed to the Institute, forms the nucleus about which have been gathered more than nine thousand volumes and seventeen hundred pamphlets. This library, which is open to all students, contains complete sets of most of the important chemical periodicals and a noteworthy collection of works upon Sanitary Science. The number of periodicals currently received is ninety-six.

The Physical Library.—The library of the Department of Physics contains seven thousand volumes, and is very complete in recent works upon Physics, Electricity, and Electrochemistry. Seventy-five of the principal physical periodicals are received regularly, and all new publications of importance are procured.

The Library of Electrical Engineering.—This library, recently separated from that of the Department of Physics, contains about nine hundred volumes, including important sets of periodicals dealing with electrical and engineering subjects. For this Department the Institute takes regularly thirty-four current periodicals.

The Geological Library.—The Rogers Geological Library, which had for its foundation the private collections made by the first president of the Institute and by his brother, Professor Henry D. Rogers, contains twenty-five hundred volumes, the current periodicals, and the geological and geographical maps used in giving instruction, including a complete set of the publications of the United States Geological Survey. In the same room is a valuable collection of fossils stratigraphically arranged in two hundred and seventy-five drawers. An additional collection is selected and arranged with special reference to teaching Structural Palæontology.

The Biological Library.—The Department of Biology is provided with a well-appointed library and reading-room, centrally placed, and containing more than three thousand volumes and pamphlets. For this Department there are received regularly sixty-nine periodicals, and the library is especially rich in standard works upon Bacteriology, and Sanitary Science.

The Library of Naval Architecture.—Conveniently situated next to the drawing-room of this Department is a collection of books that formerly was a part of the Engineering Library. It consists of about eight hundred volumes and pamphlets on Naval Architecture, Ship-building, and Marine Engineering; and twenty-three periodicals and annuals are sent regularly to this Department.

There is also an extensive collection of plans and drawings carefully classified and arranged for easy reference by students.

Regulations.

School Year.—The first term begins on the first Wednesday after September 25. There is a recess of one week after the Semi-annual Examinations, and the second term begins on the first Tuesday after February 4. On legal holidays, and for one week at Christmas, and on two days in the second term, the exercises of the school are suspended.

CALENDAR FOR 1905–1906.

School Year began	Wednesday, Sept. 27, 1905
Semi-annual Examinations begin	Tuesday, Jan. 16, 1906.
Second Term begins	Tuesday, Feb. 6, 1906.
Annual Examinations begin	Tuesday, May 22, 1906.
Degrees conferred.—School Year ends	Tuesday, June 5, 1906.
First Entrance Examinations	Wednesday, June 27, 1906, Thursday, June 28, 1906, Friday, June 29, 1906, and Saturday, June 30, 1906.
Examinations for Advanced Standing begin	Monday, Sept. 17, 1906.
Second Entrance Examinations[1]	Tuesday, Sept. 18, 1906, Wednesday, Sept. 19, 1906, and Thursday, Sept. 20, 1906.

CALENDAR FOR 1906–1907.

School Year begins	Wednesday, Sept. 26, 1906.
Semi-annual Examinations begin	Tuesday, Jan. 15, 1907.
Second Term begins	Tuesday, Feb. 5, 1907.
Annual Examinations begin	Tuesday, May 21, 1907.
Degrees conferred.—School Year ends	Tuesday, June 4, 1907.
First Entrance Examinations	Wednesday, June 26, 1907, Thursday, June 27, 1907, Friday, June 28, 1907, and Saturday, June 29, 1907.
Examinations for Advanced Standing begin	Monday, Sept. 23, 1907.
Second Entrance Examinations[1]	Tuesday, Sept. 24, 1907, Wednesday, Sept. 25, 1907, and Thursday, Sept. 26, 1907.
School Year of 1906–1907 begins	Wednesday, Oct. 2, 1907.

[1] See page 90.

The Status of Students in regard to scholarship and ability 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; but examinations in fourth-year subjects finished before the end of the term may be held at the close of the respective courses. The January examinations are confined to the work of the first half of the year. The May examinations may cover the work of the entire year. In the fourth year the annual examination may cover, in addition, professional subjects of earlier years. Any member of the Faculty may omit an examination in a third- or fourth-year subject, if, in his judgment, such examination is unnecessary. 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 Monday and following days previous to the September entrance examinations, 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, but will be required either to repeat the subject or to discontinue it, as well as all subjects dependent thereon, unless further time be allowed by special vote of the Faculty. A regular student failing entirely to make up any condition will cease to be regular, and his name will be transferred to the list of special students.

Students having clear records at the end of their first term

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. Intermediate cases are specially considered by the Faculty.

Any special student attaining a proper standing in all subjects required of a regular student, up to any given period of the Course, may apply to have his name transferred to the list of regular students.

Reports of Standing.—Intermediate informal reports for all first- and second-year subjects are sent to students, and to the guardians of those not of age, twice during each term. Formal semi-annual reports are sent at the close of each term. In connection with these reports special votes of the Faculty are transmitted in cases requiring consideration.

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. All subjects applied for must be regularly pursued, and no others can be taken except by special permission of the Faculty, duly applied for by petition.

Deposit for Breakage.—No bond is required, but a deposit must be made to defray the expenses 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 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 labora-

tory $15 for the second and third years, and $20 for the fourth year. 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.

Fees.—The tuition fee for regular students is $250 per year, and must be paid *in advance* as follows,—$150 on or before October 10, and $100 on or before February 20. 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 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 students in Graduate Courses is the same as that for regular students.

It is desired that regular students whose financial necessities are such as to prevent their continuance at the Institute communicate, through the Secretary, with the Scholarship Committee of the Faculty.

Payments.—All payments should be made to Frank H. Rand, Bursar. If by check, remittance from points out of New England should be in New York or Boston funds.

Undergraduate Scholarships.—It is the policy of the Faculty to apply the available funds to the assistance of as many students as possible by assigning, in general, amounts less than the full tuition. Preference is given in making awards to applicants 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. It is expected that only those students who are greatly in need of aid will apply for scholarships, and none will be awarded to a student who gives little promise of future usefulness. Awards will be made in October, 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 June 1 on blanks supplied by the Registrar. Application for Massachusetts State Scholarships should be made only to the Secretary of the State Board of Education, State House, Boston, from whom the necessary blanks may be obtained. The Faculty Committee on Scholarships desires, however, to be informed, through the Secretary of the Faculty, in regard to the needs of applicants for State Scholarships, in order that recommendations to the State Board of Education may be based on full knowledge of personal circumstances, as well as of scholastic standing.

Sherwin Scholarship. Founded by the English High School Association in memory of Thomas Sherwin. The pupil to receive the privilege of this scholarship is to be a graduate of the English High School of Boston and a regular student of the Institute.

William Barton Rogers Scholarship Fund. The income from this fund, which was presented by the Alumni Association of the Institute as a memorial of the late 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.

Joy Scholarships. 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. At present one scholarship only is available: a second will be established when the fund has increased sufficiently to warrant such an expenditure.

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.

Milton High School Scholarship. Founded by the contributions of residents of Milton. This scholarship will be conferred upon such former pupil of the Milton High School as the master of that school and the school committee of the town may select.

Massachusetts State Scholarships. In consideration of aid received from the Commonwealth, the Institute has established forty free scholarships, one being assigned to each senatorial district of the State. In some cases these scholarships are divided into halves in order to assist a larger number of applicants. Information regarding the terms and condition upon which these are to be awarded may be obtained by addressing the Secretary of the State Board of Education, State House, Boston.

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.

Coöperative Scholarship. The Coöperative Society of the students of the Institute applies its annual profits to the assistance of members of the society selected by its Board of Directors.

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 High School.

Elisha T. Loring Scholarship. Founded by Elisha Thacher Loring, of Boston.

Class of 1891 Fund. The Class of 1891, 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.

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.

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.

Elisha Atkins Scholarship and Farnsworth Scholarship. Founded by Mrs. Mary E. Atkins, of Boston.

T. Sterry Hunt Scholarship. Founded by bequest of T. Sterry Hunt, for seven years Professor of Geology at the Institute. Preference will be given to students of Chemistry in the higher years.

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.

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.

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 needy and deserving students.

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.

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.

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.

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.

Graduate Scholarships and Fellowships.—Applications for graduate scholarships or fellowships should, if possible, be presented to the Secretary of the Institute not later than April 1; but they will be received and considered up to October 1 of each year. Each application must be accompanied by a detailed statement of the candidate's qualifications and his proposed course of study.

The Institute now possesses the following funds, the income of which is available, wholly or in part, for fellowships and graduate scholarships.

James Savage Fellowship Fund. Founded by the late James Savage. 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. 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 Fellowship Fund. 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. The holder of this fellowship will be eligible to reappointment for a second year; but, if in any year the sum above named cannot be advantageously used for the purpose prescribed, no appointment will be made.

For both of the above fellowships the preference is given to graduate students who are candidates for advanced degrees.

Perkins Graduate Scholarship. Founded by bequest of

Willard B. Perkins, of the Class of '72. The income of six thousand dollars will be available in 1907–08 and every fourth year for a travelling scholarship in Architecture.

Dalton Graduate Scholarship. 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.

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. The distribution for the year 1904–1905 included provision for thirty-five undergraduate scholarships, in addition to those referred to on pages 307 to 310.

Richard Lee Russel Fellowship. Founded by Theodore E. Russel in memory of his brother, Richard Lee Russel. The income of two thousand dollars is to be awarded to graduates highest in standing in the Department of Civil Engineering.

Prizes.—Two prizes of two hundred dollars each, known as the Rotch prizes, are given according to the will of the late Mr. Arthur Rotch, one to the student who is graduated with the highest standing in the regular Course in Architecture, and the other to the special student who ranks highest at the end of a two-year course. For this special student prize only those applicants are eligible who enter in accordance with the requirements on page 46, on the basis of professional office experience or as college graduates.

The Boston Society of Architects gives two prizes of the value of fifty dollars each, in books, for the best solution of a special problem design, to be made by the fourth-year regular, and the fourth-year special students in Architecture.

Residence and Expenses.—As the exercises of the school begin at nine o'clock in the morning, and end before 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 Boston and the neighboring cities and towns need not exceed seven or eight dollars a week. The cost of books, drawing instruments, paper, etc., exclusive of chemical breakage, is from twenty-five to thirty-five dollars a year.

Attendance.—Regular students are expected to attend all the exercises of their several Courses. Special students are expected to attend all the exercises in subjects applied for on their attendance cards, unless excused by special vote of the Faculty. Students are in general expected to devote themselves to the work of the school between the hours of 9 A.M. and 4 P.M., except during the interval from 1 P.M. to 2 P.M. There are no exercises on Saturday afternoon, and the rooms are closed.

Advisers.—The Dean is the general consulting officer for students, and co-operates with the President in matters touching discipline and other student relations. For the purpose of giving students the means of readily obtaining friendly advice, he assigns each new student to some member of the instructing staff, who acts as his adviser.

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. Franklin W. White, 416 Marlborough Street, a graduate of the Institute, has been appointed medical adviser for students, and will address them during the year on personal hygiene.

Gymnastics.—Class and individual work are conducted at the Institute gymnasium under the guidance of an experienced instructor.

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 the 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.

Lowell Institute.

SCHOOL FOR INDUSTRIAL FOREMEN.

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, two Courses, one Mechanical and the other Electrical, and 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 instruction embraces recitations, lectures, drawing-room practice, and laboratory exercises; and is given by members of the instructing staff of the Institute of Technology. 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.

No reports of standing are given to the students; but those students who are failing 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 will be given certificates.

The School Year.—The next school year will begin October 1, 1906, and will close May 10, 1907. 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 will be required, in addition to outside study.

Requirements for Admission.—As the number of students that can be received is limited, application for admission should be made before May 1. 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. 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 Charles F. Park, Director, Lowell Institute School for Industrial Foremen, Massachusetts Institute of Technology, Boston.

SCHOOL OF DESIGN.

The Lowell School of Practical Design was established in 1872 by the Trustee of the Lowell Institute for the purpose of promoting industrial art in the United States. At a later time it became evident that to reach its greatest efficiency the school must charge a fee to the pupils, and, as the Lowell Institute could not permanently support non-gratuitous instruction, the school was reorganized under the name of the Massachusetts School of Design. The control of the school

has now been transferred to the Museum of Fine Arts, and the name changed to the MUSEUM SCHOOL OF DESIGN.

For information in regard to the requirements for admission, tuition fee, regulations, and course of study, apply to Mr. C. Howard Walker, Director Museum School of Design, Boylston Chambers, Boylston Street, Boston.

Alumni Associations.

THE ALUMNI ASSOCIATION.

The Alumni Association of the Institute holds its annual meeting in Boston in December (usually the last Friday); and at the close of each year gives a reception to the graduating class. It includes in its membership all graduates of the Institute. Associate membership is open to non-graduates, members of classes that have graduated. Honorary membership is open to present and former members of the Faculty and Corporation.

Its officers for 1905 are:

President: FRANK L. LOCKE, '86.

Vice-Presidents: WALTER B. SNOW, '82; ALEX. RICE MCKIM, '86.

Secretary: ARTHUR G. ROBBINS, '86, Massachusetts Institute of Technology.

Executive Committee: THE PRESIDENT, VICE-PRESIDENTS, SECRETARY; HARVEY S. CHASE, '83; EDWARD G. THOMAS, '87; WALTER B. TROWBRIDGE, '92; AND CHARLES-EDWARD A. WINSLOW, '98.

THE TECHNOLOGY CLUB.

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 Club-house is at No. 83 Newbury Street, nearly opposite the Rogers Building, and the membership is at present somewhat over six hundred, including graduates and other former students, members of

the Corporation and of the instructing staff, and a limited number of undergraduates.

The officers for the current year are:

President: GUY LOWELL, '94.
Vice-President: FRANCIS H. WILLIAMS, '73.
Secretary: LEONARD T. BUSHNELL, '05.
Treasurer: AUGUSTUS H. GILL, '84.
Chairman of House Committee:
Chairman of Membership Committee: GEORGE V. WENDELL, '92.

The Executive Committee includes the above and the Secretary of the Institute, *ex officio*.

NORTHWESTERN ALUMNI ASSOCIATION, MASSACHUSETTS INSTITUTE of TECHNOLOGY.

President: FREDERICK GREELEY, '76.
Vice-President: EDWARD H. HUXLEY, '95.
Secretary-Treasurer: ALFRED E. ZAPF, '95, 3321 Armour Ave., Chicago.
Executive Committee: THE PRESIDENT, VICE-PRESIDENT, SECRETARY, J. L. SHORTALL, '87, E. M. HAGAR, '95, and KENNETH LOCKETT, '02.

Meetings are held at the different clubs about six times a year besides the annual meeting held in February. Special bulletins announce the meetings, speakers, etc.

The ROCKY MOUNTAIN TECHNOLOGY CLUB.

President: FRANK E. SHEPARD, '87.
Vice-President: THEODORE E. SCHWARZ, '76.
Secretary: HAROLD O. BOSWORTH, '02, 1744 Champa St., Denver, Colo.
Treasurer: JOSEPH Y. PARCE, Jr., '93.

THE TECHNOLOGY CLUB OF NEW YORK CITY.

President: ALEX. RICE MCKIM, '85.
Secretary: CECIL B. ANNETT, '02, 43 Exchange Place.
Treasurer: CLARENCE D. POLLOCK, '94.
Chairman of Membership Committee: CHARLES W. AIKEN, '91.
Board of Governors: THE PRESIDENT, SECRETARY, TREASURER, CHAIRMAN OF MEMBERSHIP COMMITTEE, and ROBERT S. ALLYN, '98.
Chairman of House Committee; DANIEL W. EDGERLY, '98.

ENTERTAINMENT COMMITTEES.

CHARLES R. RICHARDS, '85, Chairman for 10th of each month.
SUMNER B. MERRICK, '88, Chairman for 20th of each month.
CLARENCE B. VORCE, '88, Chairman for 30th of each month.

Meetings are held at the Club, 36 East 28th St., on the 10th, 20th, and 30th of each month. Meals are served at the Club. Members of other Technology Clubs have the privileges of the Club upon presentation of a letter from their Secretary.

THE TECHNOLOGY ASSOCIATION OF THE CONNECTICUT VALLEY.

Executive Committee: HENRY SOUTHER, '87, *Chairman*, 440 Capitol Avenue, Hartford, Conn.; CLARENCE WHITNEY, '91; FREDERIC W. FULLER, '97.

THE TECH SOCIETY OF PHILADELPHIA.

President: BENJAMIN ADAMS, '95.
Vice-President: WILLIAM G. SNOW, '87.
Secretary-Treasurer: J. R. DANIELL, '97, 102 Cooper Street, Woodbury, N.J.
Executive Committee: A. W. AYER, '89; JAMES SWAN, '91; FRANK H. KEISKER, '97; J. PETERSON RYDER, '84; SAMUEL S. SADTLER, '95; PAUL WEEKS, '02.

Annual dinner in February.

THE PITTSBURGH ASSOCIATION, MASSACHUSETTS INSTITUTE OF TECHNOLOGY.

President: COLBERT A. MACCLURE, '94, 1408 Keystone Bldg.
Vice-President: SUMNER B. ELY, '92, Carnegie Bldg.
Secretary and Treasurer:

THE TECH SOCIETY OF WESTERN NEW YORK.

Secretary-Treasurer: HENRY A. BOYD, '79, 125 Erie Co. Bank Bldg., Buffalo, N.Y.

Executive Committee: THE SECRETARY-TREASURER, FRANK W. LOVEJOY, '94; MAURICE B. PATCH, '72; N. LORING DANFORTH, '01, and GEORGE A. RICKER, '86.

Annual meeting second Saturday in September.

WASHINGTON SOCIETY OF THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY.

President: WINTHROP COLE, '87.
Vice-President: WILLIAM J. RICH, '84.
Secretary: BERNARD HERMAN, '99, Southern Railway, Washington, D.C.
Treasurer: ALBERT S. MERRILL, '00.
Executive Committee: THE PRESIDENT, VICE-PRESIDENT, SECRETARY, TREASURER, and FRED W. SWANTON, '90.

Regular meetings of the society are held on the second and fourth Mondays of each month. The annual meeting being on the first Monday in December.

Institute men visiting Washington, or expecting to reside there, are invited to communicate with the officers of the society.

M. I. T. CLUB OF CINCINNATI.

President: CHARLES G. MERRELL, '88.
Vice-President: STANLEY A. HOOKER, '98.
Treasurer: GEORGE W. KITTREDGE, '77.
Secretary: A. H. PUGH, Jr., '97, 1912 Madison Road.
Executive Committee: THE PRESIDENT, VICE-PRESIDENT, SECRETARY, TREASURER, ARTHUR S. MORE, '02; WALTER L. RAPP, '00; and RUDOLPH TIETIG, '98.

THE TECHNOLOGY CLUB OF THE MERRIMACK VALLEY.

President: RICHARD A. HALE, '77.

Vice-President: GEORGE A. NELSON, '77.

Secretary: JOHN A. COLLINS, Jr., '97, 74 Saunders St., Lawrence.

Treasurer: WILLIAM O. HILDRETH, '87.

Executive Committee: THE PRESIDENT, VICE-PRESIDENT, SECRETARY, TREASURER, and EDGAR H. BARKER, '97.

Annual meeting in February. Numerous meetings are held during the year.

THE TECHNOLOGY CLUB OF RHODE ISLAND.

President: FREDERICK H. HOWLAND, '93.

Vice-President: KENNETH W. WOOD, '94.

Secretary-Treasurer: LATIMER W. BALLOU, '95, Woonsocket, R.I.

Executive Committee: THE PRESIDENT, VICE-PRESIDENT, SECRETARY-TREASURER, JAMES G. WOOLWORTH, '78; and ELEAZER B. HOMER, '85.

The annual meeting of the society is held the last Saturday in May.

THE TECHNOLOGY CLUB OF NEW BEDFORD.

President: THEODORE F. TILLINGHAST, '70.

Secretary-Treasurer: CHARLES F. WING, Jr., '98, 34 Purchase St.

Executive Committee: THE PRESIDENT, SECRETARY-TREASURER, and CHARLES F. LAWTON, '77.

VERMONT TECHNOLOGY ASSOCIATION.

President: JOHN F. ANCONA, '03.

Vice-President: CHARLES P. MOAT, '96.

Secretary-Treasurer: REDFIELD PROCTOR, Jr., '02, Proctor, Vt.

Executive Committee: THE PRESIDENT, VICE-PRESIDENT, SECRETARY, E. T. POLLARD, '02, and H. W. CLEMENT, '90.

Annual meeting and dinner is held in April or May.

Tech men expecting to spend any time in Vermont are requested to send their names to the Secretary.

THE TECHNOLOGY CLUB OF HARTFORD.

President, CHARLES L. W. PETTEE, '97.
Vice-President, HOWARD H. BURDICK, '97.
Secretary-Treasurer, GEORGE W. BAKER, '92, 783 Main Street.
Board of Governors: THE PRESIDENT, VICE-PRESIDENT, SECRETARY-TREASURER, HERBERT W. ALDEN, '93, and A. MAYNARD HOLCOMBE, '04.

The annual meeting is held the first Saturday in February of each year.

ASSOCIATION OF CLASS SECRETARIES.

This association includes the Secretaries of all graduate and under-graduate classes and of all local alumni societies, as well as certain other members, *ex officiis*. Its object is to promote class spirit and the welfare of the Institute, and to systematize all matters pertaining to class organization and record. It has undertaken and, through a Committee on Publication, maintains the *Technology Review*, a quarterly magazine.

The present officers of the association are:

Secretary, FREDERIC H. FAY, '93, 60 City Hall, Boston.
Assistant Secretary, CHARLES F. READ, '74, Old State House, Boston, Mass.

Statistics of the Graduates.

The following statistics of the number of graduates in the various Courses and their present occupation and location are based on the register for 1905 and are interesting as showing not only the exceedingly varied lines of work to which Institute graduates are now devoting themselves, but also their wide distribution.

MASTERS OF SCIENCE.

The degree of Master of Science was first granted by the Institute in 1886 and since then the title has been conferred seventy-two times. Of the total number of recipients of the Master's degree fifty-eight received their Bachelor's degree also from the Institute.

The following table exhibits the number of persons receiving the Master's degree in different years.

MASTERS OF SCIENCE BY YEARS.

1886	1	1898	5
1887	1	1899	3
1890	1	1901	4
1893	1	1902	8
1894	1	1903	7
1895	3	1904	12
1896	3	1905	18
1897	4	Total	72

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. The figures for the totals in this table differ from those in the succeeding tables in including the Class of 1905.

GRADUATES BY COURSES.

Year.	Civil Engineering.	Mechanical Engineering.	Mining Engineering.	Architecture.	Chemistry.	Metallurgy.	Electrical Engineering.	Natural History or Biology.	Physics.	General Course.	Chemical Engineering.	Sanitary Engineering.	Geology.	Naval Architecture.	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	7	–	5	1	–	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	4	1	10	4	1	12	190
1904	34	45	32	24	15	–	34	3	13	5	7	2	1	17	232
1905	46	54	26	12	23	–	31	3	3	3	13	5	1	24	244
Totals	605	742	306	287	345	1	571	52	59	96*	144	51	12	126	3,392*

Names counted twice, students graduating in two different years . . .	16
Bachelors of Science	3,376*
Masters of Science, not included in the above	14
Total . . .	3,390*

* Deducting names counted twice (students graduating in two courses).

GEOGRAPHICAL DISTRIBUTION OF GRADUATES.

UNITED STATES.

State	Number	State	Number
Alabama	11	Nevada	4
Arizona	6	New Hampshire	27
Arkansas	2	New Jersey	61
California	65	New Mexico	3
Colorado	48	New York	429
Connecticut	60	North Carolina	7
Delaware	11	North Dakota	2
District of Columbia	82	Ohio	116
Florida	2	Oklahoma	2
Georgia	18	Oregon	6
Hawaii	5	Pennsylvania	226
Idaho	6	Philippine Islands	5
Illinois	136	Porto Rico	5
Indiana	30	Rhode Island	63
Iowa	16	South Carolina	3
Kansas	6	South Dakota	1
Kentucky	6	Tennessee	4
Louisiana	7	Texas	10
Maine	40	Utah	10
Maryland	24	Vermont	15
Massachusetts	1,094	Virginia	23
Michigan	38	Washington	14
Minnesota	18	W. Virginia	5
Mississippi	1	Wisconsin	19
Missouri	33	Wyoming	2
Montana	17		
Nebraska	8		
			2,852

FOREIGN COUNTRIES.

Country	Number	Country	Number
Australia	2	Panama	3
Belgium	1	Persia	1
Brazil	3	Peru	1
British Columbia	3	Quebec	14
Burma	1	Scotland	2
China	2	Siam	1
Cuba	8	Switzerland	1
Ecuador	1	Syria	1
England	10	Turkey	1
France	7	Transvaal	2
Germany	6		
Guatemala	1		127
India	1		
Japan	6		2,979
Korea	2	Unreported	24
Manitoba	1		
Mexico	22		3,003
New Brunswick	4	Deceased	134
Nova Scotia	9		
Ontario	10	Total	3,137

OCCUPATIONS OF GRADUATES.

The following tables contain a classification of graduates in the several Courses according to their occupation. A detailed classification has not been attempted, but a sufficient differentiation of occupations has been made to indicate the lines of work to which the several Courses lead.

It will be noted that a considerable number of graduates have not adhered closely to the profession corresponding to their Course at the Institute, this number tending to increase in a given class with lapse of time. The reason for this is to be found in the fact that the Faculty has always endeavored to avoid that degree of narrow specialization in any Course which would restrict the graduate's future initiative. Students have been advised to choose their Courses with reference to their aptitudes as students, and have in all Courses been offered sufficiently broad scientific education to serve as a basis for any probable subsequent change of occupation.

COURSE I., CIVIL ENGINEERING.

1868–1904.

In Engineering Practice	157
With Railroad or Street Railway Companies	96
In United States Employ	43
In State Employ	19
In Municipal Employ	33
Steel and Iron Manufactures	8
Miscellaneous Manufactures	20
Engineering Business	15
Mining Business	2
Draughtsman	5
Contractors	9
With Construction Companies	11
With Gas and Insurance Companies	9
Teachers	28
Other Professions and Business	49
Unassigned	20
	524
Deceased	35
	559

COURSE II., MECHANICAL ENGINEERING.

1868–1904.

Experts and Consulting Engineers	129
In Railroad Employ	26
Textile Industries	20
Ship and Marine Engine Works	9
Heating and Ventilation	6
Steel and Iron Works	23
Machine Construction	71
Special Machinery and Manufactures	91
Electrical Business	38
Engineering Business	67
In United States Employ	24
Teachers	54
Students	1
Lawyers	7
Manufacturing Chemists	6
Other Professions and Business	61
Unassigned	26
	659
Deceased	29
	688

COURSE III., MINING ENGINEERING AND METALLURGY.

1868–1904.

In Engineering Practice and Business	101
With Iron and Steel Works	32
Assayers and Chemists	21
In United States Employ	5
In State Employ	3
In Municipal Employ	5
Miscellaneous Manufactures	15
With Electric Companies	5
In Railroad Employ	3
Teachers	24
Students	2
Lawyers	2
Bankers and Brokers	6
Other Professions and Business	23
Unassigned	16
	263
Deceased	17
	280

COURSE IV., ARCHITECTURE.

1873–1904.

Architects	155
Landscape Architects	3
Architectural Engineers	27
Draughtsmen	11
Teachers	10
Students	14
In United States Employ	2
Miscellaneous Manufactures	3
Building	2
Brokers	2
Library Work	1
Other Professions and Business	15
Unassigned	21
	266
Deceased	9
	275

COURSE V., CHEMISTRY.

1869–1904.

Manufacture of Chemicals or Chemical Products	30
Metallurgists or Metallurgical Chemists	13
Analytical Chemists or Consulting Experts	40
Textile Industries	19
Soap, Lard, Glycerine, and Oil Industries	12
Public Health Laboratories	18
Miscellaneous Manufactures	29
Paper Industries	7
Rubber Industries	7
Sugar and Starch Industries	5
White Lead and Paint Industries	2
Gas Inspectors	4
Teachers	48
Research Work	8
Students	5
Insurance	3
Physicians	4
In United States Employ	3
Other Professions and Business	26
Unassigned	23
	306
Deceased	16
	322

COURSE VI., ELECTRICAL ENGINEERING.

1885–1904.

Electrical Engineers	213
Electrical Business	47
With Telegraph and Telephone Companies	67
With Street Railway Companies	13
Electro-chemists and Chemists	4
Engineers other than Electrical	33
General Business	66
In United States Employ	14
Teachers	34
Other Professions	12
Unassigned	22
	525
Deceased	15
	540

COURSE VII., BIOLOGY.

1876–1904.

Biologists	10
Physicians	10
In United States Employ	1
Library Work	2
Teachers	13
Students	2
Other Professions and Business	10
	48
Deceased	1
	49

COURSE VIII., PHYSICS.

1875–1904.

Astronomers	7
Teachers	21
Engaged in Private Research	3
In United States Employ	4
Other Professions and Business	11
Unassigned	7
	53
Deceased	3
	56

COURSE IX., GENERAL STUDIES.

1868–1904.

General Business	25
Bankers and Brokers	8
Lawyers	6
Journalists	3
In Engineering Practice	6
Teachers	12
Students	4
Miscellaneous Manufactures	10
Insurance	3
In United States Employ	2
Other Professions	3
Unassigned	7
	89
Deceased	4
	93

COURSE X., CHEMICAL ENGINEERING.

1891–1904.

Manufacture of Chemicals or Chemical Products	25
Other Manufactures	20
Soap, Glycerine, or Oil Industries	4
Textile Industries	9
Insurance Inspection	8
Paper Manufacture	4
Rubber Manufacture	5
Sugar Industries	1
Water and Sewerage	2
In United States Employ	1
Consulting Engineers	4
Gas Manufacture	4
Electro-chemical or Electrical Industries	9
Teachers	7
Students	2
Lawyers	5
Publishers	1
Other Professions and Business	10
Unassigned	7
	128
Deceased	3
	131

COURSE XI., SANITARY ENGINEERING.

1892–1904.

In United States Employ	4
In State Employ on Sanitary Work	4
In Municipal Employ on Sanitary Work	13
In Private Employ on Sanitary Work	6
In Engineering Work other than Sanitary	10
Teachers	2
Bankers	1
Miscellaneous Manufactures	3
Other Professions and Business	1
Unassigned	2
	46

COURSE XII., GEOLOGY.

1891–1904.

Geologists	3
Civil Engineers	2
Teachers	3
Student	1
Unassigned	1
	10
Deceased	1
	11

COURSE XIII., NAVAL ARCHITECTURE.

1895–1904.

Naval Architects	37
Marine Engineers	13
Mechanical Engineers	8
Electrical Engineers	6
Machine Construction	3
Steel Companies	4
Miscellaneous Manufactures	4
Business	7
Teachers	11
Unassigned	9
	102

Titles of Theses

OF SUCCESSFUL CANDIDATES FOR GRADUATION,
JUNE, 1905.

Candidates for the Degree of Master of Science.

JAMES MCFARLAN BAKER, S.B. — Brooklyn, N.Y.
A Design for a Cathedral.

FRANKLIN MURPHY CHACE, S.B. — Dorchester
A Design for a Cathedral.

LEWIS CUTLER CLARKE, JR., S.B. — Cambridge
A Design for a Cathedral

WILLIAM BAILEY FOGARTY — Cincinnati, Ohio
A Test of the Ventilation System of the U.S.S. *Cumberland*. (*With S. M. Henry.*)

JULIUS AUGUSTUS FURER — Sheboygan, Wis.
An Investigation of the Strength of Large Water-tight Bulkheads.

MOÏSE HERBERT GOLDSTEIN, S.B. — New Orleans, La.
A Design for a Cathedral.

FRANK DAVID HALL — Milford, Ill.
An Investigation of the Launching of the U.S. Battleship *Connecticut*.

SIDNEY MORGAN HENRY — Washington, D.C.
A Test of the Ventilation System of the U.S.S. *Cumberland*. (*With W. B. Fogarty.*)

ALFRED HENRY JACOBS, S.B. — San Francisco, Cal.
A Design for a Cathedral.

ELBERT EMERSON LOCHRIDGE, B.S. — Springfield
The Relation between the Ionic Dissociation of Certain Organic and Mineral Acids and Their Disinfecting Value.

LEWIS BOWEN MCBRIDE — Washington, D.C.
An Investigation of the Strength of Large Water-tight Bulkheads. (*With J. A. Furer.*)

GEORGE MERRILL MAGEE, S.B. — Wenham Depot
A Design for a Cathedral.

FREDERIC NICKERSON, S.B. Boston
A Design for a Cathedral.

GEORGE STANLEY RADFORD Detroit, Mich.
A Study of Bulkhead Plating Subjected to Water Pressure.

HENRY WOODBURY ROWE, S.B. Lawrence
A Design for a Cathedral.

ROSS PELTON SCHLABACH Washington, D.C.
On the Determination of Certain Coefficients for the Flow of Water through Pipes. (*With C. M. Simmers.*)

CLAYTON MILLER SIMMERS Phœnixville, Pa.
On the Determination of Certain Coefficients for the Flow of Water through Pipes. (*With R. P. Schlabach.*)

LEON HILLS SMITH, S.B. Leominster
A Design for a Cathedral.

Candidates for the Degree of Bachelor of Science.

FRED HATHAWAY ABBOTT
Tests on the Generating Plant of the Atlas Tack Company. (*With E. Lum.*)

CHARLES ROBERT ADAMS
Determination of the Water Power of the Charles River at Charles River Village. (*With L. J. Killion.*)

CHESTER ALLEN
Tests of the Strength of Ice. (*With F. G. Bennett.*)

ROY HUTCHINS ALLEN
The Concentration of a Copper Ore from New Mexico by the Elmore Process. (*With L. T. Buell.*)

WILLIAM WETHERALL AMMEN, A.B.
Test of a DeLaval Steam Turbine.

CLAUDE AURELIUS ANDERSON (XIII) Austin, Minn.
A Design for a Steam Stern-wheel Steamboat.

CARLTON ELLIOT ATWOOD (VI) Chelmsford
Tests of the Power Plant of the Augustus Lowell Laboratory. (*With L. C. Winship.*)

JOHN AYER (I) Belmont
A Plan for the Elimination of the Grade Crossing at West Lynn, Massachusetts. (*With T. Green.*)

SAMUEL HENRY AYERS (VII) Portsmouth, N.H.
An Investigation of the Gas Forming Bacteria in Massachusetts Natural Waters with Special Reference to the Presumptive Test for Bacillus coli.

COURTLANDT WOODRUFF BABCOCK, PH.B. (VI) Stonington, Conn.
Investigation of the Relation between the Constants of a Transmission Line and the Receiving Apparatus for Maximum Efficiency. (*With H. P. Charlesworth, F. J. Chesterman, E. M. Lines.*)

JOSEPH CHENEY BAKER (II) Syracuse, N.Y.
Air Filtration with Coke Filter. (*With L. Clough.*)

WILLIAM GILBERT BALL (III) Roxbury
The Geology of the Newbury Mining District. (*With C. H. Clapp.*)

JAMES EVANS BARLOW (I) Lawrence
A Design for a Reinforced Concrete Highway Bridge.

JAMES PHILLIPS BARNES (VI) Syracuse, N.Y.
Service Car Tests on the Utica and Mohawk Valley Railway. (*With F. J. Schwarz.*)

EDWARD ANDRÉ BARRIER (V) Cambridge
An Attempt to Prepare Vanillin from Safrol.

EDWARD TAYLOR BARRON (III) Pittsburgh, Pa.
The Concentration of a Washington Ore Containing Tetrahedrite.

ALLAN HANSCOM BARROWS (V) Reading
A Study of some Aliphatic Sulphonic Acids.

GEORGE HERBERT BARROWS (IV) Taunton
A Design for a Small Theatre.

EDWARD HALE BARTLETT (X) Newburyport
A Proposed Method for the Determination of Carbon Monoxide in the Analysis of Illuminating Gas.

ROBERT STANLEY BEARD (I) York, Pa.
A Plan for the Elimination of Grade Crossings at Framingham, Massachusetts. (*With C. H. Smith.*)

WILLIAM HERBERT BEERS, JR. (VII) Watertown, Conn.
Certain Instances of the Masking of Familiar Ionic Effects by Organic Solutes as Evidenced by the Reactions of Living Tissues.

ARTHUR FIELD BELDING (II) Fitchburg
Determination of Heat Necessary to Prevent Freezing on Metallic Surfaces Alternately Exposed to Air and Water and of the Best Method of Applying the Same. (*With A. E. Freeman.*)

FREDERICK GARDNER BENNETT (I) Southampton, L.I., N.Y
Tests of the Strength of Ice. (*With C. Allen.*)

STUART WELLS BENSON (X) Boston
An Investigation of a Gasolene Engine. (*With W. G. Bent.*)

WALTER GREGORY BENT (X) Framingham
An Investigation of a Gasolene Engine. (*With S. W. Benson.*)

WILLIAM PEET BIXBY (II) Woburn
A Test of a Gas Engine and a Producer Plant. (*With A. M. Dean.*)

WILLIAM HILDRETH BLAKEMAN, A.B. (XIII) Mt. Vernon, N.Y.
Experiments on Propellers for a Motor-boat. (*With P. J. Ralph.*)

FERNANDO MORENO BLOUNT (IV) Pensacola, Fla.
A Design for a Railroad Station.

CHARLES REID BOGGS (V) Washington, D.C.
A Study of the Principles of Solubility Effect in the Case of Salts with Common Ions.

CHARLES EDWARD BROAD (II) Newton Centre
An Investigation of the Line of Resistance in a Concrete Arch. (*With F. W. Goldthwaite.*)

JOSEPH HENRY BROWN, JR. (II) Charlestown
A Test of a 500 K.W. Curtis Turbine. (*With C. R. Prichard.*)

FRANK WILBUR BROWNELL, B.A. (VI) Northport, N.S.
A Test on a Turbo-Alternator.

LLOYD THOMAS BUELL (III) Cerrillos, N. Mex.
The Concentration of a Copper Ore from New Mexico by the Elmore Process. (*With R. H. Allen.*)

HENRY ARTHUR BUFF (III) Jamaica Plain
The Decomposition of Silver Sulphide by means of Mercury in Iron and Copper Pans.

EDWARD ARTHUR BURKHARDT (XIII) Jamaica Plain
Tests on a 50 ton Ammonia Refrigerating Plant. (*With G. W. Perry.*)

WALTER BURNS (V) North Adams
A Study of the Absorption Spectra of Certain Organic Color Reactions.

EUGENE BURTON (III) Louisville, Ky.
Dracut Nickel Ore. The Geology and Concentration. (*With W. L. Spalding.*)

LEONARD THEAKER BUSHNELL, B.A. (II) New Bedford
A Test of a Power Plant under Running Conditions. (*With R. K. Clark.*)

THOMAS BRECKINRIDGE CABELL (VI) Bowling Green, Ky.
Cyclic Variation as Affecting Disruptive Discharge.

SYDNEY ATMORE CAINE (XIII) Louisville, Ky.
A Device for Recording the Thrust of a Propeller. (*With A. J. Ortseifen.*)

FRANK MILTON CARHART (I) Salt Lake City, Utah
An Investigation of the Physical Properties of Antimonial Lead. (*With B. A. Yoder.*)

HARRY PRESCOTT CHARLESWORTH (VI) Haverhill
Investigation of the Relation between the Constants of a Transmission Line and the Receiving Apparatus for Maximum Efficiency. (*With C. W. Babcock, F. J. Chesterman, E. M. Lines.*)

FRANCIS JOHN CHESTERMAN (VI) Newburyport
Investigation of the Relation between the Constants of a Transmission Line and the Receiving Apparatus for Maximum Efficiency. (*With C. W. Babcock, H. P. Charlesworth, E. M. Lines.*)

NORMAN MOORE CHIVERS, A.B. (I) New York, N.Y.
A Study of Design of Wooden and Steel Pipe Lines for Power Purposes.

CHARLES HORACE CLAPP (III) South Boston
The Geology of the Newbury Mining District. (*With W. G. Ball.*)

ROBERT KEEP CLARK, B.A. (II) Chicago, Ill.
A Test of a Power Plant under Running Conditions. (*With L. T. Bushnell.*)

WALTER AYER CLARKE (XIII) Biddeford, Me.
An Investigation of the Effect of the Amount of Water on the Strength of Cement Briquettes.

WILLIAM DEXTER CLARKE, A.B. (I) Portland, Oreg.
Tests to Determine the Shearing Strength of Mortar and Concrete. (*With L. B. Turner.*)

MAX CLINE (V) Boston
The Use of Sodium 1, 2-Naphtholquinone-4-Sulphonate and Picryl Chloride as Reagents in the Characterization of Organic Bases.

LESLIE CLOUGH (II) Wakefield
Air Filtration with Coke Filter. (*With J. C. Baker.*)

EDWARD MAY COFFIN (X) Newburyport
A Comparison of the Various Materials Used in Filtering Oil from Condensed Steam. (*With R. M. Folsom.*)

SIDNEY LOVETT COLE (II) Somerville
The Flow of Air through an Orifice against a Back Pressure. (*With R. C. Cutting.*)

RICHARD VINCENT COLLINS (I) Medway
The Use of Concrete in Dams.

EDGAR BAILEY COOPER (II) Roxbury
A Test on a 500 K.W. Curtis Turbine. (*With P. G. Darling.*)

IRVING HENRY COWDREY (II) Fitchburg
An Investigation of the Heating and Ventilating System at the Fitchburg High School.

HOWARD MONTGOMERY COWPER (III) Buffalo, N.Y.
The Concentration of St. Joe Mud; the Treatment of a Mexican Iron Ore Containing Gold and Silver; the Concentration of a Bruce, Ontario, Chalcopyrite Ore. (*With W. S. Gouinlock.*)

HAROLD GILLILAND CRANE (VI) Adrian, Mich.
An Investigation of Enclosed Fuses. (*With J. C. Damon.*)

ROBERT CURTIS CUTTING (II) Weston
The Flow of Air through an Orifice against a Back Pressure. (*With S. L. Cole.*)

JOHN CHURCHILL DAMON (VI) Concord
An Investigation of Enclosed Fuses. (*With H. G. Crane.*)

CARL EUGENE DANFORTH (III) Bangor, Me.
The Influence of Temperature and Reagents on the Assay of Gold Telluride Ores.

JOSEPH DANIELS (III) Boston
The Economic and Structural Geology of the Quincy Granite. The Geology and Mining of the Nome District, Alaska.

PHILIP GRENVILLE DARLING, A.B. (II) Somerville
A Test on a 500 K.W. Curtis Turbine. (*With E. B. Cooper.*)

ROSWELL DAVIS (XIII) West Newton
A Design for a Ferry-boat.

ARTHUR MALCOLM DEAN (II) Canton
A Test of a Gas Engine and a Producer Plant. (*With W. P. Bixby.*)

CHARLES LAKE DEAN (III) Edgewood Park, Pa.
The Influence of Heat Treatment upon the Structure and Properties of Wrought Iron and Low Carbon Steel. (*With T. D. Geraghty.*)

HENRY LAWRENCE DEAN (XIII) Canton
A New Method of Comparative Cement Testing.

WARD PARKER DELANO, JR. (IV) Worcester
A Design for a Post Office and Court House.

JAMES MARTIN DEMALLIE, PH.B. (VI) Rochester, N.Y.
Tests on a 500 K.W. Curtis Turbine. (*With F. L. Snow.*)

JOHN FREDERIC HOWARD DOUGLAS (VI) Bucksport, Me.
A Study of Scott's Method for Determining Hysteresis. (*With H. M. Edmunds.*)

FREDERICK MALCOLM EATON (V) Dorchester
A Study of the Constitution of Chromic Acid and of Bichromate Solutions.

HOWARD MAURICE EDMUNDS (VI) London, England
A Study of Scott's Method for Determining Hysteresis. (*With J. F. H. Douglas.*)

WALTER GOTTFRIED EICHLER (II) Roxbury
Tests on an Eight-inch Three-stage Worthington Turbine Pump. (*With H. L. R. Walker.*)

HERMAN EISELE (XIII) Cleveland, Ohio
Test of a Sixty Horse-power Marine Gasolene Engine. (*With R. P. Stebbins.*)

FRANK SPENCER ELLIOTT (III) Gloucester
The Smelting of a Rich Sulphide Copper Ore in a Blast Furnace. (*With J. T. Glidden.*)

CHARLES ALVIN EMERSON, JR., B.S. (XI) Beloit, Wis.
An Investigation of the Occurrence of Bacillus coli and the Sewage Streptococci of Houston in Unpolluted Waters near Boston.

RALPH DAMMARELL EMERSON (IV) Worcester
A Structural Investigation of the Girders Carrying the Superstructure over the Auditorium of the Colonial Theatre, Boston.

FRANK SHERIDAN FARRELL (V) Stoughton
A Comparison of the Dissociation Values of Two Partially Dissociated Salts as Derived from Conductivity and Solubility Measurements.

CHARLES FIELD, 3D, B.S. (V) Newton Centre
Specific Characterizations for some of the Important Aromatic Nitro-Compounds.

JOSEPH CONROW FIELD, C.E. (VI) Hightstown, N.J.
A Study of a Quarter Phase Generating Unit. (*With H. C. Kendall.*)

TRUE HERBERT FILES (I) Everett
A Design for a Reinforced Concrete Retaining Wall.

JOHN HENRY FLYNN, JR. (II) Roxbury
A Thermo-dynamic Study of an SO_2 Waste Heat Engine as Applied to a Thirty-six Horse-power Otto Gas Engine. (*With J. W. Taylor.*)

ROBERT MORSE FOLSOM (X) Dorchester
A Comparison of the Various Materials Used in Filtering Oil from Condensed Steam. (*With E. M. Coffin.*)

ROBERTS SHEPHERD FOULDS (IV.) Taunton
A Design for a Two-hinged Reinforced Concrete Arch of 150 feet Span.

ARTHUR EMERY FREEMAN (II) Arlington
Determination of Heat Necessary to Prevent Freezing on Metallic Surfaces Alternately Exposed to Air and Water and of the Best Method of Applying the Same. (*With A. F. Belding.*)

GEORGE CHARLES FUNK (IV) Brookline
A Design for a Terminal Station Associated with an Elevated and a Subway Station.

HARRY RICHARD GABRIEL (I) Cincinnati, Ohio
Tests on Reinforced Concrete Tee-beams. (*With O. C. Merrill, K. Whitman, Jr.*)

CLARENCE EDWARD GAGE (II) Woburn
An Investigation of the Specific Heat of Superheated Steam. (*With R. W. Morse.*)

HARRY WALLACE GALLUP (V) Norwich, Conn.
The Production of Soluble Potash Salts from Feldspar.

BURTON EDWARD GECKLER (IV) Orange
A Design for a Public Library for a City of 150,000 Inhabitants.

THOMAS FRANCIS GERAGHTY, A.B. (III) Chicago, Ill.
The Influence of Heat Treatment upon the Structure and Properties of Wrought Iron and Low Carbon Steel. (*With C. L. Dean.*)

ARTHUR PETERSON GERRY (II) Franklin Falls, N.H.
An Investigation of the Effect of Burnt Products on the Explosive Power of Gas and Air.

RALPH STAPLES GIFFORD (V) New Bedford
A Study of the Reduction of the Oxides of Uranium and Titanium.

ALBERT CHAMPION GILBERT, B.AGR. (V) Gilead, Conn.
A Critical Study of the Methods for the Detection of Small Quantities of Benzoic Acid.

WESLEY CLIFTON GILMAN (II) North Abington
An Investigation of the Flow of Superheated Steam through an Orifice. (*With A. L. Whitmarsh.*)

LUTHER ELMER GILMORE (X) Lowell
Commercial Tests of a Suction Gas Producer and Gas Engine Plant. (*With S. T. Hyde.*)

JOHN TINKER GLIDDEN (III) Cambridge
The Smelting of a Rich Sulphide Copper Ore in a Blast Furnace. (*With F. S. Elliott.*)

FRED WARREN GOLDTHWAIT (II) Peabody
An Investigation of the Line of Resistance in a Concrete Arch. (*With C. E. Broad.*)

WILLIAM STRACHAN GOUINLOCK (III) Warsaw, N.Y.
The Concentration of St. Joe Mud; the Treatment of a Mexican Iron Ore Containing Gold and Silver; the Concentration of a Bruce, Ontario, Chalcopyrite Ore. (*With H. M. Cowper.*)

CARL HERMAN GRAESSER (II) Buffalo, N.Y.
An Experiment to Show the Effect of Impact on Mild Steel.

ERRETT MCLOED GRAHAM, B.S. (I) Irvington, Ind.
A Design for a Railroad Yard at Rochester, New Hampshire. (*With E. C. Weaver.*)

EDWIN SMITH GRAHAM, B.S. (III) Graham, Texas
The Concentration of a North Carolina Chalcocite Ore. (*With C. W. Johnston.*)

EDWARD CHESTER GRANT (XIII) Covington, Ky.
A Determination of the Latent Heat of Sulphur-dioxide. (*With H. M. Wilcox.*)

THEODORE GREEN (I) Louisville, Ky.
A Plan for the Elimination of the Grade Crossing at West Lynn, Massachusetts. (*With J. Ayer.*)

FRED WILLIS GUIBORD (V) Plattsburg, N.Y.
A Physico-chemical Study of Sulphurous Acid.

SELSKAR GUNN (VII) London, England
Lactic Acid and some Investigations on its Production by Fermentation.

THOMAS MCCHEYNE GUNN, M.A. (XIII) Cashmere, Wash.
A Determination of the Variation of Torsion in the Shaft of a Steamship. (*With A. W. Smith.*)

RALPH EDGAR HADLEY (I) Lawrence
A Design for a System of Block Signals for the Boston and Maine Railroad between Somerville and Lawrence, Massachusetts.

LOUIS WILBAR HAMMETT (IX) Newport, R.I.
Art in the Plays of Pinero.

REYNOLD MUNROE HARDING (I) Melrose
A Study of the Properties of Concrete in Tension. (*With W. S. Richmond.*)

CLINTON OAKLEY HARRINGTON, JR. (I) Vinton, Iowa
A Study of Automatic Cab Signals.

WILLIS FLEMING HARRINGTON, A.B. (X) Farmington, Del.
The Bleaching of Wood Pulp with Special Reference to the Economy of Bleaching Powder.

MYRON HELPERN (V) Boston
Cyclotetranone.

HARVEY MARTIN HICKOK (I) Minneapolis, Minn.
A Design for a Grain Elevator in Reinforced Concrete.

EDWIN BRUCE HILL (IX.) Pittsburgh, Pa.
A Study of the Development of Banking in Pittsburgh, 1892–1903.

PERCY GRANVILLE HILL (II) Wallingford, Conn.
The Investigation of a Pneumatic Motion for a Braiding Machine.

PHILIP EDWARD HINKLEY (II) Portland, Me.
An Apparatus for Measuring the Deflection of Locomotive Driver Springs.

JOHN HAMPDEN HOLLIDAY, JR. (II) Indianapolis, Ind.
The Slip and Creep of Belting.

GEORGE ALBERT HOOL (I) Lawrence
An Investigation of the Terminal Passenger Yards of Boston.

CARL ALFRED HOUCK (I) Buffalo, N.Y.
A Comparison of Leading Features of Bridge Specifications.

WILLIAM GIBBONS HOUSKEEPER, B.S. (II) Philadelphia, Pa.
Stresses in Locomotive Connecting Rods with Tests on Full Size Specimens.

CARL THOMAS HUMPHREY (I) Weymouth
The Design of Large Arches for Sewers and Aqueducts.

EDMUND JOSEPH HURLEY (II) Malden
Tests on the Ventilating Apparatus of the East Boston Tunnel.

STANLEY TABER HYDE (X) Waltham
Commercial Tests of a Suction Gas Producer and Gas Engine Plant. (*With L. E. Gilmore.*)

HENRY LOUIS JACKSON (V) Utica, N.Y.
On the Lactone of Salicylic Acid.

THOMAS EDWARD JEWETT (I) Boston
Tests to Determine the Bond of Union between Steel and Concrete for Reinforced Concrete Construction. (*With T. P. Moorehead.*)

BERTRAND LEROY JOHNSON (III) Boston
The Geology and Petrography of Iron Mine Hill, Cumberland, Rhode Island.

CHARLES WISWELL JOHNSTON (III) Roxbury
The Concentration of a North Carolina Chalcocite Ore. (*With E. S. Graham.*)

GEORGE BAYARD JONES (II) St. Louis, Mo.
An Investigation of the Pneumatic Tube Mail Service. (*With M. B. Landers.*)

WILLIAM HERBERT KEEN (V) Malden
The Extraction of Gold from Raw Telluride Ores.

HENRY HIRAM WHEATON KEITH (XIII) New Bedford
A Design for the Heating and Ventilation of a Coastwise Passenger Steamer.

HARRY COLE KENDALL, B.S. (VI) St. Louis, Mo.
A Study of a Quarter Phase Generating Unit. (*With J. C. Field.*)

LOUIS JOHN KILLION (I) Roxbury
Determination of the Water Power of the Charles River at Charles River Village. (*With C. R. Adams.*)

CHARLES DEAN KLAHR, B.S. (II) Clarion, Pa.
A Test of Reinforced Concrete Beams. (*With J. M. Lambie.*)

EUGEN FREDERICK KRIEGSMAN (I) Providence, R.I.
A Study of District Regulators for Sewers with a Design for an Improved Form.

HERMAN WILLIAM LACKMAN (II) Glendale, Ohio
An Investigation of Water Hammer.

JAMES MCCLURG LAMBIE (II) Washington, Pa.
A Test of Reinforced Concrete Beams. (*With C. D. Klahr.*)

MAURICE BIRDSALL LANDERS, A.B. (II) Addison, N.Y.
An Investigation of the Pneumatic Tube Mail Service. (*With G. B. Jones.*)

CHARLES EVAN LEAVITT (XIII) Weymouth
General Arrangement of Machinery for a Coastwise Passenger Steamer.

HENRY FRANCIS LEWIS (VIII) Toronto, Ontario
An Investigation of the Velocity of the Migrations of Ions in Fused Electrolytes.

WARREN KENDALL LEWIS (X) Laurel, Del.
A Design of an Apparatus for the measurement of the Specific Volume of Superheated Steam by means of the Pitôt Tube.

BEN EDWIN LINDSLY (III) Kansas City, Mo.
The Cyanide and Concentration Treatment of Two Silver-Gold Ores from Taylor Park, Colorado. (*With R. W. Senger.*)

EDWIN MOREHOUSE LINES, PH.B. (VI) Newark, N.J.
Investigation of the Relation between the Constants of a Transmission Line and the Receiving Apparatus for Maximum Efficiency. (*With C. W. Babcock, H. P. Charlesworth, F. J. Chesterman.*)

NORMAN LOMBARD (II) Kansas City, Mo.
Tests of a Boyer Cooling Tower at the Malden Electric Company.

ARTHUR CHANNING LONG, B.A. (V) Sharon
The Application of the Laws Governing the Speed of Reaction to Nitrification Processes.

WARREN WESTON LOOMIS (VI) Windsor, Conn.
Car Runs on the Main Line of the Boston & Worcester Street Railway. (*With A. J. Manson.*)

ROBERT HOWARD WILLIAM LORD (X) Newton
An Investigation of the Bacteria Involved in the Liming Process in Tanneries.

EDWARD HENRY LORENZ, B.S. (II) Hartford, Conn.
Tests on a Napier Automobile Engine. (*With J. B. Whitmore.*)

JOHN SHERWOOD LOUGHLIN (II) Dorchester
Tests on Concrete Columns Reinforced with Steel Rods.

ROY FISK LOVEJOY (IX) Lowell
Statistics of the Number of Corporations organized in the United States since 1890.

ELLIOTT LUM (VI) Aberdeen, S. Dak.
Tests on the Generating Plant of the Atlas Tack Company. (*With F. H.* Abbott.)

WALDO VINTON LYON (VI) Woonsocket, R.I.
A Study of the Insulation of Rubber Covered Cables. (*With M. E. Weaver.*)

WALLACE NOBLE MACBRIAR (II) Brookline
The Determination and Elimination of Moisture in the Air Brake Train-Pipe.

HORACE JAMES MACINTIRE (II) St. Simons Island, Ga.
Torsional Tests on Spring Steel.

ROBERT WALTER MCLEAN (II) Malden
Comparative Tests on Water Tube Boiler Tube Cleaners.

JOHN HERBERT MCMANUS (XI) Dorchester
A Study of the Sewage Disposal System of the North Metropolitan District. (*With A. W. Walker.*)

ARTHUR JAMES MANSON (VI) Dorchester
Car Runs on the Main Line of the Boston & Worcester Street Railway. (*With W. W. Loomis.*)

GROSVENOR DEWITT MARCY (II) Dorchester
Test of a DeLaval Steam Turbine Pump at the Massachusetts Institute of Technology. (*With A. G. Prescott.*)

CHARLES BENAJAH MAYER (IV) Madison, Wis.
A Study of Wind Pressure on High Buildings.

JASON LESLIE MERRILL, PH.B. (V) Waterville, Me.
A Sodium Bisulphite Pulp Process and the Recovery of the Waste-liquors.

OSCAR CHARLES MERRILL, A.B. (I) Boston
Tests on Reinforced Concrete Tee-beams. (*With H. R. Gabriel, K. Whitman, Jr.*)

HAROLD CARLYLE MITCHELL (I) Hardwick
Design for a Reinforced Concrete Dam.

THEODORE PARKER MOOREHEAD (I) Shanghai, China
Tests to Determine the Bond of Union between Steel and Concrete for Reinforced Concrete Construction. (*With T. E. Jewett.*)

ROBERT WILBUR MORSE (II) Jamaica Plain
An Investigation of the Specific Heat of Superheated Steam. (*With C. E. Gage.*)

ILIAS ASÀAD MURR, B.A. (I) Mt. Lebanon, Syria
Application of the Theory of Least Work to the Determination of Stresses in the Elevated Structure of the Boston Elevated Railway.

WILLIAM ANDREW NELSON (XIII) Chicago, Ill.
Duty Trial of a Sewage Pumping Engine.

DOW HIRAM NICHOLSON (I) Jamaica Plain
An Investigation of the Pitôt Tube. (*With L. H. Parker.*)

ISADORE NIDITCH (V) Boston
A Method for the Evaluation of Glue as a Sizing Agent for Paper.

ADOLPH JOHN ORTSEIFEN (XIII) Chicago, Ill.
A Device for Recording the Thrust of a Propeller. (*With S. A. Caine.*)

PAUL MCCLARY PAINE (XII) West Point, N.Y.
The Areal and Economic Geology of Fitchburg, Massachusetts.

VICTOR HUGO PAQUET (XIII) Portland, Oreg.
A Design for a Stern-wheel River Steamer.

LOVELL HALLET PARKER (I) Osterville
An Investigation of the Pitôt Tube. (*With D. H. Nicholson.*)

FRANK EDWARD PAYNE (XIII) Winchester
Economy Tests of a $14\frac{1}{2}'' \times 16''$ Hornsby-Akroyd Oil Engine. (*With G. W. Prentiss.*)

JAMES HARVEY PAYNE (X) Wilmington, N.C.
An Examination of an Essential Oil from Pine Wood.

LEON MURRAY PEASE (II) Boston
Tests on the American Superheater.

GEORGE WASON PERRY (XIII) West Medford
Tests on a 50 ton Ammonia Refrigerating Plant. (*With E. A. Burkhardt.*)

WILLIAM COPELAND PICKERSGILL (I) Brookline
An Investigation of the Creo-Resinate Preservation Process on the Properties of Timber. (*With H. R. Robbins.*)

THOMAS COULSON PINKERTON, A.B. (V) Baltimore, Md.
The Destructive Distillation of Peat.

FREDERICK ALEXANDER PIRIE (II) Beachmont
Tests on a Wainwright Even Flow Condenser. (*With J. A. Pitts.*)

JAMES ALBERT PITTS (II) Wollaston
Tests on a Wainwright Even Flow Condenser. (*With F. A. Pirie.*)

FREDERICK PARSONS POOLE (VI) Boston
Tests on a 50 K.W. Transformer of Special Design. (*With C. R. Shaw.*)

GEORGE WILLIAM PRENTISS (II) Holyoke
Economy Tests of a $14\frac{1}{2}'' \times 16''$ Hornsby-Akroyd Oil Engine. (*With F. E. Payne.*)

ALBERT GEORGE PRESCOTT (II) Dorchester
Test of a DeLaval Steam Turbine Pump at the Massachusetts Institute of Technology. (*With G. D. W. Marcy.*)

CHARLES ROLLINS PRICHARD (II) Lynn
Tests of a 500 K.W. Curtis Turbine. (*With J. H. Brown.*)

PAUL JUSTUS RALPH, C.E. (XIII) New York, N.Y.
Experiments on Propellers for a Motor-boat. (*With W. H. Blakeman.*)

GEORGE IRVING RHODES (VI) Andover
A Study of the Single Phase Series Motor. (*With E. G. Schmeisser.*)

NATHANIEL ATHERTON RICHARDS (IV) Weymouth
A Design of a Two-hinged Braced Steel Arch for an Armory Roof.

WALDEMAR SPAULDING RICHMOND (I) Adams
A Study of the Properties of Concrete in Tension. (*With R. M. Harding.*)

LOUIS ERNEST ROBBE (I) Peterboro, N.H.
The Determination of the Flow of Water through Pipes by means of Diaphragms. (*With G. W. C. Whiting.*)

HALLET RICE ROBBINS, A.B. (I) Manchester, N.H.
An Investigation of the Creo-Resinate Preservation Process on the Properties of Timber. (*With W. C. Pickersgill.*)

CHARLES LORING RODGERS (II) Binghamton, N.Y.
A Study of a Cooling Tower with Tests on the Worthington Cooling Tower at the Massachusetts Institute of Technology.

MILTON LOUIS RUBEL, B.S. (III) Philadelphia, Pa.
Treatment of an Auriferous Stibnite Ore from Nova Scotia. (*With G. G. Wald.*)

ARTHUR EDMANDS RUSSELL (XIII) Medford
Comparative Fuel Economy Tests of a Hornsby-Akroyd Oil Engine. (*With G. S. Tower.*)

IDA ANNAH RYAN (IV) Waltham
A Design for the Lay-out of a Model New England Town.

ERNEST GAIL SCHMEISSER (VI) Baltimore, Md.
A Study of the Single Phase Series Motor. (*With G. I. Rhodes.*)

FREDERIC JOSEPH SCHWARZ, A.B. (VI) Ballston Spa, N.Y.
Service Car Tests on the Utica and Mohawk Valley Railway. (*With J. P. Barnes.*)

RICHARD WARREN SENGER (III) — Port Jervis, N.Y.
The Cyanide and Concentration Treatment of Two Silver-Gold Ores from Taylor Park, Colorado. (*With B. E. Lindsly.*)

CHESTER ROY SHAW (VI) — Brockton
Tests on a 50 K.W. Transformer of Special Design. (*With F. P. Poole.*)

THOMAS SHAW (VI) — Plymouth
An Investigation of a Three Wire Generator.

RUSSELL BISSELL SIMONS (XIII) — Greenfield
A Design for an Independent Air Pump.

WILLARD EASTMAN SIMPSON (I) — San Antonio, Texas
A Design for a Reinforced Concrete Arch.

CHARLES EDWIN SMART (II) — Greenfield
Pressure and Temperature Variations along a DeLaval Steam Turbine Nozzle. (*With H. J. Stevenson.*)

WILLIAM FULLER SMART (IV) — Lewiston, Me.
A Study of Fire Proof Doors and Shutters as a Means of Preventing the Spread of Fire.

ALBERT HOWELL SMITH (XIII) — Malden
A Determination of the Variation of Torsion in the Shaft of a Steamship. (*With T. McC. Gunn.*)

ALBERT LOOMIS SMITH (V) — Hamilton
A Study of Colloidal Suspensions of Gold.

CHARLES HUNTINGTON SMITH, B.L. (I) — Cleveland, Ohio
A Plan for the Elimination of Grade Crossings at Framingham, Massachusetts. (*With R. S. Beard.*)

EDWARD CHURCH SMITH, B.A. (V) — Amherst
On the Products of the Distillation of Pine Wood. (*With E. W. Wiggins.*)

PRESTON MORRIS SMITH (X) — Syracuse, N.Y.
A Study of the Effect of Heat Treatment upon the Hysteresis Value of Low Carbon Steels.

SIDNEY ALFRED SMITH (VI) — Jamestown, N.Y.
Electrolysis of Underground Water Pipes by Electric Railroad Return Currents. (*With H. C. Stetson*).

FRANK LAMONT SNOW, PH.B. (VI) — Rochester, N.Y.
Tests on a 500 K.W. Curtis Turbine. (*With J. M. DeMallie.*)

WILLIAM LIVINGSTON SPALDING (III) — Lowell
Dracut Nickel Ore. The Geology and Concentration. (*With E. Burton.*)

FRANK CHARLES STARR (I) — Canning, N.S.
A Study of the Effect upon the Coefficient of Discharge of an Increase in the Length of a Module. (*With R. E. Wise.*)

ROGER PIERCE STEBBINS (XIII) — Roslindale
Test of a Sixty Horse-power Marine Gasolene Engine. (*With H. Eisele.*)

HAROLD CLAP STETSON (VI) Walpole
Electrolysis of Underground Water Pipes by Electric Railroad Return Currents. (*With S. A. Smith.*)

HENRY JOSEPH STEVENSON (II) East Boston
Pressure and Temperature Variations along a DeLaval Steam Turbine Nozzle. (*With C. E. Smart.*)

SIDNEY TALBOT STRICKLAND (IV) Brookline
A City Hall for a City Having Thirty-five to Fifty Thousand Inhabitants.

RALPH EDWIN TARBETT (XI) Stoneham
The Purification of Glue Waste. Preliminary Studies and Design of a Plant for Treatment of a Counter Factory Waste. (*With A. O. True.*)

JOHN WALLACE TAYLOR, B.A. (II) Oberlin, Ohio
A Thermo-Dynamic Study of an SO_2 Waste Heat Engine as Applied to a Thirty-six Horse-power Otto Gas Engine. (*With J. H. Flynn.*)

GEORGE CARLYLE THOMAS (II) Boston
A Design of an Electric Drive for Sewing Machines.

GILBERT SANDERS TOWER (XIII) Cohasset
Comparative Fuel Economy Tests of a Hornsby-Akroyd Oil Engine. (*With A. O. Russell.*)

ALBERT OTIS TRUE (XI) Newton Highlands
The Purification of Glue Waste. Preliminary Studies and Design of a Plant for Treatment of a Counter Factory Waste. (*With R. E. Tarbett.*)

WILLIAM TUFTS (I) Boston
A Study of Boring Tools and Methods of Making Borings.

LEBARON TURNER (I) Geneva, Ill.
Tests to Determine the Shearing Strength of Mortar and Concrete. (*With W. D. Clarke.*)

GEORGE GUSTAV WALD (III) West Roxbury
Treatment of an Auriferous Stibnite Ore from Nova Scotia. (*With M. L. Rubel.*)

ALBERT WILLARD WALKER (XI) Marlboro
A Study of the Sewage Disposal System of the North Metropolitan District. (*With J. H. McManus.*)

HIRAM LEROY WALKER (II) East Somerville
A Test on an Eight-inch Three-stage Worthington Turbine Pump. (*With W. C. Eichler.*)

EDWARD WIGHT WASHBURN (V) Roxbury
A Method for Determining the Hydration of Ions by Transference Measurements.

EARLL CHASE WEAVER (I) Buffalo, N.Y.
A Design for a Railroad Yard at Rochester, New Hampshire. (*With E. M. Graham.*)

MAURICE EDGAR WEAVER (VI) Washington, D.C.
A Study of the Insulation of Rubber Covered Cables. (*With W. V. Lyon.*)

ALBERT WARREN WELLS (III) Chicago, Ill.
A Report on Properties of Central Rawdon Consolidated Mines, Limited.

PERCY LEONARD WELLS (I) Waltham
Rating of the Calvary Street Sewer in Waltham, Massachusetts.

HENRY AZOR WENTWORTH (VIII) Lynn
A Study of Certain Voltaic Cells Composed of Fused Electrolytes.

RALPH NIMS WHITCOMB (I) Keene, N.H.
A Design for a Steel Highway Bridge.

RAY HILL WHITE, A.B. (VIII.) Rochester, N.Y.
An Experimental Study of the Salom Process for the Electrolytic Reduction of Lead Sulphide.

GEORGE WILLIAM CARLYLE WHITING (I) Baltimore, Md.
The Determination of the Flow of Water through Pipes by means of Diaphragms. (*With L. E. Robbe.*)

HORATIO WHITING (III) Dorchester
Stamp Milling and Cyanide Treatment of a Nova Scotia Gold Ore.

KILBORN WHITMAN, JR. (I) Roxbury
Tests on Reinforced Concrete Tee-beams. (*With H. R. Gabriel, O. C. Merrill.*)

ALFRED LAMSON WHITMARSH (II) Somerville
An Investigation of the Flow of Superheated Steam through an Orifice. (*With W. C. Gilman.*)

JAMES BRYANT WHITMORE (II) Akron, Ohio
Tests on a Napier Automobile Engine. (*With W. H. Lorenz.*)

ELMER WESLEY WIGGINS, B.S. (V) Warsaw, N.Y.
On the Products of the Distillation of Pine Wood. (*With E. C. Smith.*)

HERBERT MYGATT WILCOX (X) Orange, N.J.
The Determination of the Latent Heat of Sulphurous Anhydride above 100° Fahrenheit.

LOUIS CLARENCE WINSHIP, PH.B. (VI) Woburn
Tests of the Power Plant of the Augustus Lowell Laboratory. (*With C. E. Atwood.*)

ROBERT EMMET WISE (I) South Lancaster
A Study of the Effect upon the Coefficient of Discharge of an Increase in the Length of a Module. (*With F. C. Starr.*)

MILFORD WORTHAM (III) New York, N.Y.
A Free Settling Classifier.

BARTOLETTE ARTMAN YODER (I) Omaha, Nebr.
An Investigation of the Physical Properties of Antimonial Lead. (*With F. M. Carhart.*)

Register of Students.

For residence addresses in suburban portions of Boston the following abbreviations are used:

A.	Allston.	M.	Mattapan.
B.	Brighton.	N.	Neponset.
C.	Charlestown.	R.	Roxbury.
D.	Dorchester.	Ros.	Roslindale.
E.B.	East Boston.	S.B.	South Boston.
J.P.	Jamaica Plain.	W.R.	West Roxbury.

FELLOWS.

NAME.	HOME.	RESIDENCE.
Abbott, George Alonzo	*Greencastle, Ind.* . .	Boston, Mass.
A.M., DePauw University.		
Austin Fellow.		
Comstock, Daniel Frost	*Boston*	Zürich, Switzerland.
S.B., Massachusetts Institute of Technology.		
Savage Fellow.		
Ford, George Burdett	*Clinton*	Paris, France.
A.B., Harvard University.		
S.B., Massachusetts Institute of Technology.		
Savage Fellow.		
Haskell, Raymond	*Indianapolis, Ind.* .	Boston, Mass.
S.M., Massachusetts Institute of Technology.		
Austin Fellow.		
Kalmus, Herbert Thomas . . .	*Boston*	Zürich, Switzerland.
S.B., Massachusetts Institute of Technology.		
Austin Fellow.		
Kraus, Charles Angus	*Boston*	Boston, Mass.
B.S., University of Kansas.		
Austin Fellow.		
Mathewson, Champion Herbert	*Milford, Conn.* . .	Göttingen, Germany.
Ph.B., Yale University.		
Austin Fellow.		
Miller, Ernest A.	*Ithaca, N.Y.* . . .	Göttingen, Germany.
A.M., Cornell University.		
Austin Fellow.		

FELLOWS (*continued*).

NAME.	HOME.	RESIDENCE.
Rowe, Allan Winter	*Boston*	Göttingen, Germany
S.B., Massachusetts Institute of Technology. Swett Fellow.		
Sosman, Robert Browning . . .	*Chillicothe, Ohio* .	Boston, Mass.
B.Sc., Ohio State University. S.B., Massachusetts Institute of Technology. Austin Fellow.		
Stewart, Morris Archer	*Dover, N.H.* . . .	Boston, Mass.
B.S., New Hampshire College of Agriculture and Mechanic Arts. Austin Fellow.		
Tolman, Richard Chase	*W. Newton*	Boston, Mass.
S.B., Massachusetts Institute of Technology. Dalton Fellow.		
Williams, Robert Seaton	*Boston*	Göttingen, Germany.
S.B., Massachusetts Institute of Technology. Austin Fellow.		

CANDIDATES FOR THE DEGREE OF DOCTOR OF PHILOSOPHY.

NAME.	HOME.	RESIDENCE.
Abbott, George Alonzo, A.M. .	*Greencastle, Ind.* . .	407 Columbus Ave.
Field, Charles, 3d, S.B.	*Chestnut Hill* . . .	Chestnut Hill.
Haskell, Raymond, S.M. . . .	*Indianapolis, Ind.* .	670 Mass. Ave.
Kraus, Charles Angus, B.S. . . .	*Boston*	4 Haviland St.
Sosman, Robert Browning, S.B.	*Chillicothe, Ohio* .	670 Mass. Ave.
Stewart, Morris Archer, B.S. . .	*Dover, N.H.* . . .	Somerville.
Tolman, Richard Chase, S.B. .	*W. Newton*	W. Newton.

CANDIDATES FOR THE DEGREE OF MASTER OF SCIENCE.

NAME.	HOME.	RESIDENCE.
Ackerson, James Lee	*Washington, D.C.*	261 Newbury St.
Barrows, George Herbert, S.B.	*Taunton*	213 W. Newton St.
Battles, Donald Raymond	*Erie, Pa.*	Hemenway Chambers.
Blount, Fernando Moreno, S.B.	*Pensacola, Fla.*	428 Newbury St.
Caine, Sydney Atmore, S.B.	*Boston*	1077 Boylston St.
Funk, George Charles, S.B.	*Brookline*	Brookline.
Gatewood, Richard Duncan	*Boston*	316 Newbury St.
Hoefer, Chester Arthur, B.S.	*Freeport, Ill.*	47 Hemenway St.
Hoyt, Ray Stevens, B.S.	*Bellevue, Nebr.*	366 Columbus Ave.
Merryweather, Hubert, S.B.	*Cincinnati, Ohio*	262 Newbury St.
Ryan, Ida Annah, S.B.	*Waltham*	Waltham.
Tower, Gilbert Sanders, S.B.	*Cohasset*	Cohasset.

GRADUATE STUDENTS.

(This list includes the names of all students, except Fellows, 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.)

NAME.	HOME.	RESIDENCE.
Ackerson, James Lee Graduate, U.S. Naval Academy.	*Washington, D.C.*	261 Newbury St.
Adams, Arthur Kinney. A.M., Harvard University.	*Spencer*	No. Cambridge.
Adams, Franklin Oliver, Jr. B.S., Centenary College.	*Locust Ridge, La.*	Brookline.
Adams, Percival Lysander B.S., Oregon Agricultural College.	*Hood River, Oreg.*	46 Florence St., Ros.
Ahern, Michael Joseph, S.J. A.B., Saint Francis Xavier College.	*Boston*	761 Harrison Ave.
Altgelt, Ernest Simpson B.S., Agricultural and Mechanical College of Texas. C.E., University of Texas.	*San Antonio, Texas*	124 St. Botolph St.
Arnold, Anthony Brown B.A., Yale University.	*Plainfield, Conn.*	230 Newbury St.
Ayres, Richard Samuel. A.B., Centre College.	*Pineville, Ky.*	91 Newbury St.
Baker, Harold Peters A.B., Princeton University.	*White Haven, Pa.*	Technology Chambers.

GRADUATE STUDENTS (*continued*).

NAME.	HOME.	RESIDENCE.
Barker, Bertha Isabel B.S., Wellesley College.	*Cambridge*	Cambridge.
Barnes, Roderic Barbour A.B., Princeton University.	*New York, N.Y.*	Technology Chambers.
Barrows, George Herbert. S.B., Massachusetts Institute of Technology.	*Taunton*	213 W. Newton St.
Bartlett, Edwin Ball A.B., University of Wisconsin.	*Milwaukee, Wis.*	311 Beacon St.
Battles, Donald Raymond Graduate, U.S. Naval Academy.	*Erie, Pa.*	Hemenway Chambers.
Beam, Charles Willett B.A., Amherst College.	*Passaic, N.J.*	535 Mass. Ave.
Beede, Everett Jefts A.B., Boston University.	*Hudson*	159 W. Canton St.
Blount, Fernando Moreno S.B., Massachusetts Institute of Technology.	*Pensacola, Fla.*	428 Newbury St.
Boland, Marion Genevieve A.B., University of Maine.	*Worcester*	Worcester.
Bond, Francis Marvin A.B., Randolph-Macon College.	*Baltimore, Md.*	505 Columbus Ave.
Bradshaw, William H. B.S., Beloit College.	*De Kalb, Ill.*	240 W. Newton St.
Bragdon, Charles Ridgaway A.B., Northwestern University.	*Evanston, Ill.*	Technology Chambers.
Brewer, Carl B.A., Yale University.	*New Haven, Conn.*	25 St. Botolph St.
Brown, Harold Gibson A.B., Williams College.	*Pittsfield*	Technology Chambers.
Buchanan, James Marion S.B., Princeton University.	*Trenton, N.J.*	171 St. Botolph St.
Buckler, Riggin A.B., Johns Hopkins University.	*Baltimore, Md.*	Technology Chambers.
Burpee, George William A.B., Bowdoin College.	*Houlton, Me.*	240 W. Newton St.
Byron, Walter Harwood B.S., Maryland Agricultural College.	*Williamsport, Md.*	Technology Chambers.
Cady, John Hutchins Ph.B., Brown University.	*Providence, R.I.*	Technology Chambers.
Caine, Sydney Atmore S.B., Massachusetts Institute of Technology.	*Boston*	1077 Boylston St.
Caldwell, William Anderson B.S., University of Michigan.	*St. Louis, Mo.*	249 Berkeley St.
Calley, Walter England B.S., University of Chicago.	*Upland, Pa.*	59 Georgia St., R.
Cartagena, Juan José A.B., Spanish University.	*Mayagüez, Porto Rico*	14 Follen St.
Chandler, Benjamin F. B.S., Rose Polytechnic Institute.	*So. Coventry, Conn.*	566 Columbus Ave.
Clarke, Lewis Cutler, Jr. S.M., Massachusetts Institute of Technology.	*Cambridge*	Cambridge.
Coburn, Frederic Gallup Graduate, U.S. Naval Academy.	*Duluth, Minn.*	142 Huntington Ave
Coffin, William Balch A.B., Harvard University.	*Brookline*	Brookline.

GRADUATE STUDENTS (*continued*).

NAME.	HOME.	RESIDENCE.
Conover, John Woodhull . . . A.B., Washington and Lee University.	*Norfolk, Va.* . . .	26 St. James Ave.
Correll, James A. . . . . B.S., Kansas State Agricultural College.	*Manhattan, Kans.* .	34 Dartmouth St.
Couper, William . . . . . Graduate, Virginia Military Institute.	*Norfolk, Va.* . . .	424 Mass. Ave.
Critchlow, Paul Nisbet . . . . B.S., Geneva College.	*New Brighton, Pa.*	240 W. Newton St.
Cutten, Leverett Howell . . . . A.B., Bates College.	*Boston*	31 Worcester St.
Daddow, Samuel Harries . . . A.B., Princeton University.	*St. Clair, Pa.* . .	Technology Chambers.
Davidson, James Holroyd . . . C.E., Pennsylvania Military College.	*Denver, Colo.* . . .	311 Beacon St.
Davis, Lawrence Ritchie . . . . B.S., Ohio Wesleyan University.	*Peking, China* . .	22 Claremont Park.
Deavitt, William Jefferson . . . A.B., Williams College.	*Montpelier, Vt.* .	Technology Chambers.
Diamond, Henry Hyman . . . A.B., Harvard University.	*Boston*	63 Allen St.
Dickson, Victor Heyle . . . . . Associate in Science, Bradley Polytechnic Institute.	*Peoria, Ill.* . . .	Technology Chambers.
Dill, Colby . . . . . A.B., Harvard University.	*Newton Centre* . .	Newton Centre.
Donnewald, Albert Henry . . . A.B., Saint Louis University.	*St. Louis, Mo.* . . .	264 Newbury St.
Dore, Clement Joseph . . . . . A.B., Boston College.	*Roxbury*	40 Howland St., R.
Druley, Waldo Putnam . . . . Graduate, U.S. Naval Academy.	*Belpre, Ohio* . . .	159 Foster St., D.
Dyer, Kirk Worrell . . . . . B.S., Throop Polytechnic Institute.	*Pasadena, Cal.* . .	240 W. Newton St.
Edwards, Carl Francis . . . . B.S., Princeton University.	*Santa Barbara, Cal.*	Technology Chambers.
Eisenhart, Martin Herbert . . . B.S., Princeton University.	*York, Pa.* . . .	Technology Chambers.
Ewing, Charles Goodman . . . A.B., Saint Louis University.	*St. Louis, Mo.* . . .	63 Chestnut St.
Faulkner, Frederick R. . . . . A.B., Acadia College.	*Sackville, N.B.* . .	131 Pembroke St.
Fellows, John Hibbard. . . . . B.S., Dartmouth College.	*Tilton, N.H.* . . .	7 Follen St.
Ferreira, Cesar . . . . . University of Montevideo.	*Montevideo, Uruguay*	45 St. Botolph St.
Field, Charles, 3d . . . . . B.S., University of Pennsylvania. S.B., Massachusetts Institute of Technology.	*Chestnut Hill* . . .	Chestnut Hill.
Fisher, Charles Willis, Jr . . . Graduate, U.S. Naval Academy.	*Washington, D.C.* .	Brookline.
Fleming, Cornelius Simmons, Jr. B.S., Washington and Jefferson College.	*Washington, Pa.* . .	78 Huntington Ave.
Funk, George Charles . . . . . S.B., Massachusetts Institute of Technology.	*Brookline*	Brookline.
Gatewood, Richard Duncan . . Graduate, U.S. Naval Academy.	*Boston*	316 Newbury St.

GRADUATE STUDENTS (*continued*).

NAME.	HOME.	RESIDENCE.
Gaylord, James Mason . . . . B.S., Throop Polytechnic Institute.	*Pasadena, Cal.* . .	4 Kearsarge St., R.
Gilman, Wesley Clifton . . . . S.B., Massachusetts Institute of Technology.	*No. Abington* . . .	No. Abington.
Goodwin, Edwin Sykes . . . . Ph.B., Brown University.	*Laconia, N.H.* . .	Somerville.
Greene, John Francis . . . . . A.B., Boston College.	*So. Boston.*	50 Thomas Park, S.B.
Groover, Francis Bartow . . . B.S., Mercer University.	*Statesboro, Ga.* . .	20 Berwick Park.
Hamill, Edward William . . . A.B., Harvard University.	*Belleville, Ill.* . . .	Cambridge.
Hamner, Edward Chambers, Jr. Graduate, U.S. Naval Academy.	*Lynchburg, Va.* . .	Garrison Hall.
Hanley, Gerald Thomas . . . . B.S., Pennsylvania Military College.	*Winsted, Conn.* . .	311 Beacon St.
Harrison, Jerome Gabriel . . . B.S., Agricultural and Mechanical College of Texas.	*College Station, Texas.*	43 St. Botolph St.
Hasbrouck, Frank Flinn . . . . A.M., Wabash College.	*Peoria, Ill.* . . .	Technology Chambers.
Hazen, Howard Spencer, Jr. . . B.S., University of Illinois.	*La Salle, Ill.*	154 Newbury St.
Hoefer, Chester Arthur . . . . B.S., University of Wisconsin.	*Freeport, Ill.* . . .	47 Hemenway St.
Holmes, William King . . . . A.B., Bates College.	*So. Paris, Me.* . .	Cambridge.
Holmquist, Charles Albert . . . B.S., University of Rochester.	*Rochester, N.Y.* . .	Technology Chambers.
Hoyt, Ray Stevens . . . . . B.S. in E.E., University of Wisconsin.	*Bellevue, Nebr.* . .	366 Columbus Ave.
Hull, Andrew Wilmer . . . . . A.B., Johns Hopkins University.	*Baltimore, Md.* . .	505 Columbus Ave.
Ingalsbe, Frank Richmond . . . B.S., Middlebury College.	*Oakfield, N.Y.* . . .	126 W. Newton St.
Jacobson, Conrad . . . . . Ph.B., Beloit College.	*Chicago, Ill.*	
James, Edwin Warley . . . . . A.B., Harvard University.	*Ossining, N.Y.* . .	134 Chandler St.
Jennings, Oliver Saunders . . . A.B., Brown University.	*Fall River*	76 St. Stephen St.
Johnson, Bert Day . . . . . A.B., Princeton University.	*Pittston, Pa.* . .	Technology Chambers.
Jones, Grandville Reynard . . . C.E., Ohio State University.	*Columbus, Ohio* . .	Newton Highlands.
Jones, Samuel Percy . . . . . M.S., University of California.	*Atlanta, Ga.* . . .	Cambridge.
Kendall, Albert Stearns . . . . A.B., Harvard University.	*Newton Centre* . .	Newton Centre.
Kennedy, Philip Francis . . . . A.B., Boston College.	*Roslindale*	12 Brown Ave., Ros.
Key, Howard W. . . . . B.Litt., University of Texas.	*Austin, Texas* . . .	31 Concord Square.
Kiefaber, Warner Harshman . . B.S., Saint Mary's Institute.	*Dayton, Ohio* . .	Technology Chambers.

GRADUATE STUDENTS (*continued*).

NAME.	HOME.	RESIDENCE.
Kintner, Edwin Graham . . . . Graduate, U.S. Naval Academy.	*Rock Haven, Ky.* .	45 St. Botolph St.
Kudlich, Rudolf H. . . . . E.E., Lafayette College.	*Drifton, Pa.* . . .	477 Mass. Ave.
Labbé, Antoine Gilbert . . . . A.B., Williams College.	*Boston*	8 Westland Ave.
Land, Emory Scott . . . . . Graduate, U.S. Naval Academy.	*Gunnison, Colo.* . .	Garrison Hall.
Larned, John Insley Blair . . . A.B., Harvard University.	*Lake Forest, Ill.* . .	32 St. James Ave.
Lasnier, Gilberto C. . . . . A.B., University of Montevideo.	*Montevideo, Uruguay*	45 St. Botolph St.
Lawrence, Edmund Kent . . . A.B., Rock Hill College.	*Catonsville, Md.* . .	242 Newbury St.
Lee, Tsan-chi. . . . . B.C.E., Imperial Tientsin University.	*Canton, China* . .	29 Newbury St.
Lewis, Ernest Farnum . . . . A.B., Brown University.	*Providence, R.I.* . .	Beacon Chambers.
Libbey, Harold Shaw . . . . . A.B., Bates College.	*Lewiston, Me.* . . .	79 St. Botolph St.
Lightner, Milton Turnley . . . A.B., Harvard University.	*Highland Park, Ill.*.	237 Beacon St.
Link, John Hanger . . . . . A.B., Earlham College.	*Rushville, Ind.* . .	407 Columbus Ave.
Logan, Frank. . . . . A.B., Indiana University.	*Pierceton, Ind.* . .	7 Follen St.
Loring, Charles Greely . . . . A.B., Harvard University.	*Boston*	8 Otis Place.
Luehrs, Daniel Michael . . . . B.S., Case School of Applied Science.	*Cleveland, Ohio* . .	136 Chandler St.
Lyne, William . . . . . B.M.E., Kentucky State College.	*Brannon, Ky.* . . .	11 Blackwood St.
McCain, Elmer Dwight . . . . A.B., Washington and Jefferson College.	*Allegheny, Pa.* . .	Cambridge.
McElroy, James Aloysius . . . A.B., Georgetown University.	*Bridgeport, Conn.*	Technology Chambers.
McRae, Henry Clinton. . . . . B.S., Beloit College.	*Gas, Kansas* . . .	311 Beacon St.
Mann, Paul Ford . . . . . B.A., Yale University	*Buffalo, N.Y.* . .	Technology Chambers.
Mathison, William Edward H. . B.A., Wesleyan University.	*Springfield*	18 Batavia St.
Maxwell, J. North . . . . . B.S., Agricultural and Mechanical College of Texas.	*Austin, Texas* . . .	94 St. Botolph St.
Mayberry, Edward Leodore . . B.L., University of California.	*Long Beach, Cal.* .	Brookline.
Mayer, Paul Hirschl . . . . . B.S., Princeton University.	*Mt. Vernon, N.Y.*	Technology Chambers.
Merritt, Aaron Riley. . . . . B.A., Yale University.	*E. Aurora, N.Y.* .	477 Mass. Ave
Merrow, John William . . . . A.B., Dartmouth College.	*Cambridge*	Cambridge.
Merryweather, Hubert . . . . S.B., Massachusetts Institute of Technology.	*Cincinnati, Ohio* .	262 Newbury St.

GRADUATE STUDENTS (*continued*).

NAME.	HOME.	RESIDENCE.
Mesmer, Louis Francisco. . . . B.S., Saint Vincent's College.	*Los Angeles, Cal.* . .	242 Newbury St.
Miller, Carroll Everard, Jr. . . Graduate, U.S. Naval Academy.	*Cadillac, Mich.* . .	Somerville.
Mills, Benjamin Franklin . . . A.B., Williams College.	*Pittsfield*	50 S. Russell St.
Moller, Kenneth . . . . . A.B., Harvard University.	*Jamaica Plain* . .	5 Greenough St., J.P.
Moore, Chester Newell. . . . . B.S., Dartmouth College.	*Worcester*	86 Myrtle St.
Moore, John Ernest . . . . . A.B., Boston University.	*Allegheny, Pa.* . .	Chelsea.
Moreland, Edward Leyburn . . A.B., Johns Hopkins University.	*McDonogh, Md.* . .	Beacon Chambers.
Myers, Desaix Brown . . . . . B.S., University of Pennsylvania.	*Philadelphia, Pa.* .	26 St. James Ave.
Neale, Arthur. . . . . Associate, Royal College of Science for Ireland.	*Dublin, Ireland* . .	Melrose Highlands.
Nelson, Stanley Foushee . . . . A.B., Princeton University.	*Winchester, Ky.* . .	94 St. Botolph St.
Nickerson, Harry Levin Roeschland B.A., Yale University.	*Quincy, Ill.* . . .	3 Berwick Park.
Otis, Webb Harlan . . . . . B.S., Iowa State College.	*Ames, Iowa*	444 Mass. Ave.
Owings, Thomas . . . . . A.B., Johns Hopkins University.	*Baltimore, Md.* . .	80 Pinckney St.
Pagon, William Watters . . . . A.B., Johns Hopkins University.	*Baltimore, Md.* . . .	Beacon Chambers.
Patterson, Henry Rathbone . . A.B., Harvard University.	*Roxbury*	8 Montrose St., R.
Perry, William Graves . . . . A.B., Harvard University.	*Boston*	135 Beacon St.
Philbrick, Herbert Shaw . . . . A.B., Colby College.	*Waterville, Me.* . .	52 Pinckney St.
Place, Mark Hopkins . . . . . A.B., Milton College.	*Francestown, N.H.* .	195 W. Brookline St.
Pratt, Arthur Dendney . . . . A.B., Princeton University.	*Brooklyn, N.Y.* .	Technology Chambers.
Puhl, Paul William . . . . . A.B., Princeton University.	*Harrisburg, Pa.* . .	27 St. Botolph St.
Pulman, Oscar Stoddard, Jr. . . B.A., Yale University.	*Albany, N.Y.* . . .	84 Charles St.
Quinlan, George Austin . . . . A.B., Georgetown University.	*Houston, Texas* . .	311 Beacon St.
Rambo, Marcellus. . . . . B.S., University of Georgia.	*Marietta, Ga.* . . .	240 W. Newton St.
Rayner, William Pearce . . . . A.B., Wittenberg College.	*Springfield, Ohio* .	47 St. Botolph St.
Reed, James, Jr. . . . . Graduate, U.S. Naval Academy.	*Ashtabula, Ohio* . .	311 Beacon St.
Reyburn, John Randolph . . . A.B., Saint Louis University.	*St. Louis, Mo.* . . .	6 Louisburg Sq.
Richardson, Holden Chester . . Graduate, U.S. Naval Academy.	*Shamokin, Pa.* . .	311 Beacon St.

GRADUATE STUDENTS (*continued*).

NAME.	HOME.	RESIDENCE.
Roby, Thomas Walton, Jr. . . B.S., Virginia Military Institute.	*Norfolk, Va.* . . .	424 Mass. Ave.
Rockwell, Seldon Emmett . . . Ph.B., Yale University.	*Denver, Colo.* . . .	120 Huntington Ave.
Ruppel, Henry Erich Kasemen . A.M., Dartmouth College.	*Brooklyn, N.Y.* . .	35 Cushing Ave., D.
Ryan, Ida Annah . . . . . S.B., Massachusetts Institute of Technology.	*Waltham*	Waltham.
Ryden, Roy Warren . . . . . Graduate, U.S. Naval Academy.	*Des Moines, Iowa* .	45 St. Botolph St.
Schmidt, Paul Sylvester . . . . B.S., Case School of Applied Science.	*E. Cleveland, Ohio* .	Cambridge.
Schwab, Arthur John . . . . . A.B., Hamilton College.	*Binghamton, N.Y.* .	171 Newbury St.
Scott, George Walter . . . . . A.B., Princeton University.	*Asbury Park, N.J.*	Beacon Chambers.
Shipman, LeRoy Holton . . . . B.S., University of Vermont.	*Winooski, Vt.* . . .	9 Maryland St., D.
Sissa, Ugo . . . . . Graduate, University of Ferrara.	*Revere, Italy* . . .	12 North Square.
Small, Walter Blaisdell. . . . . B.S., Dartmouth College.	*Providence, R.I.* . .	Chelsea.
Smith, Tracy . . . . . B.A., Wesleyan University.	*Waterbury, Conn.*	Technology Chambers.
Soule, Winsor. . . . . A.B., Harvard University.	*Brookline*	Brookline.
Souther, John Glendon . . . . A.B., Harvard University.	*Jamaica Plain* .	36 Greenough Ave., J.P.
Stockwell, Frank Clifford . . . A.B., Bates College.	*So. Framingham* .	So. Framingham.
Stone, Elizabeth . . . . . A.B., Radcliffe College.	*Dorchester*	53 Harvard St., D.
Stone, Lawrence Edward . . . A.B., Harvard University.	*Cleveland, Ohio* .	Technology Chambers.
Story, Carroll Fitch . . . . . B.S., Beloit College.	*Milwaukee, Wis.* .	69 Pinckney St.
Sullivan, Homer Vincent . . . . B.S., Fordham College.	*Boston*	35 Melville St.
Sweeny, Harry Patterson . . . B.A., Yale University.	*Drifton, Pa.*	477 Mass. Ave.
Symes, George Gifford . . . . Ph.B., Yale University.	*New York, N.Y.* .	99 Newbury St.
Tashjian, Armen Haigouny . . A.B., Anatolian College.	*Smyrna, Turkey* . .	54 The Fenway.
Terrell, Wendell Phillips . . . . B.S., Kansas State Agricultural College.	*Fort Worth, Texas* .	84 Sawyer St.
Thomson, Henry Bowers . . . B.S., University of Texas.	*Austin, Texas* . .	Technology Chambers.
Thorndike, John Richard . . . A.B., Harvard University.	*Boston*	181 Marlborough St.
Tolman, George Edward . . . A.B., Colby College.	*Westbrook, Me.* . .	194 W. Springfield St.
Tourtellot, Henry Bernon . . . A.B., Williams College.	*Derry, N.H.* . . .	50 S. Russell St.

GRADUATE STUDENTS (*continued*).

NAME.	HOME.	RESIDENCE.
Tower, Gilbert Sanders . . . . S.B., Massachusetts Institute of Technology.	*Cohasset*	Cohasset.
Tufts, William . . . . . S.B., Massachusetts Institute of Technology.	*Boston*	56 Dwight St.
Turner, Claude Vernon . . . . Ph.B., Iowa College.	*Minneapolis, Minn.*	120 W. Newton St.
Tyler, John . . . . . William and Mary College.	*Williamsburg, Va.* .	10 Durham St.
Tyndall, James . . . . . A.B., University of Vermont.	*Old Mystic, Conn.* .	179 Chestnut Ave., J.P.
Udale, Stanley Martin . . . . . A.C.G.I., B.Sc., Central Technical College, London University.	*London, England* .	Technology Chambers.
Van Keuren, Alexander Hamilton Graduate, U.S. Naval Academy.	*Howell, Mich.* . .	142 Huntington Ave.
Walsh, John Henry . . . . . Graduate, U.S. Naval Academy.	*Washington, D.C.* .	Garrison Hall.
Westervelt, George Conrad . . Graduate, U.S. Naval Academy.	*Corpus Christi, Texas*	Garrison Hall.
Whittle, George Dilley . . . . B.S., Southwestern University.	*Georgetown, Texas* .	124 Chandler St.
Wilfley, Clifford Redman . . . B.S., Missouri School of Mines.	*Maryville, Mo.* . . .	147 Appleton St.
Wilson, Elbert Carson . . . . . A.B., Bates College.	*Portland, Me.* . . .	31 Worcester St.
Winslow, Arthur Melvin . . . . Ph.B., Brown University.	*Providence, R.I.* . .	Providence, R.I.
Wint, Rufus William George . . A.B., Franklin and Marshall College.	*Catasauqua, Pa.* . .	47 St. Botolph St.
Woodruff, Leland Sargeant . . . A.B., Beloit College	*Syracuse, N.Y.* . .	31 Concord Sq.
Yates, Isaac Irving . . . . . Graduate, U.S. Naval Academy.	*Schenectady, N.Y.* .	311 Beacon St.

REGULAR STUDENTS.

FOURTH YEAR.

NAME.	COURSE.	HOME.	RESIDENCE.
Adams, Daniel	II.	*Wellesley*	Wellesley.
Allen, Simeon Carlyle . . .	V.	*Roxbury*	43 Holborn St., R.
Anderson, John Wallace . .	II.	*Arlington*	Arlington.
Anson, Charles Lyman. .	XIII.	*Milwaukee, Wis.* .	215 Newbury St.
Ashmore, Morse Breckenfeld	VI.	*Boston*	38 W. Newton St.
Bailey, Herbert Stevens . .	V.	*Lawrence, Kans.* . .	15 Wadsworth St., A.
Ball, Herbert James . . .	II.	*Allston*	Cambridge Terrace, A.
Banash, James Ira . . .	VIII.	*Roxbury*	5 Fayston St. R.
Barber, Raymond Jenness	III.	*Newton*	234 Newbury, St.
Bardwell, Earl Smith . . .	III.	*Florence*	Winthrop.
Barnes, Howard Parker . . .	I.	*Plymouth*	Technology Chambers.
Bartlett, Charles Terrell . .	I.	*Fortress Monroe, Va.*	Technology Chambers.
Batchelder, Frederick Russell	VI.	*Hampton, N.H.* .	Brookline.
Beers, Harold William . . .	I.	*Taunton*	60 W. Rutland Sq.
Benham, Frank Arthur . . .	I.	*Milton, Vt.*	48 St. Stephen St.
Bent, Leavitt Newell . . .	X.	*Framingham* . . .	Framingham.
Bentley, Fred Harold . . .	II.	*Plainville, Conn.* .	42 Rutland Sq.
Blackwell, Otto Bernard . .	VI.	*Bourne*	393 Mass. Ave.
Blodgett, Albert Alden . .	IV.	*Roxbury*	28 Greenville St., R.
Blodgett, Laurence Gould . .	I.	*Kansas City, Mo.* .	237 Beacon St.
Boynton, Augustus Swaine .	II.	*Groveland*	2 St. Botolph St.
Bradbury, Royall Douglas . .	I.	*Kansas City, Mo.*	Technology Chambers.
Brown, Harry Wheeler . .	II.	*Allston*	118 Brighton Ave., A.
Brown, Howard Hayes .	XIII.	*Penacook, N.H.* .	Technology Chambers.
Browne, Frank Atwood .	XIII.	*Westboro*	60 W. Rutland Sq.
Buchanan, James M., B.S. .	III.	*Trenton, N.J.* . .	171 St. Botolph St.
Buker, Harry William . . .	III.	*Salem*	Lynn.
Burke, Ralph Haney	I.	*Chicago, Ill.* . .	Technology Chambers.
Burleigh, Charles Randall .	II.	*Malden*	Malden.
Burnap, George Elberton .	IV.	*Newtonville* . . .	Newtonville.
Cady, William James . . .	VI.	*Brookline*	Brookline.
Campbell, Edmund S. . . .	IV.	*Freehold, N.J.* . .	48 St. Stephen St.
Carr, Sidney Taylor	VI.	*Quincy*	Quincy.
Cartagena, Juan José, A.B.	VI.	*Mayagüez, Porto Rico*	14 Follen St.
Caypless, Willis Smith . .	III.	*Denver, Colo.* . . .	311 Beacon St.
Cederholm, Anna Margaret	V.	*Belmont*	Belmont.

Fourth Year (*continued*).

NAME.	COURSE.	HOME.	RESIDENCE.
Chadbourne, Walter E.	XIII.	*Dorchester*	41 Newport St., D.
Chadwick, Louis Robinson	XIII.	*New Bedford*	38 W. Newton St.
Chase, Charles Henry	II.	*Dedham*	Dedham.
Chase, Eugene Preston.	VI.	*Portland, Me.*	Somerville.
Cheney, Arthur Morton	II.	*Camden, N.J.*	2 Durham St.
Chidester, Arthur Mercer	I.	*Philadelphia, Pa.*	Technology Chambers.
Clark, Robert Sidney	XIII.	*Derry, N.H.*	670 Mass. Ave.
Clarke, Ralph Scudder	VI.	*Dorchester*	35 Rockwell St., D.
Coes, Harold Vinton Otis	II.	*Germantown, Pa.*	Somerville.
Coey, Stewart Clark	VI.	*Newark, N.J.*	53 Gloucester St.
Cook, Harry Hall	II.	*Jamaica Plain*	27 Lamartine St., J.P.
Couper, William	I.	*Norfolk, Va.*	424 Mass. Ave.
Cranston, Raymond Earl	II.	*Providence, R.I.*	425 Quincy St., D.
Cushman, Robert Ellis	II.	*Kingston*	159 Warren Ave.
Daly, John Charles, Jr.	I.	*Roxbury*	47 Townsend St., R.
Davenport, George Lyman, Jr.	I.	*Cohasset*	Cohasset.
Davis, David Cady	VI.	*Ludlow*	Quincy.
Davis, Roland Parker	I.	*Beverly*	Beverly.
Dean, Herbert Welton	VI.	*Cambridge*	Cambridge.
Deavitt, Wm. Jefferson, A.B.	III.	*Montpelier, Vt.*	Technology Chambers.
Dill, Colby, A.B.	X.	*Newton Centre*	Newton Centre.
Dissel, Theodore Augustine	II.	*Syracuse, N.Y.*	215 Newbury St.
Donovan, John Joseph	IV.	*No. Andover*	111 Falmouth St.
Dorsey, Thomas Francis	I.	*Dorchester*	93 Clarkson St., D.
Dwight, Joseph	IV.	*Boston*	235 Beacon St.
Eames, David Darby	II.	*So. Framingham*	So. Framingham.
Eliot, Edward Munroe	VI.	*St. Louis, Mo.*	Technology Chambers.
Evans, Edward Burrowes	IV.	*Malden*	Malden.
Evans, Ernest Cleveland	II.	*E. Boston*	277 Princeton St., E.B.
Faber, Thomas William	II.	*E. Boston*	179 Princeton St., E.B.
Farley, William Frederick	I.	*Waltham*	166 W. Canton St.
Farrington, Robert Douglas	II.	*W. Roxbury*	Bellevue St., W.R.
Farwell, Carroll Andrew	I.	*Ponkapog*	Melrose Highlands.
Fisher, Andrew, Jr.	X.	*Hyde Park*	Hyde Park.
Fisher, Charles Willis, Jr.	XIII.A.	*Washington, D.C.*	Brookline.
Fouhy, James Francis	I.	*Charlestown*	21 Wall St., C.
Frank, Edwin Diederich A.	II.	*Milwaukee, Wis.*	Technology Chambers.
Fuller, Floid Merrill	II.	*Scranton, Pa.*	19 Linden St., A.
Furer, William Charles	IV.	*Sheboygan, Wis.*	39 St. Botolph St.
Gammons, Herman Trafton	II.	*Cliftondale*	Cliftondale.
Gaylord, William Waterman	II.	*Torringford, Conn.*	Brookline.
Gerhard, Norman Paul	I.	*Brooklyn, N.Y.*	41 St. Botolph St.
Ginsburg, Henry Abraham	VI.	*Cambridge*	Cambridge.
Gladding, James Nickerson	II.	*Fall River*	U.S. Navy Yard, C

Fourth Year (*continued*).

NAME.	COURSE.	HOME.	RESIDENCE.
Green, William	VI.	*Gloversville, N.Y.*	138 Eustis St., R.
Griffin, Perley Kimball	II.	*Neponset*	180 Walnut St., N.
Groesbeck, Edward Center	V.	*Albany, N.Y.*	Technology Chambers.
Guernsey, George Rockwell	I.	*Winchester*	Winchester.
Haley, John Francis	I.	*Lowell*	102 Appleton St.
Hall, Wallace Ralph	I.	*Newton Highlands*	Newton Highlands.
Hamilton, Charles Eaton	VI.	*Beachmont*	Waverley House, C.
Hamner, Edward C., Jr.	XIII.A.	*Lynchburg, Va.*	Garrison Hall.
Hardy, William Abbott	II.	*Andover*	7 Follen St.
Harrington, Elmer Ellsworth	III.	*Malden*	Malden.
Harvey, Herbert Winthrop	XI.	*Haverhill*	10 Durham St.
Hawkes, Charles Whitney	II.	*Dorchester*	15 Euclid St., D.
Hayes, James, Jr.	I.	*Brockton*	Brockton.
Hayward, Marden Warner	III.	*Quincy*	Quincy.
Heckman, Alfred Raymond	V.	*Bradford*	16 Gates St., S.B.
Henderson, George Mitchell	III.	*No. Duxbury*	53 Gloucester St.
Henrici, Hermann Charles	II.	*Kansas City, Mo.*	Technology Chambers.
Heuter, Royal Robbins	II.	*Waltham*	Waltham.
Heywood, Angelo Tilton	III.	*Boston*	88 Gainsborough St.
Hinckley, Thomas Lesley	XI.	*St. Paul, Minn.*	Technology Chambers.
Hirt, Leon Edwin	III.	*New York, N.Y.*	Central St., W.R.
Holmquist, Chas. Albert, B.S.	I.	*Rochester, N.Y.*	Technology Chambers.
Honeyman, Bruce Ritchie	IV.	*Portland, Oreg.*	18 Batavia St.
Hosmer, Helen Ross	V.	*Billerica*	27 St. Botolph St.
Howard, Charles Alton	II.	*Portland, Me.*	41 Concord Sq.
Hunt, George Fessenden	IV.	*Portland, Me.*	144 W. Newton St.
Hursh, Robert	III.	*Cambridge*	Cambridge.
Hyde, Edward Ruddock	I.	*Somerville*	Somerville.
Ingalsbe, Frank R., B.S.	III.	*Oakfield, N.Y.*	126 W. Newton St.
Jackson, Ralph Templeton C.	IV.	*Brighton*	57 Oak Square Ave., B.
Juengling, Karl Frank	II.	*Cleveland, Ohio*	Cambridge.
Kasson, Charles LeBaron	VI.	*Dorchester*	10 Thetford Ave.
Keleher, Andrew Hamilton	VI.	*Burlington, Vt.*	2 Claremont Pk.
Kelley, Ralph Dudley	I.	*So. Yarmouth*	625 Tremont St.
Kendall, Burton Warren	VIII.	*Gardner*	45 W. Newton St.
Kennedy, Patrick James, Jr.	II.	*Holyoke*	7 Follen St.
Kenway, Herbert Winthrop	II.	*Newton*	Newton.
Kidder, James William	VI.	*Somerville*	Somerville.
Kingsbury, Harold Avery	X.	*Westfield*	Technology Chambers.
Knapp, William Jared	II.	*Chicago, Ill.*	215 Newbury St.
Lage, Jorge	II.	*Rio de Janeiro, Brazil*	263 Newbury St.
Land, Emory Scott	XIII.A.	*Gunnison, Colo.*	Garrison Hall.
Libbey, Fay Wilmott	III.	*Bangor, Me.*	12 Westland Ave.
Light, Hunter Ulrich	II.	*Lebanon, Pa.*	610 Columbus Ave.

Fourth Year (*continued*).

NAME.	COURSE.	HOME.	RESIDENCE.
Lincoln, William Hamilton	I.	*W. Newton*	W. Newton.
Logan, Frank, A.B.	IV.	*Pierceton, Ind.*	7 Follen St.
Lord, Harold	IV.	*Malden*	Malden.
Loring, Charles Greely, A.B.	IV.	*Boston*	8 Otis Place.
Lourie, William Isaac	II.	*Boston*	30 Allen St.
Luce, Robert Francis	I.	*Melrose*	Melrose.
Lutze, Fred Clemens	IV.	*Sheboygan, Wis.*	213 W. Newton St.
Lynde, Clifford	I.	*Waltham*	Waltham.
Lyons, Robert Joseph	XIII.	*Manchester, N.H.*	23 Wigglesworth St.
McCain, Elmer Dwight, A.B.	I.	*Allegheny, Pa.*	Cambridge.
McClintock, James R.	XI.	*Rochester, N.Y.*	Melrose.
McKay, Richard Vincent, Jr.	III.	*E. Milton*	E. Milton.
McKernan, Joseph Newall	I.	*Westerly, R.I.*	82 Gainsborough St.
Manning, Eleanor	IV.	*Lynn*	Lynn.
Manson, Edward Scholfield	VI.	*Wausau, Wis.*	169 St. Botolph St.
Mayberry, Edward L., B.L.	IV.	*Long Beach, Cal.*	Brookline.
Mears, Henry Savier	III.	*Portland, Oreg.*	7 Follen St.
Merriam, Charles Allen	II.	*Portland, Oreg.*	134 St. Botolph St.
Merriam, Harry Caleb	V.	*Fitchburg*	183 Warren Ave.
Merrill, Alden	V.	*Dorchester*	16 Tremlett St., D.
Merrow, Harold Kay	X.	*Hyde Park*	Hyde Park.
Monaghan, John Edward L.	I.	*So. Boston*	319 Fourth St., S.B.
Morse, Harold	VI.	*Newton Lower Falls*	Newton Lower Falls.
Mowry, Charles William	II.	*Fall River*	17 St. James Ave.
Munroe, Harold Knapp	VI.	*Woburn*	Woburn.
Munroe, Walter Nathan	VI.	*Dorchester*	56 Bowdoin Ave., D.
Nabstedt, Harry Martin	I.	*Roxbury*	138 Eustis St., R.
Neale, Arthur, A.R.C. Sc.I.	V.	*Dublin, Ireland*	Melrose Highlands.
Neilson, William	III.	*Boston*	8 Cumberland St.
Nelson, Henry Hawkins, Jr.	II.	*Jamaica Plain*	16 Myrtle St., J.P.
Newton, Sherley Purl	V.	*Cyrus*	30 Claremont Park.
Noble, George Curtis	IV.	*Eau Claire, Wis.*	25 St. Botolph St.
Norton, John Foote	V.	*Chicago, Ill.*	Auburndale.
Nutter, Charles Warren	II.	*Chelsea*	Chelsea.
Orcutt, Harvey Baxter	I.	*Florence*	240 W. Newton St.
Parker, Louie Adelbert	IV.	*Los Angeles, Cal.*	Cambridge.
Patch, Ralph Reginald	XI.	*Stoneham*	138 Eustis St., R.
Patterson, Henry R., A.B.	II.	*Roxbury*	8 Montrose St., R.
Phelps, Fred Sydney	II.	*Andover*	Andover.
Philbrick, Herbert Shaw, A.B.	II.	*Waterville, Me.*	52 Pinckney St.
Plummer, Harold Cleveland	III.	*Dorchester*	27 Glenarm St., D.
Polhemus, James Higbie	III.	*Newton Centre*	Newton Centre.
Poole, Burnell	VI.	*Boston*	110 Gainsborough St.
Powell, Clarence Brewster	VI.	*Kansas City, Mo.*	Brookline.

Fourth Year (*continued*).

NAME.	COURSE.	HOME.	RESIDENCE.
Pulman, Oscar S., Jr., B.A.	X.	*Albany, N.Y.*	84 Charles St.
Quinlan, George Austin, A.B.	I.	*Houston, Texas*	311 Beacon St.
Ranney, Willis	I.	*St. Paul, Minn.*	Technology Chambers.
Raynolds, Russell Peter	III.	*Denver, Colo.*	261 Newbury St.
Read, Edward Mason, Jr.	I.	*St. Louis, Mo.*	Technology Chambers.
Reed, James, Jr.	XIII.A.	*Ashtabula, Ohio*	311 Beacon St.
Richardson, Charles Dana	VI.	*Washington, D.C.*	11 Wabon St., R.
Richardson, Holden C.	XIII.A.	*Shamokin, Pa.*	311 Beacon St.
Rippey, Attwood Eugene	III.	*San Diego, Cal.*	Brookline.
Rose, Robert Ware	XIII.	*Clifton*	Clifton.
Rowe, Edward Bennett	VIII.	*Gloucester*	9 St. James Ave.
Ruggles, Mary Julia	V.	*Cambridge*	Cambridge.
Sargent, Ralph Nelson	X.	*Lynn*	Lynn.
Schmidt, Paul Sylvester, B.S.	II.	*E. Cleveland, Ohio*	Cambridge.
Seaver, Samuel	XIII.	*Waban*	Cambridge.
Shaw, Howard Payne	I.	*Bucksfield, Me.*	42 Woodbine St., R.
Shedd, Ray Elmer	I.	*Somerville*	Somerville.
Sheldon, William Adams	III.	*Ashby*	164 W. Canton St.
Sherman, Andrew B., Jr.	VI.	*Fitchburg*	Technology Chambers.
Sherman, Arthur Louis	I.	*Mansfield*	Mansfield.
Shipman, LeRoy Holton, B.S.	X.	*Winooski, Vt.*	9 Maryland St., D.
Simpson, Guy Carleton	I.	*San Antonio, Texas*	19 Linden St., A.
Smith, Ernest Maxwell	II.	*Syracuse, N.Y.*	215 Newbury St.
Spaulding, Henry Seville	XI.	*Ipswich*	22 Union Park.
Stanley, Philip Bartholomew	II.	*New Britain, Conn.*	237 Beacon St.
Staples, Percy Alexander	I.	*Boston*	215 Newbury St.
Steel, Edward Thomas	VI.	*Brooklyn, N.Y.*	21 Chestnut St.
Steinharter, Edgar Clifford	VII.	*Cincinnati, Ohio*	Technology Chambers.
Stephens, Albert Leslie	III.	*Cambridge*	Cambridge.
Taylor, Allyn Chandler	II.	*Lawrence*	135 Pembroke St.
Taylor, DeWitt McClure	II.	*Homestead, Pa.*	474 Mass. Ave.
Terrell, Herbert Arthur	II.	*Newtonville*	Newtonville.
Thomson, Henry Bowers, B.S.	IV.	*Austin, Texas*	Technology Chambers.
Thorp, Lambert	V.	*Cincinnati, Ohio*	Technology Chambers.
Tillson, Percy Ethan	VI.	*Concord Junction*	240 W. Newton St.
Tomlinson, Everett F.	XIII.	*Dorchester*	63 McLellan St., D.
Tompkins, Maurice Crawford	I.	*Boston*	264 Newbury St.
Trask, Walter Haywood, Jr.	II.	*Denver, Colo.*	237 Beacon St.
Tripp, Louis Hillman	II.	*Westport*	42 Rutland Sq.
Trowbridge, Arthur T.	II.	*Arlington*	Arlington.
Tucker, Clarence Edward	V.	*Hyde Park*	Hyde Park.
Tuckerman, Louis	II.	*Greeley, Colo.*	17 Yarmouth St.
Turner, William Camillo	II.	*Newton Highlands*	Newton Highlands.
Udale, Stanley Martin, B.Sc.	II.	*London, England*	Technology Chambers.

Fourth Year (*continued*).

NAME.	COURSE.	HOME.	RESIDENCE.
Van Hook, Franklin James	I.	*Roxbury*	40 Sherman St., R.
Varian, Jean Philip	III.	*Denver, Colo.*	84 Huntington Ave.
Walsh, John Henry	XIII.A.	*Washington, D.C.*	Garrison Hall.
Walsh, William James	X.	*Roxbury*	5 Woodville St., R.
Walter, Ernest Albert	IV.	*Walters Park, Pa.*	92 Gainsborough St.
Ware, Raymond	XIII.	*Dorchester*	11 Sayward St., D.
Ware, Samuel Langmaid	XIII.	*Somerville*	Somerville.
Warren, Clarke Edward	II.	*La Grange, Ill.*	192 Dartmouth St.
Watt, Arthur Percy	III.	*Winchester*	Winchester.
Webber, Thomas Gray	II.	*Salem*	Salem.
Wells, Arthur Edward	III.	*So. Framingham*	So. Framingham.
Westervelt, Geo. Conrad	XIII.A.	*Corpus Christi, Tex.*	Garrison Hall.
Wetterer, Chas. Frederick W.	VI.	*Gloucester*	2 Claremont Park.
White, George Frederic	V.	*Franklin Park*	Franklin Park.
White, Nathaniel Aldrich	XIII.	*Concord, N.H.*	Technology Chambers.
Whiting, Herbert Stockwell	VI.	*Roxbury*	274 Seaver St., R.
Wick, James Lippincott, Jr.	II.	*Youngstown, Ohio*	102 W. Concord St.
Wilder, Sylvanus Wells	II.	*Cambridge*	Cambridge.
Wilkins, Harold Street	II.	*Wallingford, Conn.*	213 Newbury St.
Willey, Nahum Clark	XIII.	*Aurora, Ill.*	138 Eustis St., R.
Williams, Herbert Lawrence	III.	*Newtonville*	53 Gloucester St.
Willis, Charles Francis	III.	*So. Boston*	5 Gates St., S.B.
Wilson, Edward Lowell	II.	*Watertown*	Watertown.
Winne, George Morris	II.	*Chicago, Ill.*	264 Newbury St.
Wolfe, Sylvester Cuthbert	I.	*W. Medford*	W. Medford.
Wood, Dana Melvin	I.	*Belmont*	Belmont.
Woodruff, Leland S., B.A.	VI.	*Syracuse, N.Y.*	31 Concord Sq.
Wrinkle, John Timothy	IV.	*Holyoke*	27 Cumberland St.
Yates, Isaac Irving	XIII.A.	*Schenectady, N.Y.*	311 Beacon St.
Young, George Chester	II.	*Dorchester*	10 Rawson St., D.
Young, Harold Eugene	VI.	*Boston*	41 Rutland Sq.

THIRD YEAR.

NAME.	COURSE.	HOME.	RESIDENCE.
Albro, Robert Clifford . . .	I.	*Springfield*	47 St. Botolph St.
Allen, Charles Everett . . .	I.	*Spencer*	134 W. Newton St.
Allen, Lawrence	I.	*E. Freetown*	234 Newbury St.
Alvord, Henry Bissell . . .	I.	*So. Weymouth* . . .	So. Weymouth.
Amadon, Frederick Webber .	I.	*So. Framingham* .	So. Framingham.
Arnold, Anthony Brown, B.A.	II.	*Plainfield, Conn.* .	230 Newbury St
Bachmann, Frederick . .	XIII.	*Baltimore, Md.* . .	27 Yarmouth St..
Baker, Harold Peters, A.B.	VI.	*White Haven, Pa.*	Technology Chambers.
Baker, Joseph Mullin . . .	VI.	*Watertown, N.Y.* .	69 Gainsborough St.
Barker, James Madison . .	I.	*Pittsfield*	Technology Chambers.
Beam, Charles Willett, B.A.	I.	*Passaic, N.J.* . . .	535 Mass. Ave.
Boles, Edwin Dexter . . .	II.	*Marblehead*	Marblehead.
Bonta, Edwin Witthaus . .	IV.	*Syracuse, N.Y.* . .	43 Hemenway St.
Bowen, Clarence Allen . .	II.	*Lowell*	35 St. Botolph St.
Bradley, John Clement .	VIII.	*Hyde Park*	Hyde Park.
Bradshaw, William H., B.S.	X.	*DeKalb, Ill.* . . .	240 W. Newton St.
Bragdon, Charles R., A.B. .	X.	*Evanston, Ill.* . .	Technology Chambers.
Brock, Lester Wellington .	VI.	*Allston*	496 Cambridge St., A.
Brooks, Alfred Austin . . .	II.	*Medford*	Medford.
Brown, Harold Gibson, A.B.	VIII.	*Pittsfield*	Technology Chambers.
Carter, Benjamin Franklin .	VI.	*Lynn*	Lynn.
Cenedella, Attilio Horace . .	I.	*Milford*	Somerville.
Chadwick, John Patten . .	III.	*Saco, Me.*	25 Cumberland St.
Chaffee, Emory Leon . . .	VI.	*Somerville*	Somerville.
Chase, Howard Root	I.	*Malden*	Malden.
Christiansen, Eugene Olaf . .	I.	*Boston*	15 Dilworth St.
Clapp, Prescott Jones . . .	II.	*Dorchester*	169 Boston St., D.
Coburn, Frederick Gallup	XIII.A.	*Duluth, Minn.* . .	142 Huntington Ave.
Coffin, Charles Wolston . . .	I.	*Boston*	215 Newbury St.
Colvin, Percy Johnson . . .	IV.	*Worcester*	Technology Chambers.
Coupal, Joseph Samuel . .	III.	*So. Boston.*	821 E. Fourth St., S.B.
Cowen, Everett Russell . . .	I.	*Fairhaven*	7 Concord Sq.
Crane, George Arthur	I.	*Taunton*	Taunton.
Crosby, Ralph Haskell . .	VI.	*Wakefield*	Wakefield.
Cullimore, Allan Reginald . .	I.	*Roslindale*	938 South St., Ros.
Cumings, Paul Leander . .	IV.	*Fitchburg*	Technology Chambers.
Darling, Maude Frances . .	IV.	*Fall River*	27 St. Botolph St.
Day, Herbert Winch . . .	II.	*Rockford, Ill.* . . .	212 W. Canton St.
Dean, Carroll Sisson . . .	VI.	*Waverly, Pa.* . .	236 Newbury St.
Dempwolf, Frederick G. . .	IV.	*York, Pa.* . . .	Technology Chambers.
Dodge, Parker Van Patten .	II.	*Washington, D.C.*	Technology Chambers.
Druley, Waldo Putnam	XIII.A.	*Belpre, Ohio* . . .	159 Foster St., B.

Third Year (*continued*).

NAME.	COURSE.	HOME.	RESIDENCE.
Dubois, Gustavo Adolfo	I.	*Matanzas, Cuba*	279 Dartmouth St.
Duncan, Harold Stephen	III.	*Melrose Highlands*	Melrose Highlands.
Eaton, Charles Albert	II.	*Waltham*	Waltham.
Egan, Seymour Joseph	XIII.	*Syracuse, N.Y.*	15 Concord Sq.
Evans, John	VI.	*Denver, Colo.*	261 Newbury St.
Fales, Otis Gerry	II.	*Roxbury*	7 Haley St., R.
Fallon, John Tiernan, Jr.	IV.	*York, Pa.*	12 W. Cedar St.
Farrington, Harold Phillips	I.	*W. Roxbury*	Bellevue St., W.R.
Fleming, Cornelius S., Jr., B.S.	X.	*Washington, Pa.*	78 Huntington Ave.
Frank, John Mayer	VI.	*Natchez, Miss.*	236 Newbury St.
Fuller, Archibald Prescott	I.	*E. Milton*	E. Milton.
Gale, Roger David	V.	*Gloucester*	Gloucester.
Garratt, James Ernest	I.	*No. Cambridge*	No. Cambridge.
Gates, Warren Austin	IV.	*Coxsackie, N.Y.*	27 Yarmouth St.
Greenwood, Phil Prescott	VI.	*Malden*	Malden.
Griffin, George Appleton	I.	*Washington, D.C.*	19 St. James Ave.
Griffin, Wheaton Ira	I.	*Utica, N.Y.*	215 Newbury St.
Gupta, Birendra C.	VI.	*Calcutta, India*	203 W. Newton St.
Hall, Harry Rutledge	I.	*So. Boston*	770 Broadway, S.B.
Hallett, Lucius Felt	VI.	*Denver, Colo.*	261 Newbury St.
Hamill, Edward W., A.B.	IV.	*Belleville, Ill.*	Cambridge.
Hartwell, Arthur Edward	II.	*Houston, Texas*	95 Robinwood Ave., J.P.
Hastings, Hudson Bridge	I.	*Walpole, N.H.*	12 Newbury St.
Hastings, Warren	III.	*Lancaster, N.H.*	Technology Chambers.
Hennen, Robert David	I.	*Morgantown, W. Va.*	112 Huntington Ave.
Holmes, William King, A.B.	V.	*So. Paris, Me.*	Cambridgeport.
Howe, Clarence Decatur	I.	*Waltham*	Waltham.
Hudson, Ralph Gorton	VI.	*Lawrence*	Garrison Hall.
Jaccard, Frederick Constant	III.	*Kansas City, Mo.*	133 St. Botolph St.
James, Edwin Warley, A.B.	I.	*Ossining, N.Y.*	134 Chandler St.
Jealous, Arthur Rowney	II.	*No. Vassalboro, Me.*	Winchester.
Johnson, Bert Day, A.B.	X.	*Pittston, Pa.*	Technology Chambers.
Kennedy, Philip F., A.B.	VI.	*Roslindale*	12 Brown Ave., Ros.
Keyes, Robert Eugene	II.	*Boston*	91 Newbury St.
Kimball, John	I.	*Easton*	Easton.
Kintner, Edwin Graham	XIII.A.	*Rock Haven, Ky.*	45 St. Botolph St.
Knight, Ralph Frank	VI.	*Hudson*	159 W. Canton St.
Kolatschevsky, André T.	VI.	*Naples, Italy*	279 Dartmouth St.
Kudlich, Rudolf H., E.E.	II.	*Drifton, Pa.*	477 Mass. Ave.
Labbé, Antoine Gilbert, A.B.	II.	*Boston*	8 Westland Ave.
Lamont, Clarence Ronald	III.	*Malden*	Malden.
Larned, John Insley Blair, A.B.	I.	*Lake Forest, Ill.*	32 St. James Ave.
Leavell, John H.	III.	*Temple, Texas*	85 Newbury St.
Lee, Edward Guild	I.	*Greenwood*	Greenwood.

Third Year (*continued*).

NAME.	COURSE.	HOME.	RESIDENCE.
Lewis, Ernest Farnum, A.B.	IV.	*Providence, R.I.*	Beacon Chambers.
Libby, Harold Clifton	I.	*Littleton*	Littleton.
Luce, Byron Peakes	II.	*Vineyard Haven*	17 Follen St.
Lucey, William Sylvester	II.	*Natick*	Natick.
McChesney, Howard Hazen	VI.	*Syracuse, N.Y.*	263 Newbury St.
McGregor, Frank S.	VIII.	*Hyde Park*	Hyde Park.
McMillin, John Milton	III.	*Newtonville*	Newtonville.
Macomber, Alexander	VI.	*Newton*	362 Longwood Ave.
McRae, Henry Clinton, B.S.	XI.	*Gas, Kans.*	311 Beacon St.
Mahr, Hermann William	V.	*Roxbury*	179 Heath St., R.
Martin, William Henry	I.	*Taunton*	383 Columbus Ave.
Marx, Samuel Abraham	IV.	*Natchez, Miss.*	236 Newbury St.
Mathesius, Anthony Paul	II.	*New York, N.Y.*	12 St. James Ave.
Middleton, Nathan A.	II.	*Baltimore, Md.*	261 Newbury St.
Miller, Stuart Read	II.	*Cincinnati, Ohio*	263 Newbury St.
Milne, William Durant	I.	*Lexington*	45 St. Botolph St.
Moller, Kenneth, A.B.	II.	*Jamaica Plain*	5 Greenough Pl., J.P.
Monahan, William Patrick	III.	*Boston*	155 Ruggles St.
Moody, Harry Lawrence	X.	*Newburyport*	53 Gloucester St.
Moore, Fred	VI.	*Cleveland, Ohio*	9 Milford St.
Morrill, Fred William	I.	*Haverhill*	20 Yarmouth St.
Moses, Frederick Taft	V.	*Ayer*	Ayer.
Nichols, Bryant	II.	*Everett*	Everett.
Noyes, Emory Chase	I.	*Malden*	Malden.
Packard, Emerson Heard	X.	*Brockton*	154 Huntington Ave.
Pagon, William Watters, A.B.	I.	*Baltimore, Md.*	Beacon Chambers.
Pastoriza, Hugh Girard	VI.	*Houston, Texas*	101 St. Botolph St.
Peabody, Octavus Libbey	X.	*Haverhill*	Technology Chambers.
Pease, Maurice Henry	VI.	*New Britain, Conn.*	25 St. Botolph St.
Polsey, Chester Alanson	I.	*Somerville*	Somerville.
Pope, Allen	II.	*Springfield*	179 Mass. Ave.
Potter, Eugene Voorhees	I.	*Somerville*	Somerville.
Randall, John Ralph	II.	*Minneapolis, Minn.*	Beacon Chambers.
Rayner, William Pearce, A.B.	II.	*Springfield, Ohio*	47 St. Botolph St.
Rech, Everett	II.	*Chicago, Ill.*	474 Mass. Ave.
Reed, Earl Howell, Jr.	IV.	*Chicago, Ill.*	215 Newbury St.
Reed, Harold Douglas	VI.	*No. Cambridge*	No. Cambridge.
Richardson, Edwin Cole	II.	*Redlands, Cal.*	317 Marlborough St.
Ripley, Franklin, Jr.	II.	*Troy, N.H.*	48 Hereford St.
Robbins, Donald Goodrich	II.	*Springfield*	68 W. Rutland Sq.
Roby, Thomas Walton, Jr., B.S.	I.	*Norfolk, Va.*	424 Mass. Ave.
Rockwell, Selden E., Ph.B.	II.	*Denver, Colo.*	120 Huntington Ave.
Runey, Charles Francis	V.	*Belmont*	Belmont.
Russ, Donald Edwin	V.	*Oil City, Pa.*	15 Concord Sq.

Third Year (*continued*).

NAME.	COURSE.	HOME.	RESIDENCE.
Russell, Leonard Pomeroy	VI.	*Pittsfield*	237 Beacon St.
Ryden, Roy Warren	XIII.A.	*Des Moines, Iowa*	45 St. Botolph St.
Sage, Merton Wilfred	VIII.	*Medford*	Medford.
Sampson, Roswell Eustis	III.	*Medford*	Medford.
Sharp, Benjamin Karl	XIII.	*Brookline*	Brookline.
Sissa, Ugo	VI.	*Revere, Italy*	12 North Sq.
Small, Gilbert	II.	*Waltham*	Waltham.
Smith, Lemuel David	XIII.	*Spokane, Wash.*	777 Tremont St.
Smith, Tracy, B.A.	VI.	*Waterbury, Conn.*	Technology Chambers.
Soule, Winsor, A.B.	IV.	*Brookline*	Brookline.
Spiehler, Clarence Herbert	II.	*Rochester, N.Y.*	4 Claremont Park.
Squire, Edmund Hincks	II.	*Malden*	Malden.
Stevenson, Albert Fletcher	XI.	*E. Boston*	41 Princeton St., E.B.
Stevenson, Robert Pevey	II.	*Lowell*	Lowell.
Story, Carroll Fitch, B.S.	XI.	*Milwaukee, Wis.*	69 Pinckney St.
Story, Edward Carleton	VIII.	*Lynn*	Lynn.
Swett, Phelps Nash	I.	*No. Cambridge*	No. Cambridge.
Symes, George Gifford, Ph B.	II.	*New York, N.Y.*	99 Newbury St.
Tashjian, Armen H., A.B.	I.	*Smyrna, Turkey*	54 The Fenway
Thacher, Sheldon Perry	V.	*Hartford, Conn.*	179 Mass. Ave.
Thornton, Edmund Abiel	I.	*Stoneham*	Stoneham.
Tompson, William Randall	I.	*Wakefield*	Wakefield.
Treuthardt, Ernest Leonard	P. V.	*Boston.*	1413 Washington St.
Turkington, Everett Esten	VI.	*Malden*	Malden.
Tylee, Arthur Kellam	VI.	*Brookline*	Brookline.
Van der Stucken, Frank R.	I.	*Cincinnati, Ohio*	12 St. James Ave.
Van Keuren, Alexander H.	XIII.A.	*Howell, Mich.*	142 Huntington Ave.
Walker, Laurence Tidd	XI.	*Stoneham*	Stoneham.
Walker, Philip Bangs	I.	*Needham*	Needham.
Wells, Sidney Deeds	X.	*Roslindale*	23 Selwyn St., Ros.
Wetmore, Laurence	II.	*Essex*	Essex.
Whitney, Erle Francis	VI.	*Natchez, Miss.*	6 Louisburg Sq.
Whitney, Parker Richards	I.	*Bradford, Pa.*	19 Upton St.
Whittemore, Leslie Clifford	XI.	*Milford*	Milford.
Wiggin, Albert Edward	III.	*Wakefield*	Wakefield.
Wilson, William Samuel	V.	*Roslindale*	155 Ashland St., Ros.
Wint, Rufus William G., A.B.,	V.	*Catasauqua, Pa.*	47 St. Botolph St.
Wonson, Harold Sayward	XIII.	*Gloucester*	120 Dartmouth St.
Woodbridge, Richard G., Jr.	V.	*Somerville*	Somerville.

SECOND YEAR.

NAME.	COURSE.	HOME.	RESIDENCE.
Adams, William Alexander	I.	*Roxbury*	47 Kenwood Rd., R.
Allen, Horace Ethan	II.	*Boston*	215 Newbury St.
Allen, Lawrence Howe	I.	*Quincy*	Quincy.
Ames, Monroe	II.	*W. Medford*	W. Medford.
Bangs, Carl Henry	II.	*So. Braintree*	So. Braintree.
Barcus, Walter J. Emmons	III.	*Albany, N.Y.*	264 Newbury St.
Barnes, John Stetson	II.	*Syracuse, N.Y.*	264 Newbury St.
Barnett, Louis	VI.	*Boston*	480 Tremont St.
Barrett, Paul Bosworth	X.	*E. Taunton*	33 St. Botolph St.
Barton, William Edward	I.	*Somerville*	Somerville.
Batchelder, Ralph Johnson	IV.	*No. Cambridge*	No. Cambridge.
Batsford, Howard Edwin	X.	*Utica, N.Y.*	75 Cedar St., R.
Beck, Ralph Ernest	VI.	*Newton Lower Falls*	Newton Lower Falls.
Beede, Everett Jefts, A.B.	II.	*Hudson*	159 W. Canton St.
Belcher, Frank Kennedy	II.	*Medford*	Medford.
Belcher, George Myron	I.	*Malden*	Malden.
Bentley, Harry Howe	IV.	*Oskaloosa, Iowa*	424 Mass. Ave.
Besselievre, Arthur Cleborne	XIII.	*New London, Conn.*	701 Tremont St.
Bird, Viggo Edward	VI.	*Copenhagen, Denmark*	43 St. Botolph St.
Blackburn, Henry Washington	II.	*Lawrence*	Lawrence.
Bond, Francis Marvin, A.B.	II.	*Baltimore, Md.*	505 Columbus Ave.
Booth, Wilfred Edwin	VI.	*Waterville, Conn.*	153 Warren Ave., R.
Bounetheau, Harold Du Pré	XIII.	*Jacksonville, Fla.*	Hotel Kempton.
Boylston, Clifford Hall	I.	*Milton*	Milton.
Boynton, William Wilmot	XI.	*Cambridge*	Cambridge.
Bradford, Alexander Henry	III.	*Raynham*	74 W. Rutland Sq.
Bremer, Arthur Edmund	I.	*Hoboken, N.J.*	99 Appleton St.
Brooks, John Cummings	II.	*Westfield*	264 Newbury St.
Brown, Claude Osgood	I.	*Haverhill*	Haverhill.
Brown, Eugene Le Vert, Jr.	II.	*St. Louis, Mo.*	48 Hereford St.
Bullard, Benjamin	VI.	*Garden City, Kans.*	449 Mass. Ave.
Burch, James Merrill, Jr.	II.	*Dubuque, Iowa*	Technology Chambers.
Burgess, Harry Lancaster	VI.	*New York, N.Y.*	109 Walnut Ave., R.
Calder, Horace Walter	VI.	*Norwood*	Norwood.
Callaway, Hendley Ross	II.	*Westfield, N.J.*	41 St. Botolph St.
Carter, Harold Leston	II.	*Beachmont*	Beachmont.
Cary, Burton Wolcott	II.	*Lowell*	21 St. Botolph St.
Cassino, Leslie Phelps	II.	*Peabody*	Peabody.
Chandler, Harry Stuart	X.	*Somerville*	Somerville.
Clapp, Chalmers Stevens	IV.	*Dorchester*	169 Boston St., D.
Clark, Lawrence Addison	II.	*Pontiac, Ill.*	4 Claremont Park.
Clark, Milton Stanley	III.	*Jamestown, N.Y.*	264 Newbury St.

Second Year (*continued*).

NAME.	COURSE.	HOME.	RESIDENCE.
Coffin, Langdon	II.	*Newton*	Newton.
Cohen, Abraham Saul	II.	*Boston*	250 Chambers St.
Cole, Frederick Arthur	I.	*Newton Highlands*	Newton Highlands.
Collins, Richard Carter	II.	*Malden*	Malden.
Colson, Chester Simmons	I.	*Beverly*	Beverly.
Cook, Alton Mace	VI.	*Hyannis*	151 W. Newton St.
Crane, Russell Gilbert	IV.	*Taunton*	Taunton.
Curran, John Frank	VI.	*Nahant*	Nahant.
Cushing, Richard Watson	VI.	*Cohasset*	Cohasset.
Davis, Myron Mathews	VI.	*Augusta, Me.*	424 Mass. Ave.
Davis, Waldo Frank	X.	*Newburyport*	Newburyport.
Dean, Arnold Truman	I.	*Taunton*	Taunton.
Denny, Maurice Edward	XIII.	*Cardross, Scotland*	261 Newbury St.
Dexter, Gregory Mumford	I.	*Providence, R.I.*	221 Newbury St.
Diamond, Henry Hyman, A.B.	I.	*Boston*	63 Allen St.
Douglass, Arthur Sylvester	I.	*Auburndale*	Auburndale.
Drake, Raymond Edward	V.	*Brockton*	Brockton.
Dun, Henry Walke, Jr.	I.	*Albany, N.Y.*	6 Louisburg Sq.
Eames, Herbert Seton	II.	*So. Framingham*	So. Framingham.
Edmonds, Charles Ashton	II.	*Lawrence*	224 W. Springfield St.
Ellsworth, John Thayer	III.	*Peterboro, N.H.*	W. Newton.
Elton, Herbert Charles	II.	*Dorchester*	105 King St., D.
Esten, Paul Albert	V.	*Dorchester*	101 Evans St., D.
Everett, Wilbur	VIII.	*Georgetown*	Georgetown.
Faxon, Harold Cushing	II.	*Randolph*	Randolph.
Fernald, Paul Edmunds	III.	*Wilmette, Ill.*	69 St. Botolph St.
Ferris, Raymond West	I.	*Waban*	74 Huntington Ave.
Flaherty, Herbert William	I.	*Cheshire*	116 W. Newton St.
Folsom, William Cumner	VI.	*Melrose Highlands*	Melrose Highlands.
Ford, Winthrop Drew	II.	*Kingston*	159 Warren Ave.
Franks, Fred Lester	I.	*Medfield*	92 Gainsborough St.
French, Hobert Ward	VI.	*Chelsea*	Chelsea.
Gallagher, James Thomas	II.	*Leominster*	25 Rutland Sq.
Gardner, Arthur Livermore	X.	*Wakefield*	Wakefield.
Genoud, Ernest George	V.	*Roslindale*	4181 Washington St., Ros.
Gerrish, Herbert Thurston	I.	*Melrose Highlands*	Melrose Highlands.
Gianella, John, Jr.	X.	*Brooklyn, N.Y.*	213 W. Canton St.
Gibbons, Charles A., Jr.	III.	*Taunton*	Taunton.
Gimson, Basil Lovibond	II.	*Leicester, England*	237 Beacon St.
Given, William Barns, Jr.	VI.	*Columbia, Pa.*	261 Newbury St.
Glover, George Thumel	II.	*Grand Island, Nebr.*	236 Newbury St.
Greene, John Francis, A.B.	I.	*So. Boston*	50 Thomas Park, S.B.
Grimes, William Francis	VI.	*Belmont*	Belmont.
Griswold, Harold Wiley	I.	*Hartford, Conn.*	179 Mass. Ave.

Second Year (*continued*).

NAME.	COURSE.	HOME.	RESIDENCE.
Grübnau, Victor Carl	III.	*Wyncote, Pa.*	708 Huntington Ave.
Guilford, Irving Morse	VI.	*W. Cheshire, Conn.*	6 St. Botolph St.
Gurney, Harold Peaslee	X.	*E. Boston*	196 Trenton St., E.B.
Hale, James Ellis	II.	*Manchester, N.H.*	W. Somerville.
Hale, Joseph Woodwell L.	VI.	*Newburyport*	Newburyport.
Hale, Philip Jewett	I.	*Denver, Colo.*	63 St. Botolph St.
Hall, Carl Albe	II.	*Concord, N.H.*	30 Claremont Park.
Hall, Edwin Rymes	II.	*Somerville.*	Somerville.
Hall, Melville Beardslee	VI.	*St. Louis, Mo.*	48 Hereford St.
Hammond, James Clement	III.	*Roslindale*	3 S. Fairview St., Ros.
Hammond, Newton LeRoy	I.	*Newtonville*	Newtonville.
Handy, Percy Lawson	VI.	*Dorchester*	75 Bloomfield St., D.
Harwood, Julian Herbert H.	I.	*Marion*	Rockport.
Hathaway, Joseph Wood	VI.	*Middleboro*	Somerville.
Heath, Arnold Winchester	I.	*Allston*	71 Harvard Ave., A.
Hedge, Lafayette Boyd	VI.	*Citronelle, Ala.*	84 Worcester St.
Heilman, William Roy	II.	*Evansville, Ind.*	237 Beacon St.
Heimer, Paul Harold	III.	*Mattapan*	498 Norfolk St., M.
Hersey, Ira Grover, Jr.	I.	*Hingham*	Hingham.
Hinckley, Arthur Thacher	VIII.	*Roslindale*	16 Sherwood St., Ros.
Hoole, Henry William	II.	*Lowell*	206 Mass. Ave.
Howland, Harold Howard	I.	*Westdale*	Westdale.
Hubbard, Carleton Waterbury	II.	*Greenwich, Conn.*	Technology Chambers.
Hunt, Franklin Livingston	VIII.	*Waltham*	Waltham.
Hussey, Clarence Loring	II.	*Milford*	Milford.
Hyde, Russell Taber.	IV.	*Waltham*	Waltham.
Jones, Barry Hayes	VI.	*Poughkeepsie, N.Y.*	12½ St. James Ave.
Joy, Charles Frederick, Jr.	VI.	*Chelsea*	Chelsea.
Kelley, Mark Elbridge	I.	*Peabody*	Peabody.
Kennard, Richard Yale	III.	*Winsted, Conn.*	39 Bowdoin St.
Kerr, William Caruthers	X.	*Catonsville, Md.*	8 St. Botolph St.
Kilburn, Ernest Edwin.	VI.	*Waterbury, Conn.*	45 St. Botolph St.
Kydd, John Angus	V.	*Andover*	Andover.
Leary, John Francis	II.	*Newburyport*	Newburyport.
Leslie, Bernard Shepard	II.	*Milton*	Milton.
Locke, John Harold	VIII.	*Chelsea*	Chelsea.
Loomis, Lynn Albert	II.	*Springfield*	Technology Chambers.
Luther, Howard Bourne	I.	*Attleboro*	134 St. Botolph St.
Lyford, Emerson Fletcher	V.	*Milford*	Milford.
Lyle, Frederick William	VI.	*Waltham*	Waltham.
Lyon, Stephen Chandler	I.	*Woonsocket, R.I.*	170 Huntington Ave.
McCready, Harold	VI.	*Pittsburgh, Pa.*	59 Rutland St.
McGowan, James, Jr.	V.	*No. Adams*	161 W. Newton St.
Mack, Henry Vincent	II.	*Salem*	Salem.

Second Year (*continued*).

NAME.	COURSE.	HOME.	RESIDENCE.
McTigue, George Joseph	VI.	*Holyoke*	27 Cumberland St.
Mahoney, William Edward	I.	*Hopkinton*	Hopkinton.
Malcom, Sydney Arnold	XI.	*Somerville*	Somerville.
Manning, Ralph Erie	VI.	*No. Billerica*	No. Billerica.
Mason, Willis Harold	II.	*Wakefield*	Wakefield.
Maxwell, Donald Hebard	XI.	*Newton*	Newton.
Medlicott, William Harding	II.	*Longmeadow*	217 Newbury St.
Millard, Reginald William	X.	*Hamilton, Ontario*	263 Newbury St.
Morse, William Boulton	XIII.	*Winchester*	Winchester.
Nelson, Stanley Foushee, A.B.	I.	*Winchester, Ky.*	94 St. Botolph St.
Newhall, Everett Hiltz	V.	*Lynn*	Lynn.
Nichols, Archer Corbin	I.	*Boston*	72 Huntington Ave.
Nickerson, Harry L. R., B.A.	V.	*Quincy, Ill.*	3 Berwick Park.
Noble, Henry Johnson	II.	*Pittsfield*	10 Westland Ave.
Osborne, Harold Smith	VI.	*Cambridge*	Cambridge.
Patten, Harry Chapman	VI.	*Dorchester*	205 Savin Hill Ave., D.
Penny, Alec Newton	III.	*Philadelphia, Pa.*	428 Newbury St.
Perry, Frederick Gardiner	VI.	*Boston*	18 Huntington Ave.
Pierce, George Holt	VI.	*Nashua, N.H.*	Nashua, N.H.
Pierce, William Joseph	II.	*No. Cambridge*	No. Cambridge.
Place, Alfred Griffin	VI.	*Woburn*	Woburn.
Plumer, Edward Ashby	VI.	*Newburyport*	Newburyport.
Pope, Joseph	XIII.	*Springfield*	179 Mass. Ave.
Porosky, Matthew	VI.	*Roxbury*	10 Sunderland St., R.
Powell, Paul Rulison	II.	*Baltimore, Md.*	261 Newbury St.
Pritchard, Charles Morse	X.	*Newburyport*	Newburyport.
Putnam, Charlton Dascom	I.	*Reading*	Reading.
Putnam, Harry Rice, Jr.	III.	*Pasadena, Cal.*	6 Louisburg Sq.
Radford, Charles Weston	I.	*Oshkosh, Wis.*	12 Newbury St.
Rapelye, Harry Andrew	II.	*Hartford, Conn.*	6 Louisburg Sq.
Remick, Paul	II.	*Boston*	909 Beacon St.
Rice, Roger Cushing	I.	*Dorchester*	37 Mather St., D.
Richards, Harold Moore	I.	*Brookline*	Brookline.
Richardson, Harry Frederic	VI.	*Taunton*	Taunton.
Ripley, Read Isbell	I.	*Malden*	Malden.
Robinson, Frank John	IV.	*Boston*	75 Gainsborough St.
Ruggles, Henry Jason	I.	*Cambridge*	Cambridge.
Sampson, Miles	II.	*So. Hanson*	So. Hanson.
Sando, Joseph Blair	II.	*Scranton, Pa.*	263 Newbury St.
Savage, Edward Michael	I.	*Somerville*	Somerville.
Scannell, Albert Terence	II.	*Lowell*	69 St. Botolph St.
Schakne, Jacob Herzl	VI.	*Pittsburgh, Pa.*	33 Village St.
Schirmer, Rens Edward	VIII.	*W. Roxbury*	W. Roxbury.
Schwab, Arthur John, A.B.	II.	*Binghamton, N.Y.*	171 Newbury St.

Second Year (*continued*).

NAME.	COURSE.	HOME.	RESIDENCE.
Scott, George Walter, A.B.	VI.	*Asbury Park, N.J.*	Beacon Chambers.
Serra, Julius Herschel	III.	*Melrose Highlands*	Melrose Highlands.
Seymour, Allan	III.	*Paris, France*	21 Chestnut St.
Sharman, Frank Weller	IV.	*Boston*	11 Irvington St.
Spurr, Henry Vose	I.	*Arlington*	Arlington.
Stone, Leo Solomon	I.	*Roxbury*	59 Fort Ave., R.
Sutton, Loyd Hall	XIII.	*Marlboro*	569 Mass. Ave.
Sweeny, Harry Patterson, B.A.	III.	*Drifton, Pa.*	477 Mass. Ave.
Thöde, Allan Frederick	VI.	*Medford*	Medford.
Thompson, Stansbury	I.	*Lawrence, Kans.*	263 Newbury St.
Thurlow, Leavitt Weare	X.	*Newburyport*	Newburyport.
Tobin, John Theodore	I.	*Boston*	43 E. Newton St.
Toppan, William Hervey	X.	*Newburyport*	Newburyport.
Torossian, Aram	IV.	*Norwich, Conn.*	Everett.
Towle, Franklin Thompson	II.	*Dorchester*	81 Sawyer Ave., D.
Turner, Channing	II.	*Geneva, Ill.*	6 Louisburg Sq.
Vonnegut, Kurt	IV.	*Indianapolis, Ind.*	264 Newbury St.
Washburn, George Ellery	VIII.	*Lexington*	Lexington.
Weeks, Lester Sumner	VI.	*Malden*	Malden.
Weiler, Rudolph Boynton	II.	*Brighton*	26 Brooks St., B.
Wemple, Leland Edward	V.	*Waverly, Ill.*	Garrison Hall.
Whittle, George Dilley, B.S.	I.	*Georgetown, Texas*	124 Chandler St.
Williams, Edgar Irving	IV.	*Rutherford, N.J.*	154 Charles St.
Wiswall, Paul McCord	V.	*Providence, R.I.*	1 Mt. Warren, R.
York, Waldo Cornell	I.	*New Bedford*	Brookline.

FIRST YEAR.

NAME.	HOME.	RESIDENCE.
Adams, Elliot Quincy	*Medford*	Medford.
Allen, David Carlyle	*Roxbury*	43 Holborn St., R.
Anderson, Paul George Wilfred	*Roslindale*	331 Metropolitan Ave., Ros.
Applin, Frank Dexter	*Keene, N.H.*	146 St. Botolph St.
Austrian, Seligman Bernei	*Baltimore, Md.*	Technology Chambers.
Babcock, Elizabeth Brewer	*Roxbury*	102 Crawford St., R.
Bachelder, Charles Albert	*Dorchester*	116 Evans St., D.
Bancroft, James Robert	*Newton Lower Falls*	Newton Lower Falls.
Beers, Louis Gilbert	*Taunton*	60 W. Rutland Sq.
Belcher, Daniel	*Easton*	196 Dartmouth St.
Belden, Charles Josiah	*New York, N.Y.*	221 Newbury St.
Belknap, Howard P.	*Boston*	234 Newbury St.
Bennett, Herbert Hand	*Brookline*	Brookline.
Bishop, Francis Herbert	*Wollaston*	Wollaston.

First Year (*continued*).

NAME.	HOME.	RESIDENCE.
Black, Thomas Bass	*Sioux City, Iowa*	Technology Chambers.
Blade, Edward Hubner	*San Francisco, Cal.*	137 Newbury St.
Blair, Fred Page	*St. Louis, Mo.*	227 W. Canton St.
Blake, Aldrich	*Grand Rapids, Mich.*	237 Beacon St.
Blake, Gladys May E.	*Boston*	184 W. Canton St.
Block, Paul Henry	*So. Boston*	42 Rogers St., S.B.
Blood, Kenneth Thompson	*Concord Junction*	Concord Junction.
Bowers, George Winthrop	*Lowell*	35 St. Botolph St.
Bowman, Bion Angelo	*Dorchester*	121 Washington St., D.
Bowman, John Roswell	*Billerica*	Billerica.
Bradbury, Walworth Kileski	*Cambridge*	Cambridge.
Bullens, Denison Kingsley	*Newton*	Newton.
Bundy, Stanton Schofield	*San Antonio, Texas*	19 Linden St., A.
Burgher, Stephen Lawrence	*Winthrop*	Winthrop.
Cacicedo, Luis	*Cienfuegos, Cuba*	21 St. Botolph St.
Campbell, Charles Lincoln	*Wollaston*	Wollaston.
Chapman, Edward Prichard	*Pueblo, Colo.*	Technology Chambers.
Chapman, Laurance Dana	*Wellesley Farms*	Wellesley Farms.
Chapman, Thomas Garfield	*Boston*	18 St. Germain St.
Chinchilla, Eelayo	*Valparaiso, Chile*	35 St. James Ave.
Christie, John Anderson	*No. Adams*	Somerville.
Clifford, Walter Woodbridge	*Hyde Park*	Hyde Park.
Cloudman, Herbert Cordwell	*Wilmington, Del.*	20 St. Stephen St.
Colgan, Edward Joseph, Jr.	*Mattapan*	Dyer Ave., M.
Colson, Henry Clifford, Jr.	*Abington*	Abington.
Conner, George Cartnell	*Truro, N.S.*	58 Burnett St., J.P.
Connolly, Eugene Leo	*Caryville*	Caryville.
Cook, Hardy Merrill	*Roxbury*	189 Blue Hill Ave., R.
Cookinham, Edward Furbish	*Utica, N.Y.*	7 Follen St.
Critchett, James Hamilton	*Watertown*	Watertown.
Crossley, Frederick Turner	*Providence, R.I.*	28 Yarmouth St.
Crowley, Francis Clinton Vincent	*So. Boston*	72 Dorchester St., S.B.
Davis, John Francis	*Cambridge*	Cambridge.
Dawes, Chester Laurens	*W. Somerville*	W. Somerville.
Dickerman, Alton Leslie, Jr.	*Colo. Springs, Colo.*	Hotel Westminster.
Dole, Howard Hawes	*Portland, Me.*	7 Crestwood Park, R.
Dort, Joseph Cummings	*Providence, R.I.*	W. Somerville.
Dunkel, Charles Alexander	*Roslindale*	14 Cohasset St., Ros.
Durgin, Matthew Francis	*Cambridge*	Cambridge.
Elbert, John Jacob	*Des Moines, Iowa*	261 Newbury St.
Ellis, Ridsdale	*Leicester, England*	217 Newbury St.
Emerson, George Irving	*Haverhill*	49 Bickerstaff St.
Farnum, Frederic Reid Coolidge	*Waltham*	Waltham.
Fellows, Raymond Henry	*Concord, N.H.*	Technology Chambers.

First Year (*continued*).

NAME.	HOME.	RESIDENCE.
Ferreira, Cesar	*Montevideo, Uruguay*	45 St. Botolph St.
Fick, Wilhelm George	*St. Louis, Mo.*	109 Warren Ave.
Finnie, James Irving	*Clinton*	172 St. Botolph St.
Fisher, Howard Colburn	*Westwood*	Westwood.
Fletcher, Charles Barrows	*Indianapolis, Ind.*	19 Blagden St.
Fletcher, Matthews	*Indianapolis, Ind.*	19 Blagden St.
Forrest, Laurence Raymond	*Lynn*	Lynn.
Foss, Marion Henry	*Chicago, Ill.*	Technology Chambers.
Foster, Carl Elmer	*Ashby*	164 W. Canton St.
Foster, Harold Francis	*W. Somerville*	W. Somerville.
Freed, Charles	*Cambridge*	Cambridge.
Frost, Harwood Young	*Waltham*	Waltham.
Gardner, Harold	*W. Medford*	W. Medford.
Garrett, George Palmer	*Chestnut Hill*	Chestnut Hill.
Gibbs, Daniel Wilson	*Waltham*	Waltham.
Ginzberg, Abram Harry	*Roxbury*	24 Montrose St., R.
Glancy, Robert Clifford	*Waltham*	Waltham.
Glazier, Harold Metcalf	*Hudson*	Waltham.
Godfrey, Karl Davenport	*Roxbury*	46 St. James St., R.
Gram, Carl William	*Wollaston*	Wollaston.
Gray, George Harrison	*Arlington*	Arlington.
Green, Fred Mortimer	*Newtonville.*	Newtonville.
Hahn, Edwin	*Washington, D.C.*	Garrison Hall.
Hamilton, Earl Russell	*Roslindale*	925 South St., Ros.
Hanna, Elias Samman	*Tanta, Egypt*	82 Chandler St.
Hardison, Charles Taylor	*Wellesley Hills*	Wellesley Hills.
Harrison, Alfredo	*Tacna, Chile*	470 Mass. Ave.
Harrub, Calvin Nelson	*Plympton*	Plympton.
Hasegawa, Tetsutaro	*Tokyo, Japan*	Cambridge.
Hastings, Russell	*Walpole, N.H.*	12 Newbury St.
Havens, Harry Lucas	*Kansas City, Mo.*	Technology Chambers.
Haynes, George Allison	*Haverhill*	49 Bickerstaff St.
Healy, Leon James Dyson	*New Britain, Conn.*	Chelsea.
Heard, Frank Chisholm	*Brookline*	Brookline.
Heidelberg, Frederick Martin	*Houston, Texas*	17 Greenwich Park.
Henderson, Austin Brown	*Beverly*	Beverly.
Herold, Armin Ferdinand	*St. Louis, Mo.*	Technology Chambers.
Hodsdon, George Edward	*Gloucester*	Somerville.
Hooper, Edward Joseph	*Stoughton*	Stoughton.
Howe, Edward Somerset	*Kingston*	Kingston.
Hulsizer, Robert Inslee	*Bridgeport, Conn.*	12 St. John St., J.P.
Inglee, Robert	*Westdale*	Westdale.
Jackson, Alexander Freeman	*Milford*	126 Princeton St., E.B.
Jacobs, Carlton Dupee	*Roxbury*	28 Maple St., R.

First Year (*continued*).

NAME.	HOME.	RESIDENCE.
Jaeger, Frederick	*So. Weymouth*	411 Columbus Ave.
Johnson, Charles Adolph	*Boston*	215 Huntington Ave.
Jones, Reginald Lamont	*Abington*	Abington.
Jones, William Henry	*Ashland*	Ashland.
Judd, Arthur Curtis	*Brookline*	Trinity Court.
Keables, Austin Dow	*Lowell*	193 W. Canton St.
Keeney, Robert Mayro	*Somerville, Conn.*	Garrison Hall.
Kelley, Edward Francis	*Cambridge*	Cambridge.
Kellogg, Alfred Galpin	*Brookline*	Brookline.
Kelly, William James	*Jamaica Plain*	61 Robinwood Ave., J.P.
Kenerson, Harry Vertner	*Buffalo, N.Y.*	Beachmont.
Kimberley, Burton Russell	*Cleveland, Ohio*	33 St. Botolph St.
King, Lester Hazen	*Hartford, Conn.*	209 Newbury St.
King, Walter Wellington	*New Brighton, N.Y.*	237 Beacon St.
Kurtzmann, Christian	*Buffalo, N.Y.*	Technology Chambers.
Landis, Harold Swindells	*Philadelphia, Pa.*	234 Newbury St.
Lange, Arthur Harry	*Brookline*	Brookline.
Lange, Frank John	*Springfield*	197 W. Newton St.
Lasnier, Gilberto C., A.B.	*Montevideo, Uruguay*	45 St. Botolph St.
Lawrence, George Leonard, Jr.	*Melrose*	Melrose.
Leeder, Charles William	*Providence, R.I.*	68 Copeland St., R.
Lenox, John Edward	*Cambridge*	Cambridge.
Longyear, Helen McGraw	*Brookline*	Brookline.
Lord, Paul Burton	*Dorchester*	18 S. Munroe Terrace, D.
Lougee, Sherman	*Salem*	Salem.
Luening, Eugene George	*Wauwatosa, Wis.*	34 Gardner St., A.
Luscomb, Florence Hope	*Allston*	14 Ashford St., A.
McCarthy, John Francis	*So. Boston*	283 Bowen St., S.B.
McClintock, Paul	*Chelsea*	Chelsea.
Mace, Shirley Andrew	*Lynn*	Lynn.
McEachern, Archie	*Savannah, Ga.*	Cambridge.
Madenigian, Kevork	*Aghin, Armenia*	470 Shawmut Ave.
Marquez, Francisco Davila	*Naguabo, Porto Rico*	211 W. Newton St.
Marshall, Henry Herbert	*Elmwood*	Elmwood.
Marvin, David Patterson	*Brookline*	Brookline.
Matte, Joseph	*No. Adams*	192 Dartmouth St.
May, Kenneth Sargeant	*Newton Highlands*	Newton Highlands.
Maynard, Clarence Dickinson	*Somerville*	Somerville.
Merriman, Thurston Cables	*Bristol, Conn.*	19 Concord Sq.
Miller, George	*Lawrence*	224 W. Springfield St.
Miller, Henry Franklin, 2d	*Wakefield*	Technology Chambers.
Mitchell, Arthur Knox	*Springfield*	Garrison Hall.
Morrill, Arthur Bradford	*Haverhill*	20 Yarmouth St.
Moses, Alonzo Lemuel	*Boston*	222 Mass. Ave.

First Year (*continued*).

NAME.	HOME.	RESIDENCE.
Myers, Henry Earle	*Ashland, Ohio*	21 Rutland Sq.
Neill, Frank Damrell	*Medford*	Medford.
Nichols, Russell Harrison	*So. Boston*	325 K St., S.B.
Nickerson, John Winslow	*Roxbury*	33 Alpine St., R.
Nisbet, Lewis Dexter	*Providence, R.I.*	221 Newbury St.
O'Shea, Peter Francis	*Northampton*	517 Columbus Ave.
Parker, Joseph Warren	*Cambridge*	Cambridge.
Pearce, John Stewart	*Saltsburg, Pa.*	Technology Chambers.
Pepper, Benjamin Ward	*Dorchester*	12 Granville St., D.
Perley, Henry Chaplin	*Boxford*	Boxford.
Perry, Harold Robert	*Dorchester*	103 Evans St., D.
Pettingell, William Moulton	*Newburyport*	Newburyport.
Petzold, Herbert Robert	*Lawrence*	Lawrence.
Phelps, Dudley Winston	*Utica, N.Y.*	43 Hemenway St.
Pope, Chester Henry	*Winthrop*	Winthrop.
Racoosin, Lewis	*Worcester*	Cambridge.
Read, William Carleton	*Taunton*	60 W. Rutland Sq.
Remick, Frank Harley	*Methuen*	612 Columbus Ave.
Richards, Joseph Lovering	*Brookline*	Brookline.
Robinson, Burr Arthur	*Buffalo, N.Y.*	53 Gloucester St.
Robinson, Clark Shove	*Malden*	Malden.
Robinson, Elmo Arnold	*Canandaigua, N.Y.*	8 Blackwood St.
Scharff, Maurice Roos	*Natchez, Miss.*	236 Newbury St.
Schofield, William McNair	*Newtonville*	Newtonville.
Sharp, Harold	*Brookline*	Brookline.
Shaw, Arthur Lassell	*Clinton*	172 St. Botolph St.
Shaw, Lawrence Copeland	*Brockton*	Brockton.
Shea, John William	*Holyoke*	Caryville.
Sherman, Henry Lancey	*Pasadena, Cal.*	Technology Chambers.
Shillaber, Charles Patten, Jr.	*So. Framingham*	275 Beacon St.
Simm, Roy	*Waverley*	Waverley.
Simons, John Keith	*Greenfield*	4 Brimmer St.
Sleeper, Dwight William	*Dorchester*	10 Claybourne St., D.
Smeaton, Douglas Wilson	*Newton*	867 Boylston St.
Smith, Earl McColloch	*Little Rock, Ark.*	Brookline.
Smith, Robert Lewis	*Roslindale*	14 Cross St., Ros.
Smith, Xanthus Russell	*Weldon, Pa.*	12½ St. James Ave.
Soderstrom, Francis Harold	*Jamaica Plain*	7 Dresden St., J.P.
Spaans, Walter	*Jamaica Plain*	38 Mozart St., J.P.
Spencer, Henry Kendall	*Dorchester*	29 Stratford St., D.
Stephenson, Joseph Newell	*Great Barrington*	12 Dalrymple St., J.P.
Stevens, John Codding	*St. Paul, Minn.*	Technology Chambers.
Stiebel, Herbert Joseph	*Brookline*	Brookline
Temple, Raymond Barrus	*Reading*	Reading.

First Year (*continued*).

NAME.	HOME.	RESIDENCE.
Terry, Michael	*Springfield*	197 W. Newton St.
Thornley, Albert Edward	*Pawtucket, R.I.*	10 Rutland Sq.
Turner, Henry Charles, Jr.	*Boston*	556 Newbury St.
Turner, Marie Celeste	*Boston*	556 Newbury St.
Very, Edward McKey	*Newton Centre*	Newton Centre.
Wallis, George Edward	*Beverly*	Beverly.
Walls, James Newman	*Waverley*	Waverley.
Ware, Ernest Alonzo	*Somerville*	Somerville.
Warnen, Arthur Trumbull	*Ridgefield, Conn.*	125 Pembroke St.
Weill, Melville Kaiser	*Mexico, Mexico*	17 St. James Ave.
Weinhagen, George, Jr.	*Milwaukee, Wis.*	34 Gardner St., A.
Weinstock, Robert	*Sacramento, Cal.*	90 Gainsborough St.
Weis, Irwin Lewis	*Boston*	Hotel Westminster.
Wentworth, Philip Montgomery	*Wellesley Hills*	Wellesley Hills.
Wertheim, Herbert Joseph	*Melbourne, Australia*	14 Durham St.
Whitaker, Harry Emerson	*Newton*	Newton.
White, Clifton Hackett	*Newton Centre*	Newton Centre.
Whitney, Lyman Fiske	*Boston*	228 Marlborough St.
Willard, John Artemus	*Wrentham*	Wrentham.
Wilson, William Smith, Jr.	*Wellesley*	Wellesley.
Winchester, Laurence Somerby	*Reading*	Reading.
Wingate, Woodbury Harold	*Newburyport*	193 Main St., C.
Wolfner, Ira William	*Peoria, Ill.*	Technology Chambers.
Wood, Frederick Brayton	*Baltimore, Md.*	261 Newbury St.
Young, Philip E.	*Dedham*	Dedham.

SPECIAL STUDENTS.

NAME.	COURSE.	HOME.	RESIDENCE.
Adams, Arthur Kinney, A.M.	III.	*Spencer*	No. Cambridge.
Adams, Franklin O., Jr., B.S.	IV.	*Locust Ridge, La.*	Brookline.
Adams, Percival L., B.S.	VI.	*Hood River, Oreg.*	46 Florence St., Ros.
Ahern, Michael J., S.J., A.B.	XII.	*Boston*	761 Harrison Ave.
Allbright, Clifford	IV.	*Milton*	Milton.
Allen, Edward Earle		*Somerville*	Somerville.
Allen, Maurice Everett	XI.	*Toledo, Ohio*	215 Newbury St.
Allen, Raynor Huntington		*Cincinnati, Ohio*	237 Beacon St.
Almy, Edward Taber, Jr.	III.	*New Bedford*	Newton Centre.
Altgelt, Ernest Simpson, C.E.	I.	*San Antonio, Texas*	124 St. Botolph St.
Ames, William Oliver		*Boston*	136 St. Botolph St.
Andrews, Frederick Huntoon	VI.	*Manchester*	559 Mass. Ave.
Angus, Robert Alexander	II.	*Hartford, Conn.*	43 St. Botolph St.
Arnold, Harry Cutler	III.	*Stoneham*	Stoneham.
Ashenden, Richard Chesley	II.	*Newton*	Newton.
Ayres, Richard Samuel, A.B.	VI.	*Pineville, Ky.*	91 Newbury St.
Babcock, Alfred Bennett	X.	*Boston*	719 Boylston St.
Bailey, George William		*W. Somerville*	W. Somerville.
Baker, Benjamin Charles	IV.	*Providence, R.I.*	Technology Chambers.
Baker, Cecil Franklin	IV.	*Champaign, Ill.*	Technology Chambers.
Baker, Warren Stearns	II.	*W. Roxbury*	110 Bellevue St., W.R.
Ball, Edwin Chester	VI.	*W. Somerville*	W. Somerville.
Ballard, Harold Foote	I.	*Millington*	Woburn.
Bancroft, Albert Fitch	III.	*New Bedford*	234 Newbury St.
Barber, Earl Huntington	I.	*Newton*	Newton.
Barker, Bertha Isabel, B.S.	VII.	*Cambridge*	Cambridge.
Barker, Clinton Carter	I.	*No. Andover*	Garrison Hall.
Barnes, Roderic Barbour, A.B.	IV.	*New York, N.Y.*	Technology Chambers.
Barnett, Seymour Foster	II.	*Brooklyn, N.Y.*	136 Newbury St.
Barry, John Gerald	III.	*Salem*	Salem.
Bartlett, Edwin Ball, A.B.	VI.	*Milwaukee, Wis.*	311 Beacon St.
Batchelder, Charles Leland	I.	*No. Reading*	No. Reading.
Bearce, William Pitt	I.	*Haverhill*	Haverhill.
Belcher, Merton		*Eureka, Cal.*	10 Durham St.
Beliveau, Francis Goodwin	V.	*Keene, N.H.*	146 St. Botolph St.
Bell, Andrew Lane	XIII.	*Chelsea*	Chelsea.
Bender, Homer Charles	I.	*Reno, Nev.*	73 Rutland St.
Berliner, Edgar Maurice	II.	*Washington, D.C.*	Garrison Hall.

SPECIAL STUDENTS (*continued*).

NAME.	COURSE.	HOME.	RESIDENCE.
Bettington, Claude Albemarle	VI.	*Johannesburg, Trans.*	85 Newbury St.
Bettington, Egerton Mitford	. .	*Johannesburg, Trans.*	85 Newbury St.
Bigelow, William Walter	. II.	*Springfield*	179 Mass. Ave.
Bingham, Rutherfurd	. . . VI.	*St. Louis, Mo.* . .	264 Newbury St.
Black, Albert Shirley	. . . . I.	*Lynn*	Lynn.
Blackwell, Victor Joseph	. . IV.	*London, Ontario* . .	Malden.
Blake Arthur William	. . . II.	*Portland, Me* . . .	264 Newbury St.
Blodgett, Mildred Eleanor	XII.	*Boston*	1200 Commonwealth Ave.
Bloede, Carl Schon	. . . . X.	*Catonsville, Md.* . .	261 Newbury St.
Bloom, David	. . . . . V.	*So. Boston*	377 Broadway, S.B.
Boardman, Wallace Eugene	VI.	*Wakefield*	Wakefield.
Bodenstein, Morgan Lamoree	I.	*Arlington*	Arlington.
Boland, Marion Genevieve, A.B.		*Worcester*	Worcester.
Bonillas, Ygnacio Safford	. III.	*Nogales, Mexico*	Technology Chambers.
Boush, Kenneth Camm	. . II.	*Washington, D.C.* .	Brookline.
Bowman, Donald	. . . . . VI.	*Marion, Ind.* . . .	707 Tremont St.
Boyce, John Nelson	. . . . .	*Pleasant Mount, Pa.*	81 Montgomery St.
Breitzke, Charles F.	. . . XI.	*Newton Centre* . .	Newton Centre.
Brewer, Carl, B.A.	. . . . II.	*New Haven, Conn.*	25 St. Botolph St.
Bridgman, Grenville Temple	III.	*Boston*	264 Newbury St.
Briggs, Ernest Nathaniel	XIII.	*Newport, R.I.* . . .	18 Batavia St.
Brown, Clarence Jay	. . . IV.	*Minneapolis, Minn.*	Beacon Chambers.
Brown, Leander Moore, Jr.	VI.	*Newburyport* . . .	6 Louisburg Sq.
Brownlee, Richard William	. II.	*Toronto, Ontario* .	Technology Chambers.
Brownlee, Robert Bruce	. . .	*Youngstown, Ohio* .	102 W. Concord St.
Brush, George Sabine	. . . . .	*Newtonville*	Newtonville.
Bryant, George Henry	. . XI.	*Haverhill*	234 Newbury St.
Buckingham, George H.	. . . IV.	*Boston*	138 Newbury St.
Buckler, Riggin, A.B.	. . . . IV.	*Baltimore, Md.* .	Technology Chambers.
Bullard, Maurice Lucian	. II.	*Radford, Va.* . . .	Needham.
Burhans, Harry Newton	. . X.	*Syracuse, N.Y.* . .	59 Hemenway St.
Burpee, George William, A.B.	I.	*Houlton, Me.* . . .	240 W. Newton St.
Burwell, Albert Lewis	. . . V.	*Winsted, Conn.* . .	11 Rutland Sq.
Butler, Chester Maitland	. V.	*Avon*	Avon.
Bu[illegible] Walter Matthews	. . VI.	*So. Dartmouth* . .	17 Follen St.
Byrne, James G.	. . . . . IV.	*Cincinnati, Ohio* .	324 Shawmut Ave.
Byron, Walter Harwood, B.S.	X.	*Williamsport, Md.*	Technology Chambers.
Cady, John Hutchins, Ph.B.	IV.	*Providence, R.I.* .	Technology Chambers.
Cain, Walter Bicknell	. . XIII.	*E. Weymouth* . . .	E. Weymouth.
Caldwell, William A., B.S.	. IV.	*St. Louis, Mo.* . . .	249 Berkeley St.
Caldwell, Walter Evans	. . II.	*Louisville, Ky.* . .	43 Hemenway St.
Callahan, Charles A.	. . . . I.	*Waltham*	Waltham.
Calley, Walter [illegible], B.S.	. . VI.	*Upland, Pa.* . . .	59 Georgia St., R.
Campbell, Alfred [illegible]	. . . . .	*Pittsburgh, Pa* . .	27 St. Botolph St.

SPECIAL STUDENTS (*continued*).

NAME.	COURSE.	HOME.	RESIDENCE.
Carey, Francis Vincent	I.	*Dorchester*	Percival St., D.
Cartagena, Nicholas Manrique		*Mayagüez, Porto Rico*	14 Follen St.
Carter, Clarence Elmore	I.	*Reading*	Reading.
Casey, Frank Augustus		*Billerica*	Billerica.
Cassidy, Herbert Arthur	XIII.	*Wollaston*	Wollaston.
Caton, John Hearst, 3d	I.	*Edgewood, R.I.*	469 Columbus Ave.
Chandler, Benjamin F., B.S.	VIII.	*So. Coventry, Conn.*	566 Columbus Ave.
Chandler, Edward	XIII.	*Boston*	670 Mass. Ave.
Chandler, Fred Worthington	XIII.	*Newburyport*	319 Marlborough St.
Chase, Edward Sherman	XI.	*Merrimac*	135 Pembroke St.
Chase, Edwin Kirke	III.	*Denver, Colo.*	27 St. Botolph St.
Child, Huntley	III.	*Helena, Mont*	6 Louisburg Sq.
Chipman, Kenneth Gordon	III.	*W. Newton*	W. Newton.
Christensen, Arthur Olaf	III.	*Beaufort, S.C.*	282 Mass. Ave.
Chuchian, Avedis Melkon	I.	*Van, Armenia*	Chelsea.
Chuchian, Sahak Melkon	VI.	*Van, Armenia*	Chelsea.
Clapp, Lucy Jenkins	VII.	*So. Boston*	18 Atlantic St., S. B.
Clark, Clarence Warner	X.	*Dorchester*	485 Blue Hill Ave., R.
Clark, Horace Little		*Exeter, N.H.*	159 W. Canton St.
Clarke, Lewis C., Jr., S.M.	IV.	*Cambridge*	Cambridge.
Clatur, George Albert	I.	*Wilmington*	Wilmington.
Clifford, Walter Baker	II.	*Boston*	48 Beacon St.
Cochrane, Clifford Nelson	II.	*Melrose Highlands*	Melrose Highlands.
Coe, Maxwell Alanson	II.	*Medford*	Medford.
Coffin, William Balch, A.B.	IV.	*Brookline*	Brookline.
Cole, Marcus Johnson	II.	*Lowell*	234 Newbury St.
Coleman, George Stephen	I.	*Dorchester*	84 Spencer St., D.
Conover, John Woodhull, A.B.	II.	*Norfolk, Va.*	26 St. James Ave.
Conron, Raymond Francis	I.	*Danville, Ill.*	424 Mass. Ave.
Correll, Hugh	II.	*Canton, Ohio*	179 Mass. Ave.
Correll, James A., B.S.	VI.	*Manhattan, Kans.*	34 Dartmouth St.
Cram, Frederick Sutherland	I.	*Brunswick, Me.*	19 St. James Ave.
Critchlow, Paul Nisbet, B.S.	I.	*New Brighton, Pa.*	240 W. Newton St.
Crohurst, Harry Rounseville	XI.	*Boston*	33 Ivy St.
Crommett, Orrin James		*Chelsea*	Chelsea.
Curl, Charles Matthew	XIII.	*Concord, N.H.*	34 W. Cedar St.
Curley, Ernest		*Boston:*	51 Mass. Ave.
Cutten, Leverett Howell, A.B.	II.	*Boston*	31 Worcester St.
Daddow, Samuel Harries, A.B.	II.	*St. Clair, Pa.*	Technology Chambers.
Daley, Mitchell Joseph	III.	*Marlboro*	141 Charles St.
Dalrymple, George Emerson	II.	*Haverhill*	Haverhill.
Dass Jalota, Saran	VI.	*Panjab, India*	203 W. Newton St.
Davenport, Llewellyn D.	I.	*Hanover*	53 Gloucester St.
Davidson, James H., C.E.	VI.	*Denver, Colo.*	311 Beacon St.

SPECIAL STUDENTS (*continued*).

NAME.	COURSE.	HOME.	RESIDENCE.
Davidson, Stephen Lock	I.	*Wichita, Kans.*	99 Pinckney St.
Davis, John Allen	III.	*Sioux City, Iowa.*	Technology Chambers.
Davis, Lawrence Ritchie, B.S.	III.	*Peking, China*	22 Claremont Park.
Davis, Leon How	I.	*Somerset*	25 Union Park.
Davol, Walter Dodge	VI.	*Charlestown*	19 Bartlett St., C.
DeLoach, John Keller	XIII.	*Atlanta, Ga.*	95 Gainsborough St.
Denmark, Clayton Rhay	II.	*Quitman, Ga.*	20 Berwick Park.
Dennedy, John Howard	II.	*Detroit, Mich.*	Technology Chambers.
de Steiguer, Walter George	III.	*Cameron, Mo.*	12 Newbury St.
Dickinson, Leon Arthur	III.	*Somerville*	Somerville.
Dickson, Victor Heyle	II.	*Peoria, Ill.*	Technology Chambers.
Disque, Kenneth Hulbert	I.	*Erie, Pa.*	Newton Centre.
Dodge, Perley Kennison	VI.	*Beverly*	Beverly.
Dolke, William Frederic, Jr.	IV.	*Brookline*	Brookline.
Donaldson, John	III.	*Minneapolis, Minn.*	311 Beacon St.
Donnewald, Albert H., A.B.	III.	*St. Louis, Mo.*	264 Newbury St.
Dore, Clement Joseph, A.B.	X.	*Roxbury*	40 Howland St., R.
Doucette, Ellis John	VI.	*No. Wilmington*	No. Wilmington.
Dow, Benjamin Warren		*Dorchester*	7 Standish St., D.
Dows, Amos Hovey	VI.	*Lowell*	21 St. Botolph St.
Draper, Clifton Nathan	V.	*Norwich, Conn.*	Garrison Hall.
Draper, Harry Reed	I.	*Ayer*	Ayer.
Drown, Henry Carruth		*Dorchester*	82 Kenwood St., D.
Dyer, Bertina	VII.	*Holbrook*	Perkins St., J.P.
Dyer, Kirk Worrell, B.S.	X.	*Pasadena, Cal.*	240 W. Newton St.
Dyer, Ralph Leighton	XIII.	*Winchester*	Winchester.
Earle, Frederic Edward	II.	*Dorchester*	8 Downer Court, D.
Early, Francis H.		*Oak Park, Ill.*	Technology Chambers.
Eaton, Harold Irving		*Waltham*	Waltham.
Eaton, Warren Moseley	II.	*Waltham*	Waltham.
Edge, Alan Francis	V.	*Readville*	Readville.
Edwards, Carl Francis, B.S.	XIII.	*Santa Barbara, Cal.*	Technology Chambers.
Eisenhart, Martin H., B.S.	X.	*York, Pa.*	Technology Chambers.
Elder, Flint Cummings	V.	*Malden*	Malden.
Ellis, Alexander, Jr.	III.	*Cambridge*	Cambridge.
Ellis, Leslie Burton	I.	*Melrose*	Melrose.
Emilio, Shepard Gilbert	III.	*Salem*	Salem.
Englis, William Franklin	XIII.	*New York, N.Y.*	237 Beacon St.
Ewing, Chas. Goodman, A.B.	III.	*St. Louis, Mo.*	63 Chestnut St.
Faben, Charles Reed	II.	*Toledo, Ohio.*	4 St. Botolph St.
Fanning, Paul Revere	III.	*Boston*	Brookline.
Faulkner, Frederick R., A.B.	I.	*Sackville, N.B.*	131 Pembroke St.
Faymouville, LeRoy Bernard		*San Francisco, Cal.*	171 St. Botolph St.
Feemster, Joseph Hall, Jr.	II.	*Glendale, Ohio*	263 Newbury St.

SPECIAL STUDENTS (*continued*).

NAME.	COURSE.	HOME.	RESIDENCE.
Fenner, James Howland	VI.	*Providence, R.I.*	425 Quincy St., D.
Ferguson, William Craig		*Adams*	15 Concord Sq.
Ferrandi, Amedeo Louis S.	I.	*Roxbury*	21 Rand St., R.
Ferry, Lewis Kinsley	X.	*Pittsfield*	Technology Chambers.
Flagg, Montague		*Hartford, Conn.*	6 Louisburg Sq.
Fletcher, Herbert Lawrence	VI.	*Lawrence*	Lawrence.
Folsom, Susie Theodosia	VII.	*Roxbury*	Quincy St., R.
Forbes, Edward W.	V.	*Fern Bank, Ohio*	Essex Hotel.
Fottler, Jacob Alger	VI.	*Montello*	Montello.
Freedman, Louis Arthur	II.	*New York, N.Y.*	Garrison Hall.
Freethy, George Edwards	II.	*Brookline*	Brookline.
Friedman, Ferdinand J.	II.	*New York, N.Y.*	Garrison Hall.
Fuller, Bernard Roy		*Aspinwall, Pa.*	Malden.
Furness, George Choate	VIII.	*Manchester, N.H.*	48 Hereford St.
Gambrill, George T., Jr.	III.	*Baltimore, Md.*	279 Dartmouth St.
Gardner, Robert Sherman	XIII.	*New London, Conn.*	Wollaston.
Gay, Arthur Taro		*Kamakura, Japan*	140 Marlborough St.
Gaylord, James Mason, B.S.	VI.	*Pasadena, Cal.*	4 Kearsarge Ave., R.
Gerhard, Hans Weiskirch	II.	*Brooklyn, N.Y.*	41 St. Botolph St.
Gibbons, Michael Joseph, Jr.	VI.	*Dayton, Ohio*	Technology Chambers.
Gideon, Samuel Edward	IV.	*Boston*	Technology Chambers.
Gilkison, Gordon Mercer	I.	*Toronto, Ontario*	263 Newbury St.
Gilman, Wesley Clifton, S.B.	VI.	*No. Abington*	No. Abington.
Gilman, William F.		*Dedham*	Dedham.
Gilmer, Thornton Meriwether	I.	*Cambridge*	Cambridge.
Gonder, Walter Brayton	V.	*Strasburg, Pa.*	112 Huntington Ave.
Goodnow, Frank Edward	VI.	*Adams.*	155 W. Newton St.
Goodwin, Edwin Sykes, Ph.B.	IV.	*Laconia, N.H.*	Somerville.
Gordon, Louis	III.	*Dorchester*	6 Orchardale St., D.
Gould, Gardner Sabin	I.	*Newton Upper Falls*	Newton Upper Falls.
Greene, Albert Edwards	VIII.	*Pueblo, Colo.*	Technology Chambers.
Gregory, Clay, Jr.		*Joplin, Mo.*	3 Newbury St.
Gregory, Newman Ballard	III.	*Joplin, Mo.*	3 Newbury St.
Griffin, James Edwin	I.	*W. Newton*	53 Gloucester St.
Groff, James Stephen		*Newport, R.I.*	City Hospital.
Groover, Francis Bartow, B.S.	I.	*Statesboro, Ga.*	20 Berwick Park.
Grunsky, Eugene L.	I.	*Washington, D.C.*	Brookline.
Haas, Ludwig Friedrich C.	II.	*Lancaster, Pa.*	192 Dartmouth St.
Hale, Mary Dean		*Brookline*	Brookline.
Hall, Ralph Nickerson	II.	*Milton*	Milton.
Hallowell, Henry Bartlett	III.	*Belmont*	Belmont.
Hamilton, Frank Sidney	III.	*So. Blue Hill, Me.*	Belmont.
Hammond, Benjamin	III.	*Butte, Mont.*	455 Columbus Ave.
Hammond, Nelson Simpson	III.	*Butte, Mont.*	455 Columbus Ave.

SPECIAL STUDENTS (*continued*).

NAME.	COURSE.	HOME.	RESIDENCE.
Hampton, Lawrence Charles	III.	*Hollywood, Cal.*	11 St. James Ave.
Hanford, Jesse Warren G.	II.	*Santa Barbara, Cal.*	Dedham.
Hanington, Thomas Ross	VI.	*St. John, N.B.*	131 Pembroke St.
Hanley, Gerald Thomas, B.S.	XI.	*Providence, R.I.*	311 Beacon St.
Harlow, John Brayton	VI.	*St. Louis, Mo.*	48 Hereford St.
Harriman, Daniel Francis	XIII.	*W. Boxford*	19 St. James Ave.
Harris, Nathan	I.	*Buffalo, N.Y.*	42 E. Springfield St.
Harrison, Jerome Gabriel, B.S.	IV.	*College Station, Tex.*	43 St. Botolph St.
Harrison, Philip Stone	V.	*Cerralvo, Mexico*	261 Newbury St.
Hart, Harold Pillsbury	VI.	*So. Framingham*	So. Framingham.
Hartshorn, Dereck Sibley		*Winsted, Conn.*	75 Clarkson St., D.
Harvey, Harold Brown	VI.	*Lynnfield*	550 Mass. Ave.
Hasbrouck, Frank Flinn, A.M.,	V.	*Peoria, Ill.*	Technology Chambers.
Haskell, Robert Francis	IV.	*Claremont, N.H.*	7 Ashburton Place
Hatch, Samuel Frink	II.	*Greenland, N.H.*	112 Chandler St.
Hatton, John Matthews		*Des Moines, Iowa*	99 Newbury St.
Hayden, Ralph W.	III.	*Cambridge*	Cambridge.
Hazen, Howard S., Jr., B.S.	IV.	*La Salle, Ill.*	154 Newbury St.
Henderson, Leroy Porter	I.	*Beverly*	Beverly.
Henius, Emil Theodore	V.	*Chicago, Ill.*	20 Cumberland St.
Hertz, Alfred William	IV.	*Kansas City, Mo.*	Technology Chambers.
Heydon, Joseph Kentigern	V	*Sydney, Australia*	263 Newbury St.
Hicks, Alexander	II.	*New Bedford*	26 Greenwich Park.
Higgins, Edward Leander	IV.	*Bar Harbor, Me.*	60 Pinckney St.
Hill, Guy	VIII.	*Everett*	Everett.
Hill, Harry Eaton	I.	*Georgetown*	Georgetown.
Hobson, George Foster	I.	*Lowell*	234 Newbury St.
Hogner, Pierre Richard L.	IV.	*Boston*	328 Mass. Ave.
Holbrook, Foster Webster	I.	*Waltham*	Waltham.
Hollnagel, Herbert Percival	VIII.	*Dubuque, Iowa*	186 Hamilton St. D.
Holmes, Thomas Barlow	III.	*Keene, N.H.*	48 Hereford St.
Hosea, Raphael Gay	I.	*Denver, Colo.*	311 Beacon St.
Hosmer, Herbert Buttrick	VI.	*Concord*	Concord.
Howe, Robert	VI.	*Marlboro*	53 Gloucester St.
Hoyt, Robert Nelson	I.	*Hyde Park*	Hyde Park.
Hudson, Walter Francis		*Natick*	Natick.
Hull, Andrew Wilmer, A.B.	XIII.	*Baltimore, Md.*	505 Columbus Ave.
Hunnewell, Mary Peele	VII.	*Wellesley*	Wellesley.
Hunt, Eugene Alexander		*Walla Walla, Wash.*	88 Gainsborough St.
Hunter, Alfred Redington	II.	*W. Roxbury*	233 Temple St., W.R.
Hunter, Roy	I.	*Albany, N.Y.*	116 Huntington Ave.
Hunter, William Benjamin	II.	*Roslindale*	76 Hemman St.,Ros.
Huntington, Chas. McKay	XIII.	*Boston*	18 St. Stephen St.
Hutchins, Charles Morton	III.	*Rockland*	Rockland.

SPECIAL STUDENTS (*continued*).

NAME.	COURSE.	HOME.	RESIDENCE.
Hutchinson, B. Edwin		*Chicago, Ill.* . . .	58 W. Rutland Sq.
Iasigi, Oscar Anthony . . .	VI.	*Boston*	3 Otis Place.
Isenberg, Hans Otto Carl .	II.	*Honolulu, Hawaii* .	29 Marlborough St.
Jackson, Frank	VI.	*Boston*	88 Marlborough St.
Jackson, Ralph Hahnamann	VI.	*Jamaica Plain* . .	335 Centre St., J.P.
Jacobson, Conrad, Ph.B. .	V.	*Chicago, Ill.* . . .	
Jarrett, Harry Holtham		*New York, N.Y.*	Technology Chambers.
Jenkins, William Benjamin . .		*Cleveland, Ohio* . .	Newtonville.
Jennings, Oliver S., A.B. .	VI.	*Fall River*	76 St. Stephen St.
Jerden, Carl Gustave . . .	II.	*Norwood*	Technology Chambers.
Johnson, Charles Edward .	II.	*E. Boston*	119 Trenton St., E.B.
Johnson, Joseph Warren .	II.	*Dorchester*	30 Summer St., D.
Johnson, Otto Alfred . . .	IV.	*Dedham*	Dedham.
Johnston, Cyrus Thurston .	VI.	*St. Paul, Minn.* .	Technology Chambers.
Johnston, John Frederick, Jr.	I.	*Boston*	16 St. Botolph St.
Jones, Grandville R., C.E. .	XI.	*Columbus, Ohio* .	Technology Chambers.
Jones, Samuel Percy, M.Sc.	III.	*Atlanta, Ga.* . . .	Cambridge.
Jones, William Francis		*New York, N.Y.* .	110 Charles St.
Joslin, Gamett Alfred	I.	*Los Angeles, Cal.* .	535 Mass. Ave.
Joslin, Gilman Burt . . .	XIII.	*Jamaica Plain* .	46 Burroughs St., J.P.
Kahn, Isa Wolfner	VI.	*Peoria, Ill.* . . .	Technology Chambers.
Kane, J. Allen	IV.	*Long Green, Md.* .	311 Beacon St.
Karch, Ralph James . . .	II.	*Lebanon, Pa.* . . .	15 St. James Ave.
Kedy, Stiles Fraser	II.	*Dorchester*	18 Savin Hill Ave., D.
Keeler, Warren Irving . .	VIII.	*Newton Highlands*	16 St. James Ave.
Keeling, Thomas Callender	VI.	*Nashville, Tenn.* .	10 St. James Ave.
Kelly, Edward Francis . .	II.	*Jamaica Plain* . .	30 Boylston St., J.P.
Kendall, Albert Stearns, A.B.	IV.	*Newton Centre* . .	Newton Centre.
Keniston, Carl Winthrop . .	III.	*Plymouth, N.H.*	478 Columbia Road, D.
Key, Howard W., B. Lit. .	VI.	*Austin, Tex.* . . .	31 Concord Sq.
Kiefaber, Warner H., B.S. .	VI.	*Dayton, Ohio* . .	Technology Chambers.
Kimball, William Francis .	VI.	*Brentwood, N.Y.* .	16 St. James Ave.
King, Frederick James . .	II.	*Abington*	Abington.
Kinnear, John Charles . .	III.	*Salem*	Salem.
Kinsman, Charles Collins .	VI.	*Decatur, Ill.* . . .	34 Batavia St.
Kite, Rebecca	VII.	*Boston*	25 W. Cedar St.
Koppitz, Carl George		*San Francisco, Cal.*	58 W. Rutland Sq.
Krafft, Alfred Julius	IV.	*San Francisco, Cal.*	192 Dartmouth St.
Krafft, Elmer Jerome . . .	IV.	*San Francisco, Cal.*	192 Dartmouth St.
Laird, Walter Steele		*Pittsburgh, Pa.* .	Technology Chambers.
Lalley, William Hugh . . .	XI.	*Bridgeport, Conn.* .	311 Beacon St.
Lang, Alfred George . . .	III.	*New Britain, Conn.*	234 Newbury St.
Lang, Harold Locke		*Roslindale*	33 Fairview St., Ros.
Larkin, Thomas	I.	*Boston*	41 Thorndike St.

SPECIAL STUDENTS (*continued*).

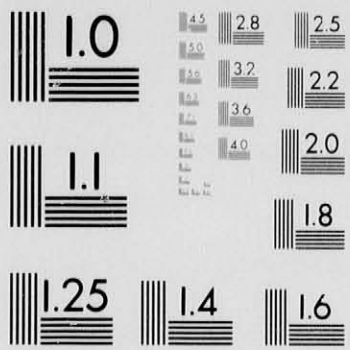
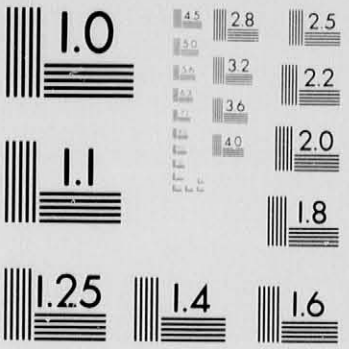
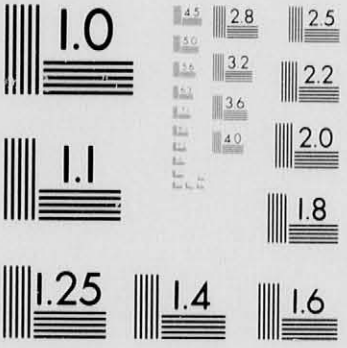
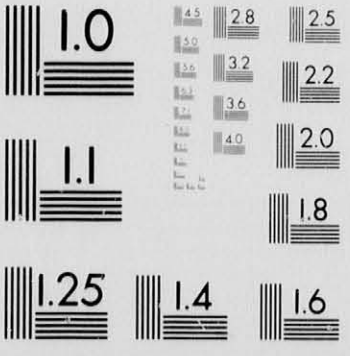
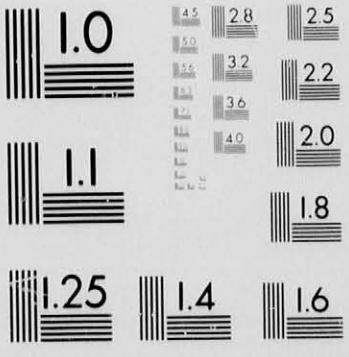
NAME.	COURSE.	HOME.	RESIDENCE.
Lathrop, Walter Harrington	II.	*Mystic, Conn.*	237 Beacon St.
Lawrence, Edmund K., A.B.	I.	*Catonsville, Md.*	242 Newbury St.
Lawton, Joseph Thomas, Jr.	II.	*Baltimore, Md.*	12 Newbury St.
Lebenbaum, Fred Charles	IV.	*San Francisco, Cal.*	Technology Chambers.
Lee, Tsan-chi, B.C.E.	I.	*Canton, China*	29 Newbury St.
Leeds, Charles Tileston	I.	*Brookline*	Brookline.
Lees, George Cooper	II.	*New Bedford*	116 Pembroke St.
Leong, Yuen Foo	VIII.	*W. Newton*	W. Newton.
Lewenberg, Harry Lewis	X.	*Roxbury*	40 Linwood St., R.
Lewis, Henry Minton, Jr.	III.	*New York, N.Y.*	112 Newbury St.
Libbey, Harold Shaw, A.B.	V.	*Lewiston, Me.*	79 St. Botolph St.
Lichtenstein, Milton	IV.	*San Francisco, Cal.*	17 Follen St.
Lightner, Milton Turnley, A.B.	II.	*Highland Park, Ill.*	237 Beacon St.
Lindsay, Roy Wallace	X.	*Andover*	Andover.
Link, John Hanger, A.B.	V.	*Rushville, Ind.*	407 Columbus Ave.
Lofting, Hugh John		*London, England*	5 St. James Ave.
Longley, Arthur Ashleigh	II.	*Kalamazoo, Mich.*	39 St. Botolph St.
Loomis, Dan Austin	XIII.	*Springfield*	Technology Chambers.
Lowe, Ralph Putnam	X.	*Fitchburg*	91 Newbury St.
Ludington, Frank Ensign	II.	*Waterbury, Conn.*	45 St. Botolph St.
Luehrs, Daniel M., B.S.	XIII.	*Cleveland, Ohio*	136 Chandler St.
Lufkin, Charles Lewis	V.	*Gloucester*	148 Trenton St., E.B.
Luther, George D.	III.	*Ashland, Pa.*	48 St. Stephen St.
Lyne, William, B.M.E.	VI.	*Brannon, Ky.*	11 Blackwood St.
Lyon, Orrin Sanborn	II.	*Malden*	Malden.
McAuliffe, William James	I.	*Boston*	4 Melrose St.
McCain, Samuel Norman		*Allegheny, Pa.*	Cambridge.
MacDonald, Howard J. C.	III.	*Brookline*	Brookline
Macdonald, William Harrison	I.	*Peabody*	Peabody.
McElroy, James Aloysius, A.B.	I.	*Bridgeport, Conn.*	Technology Chambers.
McGinnis, Claude S.	VIII.	*Greenville, Ill.*	670 Mass. Ave.
MacGregor, Milton Emery	VIII.	*Hyde Park*	Hyde Park.
McGuigan, Francis H., Jr.	I.	*Montreal, Quebec.*	215 Newbury St.
Mack, Paul Wardlaw	I.	*Williams Bridge, N.Y.*	240 W. Newton St.
McPhee, Harold Evan	VI.	*So. Framingham*	So. Framingham.
Mahar, John Theodore	II.	*So. Boston*	68 L St., S.B.
Mann, Herbert James	II.	*Chicago, Ill.*	12 Newbury St.
Mann, Paul Ford, B.A.	IV.	*Buffalo, N.Y.*	Technology Chambers.
Manning, Charles Nelson	II.	*Somerville*	Somerville.
Mansfield, Albert Preston	VI.	*Wakefield*	Wakefield.
Martin, Thorndike DeVries		*Brighton*	53 Chestnut Hill Ave., B.
Martinez, Roland A.	I.	*Havana, Cuba*	444 Mass. Ave.
Mason, George Carrington	XIII.	*Chicago, Ill.*	18 Cumberland St.
Mather, John	VI.	*Lowell*	Lowell.

SPECIAL STUDENTS (*continued*).

NAME.	COURSE.	HOME.	RESIDENCE.
Mather, Robert Harrison		*Windsor Locks, Conn.*	127 Pembroke St.
Mathison, Wm. E. H., B.A.	III.	*Springfield*	18 Batavia St.
Matte, Andrew Lewis		*No. Adams*	192 Dartmouth St.
Maxwell, J. North, B.S.	III.	*Austin, Texas*	94 St. Botolph St.
Maxwell, Ruth	IV.	*Newton*	Newton.
Mayer, Paul Hirschl, B.S.	III.	*Mt. Vernon, N.Y.*	Technology Chambers.
Mayo, Lincoln	II.	*Jamaica Plain*	11 Robeson St., J.P
Mead, Edward Arnold	VI.	*Milford*	Milford.
Menner, Frederic Bassett.	XIII.	*Honesdale, Pa.*	261 Newbury St.
Merrill, Arthur Clement	II.	*Peabody*	Peabody.
Merritt, Aaron Riley, B.A.	IV.	*E. Aurora, N.Y.*	477 Mass. Ave.
Merrow, John William, A.B.	IV.	*Cambridge*	Cambridge.
Mesmer, Louis Francisco, B.S.	I.	*Los Angeles, Cal.*	242 Newbury St.
Miller, Addison	II.	*St. Paul, Minn.*	Technology Chambers.
Miller, Carroll Everard, Jr.	XIII.	*Cadillac, Mich.*	Somerville.
Miller, Henry Usher		*St. John, N.B.*	131 Pembroke St.
Miller, John		*Boston*	518 Commonwealth Ave.
Mills, Benjamin Franklin, A.B.	I.	*Pittsfield*	50 S. Russell St.
Miner, Ernest Abbot	I.	*Malden*	Malden.
Minot, Robert Sedgwick, Jr.		*Dover*	Dover.
Mohan, Arthur Francis	XIII.	*Boston*	138 Eustis St.
Mohn, Joseph Theophile	IV.	*New York, N.Y.*	Technology Chambers.
Moore, Chester Newell, B.S.	V.	*Worcester*	86 Myrtle St.
Moore, James Gates	IV.	*Savona, N.Y.*	Technology Chambers.
Moore, John Ernest, A.B.	VI.	*Allegheny, Pa.*	Chelsea.
Moore, Thomas Joseph		*Ardee, Ireland*	900 Washington St.
Moreland, Edward L., A.B.	VI.	*McDonogh, Md.*	Beacon Chambers.
Morey, Charles Burrows	V.	*Buffalo, N.Y.*	112 Pembroke St.
Morrison, Charles Waldo	VI.	*Revere*	Revere.
Morton, Howard J.	III.	*Grand Rapids, Mich.*	264 Newbury St.
Mullen, John Joseph	VI.	*Wellesley*	Wellesley.
Mullen, John Joseph	VI.	*Denver, Colo.*	45 Rutland Sq.
Muñoz-Zertuche, Ramón	III.	*Saltillo, Mexico*	88 Gainsborough St.
Murfey, Gardner Armstrong	VI.	*Cleveland, Ohio*	Technology Chambers.
Muriel, José	I.	*San Luis Potosi, Mex.*	85 Newbury St.
Murphy, John Edward	III.	*Framingham*	Framingham.
Murray, Francis Joseph	X.	*Roxbury*	47 Quincy St., R.
Myers, Desaix Brown, B.S.	III.	*Philadelphia, Pa.*	26 St. James Ave.
Myers, Leonard Fred	I.	*Rochester, N.Y.*	206 Mass. Ave.
Naramore, Floyd Archibald	IV.	*Mason City, Iowa*	39 St. Botolph St.
Nicholl, John Seymour	II.	*Brookline*	Brookline.
Nichols, James Robinson	V.	*Haverhill*	Brookline.
Nichols, Prescott Raymond	VI.	*Reading*	Reading.
Nicol, Norman Carmichael	XI.	*Waterbury, Conn.*	469 Columbus Ave.

SPECIAL STUDENTS (*continued*).

NAME.	COURSE.	HOME.	RESIDENCE.
Niles, Frank Lee	III.	*Salt Lake City, Utah*	234 Newbury St.
Nix, Leo Demain	II.	*Dubuque, Iowa*	Technology Chambers.
Nolan, Thomas Alphonsus	I.	*Jamaica Plain*	19 Paul Gore St., J.P.
Norton, George Roswell	II.	*Allston*	33 Holton St., A.
Norton, Roy Wilmarth	VI.	*Vineyard Haven*	116 Pembroke St.
Noyes, Erskine Phillips	I.	*W. Newton*	W. Newton.
Oehme, Theodore Carl, Jr.	VI.	*Chicago, Ill.*	71 Mt. Vernon St.
Ogarrio, Rudolfo, Jr.	I.	*Mexico, Mexico*	Brookline.
O'Hara, James R., Jr.	II.	*Winthrop*	Winthrop.
Olaguibel, Romualdo E.		*Mexico, Mexico*	27 Cumberland St.
Orchard, Edward Frederick	II.	*Roslindale*	14 Fletcher St., Ros.
O'Riordan, Andrew		*Lowell*	Lowell.
Orme, James Booth Lockwood	V.	*Washington, D.C.*	424 Mass. Ave.
Orr, Thomas Whitley	I.	*Kansas City, Mo.*	215 Newbury St.
Osborne, Clarence William		*Fort Fairfield, Me.*	
Otis, Webb Harlan, B.S.	II.	*Ames, Iowa*	444 Mass. Ave.
Owings, Thomas, A.B.	IV.	*Baltimore, Md.*	80 Pinckney St.
Packwood, Lahvesia B. C.	II.	*Tampa, Fla.*	42 W. Newton St.
Page, Stanley Henry		*San Francisco, Cal.*	137 Newbury St.
Palmer, Herbert Hammond	VIII.	*Georgetown*	Georgetown.
Parlin, Raymond W.	XI.	*Wollaston*	161 W. Newton St.
Parsons, Galt Fayette	VI.	*Philadelphia, Pa.*	94 St. Botolph St.
Patten, Jane Boit	VII.	*Boston*	100 Gainsborough St.
Peet, Albert Stanton	VI.	*Callao, Peru*	Winchester.
Peirce, Frederic Newton	VI.	*Newton*	Newton.
Percival, Harry Spaulding	VI.	*Burlington, Vt.*	Quincy.
Perkins, Ralph Willis	VI.	*Wenham*	Wenham.
Perkins, Samuel Francis		*Dorchester*	Savin Hill, D.
Perry, William Graves, A.B.	IV.	*Boston*	135 Beacon St.
Pfeil, Walter George	II.	*Philadelphia, Pa.*	234 Newbury St.
Phelps, Eugene	III.	*Meeteetse, Wyo.*	234 Newbury St.
Philbrick, Halsey Raymond	VI.	*Hartford, Conn.*	12 Newbury St.
Pike, Robert	I.	*Pigeon Cove*	2 Claremont Park.
Place, Mark Hopkins, A.B.	I.	*Francestown, N.H.*	195 W. Brookline St.
Poland, Frank Webber	II.	*Nahant*	Technology Chambers.
Pollister, Edward Barker	I.	*Portland, Me.*	Brookline.
Pollock, Robert Thomas	VI.	*Salem*	Salem.
Poor, Arthur Kenneth	II.	*Danvers*	Danvers.
Poor, Walter Everett	VI.	*Salem*	Salem.
Poore, Lester Dean		*Georgetown*	Georgetown.
Pope, Ahrend Oliver	VI.	*Winthrop Highlands*	Winthrop Highlands.
Potter, Orrin William, Jr.	I.	*Chicago, Ill.*	6 Louisburg Sq.
Potter, Sarah Emeline	IV.	*Acworth, N.H.*	527 Columbus Ave.
Pratt, Arthur Dendney, A.B.	I.	*Brooklyn, N.Y.*	Technology Chambers.


1.0
1.1
1.25
1.4
1.6
2.8
2.5
3.2
2.2
3.6
2.0
4.0
1.8

1.0
1.1
1.25
1.4
1.6
2.8
2.5
3.2
2.2
3.6
2.0
4.0
1.8

1.0
1.1
1.25
1.4
1.6
2.8
2.5
3.2
2.2
3.6
2.0
4.0
1.8

1.0
1.1
1.25
1.4
1.6
2.8
2.5
3.2
2.2
3.6
2.0
4.0
1.8

1.0
1.1
1.25
1.4
1.6
2.8
2.5
3.2
2.2
3.6
2.0
4.0
1.8

SPECIAL STUDENTS (*continued*).

NAME.	COURSE.	HOME.	RESIDENCE.
Presson, William Herbert	VI.	*Gloucester*	Gloucester.
Puhl, Paul William, A.B.	X.	*Harrisburg, Pa.*	27 St. Botolph St.
Purdy, Stanley Blanchard	V.	*Wakefield*	Wakefield.
Radford, Hal Mason	V.	*Detroit, Mich.*	39 St. Botolph St.
Rambo, Marcellus, B.S.	II.	*Marietta, Ga.*	240 W. Newton St.
Rand, Robert	II.	*Newton Centre*	Newton Centre.
Rasmussen, William	IV.	*Des Moines, Iowa*	8 St. Botolph St.
Rawlinson, Wm. Woodward	III.	*Lowell*	234 Newbury St.
Regnell, Ralph Tucker	III.	*Attleboro*	59 Hemenway St.
Rehn, John Franklin	III.	*New London, Conn.*	29 Cumberland St.
Reilly, Will Robison	III.	*Salt Lake City, Utah*	59 Hemenway St.
Remick, Arthur Taylor	IV.	*Trenton, Ill.*	Technology Chambers.
Remon, John Allen	VI.	*Salem*	Salem.
Reyburn, John R., A.B.	VI.	*St. Louis, Mo.*	6 Louisburg Sq.
Reyes, Francisco Damaso	I.	*Manila, P.I.*	12½ St. James Ave.
Rich, Charles James	II.	*Norwood*	Norwood.
Richards, Karl Willis	I.	*W. Newton*	W. Newton.
Richardson, Edward M.		*Lime Rock, Conn.*	6 Louisburg Sq.
Richardson, Henry Barber	II.	*Boston*	224 Beacon St.
Riefkohl, Rudolf William	II.	*Maunabo, Porto Rico*	216 W. Newton St.
Riley, Edward John	VI.	*Charlestown*	37 Belmont St., C.
Riley, James Garfield	V.	*Waltham*	Waltham.
Riley, Lewis Adams, 2d	II.	*Philadelphia, Pa.*	215 Newbury St.
Robinson, Winslow Davis	XIII.	*Stapleton, N.Y.*	215 Newbury St.
Roco, Mateo	I.	*Manila, P.I.*	147 Appleton St.
Rood, Vernon Stone	III.	*Jeanesville, Pa.*	234 Newbury St.
Root, John Allen	III.	*St. Louis, Mo.*	Technology Chambers.
Ruff, DeWitt Clinton	II.	*St. Paul, Minn.*	Technology Chambers.
Ruggles, Guy Hall	III.	*Reading*	Reading.
Ruppel, Henry E. K., A.M.	V.	*Brooklyn, N.Y.*	35 Cushing Ave., D.
Russell, Clifford Barstow	II.	*W. Hanover*	W. Hanover.
Russell, Foster		*Colrain*	128 Berkeley St.
Sadtler, Philip Bridges	X.	*Philadelphia, Pa.*	281 Dartmouth St.
Santry, Joseph Vincent	VI.	*Roxbury*	97 Dale St., R.
Sargent, Edward Haynes	I.	*Newburyport*	Newburyport.
Sargent, Horace Stillman	II.	*Revere*	Revere.
Schmidt, Frederic Becker	IV.	*Westfield*	Technology Chambers.
Schneider, Franz, Jr.	II.	*Lawrence*	12 Newbury St.
Schriefer, Herman Carson	III.	*Brooklyn, N.Y.*	10 Ashford St., A.
Scott, Edward James	I.	*Lawrence*	41 St. Botolph St.
Segar, Ralph LeRoy	VI.	*Westerly, R.I.*	Technology Chambers.
Seiglie, Nestor Manual	I.	*Sagua la Grande, Cuba*	161 W. Canton St.
Sewell, Henry Rollo	II.	*Hastings, Nebr.*	234 Newbury St.
Seyms, Robert Wyndham	II.	*Hartford, Conn.*	264 Newbury St.

SPECIAL STUDENTS (*continued*).

NAME.	COURSE.	HOME.	RESIDENCE.
Shalling, Henry Waldo	VI.	*Stonington, Conn.*	110 Gainsborough St.
Shapira, Samuel	III.	*Boston*	32 Chambers St.
Shapleigh, Charles Henry	I.	*Lock Haven, Pa.*	10 Ashford St., A.
Shen, Tin-Ching	VI.	*Foo-Chow, China*	78 Huntington Ave.
Shields, Frank Brown	V.	*Seymour, Ind.*	140 Marlborough St.
Shingler, George Pinckney, Jr.	V.	*Donalsonville, Ga.*	444 Mass. Ave.
Shippen, Allen Edward		*E. Greenwich, R.I.*	358 Columbus Ave.
Silberman, Samuel Thomas	I.	*Baltimore, Md.*	32 Clarendon St.
Skillings, Arthur Earle	XIII.	*Brighton*	51 Dustin St., B.
Slack, Edgar Percival	VI.	*No. Abington*	1 Oxford Terrace.
Slater, Duane Smith		*Tyringham*	Brookline.
Sloss, Alexander Coffee, Jr.	VI.	*St. Louis, Mo.*	Newton Highlands.
Small, Walter Blaisdell, B.S.	V.	*Providence, R.I.*	Chelsea.
Smith, Edward Richard	I.	*So. Boston*	875 E. Second St., E.B.
Smith, Eugene Gregory	I.	*Ellis, Nebr.*	47 St. Botolph St.
Smith, Theodore Lincoln	II.	*Concord*	Concord.
Snow, Edwin Bertrand, Jr.	II.	*Medfield*	10 Durham St.
Soule, Lincoln Rockwell	X.	*Dorchester*	237 Beacon St.
Souther, John Glendon, A.B.	II.	*Jamaica Plain*	36 Greenough Ave., J.P.
Spear, Herbert Gay	X.	*Newtonville*	Newtonville.
Spencer, Walter Carpenter	I.	*Providence, R.I.*	33 St. Botolph St.
Standley, Chester Larcom	II.	*Manchester*	7 Follen St.
Stanton, Everett Chesebro	VI.	*Sharon*	Sharon.
Staples, Walter Allan	VI.	*St. John, N.B.*	Somerville.
Starkweather, Oscar Henry	IV.	*Needham*	53 Gloucester St.
Stebbins, Ralph Gilbert	IV.	*Cleveland, Ohio*	Newton.
Steele, Carroll Dame	XIII.	*Dorchester*	26 Columbia Road, D.
Steese, Charles Mullin	II.	*Mt. Holly Springs, Pa.*	10 Durham St.
Stevens, Fred Barstow, Jr.	II.	*Lynn*	Lynn.
Stevens, Herbert Alfred	II.	*Haverhill*	Haverhill.
Stevens, Louisa Bancroft	IV.	*Cambridge*	16 Louisburg Sq.
Stewart, Donald Argyle	II.	*Kalamazoo, Mich.*	264 Newbury St.
Stewart, Joseph Baird, Jr.	I.	*Newtonville*	Newtonville.
Stockwell, Frank Clifford, A.B.	VI.	*So. Framingham*	So. Framingham.
Stone, Edward Jonas	VI.	*Sherborn*	Sherborn.
Stone, Elizabeth, A.B.	IV.	*Dorchester*	53 Harvard St., D.
Stone, Lawrence Edward, A.B.	VI.	*Cleveland, Ohio*	Technology Chambers.
Stow, Joseph Pomeroy, Jr.	II.	*Middletown, Conn.*	18 Bickerstaff St.
Strongman, Elizabeth Jane	VII.	*Roslindale*	58 Hewlitt St., Ros.
Stubbs, Norman Higgins		*Chicago, Ill.*	99 Newbury St.
Sullivan, Homer Vincent, B.S.	VI.	*Boston*	35 Melville Ave.
Sullwold, Herbert Arthur	IV.	*St. Paul, Minn.*	Technology Chambers.
Symons, Harold Mortimer		*Laramie, Wyo.*	16 Cumberland St.
Taite, Frank Griffiths		*Philadelphia, Pa.*	36 Newbury St.

SPECIAL STUDENTS (*continued*).

NAME.	COURSE.	HOME.	RESIDENCE.
Taylor, Irvine Simons	I.	*Earlville, Ill.* . . .	58 Pinckney St.
Taylor, Robert Kellogg . .	XI.	*So. Glastonbury, Conn.*	1 Griggs Place.
Taylor, William Chittenden	V.	*Wiscasset, Me.* . .	Somerville.
Tebbets, James Hargraves .	II.	*Somersworth, N.H.*	Winthrop Highlands.
Temple, Edward Hastings, Jr.	III.	*Taunton*	Technology Chambers.
Terrell, Wendell P., B.S. .	II.	*Fort Worth, Texas* .	84 Sawyer St.
Tetlow, John	V.	*Adams*	15 Concord Sq.
Thayer, Ralph Carpenter .	III.	*Dorchester*	10 Hamilton St., D.
Thayer, Robert Ellis . . .	VI.	*Chelsea*	Chelsea.
Thomas, Arthur Scott . . .	II.	*Lowell*	19 St. James Ave.
Thomas, John Joseph . . .	II.	*Waltham*	Waltham.
Thompson, Abbot Howe . .	VI.	*Brookfield*	24 Cumberland St.
Thompson, Louis Arnett . .	VI.	*Warren, Pa.* . . .	71 Mt. Vernon St.
Thorndike, John Richard, A.B.	IV.	*Boston*	Beverly Farms.
Throckmorton, Oak Lee . . .	I.	*Wichita, Kans.* . .	99 Pinckney St.
Tod, Martin S.	I.	*Youngstown, Ohio* .	102 W. Concord St.
Todd, Robert Boardman .	X.	*Lawrence*	41 St. Botolph St.
T . man, George Edward, A.B.	VI.	*Westbrook, Me.* .	194 W. Springfield St.
Tourtellot, Henry Bernon, A.B.	V.	*Derry, N.H.* . . .	50 S. Russell St.
Tracy, William Alton . . .	VI.	*So. Coventry, Conn.*	17 St. James Ave.
Trauerman, Carl Joseph . .	III.	*Allegheny, Pa.* . .	Technology Chambers.
Tresnon, John Ewart . . .	VI.	*Lancaster, England*	Everett.
Trimingham, Kenneth Fenton .		*Hamilton, Bermuda*	112 Newbury St.
True, Harold Edwin . . .	X.	*Newburyport* . . .	Newburyport.
Trull, Alden Harold	II.	*Milton*	Milton.
Tse, Tsok Kai	III.	*Canton, China* . .	196 Dartmouth St.
Tufts, William, S.B. . . .	VI.	*Boston*	56 Dwight St.
Tully, Edward Joseph . .	VII.	*Jamaica Plain* . .	22 Chestnut Ave., J.P.
Tupper, Fred William, Jr. . .	I.	*E. Orange, N.J.* . .	1 Copeland Pl., R.
Turnbull, Myrton James . . .		*Hartford, Conn.* . .	43 St. Botolph St.
Turner, Claude Vernon, Ph.B.	VI.	*Minneapolis, Minn.*	120 W. Newton St.
Turner, Edgar Ames . . .	II.	*St. Louis, Mo.* . . .	63 Chestnut St.
Tyler, John	X.	*Williamsburg, Va.* .	10 Durham St.
Tyndall, James, A.B. . . .	II.	*Old Mystic, Conn.*	179 Chestnut Ave., J.P.
Van Keuren, Henry Phillip T.	XIII.	*Howell, Mich.* . .	142 Huntington Ave.
Varney, George Newton		*Rochester, N.H.* . .	39 Huntington Ave.
Vedder, James Randall . .	IV.	*Syracuse, N.Y.* .	Technology Chambers.
Vern, George James	VI.	*Detroit, Mich.* . . .	242 Newbury St.
Very, Samuel Rogers T.		*Boston*	Hotel Oxford.
Vogelsberg, Henry Thomas .	I	*Potosi, Mo.*	58 Pinckney St.
Vose, Chester Andrew	I.	*Marion*	17 Follen St.
Wade, Clifford Linwood . .	II.	*New Bedford* . . .	Cambridge.
Walbridge, Carey Albert		*Peterboro, N.H.*	Technology Chambers.
Walter, Ralph Collins . . .	VI.	*Chicago, Ill.* . . .	12 Newbury St.

SPECIAL STUDENTS (*continued*).

NAME.	COURSE.	HOME.	RESIDENCE.
Wang, Lingoh		*Peking, China*	16 St. James Ave.
Waters, Ernest Joseph Hill	I.	*Sydney, Australia*	83 St. Botolph St.
Watson, Roy Stuart	II.	*Milwaukee, Wis.*	69 Pinckney St.
Wattles, Joseph Warren, 3d	II.	*Canton Junction*	Canton Junction.
Webb, Harry	III.	*Springfield, Ohio*	237 Beacon St.
Weeks, Allen Taber	II.	*Boston*	215 Newbury St.
Weeks, Harold Eastman	VI.	*Upper Montclair, N.J.*	Newton Centre.
Weinz, William Elliot	X.	*Roxbury*	17 Hazlewood St., R.
Welch, Geoffrey Wheaton	VI.	*Fergus Falls, Minn.*	35 St James Ave.
Wellington, Harold W.	III.	*E. Braintree*	223 Newbury St.
Wells, Ernest Edward	X.	*Toronto, Ontario*	Lowell.
Wen, Ching Yü	III.	*Canton, China*	187 Mass. Ave.
Westervelt, Victor Otis	VI.	*Corpus Christi, Tex.*	Garrison Hall.
Wey, James Philip	I.	*Atlanta, Ga.*	157 Warren Ave.
White, Joseph Henry	XI.	*Lawrence*	Lawrence.
White, Thomas Henry	VI.	*Whitman*	Whitman.
Whitehouse, Morris Homans	IV.	*Portland, Oreg.*	8 Westland Ave.
Whitmore, Charles William	I.	*No. Cambridge*	No. Cambridge.
Whittemore, Joseph Damon	VI.	*Newton*	237 Beacon St.
Whittemore, Walter L., Jr.	III.	*Boston*	72 Pinckney St.
Whitten, Charles Ernest	II.	*Lynn*	234 Newbury St.
Wilcox, Frederic Stratton	IV.	*Newtonville*	Newtonville.
Wilfley, Clifford Redman, B.S.	III.	*Maryville, Mo.*	147 Appleton St.
Wilkinson, Emil	I.	*Buffalo, N.Y.*	99 Newbury St.
Willcomb, Roland Howard	III.	*Ipswich*	240 W. Newton St.
Willcox, Frederick Hartwell	V.	*Smyrna, N.Y.*	183 Warren Ave.
Williams, Clarence Benton	VI.	*Utica, N.Y.*	215 Newbury St.
Williams, Edward Thrasher	I.	*Peking, China*	264 Newbury St.
Williams, James Rice	II.	*Quincy, Ill.*	264 Newbury St.
Williamson, Robert W.		*Columbia, Tenn*	240 W. Newton St.
Wilmot, Frank Dunstan	I.	*Johannesburg, Trans.*	5 St. James Ave.
Wilson, Elbert Carson, A.B.	I.	*Portland, Me.*	31 Worcester St.
Wilson, Richard William	III.	*Deer Park, Ontario*	455 Columbus Ave.
Winch, Arthur Colburn		*Saxonville*	164 Huntington Ave.
Winslow, Arthur Melvin, Ph.B.	I.	*Providence, R.I.*	Providence, R.I.
Wires, Ephraim Stanley	IV.	*Milford*	Technology Chambers.
Witmer, George Stone	VI.	*Washington, D.C.*	261 Newbury St.
Wolfenden, James Campbell	IV.	*Holyoke*	34 Union Park.
Woodruff, Clarence Atha	X.	*Waterbury, Conn.*	Winchester.
Woods, Walter Samuel		*Germantown, Pa.*	428 Newbury St.
Woodward, William Lysander	X.	*Washington, D.C.*	215 Newbury St.
Wright, Julian May	XIII.	*New York, N.Y.*	10 Charles St.
Wright, William Henry P.	XIII.	*Lawrence*	234 Newbury St.
Wu, Nie Quang		*Canton, China*	9 St. James Ave.

SPECIAL STUDENTS (*continued*).

NAME.	COURSE.	HOME.	RESIDENCE.
Yamada, Hachiro		*Tokyo, Japan* . . .	324 Boylston St.
Young, William Augustus . .	I.	*Exeter, N.H.* . . .	10 Durham St.
Youngerman, Conrad . . .	IV.	*Des Moines, Iowa* .	15 Concord Sq.
Yrizarry, Herminio	I.	*San German, Porto Rico*	161 W. Canton St.

SUMMARY.

FELLOWS	13	REGULAR STUDENTS, 4th year .	243
CANDIDATES FOR THE DEGREE		" " 3d year .	169
OF DOCTOR OF PHILOSOPHY	7	" " 2d year .	199
CANDIDATES FOR THE DEGREE		" " 1st year .	215
OF MASTER OF SCIENCE .	12	SPECIAL STUDENTS	614
GRADUATE STUDENTS	187		

Total	1,659
Deduct names counted twice	193
	1,466

Alphabetical List of Officers and Students.

ABBREVIATIONS.—Prof. = Professor; Assoc. Prof. = Associate Professor; Asst. Prof. = Assistant Professor; Inst. = Instructor; Asst. = Assistant; Res. Assoc. = Research Associate; Res. Asst. = Research Assistant; Sp. = Special (Student). Numerals denote the year of regular students. For list of officers see pages 18 to 29. For list of students see pages 349-393.

Abbott, G. A. . *Res. Ass* .
Ackerson, J. L. . . . G.
Adams, A. K. . . . *Asst.*
Adams, A. K. . . . Sp.
Adams, C. L. *Assoc. Prof.*
Adams, D. 4
Adams, E. Q. 1
Adams, F. O., Jr. . Sp.
Adams, P. L. . . . Sp.
Adams, W. A. 2
Ahern, M. J. . . . Sp.
Albro, R. C. 3
Aldrich, C. S. . . . *Asst.*
Allbright, C. . . . Sp.
Allen, C. E. 3
Allen, C. F. . . . . *Prof.*
Allen, D. C. 1
Allen, E. E. . . . . Sp.
Allen, H. E. 2
Allen, L. 3
Allen, L. H. 2
Allen, M. E. . . . Sp.
Allen, R. H. . . . Sp.
Allen, S. C. 4
Almy, E. T., Jr. . . Sp.
Altgelt, E. S. . . . Sp.
Alvord, H. B. 3
Amadon, F. W. . . . 3
Ames, M. 2
Ames, W. O. . . . Sp.
Anderson, J. W. . . . 4
Anderson, P. G. W. . . 1
Andrews, F. H. . . Sp.
Angus, R. A. . . . Sp.
Anson, C. L. 4
Applin, F. D. 1
Arnold, A. B. 3
Arnold, H. C. . . . Sp.
Ashenden, R. C. . . Sp.
Ashmore, M. B. . . . 4
Austrian, S. B. . . . 1
Ayer, J. . . . . . *Asst.*
Ayres, R. S. . . . Sp.

Babcock, A. B. . . Sp.
Babcock, Elizabeth B. 1
Bachelder, C. A. . . . 1
Bachmann, F. 3
Bailey, F. H. *Assoc. Prof.*
Bailey, G. W. . . . Sp.
Bailey, H. S. 4
Baker, B. C. . . . Sp.
Baker, C. F. . . . Sp.
Baker, H. P. 3
Baker, J. M. 3
Baker, W. S. . . . Sp.
Ball, E. C. . . . . Sp.
Ball, H. J. 4
Ballard, H. F. . . . Sp.
Banash, J. I. 4
Bancroft, A. F. . . Sp.
Bancroft, J. R. . . . 1
Bangs, C. H. 2
Barber, E. H. . . . Sp.
Barber, R. J. 4
Barcus, W. J. E. . . 2
Bardwell, E. S. . . . 4
Bardwell, F. L. *Asst. Prof.*
Barker, Bertha I. . Sp.
Barker, C. C. . . . Sp.
Barker, J. M. 3
Barlow, J. E. . . . *Asst.*
Barnaby, G. A. . . *Asst.*
Barnes, H. P. 4
Barnes, J. S. 2
Barnes, R. B. . . . Sp.
Barnett, L. 2
Barnett, S. F. . . . Sp.
Barrett, P. B. 2
Barrier, E. A. . . . *Asst.*
Barrows, G. H. . . . G.
Barry, J. G. . . . . Sp.
Bartlett, D. P. . . . *Prof.*
Bartlett, C. T. 4
Bartlett, E. B. . . Sp.
Barton, W. E. 2
Batchelder, C. L. . Sp.

Batchelder, F. R. . . 4
Batchelder, R. J. . . 2
Batchelor, C. C. . . *Inst.*
Bates, Arlo . . . . *Prof.*
Batsford, H. E. . . . 2
Battles, D. R. . . . . G.
Beam, C. W. 3
Beane, W. P. . . . Sp.
Beck, R. E. 2
Beede, E. J. 2
Beers, H. W. 4
Beers, L. G. 1
Belcher, D. 1
Belcher, F. K. 2
Belcher, G. M. . . . 2
Belcher, M. . . . . Sp.
Belden, C. J. 1
Beliveau, F. G. . . Sp.
Belknap, H. P. . . . 1
Bell, A. L. . . . . Sp.
Bender, H. C. . . . Sp.
Benham, F. A. . . . 4
Bennett, H. H. . . . 1
Bent, L. N. 4
Bentley, F. H. . . . 4
Bentley, H. H. . . . 2
Berg, W. H. 1
Berliner, E. M. . . Sp.
Berry, C. W. . . . *Inst.*
Besselievre, A. C. . . 2
Bettington, C. A. . . Sp.
Bettington, E. M. . Sp.
Bicknell, J. W. 2
Bigelow, J., Jr. . . . *Prof.*
Bigelow, R. P. . . . *Inst.*
Bigelow, W. W. . . Sp.
Bingham, R. . . . Sp.
Bird, V. E. 2
Bishop, F. H. 1
Blachstein, J. . . . *Inst.*
Black, A. S. . . . . Sp.
Black, T. B. 1
Blackburn, H. W. . . 2

Blackwell, O. B. . . . 4
Blackwell, V. J. . . Sp.
Blade, E. H. 1
Blair, F. P. 1
Blake, A. 1
Blake, A. W. . . . Sp.
Blake, Gladys M. E. . 1
Blanchard, A. A. . . *Inst.*
Block, P. H. 1
Blodgett, A. A. . . . 4
Blodgett, L. G. . . . 4
Blodgett, Mildred E. Sp.
Bloede, C. S. . . . Sp.
Blood, K. T. 1
Bloom, D. . . . . Sp.
Blount, F. M. . . . . G.
Boardman, W. E. . Sp.
Bodenstein, M. L. . Sp.
Boland, Marion G. . . G.
Boles, E. D. 3
Bond, F. M. 2
Bonillas, Y. S. . . Sp.
Bonta, E. W. 3
Boggs, C. R. . . . *Asst.*
Booth, W. E. 2
Bounetheau, H. D. . . 2
Boush, K. C. . . . Sp.
Bowen, C. A. 3
Bowers, G. W. . . . 1
Bowman, B. A. . . . 1
Bowman, D. . . . Sp.
Bowman, J. R. . . . 1
Boyce, J. N. . . . Sp.
Boylston, C. H. . . . 2
Boynton, A. S. 4
Boynton, W. W. . . . 2
Bradbury, R. D. . . . 4
Bradbury, W. K. . . . 1
Bradford, A. H. . . . 2
Bradley, G. E. . . . *Asst.*
Bradley, H. C. . . . *Inst.*
Bradley, J. C. 3
Bradshaw, W. H. . . 3
Bragdon, C. R. . . . 3
Bray, W. C. . *Res. Assoc.*
Breed, C. B. . . . . *Inst.*
Breed, S A. . . . . *Inst.*
Breitzke, C. F. . . Sp.
Bremer, A. E. 2
Brewer, C. . . . . Sp.
Bridgman, G. T. . . Sp.
Briggs, E. N. . . . Sp.
Brock, L. W. 3
Brooks, A. A. 3
Brooks, J. C. 2
Brown, C. J. . . . Sp.
Brown, C. O. 2
Brown, E. LeV., Jr. . 2
Brown, F. A. . . . *Asst.*
Brown, H. G. 3
Brown, H. H. 4
Brown, H. W. 4
Brown, J. W. . . . *Inst.*
Brown, L. M., Jr. . Sp.
Brown, M., Jr. . . *Asst.*
Brown, W. F. . . *Inst.*
Browne, F. A. 4
Brownlee, R. B. . . Sp.
Brownlee, R. W. . Sp.
Brush, G. S. . . . Sp.
Bryant, G. H. . . . Sp.
Buchanan, J. M. . . . 4
Buckingham, G. H. Sp.
Buckler, R. . . . . Sp.
Buhler, H. W. . . . *Inst.*
Buker, H. W. 4
Bullard, B. 2
Bullard, M. L. . . . Sp.
Bullens, D. K. . . . 1
Bundy, S. S. 1
Burch, J. M., Jr. . . . 2
Burgess, H. L. . . . 2
Burgher, S. L. 1
Burhans, H. N. . . Sp.
Burke, R. H. 4
Burleigh, C. R. . . . 4
Burnap, G. E. 4
Burnham, R. G. . . *Inst.*
Burns, P. S. . . . . *Inst.*
Burpee, G. W. . . Sp.
Burrison, H. K. . . *Inst.*
Burwell, A. L. . . . Sp.
Butler, C. M. . . . Sp.
Butts, W. M. . . . Sp.
Byrne, J. G. . . . Sp.
Byron, W. H. . . . Sp.

Cacicedo, L. 1
Cady, J. H. . . . . Sp.
Cady, W. J. 4
Cain, W. B. . . . . Sp.
Caine, S. A. . . . . G.
Calder, H. W. 2
Caldwell, W. A. . . Sp.
Caldwell, W. E. . . Sp.
Callahan, C. A. . . Sp.
Callaway, H. R. . . . 2
Calley, W. E. . . . Sp.
Campbell, A. . . . Sp.
Campbell, C. L. . . . 1
Campbell, E. S. . . . 4
Carey, F. V. . . . Sp.
Carr, S. T. 4
Cartegena, J. J. . . . 4
Cartagena, N. M. . Sp.
Carter, B. E., Jr. . . *Inst.*
Carter, B. F. 3
Carter, C. E. . . . . Sp.
Carter, H. L. 2
Carty, M. W. . . . *Asst.*
Cary, B. W. 2
Casey, F, A. . . . Sp.
Cassidy, H. A. . . Sp.
Cassino, L. P. 2
Caton, J. H., 3d . . Sp.
Caypless, W. S. . . . 4
Cederholm, Anna M. . 4
Cenedella, A. H. . . . 3
Chadbourne, W. E. . 4
Chadwick, J. P. . . . 3
Chadwick, L. R. 4
Chaffee, E. L. 3
Chandler, B. F. . . Sp.
Chandler, E. . . . Sp.
Chandler, F. W. . . *Prof.*
Chandler, F. W. . . Sp.
Chandler, H. S. . . . 2
Chapman, E. P. . . . 1
Chapman, L. D. . . . 1
Chapman, T. G. . . . 1
Chase, C. H. 4
Chase, E. K. . . . . Sp.
Chase, E. P. 4
Chase, E. S. . . . . Sp.
Chase, H. R. 3
Cheney, A. M. 4
Chidester, A. M. . . . 4
Child, H. . . . . Sp.
Chinchilla, E. 1
Chipman, K. G. . . Sp.
Christensen, A. O. . Sp.
Christiansen, E. O. . . 3
Christie, J. A. 1
Chuchian, A. M. . . Sp.
Chuchian, S. M. . . Sp.
Clapp, C. S. 2
Clapp, Lucy J. . . Sp.
Clapp, P. J. 3
Clark, C. W. . . . Sp.
Clark, H. L. . . . Sp.
Clark, L. A. 2
Clark, M. S. 2
Clark, R. S. 4
Clarke, L. C., Jr. . . G.
Clarke, R. S. 4
Clatur, G. A. . . . Sp.
Clifford, H. E. . . . *Prof.*
Clifford, W. B. . . Sp.
Clifford, W. W. . . Sp.
Cloudman, H. C. . . . 1
Coburn, F. G. 3
Cochrane, C. N. . . Sp.
Coe, M. A. . . . . Sp.
Coes, H. V. O. . . . 4

Coey, S. C. 4
Coffin, C. W. 3
Coffin, L. 2
Coffin, W. B. . . . Sp.
Cohen, A. S. 2
Cole, F. A. 2
Cole, M. J. . . . . Sp.
Coleman, G. S. . . Sp.
Colgan, E. J., Jr. . . 1
Collester, C. H. . . . *Asst.*
Collins, R. C. 2
Colson, C. S. 2
Colson, H. C., Jr. . . . 1
Colvin, P. J. 3
Conner, G. C. 1
Connolly, E. L. . . . 1
Conover, J. W. . . . Sp
Conron, R. F. . . . Sp.
Cook, A. M. 2
Cook, H. H. 4
Cook, H. M. 1
Cookinham, E. F. . . 1
Correll, H. . . . . Sp.
Correll, J. A. . . . Sp.
Coupal, J. S. 3
Couper, W. 4
Cowdrey, I. H. . . *Asst.*
Cowen, E. R. 3
Cram, F. S. . . . . Sp.
Crane, G. A. 3
Crane, H. G. . . . *Asst.*
Crane, R. G. 2
Cranston, R. E. . . . 4
Critchett, J. H. . . . 1
Critchlow, P. N. . . Sp.
Crohurst, H. R. . . Sp.
Crommett, O. J. . . Sp.
Crosby, R. H. . . . Sp.
Crosby, W. O. *Assoc. Prof.*
Cross, C. R. . . . . *Prof.*
Crossley, F. T. . . . 1
Crowley, F. C. V. . . 1
Cullimore, A. R. . . . 3
Cumings, P. L. 3
Curl, C. M. . . . . Sp.
Curley, E. . . . . Sp.
Curran, J. F. 2
Currier, C. F. A. . . *Prof.*
Cushing, R. W. . . . 2
Cushman, R. E. . . . 4
Cutten, L. H. . . . Sp.

Daddow, S. H. . . Sp.
Daley, M. J. . . . Sp.
Dalrymple, G. E. . . Sp.
Daly, J. C., Jr. . . . 4
Damon, J. C. . . . *Asst.*
Darling, Maude F. . . 3
Dass Jalota, S. . . Sp.
Davenport, G. L., Jr. 4
Davenport, L. D. . Sp.
Davidson, J. H. . . Sp.
Davidson, S. L. . . Sp.
Davis, D. C. 4
Davis, J. A. . . . . Sp.
Davis, J. F. 1
Davis, L. H. . . . Sp.
Davis, L. R. . . . Sp.
Davis, M. M. 2
Davis, R. P. 4
Davis, W. F. 2
Davol, W. D. . . . Sp.
Dawes, C. L. 1
Day, H. W. 3
Dean, A. T. 2
Dean, C. S. 3
Dean, H. W. 4
Deavitt, W. J. . . . 4
DeLoach, J. K. . . Sp.
Dempwolf, F. G. . . 3
Denmark, C. R. . . Sp.
Dennedy, J. H. . . Sp.
Denny, M. E. 2
Derr, L. . . *Assoc. Prof.*
de Steiguer, W. G. . Sp.
Despradelle, D. . . *Prof.*
Dexter, G. M. 2
Dewey, D. R. . . . *Prof.*
Diamond, H. H. . . . 2
Dickerman, A. L., Jr. . 1
Dickinson, L. A. . . Sp.
Dickson, V. H. . . . Sp.
Dike, F. H . . . . *Inst.*
Dill, C. 4
Disque, K. H. . . . Sp.
Dissel, T. A. 4
Dodge, P. K. . . . Sp.
Dodge, P. V. 3
Dole, H. H. 1
Dole, M. W. . . . . *Asst.*
Dolke, W. F., Jr. . Sp.
Donaldson, J. . . . Sp.
Donnewald, A. H. . Sp.
Donovan, J. J. . . . 4
Dore, C. J. . . . . Sp.
Dorsey, T. F. 4
Dort, J. C. 1
Doten, C. W. *Asst. Prof.*
Doucette, E. J. . . Sp.
Douglass, A. S. . . . 2
Dow, B. W. . . . . Sp.
Dows, A. H. . . . Sp.
Drake, R. E. 2
Draper, C. N. . . . Sp.
Draper, H. R. . . . Sp.
Drisko, W. J. *Asst. Prof.*
Drown, H. C. . . . Sp.
Druley, W. P. 3
Dubois, G. A. 3
Dun, H. W., Jr. . . . 2
Duncan, H. S. 3
Dunkel, C. A. 1
Durgin, M. F. 1
Dwight, J. 4
Dyer, Bertina . . . Sp.
Dyer, K. W. . . . Sp.
Dyer, R. L. . . . . Sp.

Eames, D.D. 4
Eames, H. S. 2
Earle, F. E. . . . Sp.
Earle, R. B. . . . . *Inst.*
Early, F. H. . . . Sp.
Eaton, C. A. 3
Eaton, H. I. . . . Sp.
Eaton, W. M. . . . Sp.
Eastman, G. W. *Res. Assoc.*
Edge, A. F. . . . . Sp.
Edmonds, C. A. . . . 2
Edwards, C. F. . . Sp.
Egan, S. J. 3
Eisenhart, M. H. . . Sp.
Elbert, J. J. 1
Elder, F. C. . . . . Sp.
Eliot, E. M. 4
Ellis, A., Jr. . . . Sp.
Ellis, L. B. . . . . Sp.
Ellis, R. 1
Ellsworth, J. T. . . . 2
Elton, H. C. 2
Emerson, C. J. . . *Asst.*
Emerson, G. I. . . . 1
Emilio, S. G. . . . Sp.
Englis, W. F. . . . Sp.
Erhardt, J. . . . . *Inst.*
Esten, P. A. 2
Evans, E. B. 4
Evans, E. C. 4
Evans, J. 3
Everett, H. A. . . . *Inst.*
Everett, W. 2
Ewing, C. G. . . . Sp.

Faben, C. R. . . . Sp.
Faber, T. W. 4
Fales, O. G. 3
Fallon, J. T., Jr. . . . 3
Fanning, P. R. . . . Sp.
Farley, W. F. 4
Farnum, F. R. C. . . 1
Farrington, H. P. . . 3
Farrington, R. D. . . 4
Farwell, C. A. 4
Faulkner, F. R. . . Sp.

Faulkner, R. . . . *Asst.*
Faxon, H. C. 2
Fay, H. . . . *Assoc. Prof.*
Faymouville, LeR. B. Sp.
Feemster, J. H., Jr. Sp.
Fellows, J. H. . . . Sp.
Fellows, R. H. . . . 1
Fenner, J. H. . . . Sp.
Ferguson, W. C. . . Sp.
Fernald, P. E. 2
Ferrandi, A. L. S. . Sp.
Ferreira, C. 1
Ferris, R. W. 2
Ferry, L. K. . . . Sp.
Fick, W. G. 1
Field, C., 3d . . . . G.
Finnie, J. I. 1
Fisher, A., Jr. 4
Fisher, C. W., Jr. . . 4
Fisher, H. C. 1
Flagg, M. . . . . Sp.
Flaherty, H. W. . . . 2
Fleming, C. S., Jr . . 3
Fletcher, C. B. . . . 1
Fletcher, H. L. . . Sp.
Fletcher, M. 1
Folsom, Susie T. . . Sp.
Folsom, W. C. 2
Forbes, E. D. . . . *Inst.*
Forbes, E. W. . . . Sp.
Ford, W. D. 2
Forrest, L. R. 1
Foss, M. H. 1
Foster, C. E. 1
Foster, H. F. 1
Fottler, J. A. . . . Sp.
Fouhy, J. F. 4
Frank, E. D. A. . . . 4
Frank, J. M. 3
Franks, F. L. 2
Freed, C. 1
Freedman, L. A. . . Sp.
Freethy, G. E. . . Sp.
French, H. W. . . . 2
Friedman, F. J. . . Sp.
Frost, H. Y. 1
Fuller, A. P. 3
Fuller, B. R. . . . Sp.
Fuller, C. E. *Asst. Prof.*
Fuller, F. M. 4
Funk, G. C. . . . . G.
Furer, W. C. 4
Furness, G. C. . . . Sp.

Gage, C. E. . . . . *Asst.*
Gale, R. D. 3
Gallagher, J. T. . . . 2
Gambrill, G. T., Jr. . Sp.
Gammons, H. T. . . 4
Gardner, A. L. 2
Gardner, H. 1
Gardner, H. W. *Asst. Prof.*
Gardner, R. S. . . Sp.
Garratt, J. E. 3
Garrett, G. P. 1
Gates, W. A. 3
Gatewood, R. D. . . G.
Gay, A. T. . . . . Sp.
Gaylord, J. M. . . Sp.
Gaylord, W. W. . . . 4
Genoud, E. G. 2
George, N. R., Jr. . *Inst.*
Gerhard, H. W. . . Sp.
Gerhard, N. P. . . . 4
Gerrish, H. T. 2
Gianella, J., Jr. . . . 2
Gibbons, C. A., Jr. . . 2
Gibbons, M. J., Jr. . Sp.
Gibbs, D. W. 1
Gideon, S. E. . . . Sp.
Gifford, R. S. . . . *Asst.*
Gilkison, G. M. . . Sp.
Gill, A. H. . *Asst. Prof.*
Gill, W. J., Jr. . . . *Inst.*
Gilman, W. C. . . . Sp.
Gilman, W. F. . . Sp.
Gilmer, T. W. . . . Sp.
Gimson, B. L. 2
Ginsburg, H. A. . . . 4
Ginzberg, A. H. . . . 1
Given, W. B., Jr. . . . 2
Gladding, J. N. . . . 4
Glancy, R. C. 1
Gazier, H. M. 1
Glidden, J. T. . . . *Asst.*
Glover, G. T. 2
Godfrey, K. D. . . . 1
Gonder, W. B. . . Sp.
Goodman, F. E. . . Sp.
Goodnow, F. E. . . Sp.
Goodrich, A. L. . . *Inst.*
Goodwin, E. S. . . Sp.
Goodwin, H.M. *Assoc.Prof.*
Gordon, L. . . . . Sp.
Gould, G. S. . . . Sp.
Gram, C. W. 1
Gray, G. H. 1
Green, F. M. 1
Green, W. 4
Greene, A. E. . . . Sp.
Greene, J. F. 2
Greenwood, P. P. . . 3
Gregory, C., Jr. . . Sp.
Gregory, N. B. . . Sp.
Griffin, G. A. 3
Griffin, J. E. . . . Sp.
Griffin, P. K. 4
Griffin, W. I. 3
Grimes, W. F. 2
Griswold, H. W. . . . 2
Groesbeck, E. C. . . . 4
Groff, J. S. . . . . Sp.
Groover, F. B. . . Sp.
Grubnau, N. C. . . . 2
Grunsky, E. L. . . Sp.
Guernsey, G. R. . . . 4
Guilford, I. M. . . . 2
Gupta, B. C. 3
Gurney, H. P. 2

Haas, L. F. C. . . . Sp.
Hahn, E. 1
Hale, J. E. 2
Hale, J. W. L. . . . 2
Hale, Mary D. . . Sp.
Hale, P. J. 2
Haley, J. F. 4
Hall, C. A. 2
Hall, E. R. 2
Hall, H. R. 3
Hall, M. B. 2
Hall, R. N. . . . . Sp.
Hall, W. R. 4
Hall, W. T. . . . . *Inst.*
Hallett, L. F. 3
Hallowell, H. B. . . Sp.
Hamill, E. W. 3
Hamilton, C. E. . . . 4
Hamilton, E. R. . . . 1
Hamilton, F. S. . . Sp.
Hammond, B. . . . Sp.
Hammond, J. C. . . . 2
Hammond, N. S. . Sp.
Hammond, N. LeR. . 2
Hamner, E. C. . . . 4
Hampton, L. C. . . Sp.
Handy, P. L. 2
Hanford, J. W. G. . Sp.
Hanington, T. R. . Sp.
Hanley, G. T. . . . Sp.
Hanna, E. S. 1
Hardison, C. T. . . . 1
Hardy, W. A. 4
Harlow, J. B. . . . Sp.
Hare, J. A. . . . . *Inst.*
Harriman, D. F. . . Sp.
Harrington, E. E. . . 4
Harris, N. . . . . Sp.
Harrison, A. 1
Harrison, J. G. . . Sp.
Harrison, P. S. . . Sp.
Harrub, C. N. 1
Hart, H. P. . . . . Sp.
Hartshorne, D. S. . Sp.

Hartwell, A. E. . . . 3
Harvey, H. B. . . Sp.
Harvey, H. W. . . . 4
Harwood, J. H. H. . . 2
Hasbrouck, F. F. . Sp.
Hasegawa, T. 1
Haskell, R. . . . . G.
Haskell, R. F. . . . Sp.
Hastings, H. B. . . . 3
Hastings, R. 1
Hastings, W. 3
Hatch, S. F. . . . Sp.
Hathaway, J. W. . . 2
Hatton, J. M. . . . Sp.
Haven, G. B. *Asst. Prof.*
Havens, H. L. 1
Hawkes, C. W. . . . 4
Hayden, R. . . . . Sp.
Hayes, J., Jr. 4
Haynes, G. A. 1
Hayward, H. W. . . *Inst.*
Hayward, M. W. . . 4
Hazen, H. S., Jr. . Sp.
Healy, L. J. D. . . . 1
Heard, F. C. 1
Heath, A. W. 2
Heckman, A. R. . . . 4
Hedge, L. B. 2
Heidelberg, F. M. . . 1
Heilman, W. R. . . . 2
Heimer, P. H. 2
Henderson, A. B. . . 1
Henderson, G. M. . . 4
Henderson, L. P. . Sp.
Henius, E. T. . . . Sp.
Hennen, R. D. . . . 3
Henrici, H. C. 4
Herold, A. F. 1
Hersey, I. G., Jr. . . 2
Hertz, A. W. . . . Sp.
Heuter, R. R. 4
Heydon, J. K. . . . Sp.
Heywood, A. T. . . . 4
Hicks, A. . . . . Sp.
Higgins, E. L. . . . Sp.
Hill, G. . . . . Sp.
Hill, H. E. . . . . Sp.
Hiller, E. O. . . . . *Asst.*
Hinckley, A. T. . . . 2
Hinckley, T. L. . . . 4
Hirt, L. E. 4
Hobbie, J. R., Jr. . . 1
Hobson, G. F. . . . Sp.
Hodsdon, G. E. . . . 1
Hoefer, C. A. . . . . G.
Hofman, H. O. . . *Prof.*
Hogner, P. R. L. . Sp.
Holbrook, F. W. . . Sp.
Hollnagel, H. P. . . Sp.
Holmes, A. F. . . . *Asst.*
Holmes, T. B. . . . Sp.
Holmes, W. K. . . . 3
Holmquist, C. A. . . 4
Honeyman, B. R. . . 4
Hoole, H. W. 2
Hooper, E. J. 1
Hosea, R. G. . . . Sp.
Hosmer, G. L. . . . *Inst.*
Hosmer, Helen R. . . 4
Hosmer, H. B. . . Sp.
Hovgaard, W. . . . *Prof.*
Howard, C. A. . . . 4
Howard, J. W. . . *Inst.*
Howe, C. D. 3
Howe, E. S. 1
Howe, R. . . . . Sp.
Howland, H. H. . . . 2
Hoyt, R. N. . . . Sp.
Hoyt, R. S. . . . . G.
Hubbard, C. W. . . . 2
Hudgins, J. C. . . . *Asst.*
Hudson, R. G. . . . 3
Hudson, W. T. . . . Sp.
Hull, A. W. . . . . Sp.
Hulsizer, R. I. . . . 1
Humphrey, C. T. . . *Asst.*
Humphreys, W. *Registrar*
Hunnewell, Mary P. Sp.
Hunt, E. A. . . . . Sp.
Hunt, F. L. 2
Hunt, G. F. 4
Hunter, A. R. . . . Sp.
Hunter, R. . . . . Sp.
Hunter, W. B. . . Sp.
Huntington, C. McK. Sp.
Hursh, R. 4
Hussey, C. L. 2
Hutchins, C. M. . . Sp.
Hutchinson, B. E. . Sp.
Hyde, E. R. 4
Hyde, R. T. 2

Iasigi, O. A. . . . Sp.
Ingalsbe, F. R. . . . 4
Inglee, R. 1
Isenberg, H. O. C. . Sp.

Jaccard, F. C. 3
Jackson, A. F. . . . 1
Jackson, F. . . . . Sp.
Jackson, H. L. . . *Asst.*
Jackson, R. H. . . Sp.
Jackson, R. T. C. . . 4
Jacobs, C. D. 1
Jacobson, C. . . . Sp.
Jaeger, F. 1
Jaggar, T. A., Jr. . *Prof.*
James, E. W. 3
James, W. H . . . *Inst.*
Jarrett, H. H. . . . Sp.
Jealous, A. R. 3
Jenkins, W. B. . . Sp.
Jennings, O. S. . . . Sp.
Jerden, C. G. . . . Sp.
Johnson, B. D. 3
Johnson, C. A. . . . 1
Johnson, C. E. . . Sp.
Johnson, D. W. *Asst. Prof.*
Johnson, J. W. . . . Sp.
Johnson, O. A. . . Sp.
Johnston, C. T. . . Sp.
Johnston, J. F., Jr. Sp.
Johnston, W. A. *Asst. Prof.*
Jones, B. H. 2
Jones, G. R. . . . Sp.
Jones, R. L. 1
Jones, S. P. . . . . Sp.
Jones, W. F. . . . . Sp.
Jones, W. H. 1
Joslin, G. A. . . . Sp.
Joslin, G. B. . . . Sp.
Joy, C. F., Jr. 2
Judd, A. C. 1
Juengling, K. F. . . . 4

Kahn, I. W. . . . Sp.
Kane, J. A. . . . . Sp.
Karch, R. J. . . . Sp.
Kasson, C. LeB. . . . 4
Keables, A. D. . . . 1
Kedy, S. F. . . . . Sp.
Keeler, W. I. . . . Sp.
Keeling, T. C. . . . Sp.
Keeney, R. M. . . . 1
Keleher, A. H. . . . 4
Kelley, E. F. 1
Kelley, M. E. 2
Kelley, R. D. 4
Kellogg, A. C. 1
Kelly, E. F. . . . . Sp.
Kelly, W. J. 1
Kendall, A. S. . . . Sp.
Kendall, B. W. . . . 4
Kenerson, H. V. . . . 1
Kenison, E. . . . . *Inst.*
Keniston, C. W. . . Sp.
Kennard, R. Y. . . . 2
Kennedy, P. J., Jr. . . 4
Kennedy, P. F. . . . 3
Kenway, H. W. . . . 4
Kerr, W. C. 2
Key, H. W. . . . . Sp.
Keyes, R. E. 3
Kidder, J. W. 4

Kiefaber, W. H. . . Sp.
Kilburn, E. E. . . . 2
Kimball, J. 3
Kimball, W. F. . . Sp.
Kimberley, B. R. . . 1
King, C. . . . . . *Asst.*
King, F. J. . . . . Sp.
King, L. H. 1
King, W. W. 1
Kingsbury, H. A. . . 4
Kinnear, J. C. . . . Sp.
Kinsman, C. C. . . Sp.
Kintner, E. G. . . . 3
Kite, Rebecca . . . Sp.
Knapp, W. J. 4
Kneeland, F. R. . . *Inst.*
Knight, R. F. 3
Kolatschevsky, A. T. . 3
Koppitz, C. G. . . Sp.
Krafft, A. J. . . . Sp.
Krafft, E. J. . . . Sp.
Kraus, C. A. . *Res. Assst.*
Kudlich, R. H. . . . 3
Kurrelmeyer, H. R. *Inst.*
Kurtzmann, C. . . . 1
Kydd, J. A. 2

Labbé, A. G. 3
Lage, J. 4
Laird, W. S. . . . Sp.
Lalley, W. H. . . . Sp.
Lamont, C. R. . . . 3
Lambirth, J. R. . . *Inst.*
Land, E. S. 4
Landis, H. S. 1
Lang, A. G. . . . . Sp.
Lang, H. L. . . . . Sp.
Lange, A. H. 1
Lange, F. J. 1
Lanza, G. . . . . . *Prof.*
Larkin, T. . . . . Sp.
Larned, J. I. B. . . . 3
Lasnier, G. C. 1
Lathrop, W. H. . . Sp.
Lawrence, E. K. . . Sp.
Lawrence, G. L., Jr. . 1
Lawrence, R. R. *Asst. Prof.*
Lawrence, W. H.
Assoc. Prof.
Laws, F. A. . *Asst. Prof.*
Lawton, J. T., Jr. . Sp.
Leary, J. F. 2
Leavell, J. H. 3
Lebenbaum, F. C. . Sp.
Lee, E. G. 3
Lee, Tsan-chi . . . Sp.
Leeder, C. W. 1
Leeds, C. T. . . . . Sp.
Lees, G. C. . . . . Sp.
Leland, W. S. *Asst. Prof.*
Lenox, J. E. 1
Lenz, G. J. . . . . *Inst.*
Leong, Yuen Foo . . Sp.
Leslie, B. S. 2
Lewenberg, H. L. . . Sp.
Lewis, E. F. 3
Lewis, G. N. *Res. Assoc.*
Lewis, H. M., Jr. . Sp.
Libbey, F. W. 4
Libbey, H. S. . . . Sp.
Libby, H. C. 3
Lewis, W. K. . . . *Asst.*
Lichtenstein, M. . . Sp.
Light, H. U. 4
Lightner, M. T. . . Sp.
Lincoln, W. H. . . . 4
Lindsay, R. W. . . Sp.
Link, J. H. . . . . Sp.
Littlefield, C. E. . . *Inst.*
Locke, C. E. . . . *Inst.*
Locke, J. H. 2
Lodge, R. W. *Asst. Prof.*
Lofting, H. J. . . . Sp.
Logan, F. 4
Longley, A. A. . . Sp.
Longyear, Helen McG. 1
Loomis, D. A. . . . Sp.
Loomis, L. A. 2
Lord, H. 4
Lord, P. B. 1
Loring, C. G. 4
Lougee, S. 1
Lourie, W. I. 4
Lowe, R. P. . . . . Sp.
Luce, B. P. 3
Luce, R. F. 4
Lucey, W. S. 3
Ludington, F. E. . Sp.
Luehrs, D. M. . . . Sp.
Luening, E. G. . . . 1
Lufkin, C. L. . . . Sp.
Luscomb, Florence H. 1
Luther, G. D. . . . Sp.
Luther, H. B. 2
Lutze, F. C. 4
Lyford, E. F. 2
Lyle, F. W. 2
Lynde, C. 4
Lyne, W. . . . . Sp.
Lyon, O. S. . . . . Sp.
Lyon, S. C. 2
Lyon, W. V. . . . . *Asst.*
Lyons, R. J. 4

McAuliffe, W. J. . . Sp.
McCain, E. D. 4
McCain, S. N. . . . . Sp.
McCarthy, J. F. 1
McChesney, H. H. . . 3
McClintock, J. R. . . 4
McClintock, P. 1
McCready, H. 2
MacDonald, H. J. C. Sp.
MacDonald, W. E. . *Inst.*
Macdonald, W. H. . Sp.
Mace, S. A. 1
McEachern, A. . . . 1
McElroy, J. A. . . Sp.
McGinnis, C. S. . . Sp.
McGowan, J., Jr. . . 2
McGregor, F. S. . . . 3
MacGregor, M. E. . Sp.
McGuigan, F. H. . Sp.
Macintire, H. J. . . *Asst.*
Mack, H. V. 2
Mack, P. W. . . . . Sp.
McKay, R. V. 4
McKernan, J. N. . . . 4
McKibben, F. P. *Asst. Prof.*
McLean, R. W. . . *Asst.*
McManus, J. H. . . *Asst.*
McMillin, J. M. . . . 3
Macomber, A. 3
McPhee, H. E. . . . Sp.
McRae, H. C. 3
McTigue, G. J. . . . 2
Madenigian, K. . . . 1
Mahar, J. T. . . . Sp.
Mahoney, W. E. . . . 2
Mahr, H. W. 3
Mailey, R. D. *Res. Assoc.*
Malcom, S. A. 2
Mann, H. J. . . . . Sp.
Mann, P. F. . . . . Sp.
Manning, C. N. . . Sp.
Manning, Eleanor . . 4
Manning, R. E. . . . 2
Mansfield, A. P. . . Sp.
Manson, E. S. 4
Marquez, F. D. . . . 1
Marshall, H. H. . . . 1
Martin, T. DeV. . . Sp.
Martin, W. H. 3
Martinez, R. A. . . Sp.
Marvin, D. P. 1
Marx, S. A. 3
Mason, G. C. . . . Sp.
Mason, W. H. 2
Mather, J. . . . . Sp.
Mather, R. H. . . . Sp.
Mathesius, A. P. . . . 3
Mathison, W. E. H. . Sp.
Matte, A. L. . . . . Sp.
Matte, J. 1

Maxwell, D. H. . . . 2
Maxwell, J. N. . . Sp.
Maxwell, Ruth . . Sp.
May, K. S. 1
Mayberry, E. L. . . . 4
Mayer, P. H. . . . Sp.
Maynard, C. D. 1
Mayo, L. . . . . Sp.
Mead, E. A. . . . . Sp.
Mears, H. S. 4
Medlicott, W. H. . . 2
Melcher, A. C. *Res. Assoc.*
Menner, F. B. . . . Sp.
Meriam, M. G. . . . *Asst.*
Merriam, C. A. . . . 4
Merriam, H. C. . . . 4
Merrick, T. B. . . . *Inst.*
Merrill, A. 4
Merrill, A. C. . . . Sp.
Merrill, A. L. . . . *Prof.*
Merriman, T. C. . . . 1
Merritt, A. R. . . . Sp.
Merrow, H. K. . . . 4
Merrow, J. W. . . . Sp.
Merryweather, H. . . G.
Mesmer, L. F. . . . Sp.
Middleton, N. A. . . 3
Millard, R. W. . . . 2
Miller, A. . . . . Sp.
Miller, C. E., Jr. . . Sp.
Miller, E. F. . . . *Prof.*
Miller, G. 1
Miller, H. F. 1
Miller, H. U. . . . Sp.
Miller, J. . . . . Sp.
Miller, S. R. 3
Mills, B. F. . . . . Sp.
Milne, W. D. 3
Miner, E. A. . . . Sp.
Minot, R. S., Jr. . . Sp.
Mitchell, A. K. 1
Mohan, A. F. . . . Sp.
Mohn, J. T. . . . . Sp.
Moller, K. 3
Monaghan, J. E. L. . 4
Monahan, W. P. . . . 3
Moody, H. L. . . . 3
Moore, C. L. E. . . *Inst.*
Moore, C. N. . . . . Sp.
Moore, F. 3
Moore, F. J. . *Asst. Prof.*
Moore, J. E. . . . Sp.
Moore, J. G. . . . Sp.
Moore, T. J. . . . Sp.
Moreland, E. L. . . Sp.
Morey, C. B. . . . . Sp.
Morrill, A. B. 1
Morrill, F. W. 3
Morrison, C. W. . . Sp.
Morse, H. 4
Morse, W. B. 2
Morton, H. J. . . . Sp.
Moses, A. L. 1
Moses, F. T. 3
Mott, W. E. . *Assoc. Prof.*
Moulton, A. L. . . *Asst.*
Mowry, C. W. 4
Mullen, J. J. . . . Sp.
Mullen, J. J. . . . Sp.
Mulliken, S. P. *Asst. Prof.*
Munoz-Zertuche, R. Sp.
Munroe, H. K. . . . 4
Munroe, W. N. 4
Murfey, G. A. . . . Sp.
Muriel, J. . . . . Sp.
Murphy, J. E. . . . Sp.
Murray, F. J. . . . Sp.
Myers, D. B. . . . Sp.
Myers, H. E. 1
Myers, L. F. . . . Sp.

Nabstedt, H. M. . . . 2
Naramore, F. A. . . Sp.
Neale, A. 4
Neill, F. D. 1
Neilson, W. 4
Nelson, H. H., Jr. . . 4
Nelson, S. F. 2
Newhall, E. H. . . . 2
Newton, S. P. 4
Nicholl, J. S. . . . Sp.
Nichols, A. C. 2
Nichols, B. 3
Nichols, J. R. . . . Sp.
Nichols, P. R. . . . Sp.
Nichols, R. H. 1
Nickerson, H. L. R. . 2
Nickerson, J. W. . . 1
Nicol, N. C. . . . . Sp.
Niles, E. W. . . . . . *Asst.*
Niles, F. L. . . . . Sp.
Niles, W. H. . *Prof. Emer.*
Nisbet, L. D. 1
Nix, L. D. . . . . Sp.
Noble, G. C. 4
Noble, H. J. 2
Nolan, T. A. . . . Sp.
Northrup, O. W. . . *Asst.*
Norton, C. L. *Assoc. Prof.*
Norton, G. R. . . . Sp.
Norton, J. F. 4
Norton, R. W. . . Sp.
Noyes, A. A. . . . *Prof.*
Noyes, E. C. 3
Noyes, E. P. . . . . Sp.
Nutter, C. W. 4

Oehne, T. C., Jr. . . Sp.
Ogarrio, R., Jr. . . Sp.
O'Hara, J. R., Jr. . Sp.
Olaguibel, R. E. . . Sp.
Orchard, E. F. . . Sp.
Orcutt, H. B. 4
O'Riordan, A. . . . Sp.
Orme, J. B. L. . . Sp.
Orr, T. W. . . . . Sp.
Osborne, C. W. . . Sp.
Osborne, G. A. . . *Prof.*
Osborne, H. S. . . . 2
O'Shea, P. F. 1
Otis, W. H. . . . . Sp.
Owings, T. . . . . Sp.

Packard, E. H. . . . 3
Packwood, Lahvesia P. C. Sp.
Page, N. C. . . . . *Inst.*
Page, S. H. . . . . Sp.
Pagon, W. W. 3
Palmer, H. H. . . . Sp.
Park, C. F. . *Asst. Prof.*
Parker, J. W. 1
Parker, L. A. 4
Parlin, R. W. . . . Sp.
Parsons, G. F. . . . Sp.
Passano, L. M. . . *Inst.*
Pastoriza, H. G. . . . 3
Patch, R. R. 4
Patten, H. C. 2
Patten, Jane B. . . Sp.
Patterson, H. R. . . 4
Peabody, C. H. . . *Prof.*
Peabody, O. L. . . . 3
Pearce, J. S. 1
Pearson, H. G. *Asst. Prof.*
Pease, M. H. 3
Peet, A. S. . . . . Sp.
Peirce, F. N. . . . Sp.
Penny, A. N. 2
Pepper, B. W. 1
Percival, H. S. . . Sp.
Perkins, R. W. . . . Sp.
Perkins, S. F. . . . Sp.
Perley, H. C. 1
Perry, F. G. 2
Perry, H. R. 1
Perry, W. G. . . . Sp.
Pettingell, W. M. . . . 1
Petzold, H. R. . . . 1
Pfeil, W. G. . . . . Sp.
Phelan, J. W. . . . *Inst.*
Phelps, D. W. 1
Phelps, E. . . . . Sp.
Phelps, E. B. *Res. Assoc.*
Phelps, F. S. 4

Philbrick, H. R. . . Sp.
Philbrick, H. S. . . . 4
Pierce, G. H. 2
Pierce, W. J. 2
Pike, R. . . . . Sp.
Place, A. B. 2
Place, M. H. . . . Sp.
Plumer, E. A. 2
Plummer, H. C. . . . 4
Poland, F. W. . . . Sp.
Polhemus, J. H. . . . 4
Pollister, E. B. . . . Sp.
Pollock, R. T. . . . Sp.
Polsey, C. A. 3
Poole, B. 4
Poor, A. K. . . . . Sp.
Poor, W. E. . . . . Sp.
Poore, L. D. . . . . Sp.
Pope, A. 3
Pope, A. O. . . . . Sp.
Pope, C. H. . . . . .
Pope, J. 2
Pope, T. E. . . . . *Prof.*
Porosky, M. 2
Porter, C. H. . . . . *Inst.*
Porter, D. . . . . . *Prof.*
Potter, E. V. 3
Potter, O. W., Jr. . Sp.
Potter, Sarah E. . . Sp.
Powell, C. B. 4
Powell, P. R. 2
Pratt, A. D. . . . Sp.
Prescott, S. C. *Asst. Prof.*
Presson, W. H. . . Sp.
Prichard, C. LaM. . . Sp.
Pritchard, C. M. . . . 2
Pritchett, H. S. . *President.*
Puffer, W. L. *Assoc. Prof.*
Puhl, P. W. . . . . Sp.
Pulman, O. S., Jr. . . 4
Purdy, S. B. . . . Sp.
Putnam, C. D. . . . 2
Putnam, H. R., Jr. . 2

Quinlan, G. A. 4
Quinlan, J. F. . . . *Asst.*

Racoosin, L. . . . 1
Radford, C. W. . . 2
Radford, H. M. . . Sp.
Rambo, M. . . . . Sp.
Rand, F. H. . . . *Bursar*
Rand, R. . . . . Sp.
Randall, J. R. 3
Ranney, W. 4
Rapelye, H. A. . . . 2
Rasmussen, W. . . Sp.
Rawlinson, W. W. . Sp.
Rayner, W. P. . . . 3
Raynolds, R. P. . . . 4
Read, E. M., Jr. . . . 4
Read, W. C. 1
Rech, E. 3
Reed, E. H., Jr. . . . 3
Reed, H. D. 3
Reed, J., Jr. 4
Reed, R. C. . . . . *Asst.*
Regnell, R. T. . . . Sp.
Rehn, J. F. . . . . Sp.
Reilly, W. R. . . . Sp.
Remick, A. T. . . . Sp.
Remick, F. H. . . . 1
Remick, P. 2
Remon, J. A. . . . Sp.
Reyburn, J. R. . . Sp.
Reyes, F. D. . . . . Sp.
Rhodes, G. I. . . . *Asst.*
Richards, Ellen H. . *Inst.*
Rice, R. C. 2
Rich, C. J. . . . . Sp.
Richards, H. M. . . . 2
Richards, J. L. 1
Richards, K. W. . . Sp.
Richards, R. H. . . *Prof.*
Richardson, C. D. . . 4
Richardson, E. C. . . 3
Richardson, E. M. . Sp.
Richardson, H. B. . Sp.
Richardson, H. C. . . 4
Richardson, H. F. . . 2
Riefkohl, R. W. . . Sp.
Riley, E. J. . . . . Sp.
Riley, J. C. . . . . *Inst.*
Riley, J. G. . . . . Sp.
Riley, L. A., 2d . . Sp.
Ripley, F., Jr. 3
Ripley, R. I. 2
Rippey, A. E. 4
Robbins, A. G. *Asst. Prof.*
Robbins, D. G. . . . 3
Robinson, A. T. . . *Inst.*
Robinson, B. A. . . . 1
Robinson, C. S. . . . 1
Robinson, E. A. . . . 1
Robinson, F. J. . . . 2
Robinson, W. D. . Sp.
Roby, T. W., Jr. . . 3
Rockwell, S. E. . . . 3
Roco, M. . . . . Sp.
Rodenbaeck, G. A. . *Asst.*
Roever, W. H. . . . *Inst.*
Rogers, Anne F. *Res. Asst.*
Rolfe, G. W. . . . *Inst.*
Rood, V. S. . . . . Sp.
Root, J. A. . . . . Sp.
Rose, R. W. 4
Ross, J. A., Jr. . . *Inst.*
Rowe, E. B. 4
Ruff, DeW. C. . . . Sp.
Ruggles, G. H. . . Sp.
Ruggles, H. J. 2
Ruggles, Mary J. . . 4
Runey, C. F. 3
Ruppel, H. E. K. . Sp
Russ, D. E. 3
Russell, C. B. . . . Sp.
Russell, G. E. . . . *Inst.*
Russell, L. P. 3
Ruxton, E. J. . . . *Inst.*
Ryan, Ida A. . . . . G.
Ryden, R. W. 3

Sadtler, P. B. . . . Sp.
Sage, M. W. 3
Sampson, M. 2
Sampson, R. E. . . . 3
Sando, J. B. 2
Santry, J. V. . . . Sp.
Sargent, E. H. . . Sp.
Sargent, H. S. . . . Sp.
Sargent, R. N. . . . 4
Savage, E. M. 2
Sawyer, C. W. . . . *Inst.*
Scannell, A. T. . . . 2
Schakne, J. H. 2
Scharff, M. R. 1
Schirmer, R. E. . . . 2
Schmidt, F. B. . . Sp.
Schmidt, P. S. . . . 4
Schneider, F., Jr. . Sp.
Schofield, W. McN. . 1
Schriefer, H. C. . . Sp.
Schwab, A. J. 2
Schwamb, P. . . . . *Prof.*
Scott, E. J. . . . . Sp.
Scott, G. W. 2
Seaver, H. L. . . . *Inst.*
Seaver, S. 4
Sedgwick, W. T. . . *Prof.*
Segar, R. L. . . . Sp.
Seiglie, N. M. . . . Sp.
Serra, J. H. 2
Sewell, H. R. . . . Sp.
Seymour, A. 2
Seyms, R. W. . . . Sp.
Shalling, H. W. . . Sp.
Shapira, S. . . . . Sp.
Shapleigh, C. H. . . Sp.
Sharman, F. W. . . . 2
Sharp, B. K. 3
Sharp, H. 1
Shaw, A. L. 1
Shaw, C. R. . . . . *Asst.*
Shaw, H. P. 4

Shaw, L. C. 1
Shea, J. W. 1
Shedd, R. E. 4
Sheldon, W. A. . . . 4
Shen, Tinching. . . Sp.
Sherman, A. B., Jr.. . 4
Sherman, A. L. . . . 4
Sherman, H. L. . . . 1
Sherrill, M. S. . . . *Inst.*
Shields, F. B. . . . Sp.
Shillaber, C. P., Jr. . 1
Shimer, H. W. . . . *Inst.*
Shingler, G. P., Jr. . Sp.
Shipman, LeR. H. . . 4
Shippee, A. E. . . . Sp.
Silberman, S. T. . . Sp.
Simm, R. 1
Simons, J. K. 1
Simpson, G. C. . . . 4
Simpson, W. E. . . *Asst.*
Sissa, U. 3
Skillings, A. E. . . Sp.
Slack, E. P. . . . . Sp.
Slater, D. S. . . . Sp.
Sleeper, D. W. . . . 1
Sloss, A. C., Jr. . . Sp.
Small, G. 3
Small, W. B. . . . Sp.
Smeaton, D. W. . . . 1
Smith, A. H. . . . *Asst.*
Smith, A. L. . . . . *Asst.*
Smith, E. McC. . . . 1
Smith, E. R. . . . Sp.
Smith, E. M. 4
Smith, E. G.. . . . Sp.
Smith, H. W. *Asst. Prof.*
Smith, L. D.. 3
Smith, L. S. . . . . *Inst.*
Smith, L. W. . . . *Inst.*
Smith, R. H. . . . *Inst.*
Smith, R. L. 1
Smith, T. 3
Smith, T. L. . . . Sp.
Smith, X. R. 1
Snow, E. B., Jr. . . Sp.
Soderstrom, F. H. . . 1
Sosman, R. B. . . . G.
Soule, L. R. . . . . Sp.
Soule, W. 3
Souther, J. G. . . . Sp.
Spaans, W. 1
Spaulding, H. S. . . . 4
Spear, H. G. . . . Sp.
Spencer, H. K.. . . . 1
Spencer, W. C. . . Sp.
Spiehler, C. H. . . . 3
Spurr, H. V. 2
Squire, E. H. 3
Standley, C. L. . . Sp.
Stanley, P. B. 4
Stanton, E. C. . . . Sp.
Staples, P. A. 4
Staples, W. A. . . Sp.
Starkweather, I. H. Sp.
Starr, F. C. . . . . *Asst.*
Stebbins, R. G. . . Sp.
Steel, E. T. 4
Steele, C. D. . . . Sp.
Steese, C. M. . . . Sp.
Steinharter, E. C. . . 4
Stephens, A. L. . . . 4
Stephenson, J. N. . . 1
Stevens, F. B., Jr. . Sp.
Stevens, H. A. . . Sp.
Stevens, J. C. 1
Stevens, Louisa B. . Sp.
Stevenson, A. F. . . . 3
Stevenson, R. P. . . 3
Stewart, D. A. . . Sp.
Stewart, J. B., Jr. . Sp.
Stewart, M. A. . . . G.
Stiebel, H. J. 1
Stiles, P. G. . . . . *Inst.*
Stockwell, F. C. . . Sp.
Stone, E. J. . . . . Sp.
Stone, Elizabeth . . Sp.
Stone, L. E. . . . Sp.
Stone, L. S. 2
Story, C. F. 3
Story, E. C. 3
Stow, J. P., Jr. . . Sp.
Strongman, Elizabeth J. Sp.
Stubbs N. H. . . . Sp.
Sullivan, H. V. . . Sp.
Sullwold, H. A. . . Sp.
Sumner, J. O. *Assoc. Prof.*
Sutton, L. H. 2
Swain, G. F. . . . . *Prof.*
Swan, C. M. . . . . *Inst.*
Sweeny, H. P. 2
Swett, G. W. . . . *Inst.*
Swett, P. N. 3
Symes, G. G. 3
Symons, H. M. . . Sp.

Taft, T. H. . . . . *Inst.*
Taite, F. G. . . . Sp.
Talbot, H. P. . . . *Prof.*
Tashjian, A. H. . . . 3
Taylor, A. C. 4
Taylor, D. M. 4
Taylor, G. R. . . . *Asst.*
Taylor, I. S. . . . Sp.
Taylor, R. K. . . . Sp.
Taylor, W. C. . . . Sp.
Tebbets, J. H. . . . Sp.
Temple, E. H., Jr. . Sp.
Temple, R. B. 1
Terrell, H. A. 4
Terrell, W. P. . . . Sp.
Terry, M. 1
Tetlow, J. . . . . Sp.
Thacher, S. P. 3
Thayer, R. C. . . . Sp.
Thayer, R. E. . . . Sp.
Thode, A. F. 2
Thomas, A. S. . . . Sp.
Thomas, J. J. . . . Sp.
Thompson, A. H. . Sp.
Thompson, L. A. . Sp.
Thompson, H. 2
Thompson, M. DeK., Jr. *Inst.*
Thomson, H. B. . . . 4
Thorndike, J. R. . . Sp.
Thorndike, S. H. . . *Inst.*
Thornley, A. E. . . . 1
Thornton, E. A. . . . 3
Thorp, F. H. *Asst. Prof.*
Thorp, L. 4
Throckmorton, O. L. Sp.
Thurlow, L. W. . . . 2
Tillson, P. E. 4
Tobin, J. T. 2
Tod, M. S. . . . . Sp.
Todd, R. B. . . . . Sp.
Tolman, G. E. . . . Sp.
Tolman, R. C. . . . . G.
Tomlinson, E. F. . . 4
Tompkins, M. C. . . . 4
Tompson, W. R. . . . 3
Toppan, W. H. . . . 2
Torossian, A. 2
Tourtellot, H. B. . Sp.
Tousley, N. E. . . . *Asst.*
Tower, G. S. . . . G.
Towle, F. T. 2
Towne, W. C. . . . *Inst.*
Tracy, W. A. . . . Sp.
Trask, W. H., Jr. . . 4
Trauerman, C. J. . Sp.
Tresnon, J. E. . . . Sp.
Treuthardt, E. L. P. . 3
Trimingham, K. F. Sp.
Tripp, L. H. 4
Trowbridge, A. T. . . 4
True, H. E. . . . . Sp.
Trull, A. H. . . . . Sp.
Tse, Tsok Kai . . Sp.
Tucker, C. E. 4
Tuckerman, L. . . . 4
Tufts, W. . . . . Sp.
Tully, E. J. . . . . Sp.

Tupper, F. W. . . . Sp.
Turkington, E. E. . . 3
Turnbull, M. J. . . Sp.
Turner, C. 2
Turner, C. V. . . . Sp.
Turner, E. A. . . . Sp.
Turner, H. C., Jr. . . 1
Turner, Marie C. . . . 1
Turner, W. C. 4
Tylee, A. K. 3
Tyler, H. W. . . . *Prof.*
Tyler, J. . . . . Sp.
Tyndall, J. . . . . Sp.

Udale, S. M **4**
Upham, G. W. 3

van der Stucken, F. R. 3
Van Hook, F. J. . . . 4
Van Keuren, A. H. . 3
Van Keuren, H. P. T. Sp.
Varian, J. P. 4
Varney, G. N. . . . Sp.
Vedder, J. R. . . . Sp.
Venn, G. J. . . . . Sp.
Very, E. M. 1
Very, S. R. T. . . . Sp.
Vogel, F. . . . . . *Prof.*
Vogelsberg, H. T. . Sp.
Vonnegut, K. 2
Vose, C. A. . . . . Sp.

Wade, C. L. . . . . Sp.
Walbridge, C. A. . . Sp.
Walker, L. T. 3
Walker, P. B. 3
Walker, W. H. . . *Prof.*
Wallis, G. E. 1
Walls, J. N. 1
Walsh, J. H. 4
Walsh, W. J. 4
Walter, E. A. 4
Walter, R. C. . . . Sp.
Wang, Lingoh . . . Sp.
Ware, E. A. 1
Ware, R. 4
Ware, S. L. 4
Warner, A. T. 1
Warren, C. E. 4
Warren, C. H. *Asst. Prof.*
Washburn, E. W. *Res. Asst.*
Washburn, G. E. . . 2
Waters, E. J. H. . . Sp.
Watson, R. S. . . . So.
Watt, A. P. 4
Wattles, J. W., 3d . Sp.
Webb, H. . . . . . Sp.
Webber, T. G. 4
Weeks, A. T. . . . Sp.
Weeks, H. E. . . . Sp.
Weeks, L. S. 2
Weiler, R. B. 2
Weill, M. K. 1
Weinhagen, G., Jr. . . 1
Weinstock, R. 1
Weinz, W. E. . . . Sp.
Weis, I. L. 1
Welch, G. W. . . . Sp.
Wellington, H. W. . Sp.
Wells, A. E. 4
Wells, E. E. . . . Sp.
Wells, O. F. . . *Recorder*
Wells, S. D. 3
Wells, W. . . . . . *Prof.*
Wemple, L. E. . . . 2
Wen, Ching Yu . . Sp.
Wendell, G. V. *Assoc. Prof.*
Wentworth, H. A. . *Asst.*
Wentworth, P. M. . . 1
Wertheim, H. J. . . . 1
Westervelt, G. C. . . . 4
Westervelt, V. O. . Sp.
Wetmore, L. 3
Wetterer, C. F. W. . . 4
Wey, J. P. . . . . Sp.
Weysse, A. W. . . . *Inst.*
Wheeler, F. . . . . *Prof.*
Whitaker, H. E. . . . 1
Whitcomb, W. H. . *Asst.*
White, C. H. 1
White, F. W. . *Med. Adv.*
White, G. F. 4
White, J. H. . . . Sp.
White, N. A. 4
White, T. H. . . . Sp.
Whitehouse, M. H. . . G.
Whiting, H. S. . . . 4
Whitman, K., Jr. . *Asst.*
Whitmore, C. W. . Sp.
Whitney, E. F. . . . 3
Whitney, L. F. . . Sp.
Whitney, P. R. . . . 3
Whittemore, J. D. . Sp.
Whittemore, L. C. . . 3
Whittemore, W. L., Jr. Sp.
Whitten, C. E. . . Sp.
Whittle, G. D. . . . 2
Wick, J. L., Jr. . . . 4
Wiggin, A. E. 3
Wilcox, F. S. . . . . G.
Wilder, S. W. 4
Wilfley, C. R. . . . Sp.
Wilkins, H. S. 4
Wilkinson, E. . . . Sp.
Willard, C. F. . . . *Inst.*
Willard, J. A. 1
Willcomb, R. H. . . Sp.
Willcox, F. H. . . Sp.
Willey, N. C. 4
Williams, E. I. . . . 2
Williams, E. T. . . Sp.
Williams, H. L. . . . 4
Williams, J. R. . . Sp.
Williamson, R. W. . Sp.
Willis, C. F. 4
Wilmot, F. D. . . . Sp.
Wilson, E. C. . . . Sp.
Wilson, E. L. 4
Wilson, R. W . . . Sp.
Wilson, W. S. 3
Wilson, W. S., Jr. . . 1
Winch, A. C. . . . Sp.
Winchester, L. S. . . 1
Wingate, W. H. . . . 1
Winne, G. M. 4
Winslow, A. M. . . Sp.
Winslow, C.-E. *Asst. Prof.*
Wint, R. W. G. . . . 3
Wires, E. S. . . . . Sp.
Wiswall, P. M. . . . 2
Witmer, G. S. . . . Sp.
Wolfe, S. C. 4
Wolfenden, J. C. . . Sp.
Wolfner, I. W. . . . 1
Wonson, H. S. . . . 3
Wood, D. M. 4
Wood, F. B. 1
Woodbridge, R. G., Jr. 3
Woodbridge, S. H.
Assoc. Prof.
Woodman, A. G. . . *Inst.*
Woodruff, C. A. . . Sp.
Woodruff, L. S. . . . 4
Woods, F. S. *Assoc. Prof.*
Woods, W. S. . . . Sp.
Woodward, W. L. . Sp.
Wright, J. M. . . . Sp.
Wright, W. H. P. . Sp.
Wrinkle, J. T. 4
Wu, Nie Quang . . Sp.

Yamada, H. . . . Sp.
Yates, I. I. 4
York, W. C. 2
Young, G. C. 4
Young, H. E. 4
Young, P. E. 1
Young, W. A. . . . Sp.
Youngerman, C. . . Sp.
Yrizarry, H. . . . Sp.

Alphabetical Index

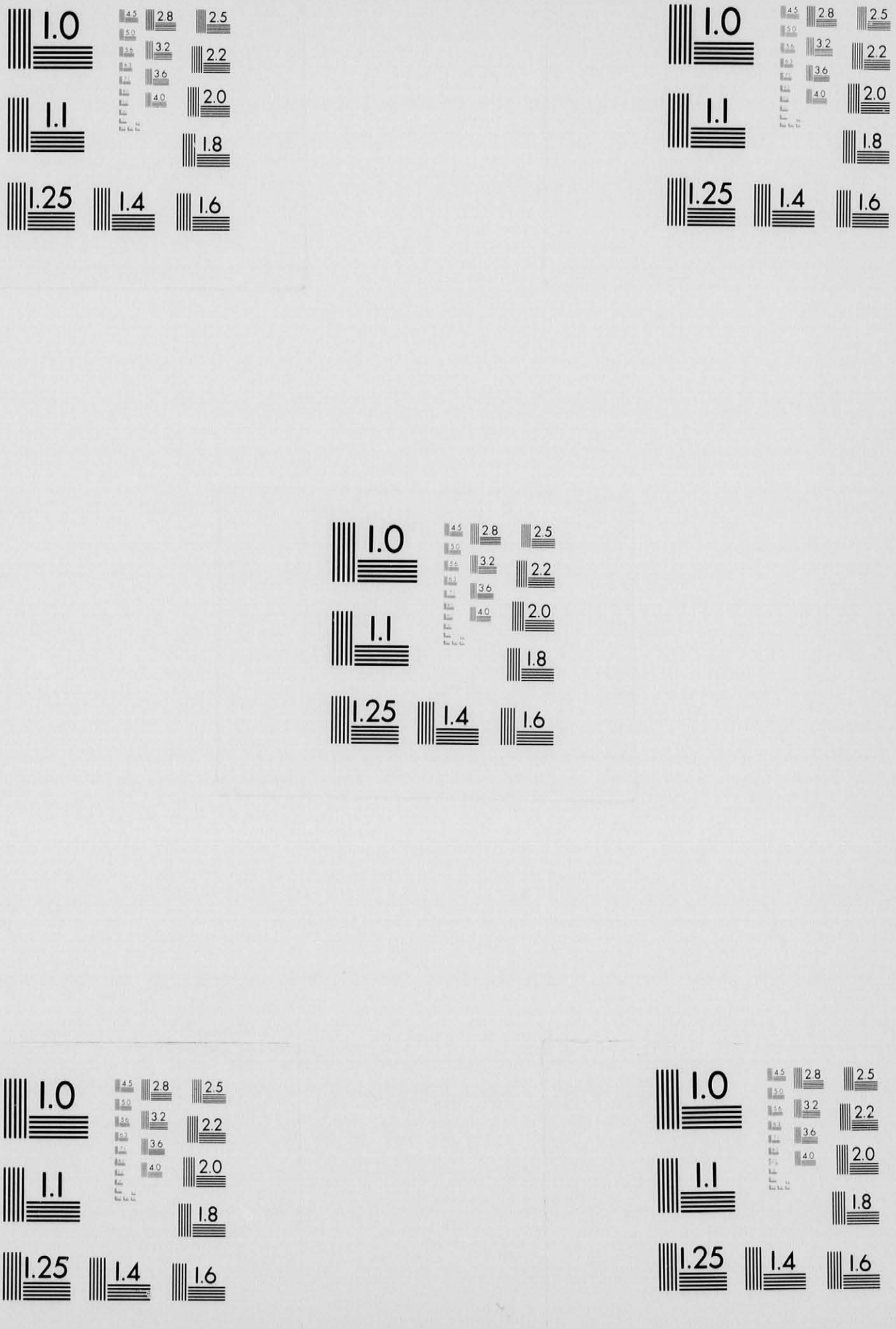
	Page
Administrative Officers	18
Admission:	
Of Special Students	110
Requirements for	93
To Advanced Standing, Requirements for	109
To Graduate Courses	84
Advanced Degrees	84
Advanced Standing	109
Advisers	313
Age of Applicants for Admission	94, 98
Algebra, Requirements in, for Admission	99
Alternative Studies	34
Alumni, Associations of	318
Applied Mechanics, Instruction in	128, 277
Architecture:	
Description of Subjects	194
Graduate Course	86
Landscape	199
Library	301
Prizes	312
Special Lecturers	194
Special Students	48
Staff	194
Summer School	79
Travelling Scholarship	311
Undergraduate Course	46
Arts, Society of	12
Attendance Card	306
Attendance, Requirements in regard to	313
Bachelor of Science, Degree of	32, 82
Biology:	
Description of Subjects	231
Elective for Admission	108
Laboratories	289
Library	303
Research in	91, 290
Staff	231
Undergraduate Course	54
Board, Cost of	313
Books, etc., Cost of	313
Breakage, Rules in regard to	306
Buildings, Description of	13
Calendar	2, 304
Certificates from Teachers	97
Charter	10
Chemistry:	
Chemical Engineering	61–63
Description of Subjects	204
Elective for Admission	106
Graduate Course	87
Laboratories	283
Library	302
Research Laboratory	285
Special Lecturers	219
Staff	204
Summer School	80
Undergraduate Course	50
Choice of Courses	32, 305
Civil Engineering:	
Description of Subjects	160
Equipment	297
Geodetic Observatory	297
Graduate Course	85
Library	301
Special Lectures	173
Staff	160
Summer School	77
Undergraduate Course	38
College Entrance Examination Board	95
Dates of Examinations	96
Order of Examinations	96
Regulations	96
Table of Equivalents	97
College Graduates, Admission of	109
Committees of the Corporation	16, 17
"Conditions" at Examinations	98, 305
Conduct	314
Corporation:	
Committees of	16
Members of	15
Powers of	11
Course for Naval Constructors	70
Courses:	
Choice of	32, 305
Five-Year	33
Four-Year	31
Graduate	84
Schedules of	36–71
Cummings Laboratory of Mining Engineering and Metallurgy	281
Damage to Apparatus	306
Dates of Examinations	305
Degrees:	
Advanced	84
Bachelor of Science	82
Doctor of Engineering	89
Doctor of Philosophy	89
Master of Science	84
Requirements for	82

	Page
Departments :	
Architecture	194
Biology	231
Chemistry	204
Civil Engineering	160
Drawing	134
Economics and Statistics	151
Electrical Engineering	222
English	144
Geology	257
History	148
Mathematics	121
Mechanical Engineering	174
Mechanic Arts	139
Military Science	273
Mining Engineering	187
Modern Languages	155
Naval Architecture	267
Physics	243
Theoretical and Applied Mechanics	128
Deposit, Requirements in regard to	306
Descriptive Geometry, Instruction in	134
Design, School of	316
Divided Examinations	98
Doctor of Philosophy:	
Requirements for	89
Candidates for	350
Drawing:	
Instruction in	134
Staff	134
Drill, Instruction in	273
Economics, Instruction in	151
Elective Requirements	105
Electrical Engineering:	
Description of Subjects	222
Graduate Course	87
Laboratories	285
Library	302
Special Lectures	230
Staff	222
Undergraduate Course	52
Electro-Chemistry	249
Engineering:	
Architectural	47, 202
Chemical	62
Civil	38, 160
Electrical	222
Highway	166
Hydraulic	168
Laboratories	276
Marine	185, 269
Mechanical	40, 174
Mining	42, 187
Railroad	164
Sanitary	64, 168
Steam	170
Engineering Research, Graduate School of	90
English:	
Description of Subjects	144
Requirements for Admission	102, 106
Staff	144
Entrance:	
Examinations in Boston	94
Examination Subjects	99
Requirements for	93
Equipment	14
Equivalents, College Board	97
Examinations:	
Character of	99
College Entrance Board	95
For Admission	93
For Admission, Divided	98
For Conditioned Students	305
For Graduation	81, 305
Intermediate	305
Order of	94, 96
Semi-annual	305
Expenses	307, 313
Faculty, List of Members	30
Fees:	
For Entrance Examinations	94
Tuition	307
Fellows	349
Fellowships	311
First-Year Courses	37
Five-Year Regular Courses	33
Foundation	9
Free Courses of Instruction	315
French:	
Description of Courses	155
Requirements in, for Admission	101, 105
Staff	155
General Information	9–14
General Science, Instruction in	60
General Studies, Options in	72
Geodetic Observatory	297
Geographical Distribution of Graduates	326
Geology:	
Course Schedule	66
Description of Subjects	257
Laboratory	295
Library	303
Staff	257
Summer School	80
Geometry, Requirements in, for Admission	100
German:	
Description of Subjects	155
Requirements in, for Admission	101, 105
Staff	155
Graduate Courses	84

	PAGE
Graduates:	
Geographical Distribution	326
Number by Courses	325
Occupations	327
Graduate Scholarships	311
Graduate School of Engineering Research	90
Graduates of Colleges, Privileges granted	109
Graduate Students	351
Graduation, Requirements for	81
Gymnastics, Instruction in	314
Highway Engineering	166
Historical Sketch	9
History:	
Description of Subjects	148
Requirements in, for Admission	103, 106
Staff	148
Holidays	304
Hours of Attendance	313
Hydraulic Engineering, Instruction in	168, 278
Industrial Chemistry, Summer School	80
Instruction:	
Courses of	36–73, 112
Officers of	18
Subjects of	112
Italian, Instruction in	159
Kidder Laboratories of Chemistry	283
Laboratories:	
Biological	289
Chemical	283
Electrical	285
Engineering	276
Geological	295
Mechanical	296
Mining	281
Physical	291
Research	285, 290
Language, Instruction in	155
Latin, Elective for Admission	106
Lecturers for the Current Year	28
Lectures, Occasional	173, 186, 219, 230
Libraries:	
Architectural	301
Biological	303
Electrical Engineering	302
Engineering	301
General	299
History and Economics	300
Margaret Cheney	299
Mining	301
Modern Languages	301
Naval Architectural	303
Physical	302
Rogers Geological	303
Runkle Mathematical	300
William Ripley Nichols Chemical	302
Literature and Language, Instruction in	144
Location	13
Lowell Laboratories	285
Lowell School for Foremen	315
Master of Science:	
Requirements for	84
Candidates for	351
Mathematics:	
Description of Subjects	121
Entrance Requirements	99
Library	300
Staff	121
Mechanical Drawing, Elective, for Admission	107
Mechanical Engineering:	
Course Schedule	40
Description of Subjects	174
Laboratories	276
Library	301
Special Lectures	186
Staff	174
Mechanic Arts:	
Description of Subjects	139
Elective, for Admission	106
Laboratory	296
Staff	139
Mechanics, Theoretical and Applied, Instruction in	128
Medical Adviser	313
Metallurgy:	
Description of Subjects	187
Laboratory	281
Methods of Instruction	31, 112
Metric System, Preparation in	101
Military Science and Tactics, Instruction in	273
Mineralogy, Instruction in	257, 295
Mining Engineering:	
Description of Subjects	187
Graduate Course	86
Laboratories	281
Library	301
Staff	187
Summer School	78
Undergraduate Course	42–45
Modern Languages:	
Instruction in	155
Library of	301
Natural Sciences, Instruction in	231
Naval Architecture:	
Course for Naval Constructors	70
Equipment	298
Description of Subjects	267
Graduate Course	88

	PAGE
Library	303
Staff	267
Undergraduate Course	68
Nichols, William Ripley, Library	302
Observatory	297
Occupations of Graduates	327
Officers:	
Administrative	18
Alphabetical List of	304
Of Instruction	18
Options	33
Options in General Studies	72
Order of Examinations:	
College Board	96
Institute	94
Payments	307
Physics:	
Description of Subjects	243
Laboratory	291
Library	302
Physical Chemistry	220, 285
Requirements for Admission	104
Research in Physical Chemistry	285
Research Laboratory	285
Staff	243
Undergraduate Courses	56-59
Plane Geometry, Requirement for Admission	100
Political Science, Instruction in	151
Preparation for the Institute	93
Prizes	312
Professional Summer Schools	77
Publications, List of	cover
Quarterly, Technology	12
Railroad Engineering, Instruction in	164
Register of Students	349
Regular Courses	36
Regular Students:	
Becoming Special	305
Register of	359
Regulations	304
Reports of Standing	306
Requirements for Admission	93
Requirements for Graduation:	
Bachelor of Science	81
Doctor of Engineering	89
Doctor of Philosophy	89
Master of Science	84
Research:	
Physico-chemical	91, 285
Sanitary	91
Scientific	91
Research Laboratory of Physical Chemistry, Described	285
Staff	220
Residence	313
Rogers Laboratory of Physics	291
Rooms, Cost of	313
Runkle Mathematical Library	300
Sanitary Engineering	62, 168
Sanitary Science:	
Description of Subjects	239
Research in	290
Research Laboratory	290
Schedules of Courses	36-73
Scholarships:	
Graduate	311
State of Massachusetts	308
Undergraduate	307
School for Industrial Foremen	315
School of Engineering Research	90
School of Industrial Science	10, 12
Scientific Research	91
Society of Arts	12
Solid Geometry, for Admission	100
Spanish, Instruction in	158
Special Courses, Requirements for Admission	110
Special Students:	
Admission of	110
Becoming Regular	306
In Architecture	48
Register of	379
Staff:	
Instructing	18
Mechanic Arts	28
Research, Physical Chemistry	27
Research, Sanitary	27
Statistics of Graduates	324
Status of Students, Determination of	305
Students:	
Alphabetical List of	304
Register of	349
Subjects:	
Alphabetical Index	114
Index	120
Of Instruction	112
For Examination	90
Summer Courses	74
Summer Reading	35
Summer Schools, Professional:	
Architecture	79
Chemistry	80
Civil Engineering	77
Geology	80
Mining and Metallurgy	78
Technology Club	318
Technology Quarterly	12
Theoretical and Applied Mechanics:	
Description of Subjects	128
Staff	128

Theses:
Of Class of 1905 333
Requirements 82
Third-Year Options 72
Tuition Fees 307
Uniforms for Drill 273
Vacation 304
Visiting Committees 17
War-ship Construction 270
Women, Admission of 32
Year, School 304
Zoölogy, Instruction in 234


1.0
1.1
1.25
1.4
1.6
2.8
2.5
3.2
2.2
3.6
2.0
4.0
1.8
4.5
5.0
5.6
6.3
7.1
8.0
9.0