M.I.T. ANNUAL CATALOGUES AND BULLETINS
1908/09

Volume 44 Number 1

BULLETIN

OF THE

Massachusetts Institute of Technology

BOSTON

CATALOGUE

OF THE

OFFICERS AND STUDENTS

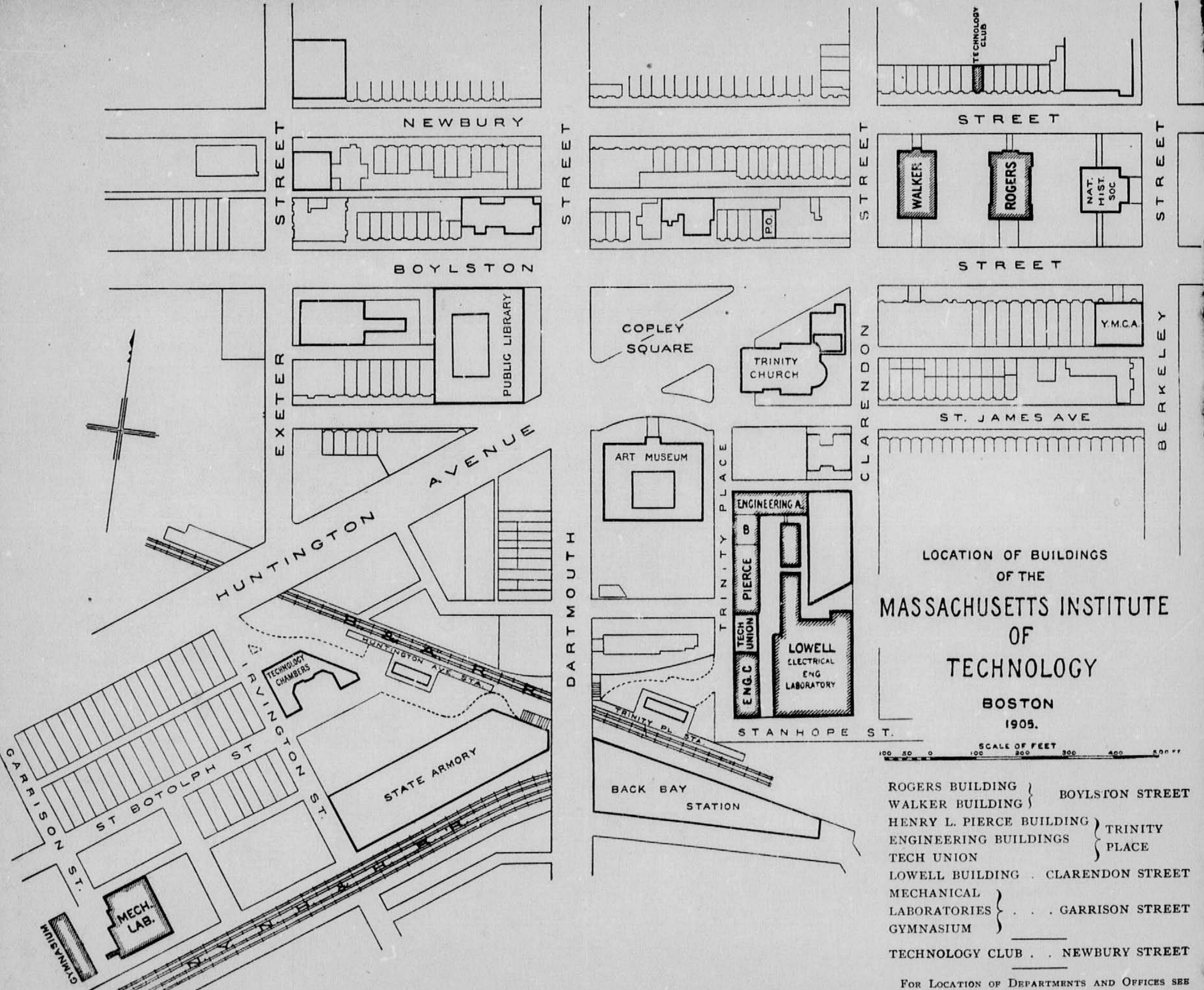
WITH

A STATEMENT OF THE REQUIREMENTS FOR ADMISSION

AND

A DESCRIPTION OF THE COURSES OF INSTRUCTION

DECEMBER
1908



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 TECH UNION	}	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."

TABLE OF CONTENTS.

YEARLY CALENDAR

1908

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	29
--	--	--	--	--	--	--

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	--	--
--	--	--	--	--	--	--

1909

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	--
--	--	--	--	--	--	--

CALENDAR.

The meetings of the Executive Committee *of* the Corporation *are held on the second and fourth Mondays in every month.*

1908.

Sept. 30, *Wed.*	FIRST TERM BEGINS.
Oct. 14, *Wed.*	Stated meeting of the Corporation.
Nov. 3, *Tues.*	End of the first five weeks of the term.
Nov. 26, *Thurs.*	Thanksgiving Day (exercises suspended).
Nov. 30, *Mon.*	Limit of time for making up second term deficiencies.
Dec. 8, *Tues.*	End of the second five weeks of the term. Students may not drop first-term subjects after this date.
Dec. 9, *Wed.*	Stated meeting of the Corporation.
Dec. 18, *Fri.*	Third-year students file choice of second-term option in General Studies.

Christmas recess of one week December 24 to December 30, inclusive.

1909.

Jan. 1, *Fri.*	First-year students file choice of Course.
Jan. 16, *Sat.*	Last exercises in the fourth and third years.
Jan. 21, *Thurs.*	Last exercises in the second year.
Jan. 23, *Sat.*	Last exercises in the first year.
Jan. 19–30	Semi-annual examinations.

Recess from Feb. 1, 1909, to Feb. 8, 1909, inclusive.

Feb. 9 *Tues.*	SECOND TERM BEGINS. Registration completed.
Feb. 22, *Mon.*	Washington's Birthday (exercises suspended).
Mar. 10, *Wed.*	Stated meeting of the Corporation.
Mar. 15, *Mon.*	End of the first five weeks of the term.
Mar. 31, *Wed.*	Limit of time for making up first term deficiencies.
Apr. 14, *Wed.*	Scholarship application due for next school year.

Recess April 19, 20 and 21.

1909.

Apr. 19, *Mon.*	End of the second five weeks of the term. Students may not drop second-term subjects after this date.
May 20, *Thurs.*	Second-year students file choice of option in General Studies for third year, first term.
May 22, *Sat.*	Last exercises of the fourth and third year.
May 27, *Thurs.*	Last exercises of the second year.
May 29, *Sat.*	Last exercises of the first year.
May 25, *Tues*	Theses due.
May 25–*June* 5	Final Examinations.
June 4, *Fri.*	Stated meeting of the Corporation.
June 7, *Mon.*	Class Day.
June 8, *Tues.*	Graduation.

SUMMER VACATION JUNE 9, 1909, TO SEPTEMBER 28, 1909, INCLUSIVE.

June 14–19, *Mon. to Sat.* . .	Examinations of the College Entrance Examination Board.
June 30–*July* 3, *Wed. to Sat.* .	First Entrance Examinations of the Massachusetts Institute of Technology.

SUMMER SCHOOL (in June and July).

Sept. 20, *Mon.*	Advanced Standing Examinations and Registration begin.
Sept. 21–23, *Tues. to Thurs.* .	Second Entrance Examinations.
Sept. 29, *Wed.*	FIRST TERM of the year 1909–1910 begins
Oct. 13, *Wed.*	Stated meeting of the Corporation.
Nov. 2, *Tues.*	End of the first five weeks of the term.
Nov. 25, *Thurs.*	Thanksgiving Day (exercises suspended).
Nov. 30, *Tues.*	Limit of time for making up marks of "D."
Dec. 7, *Tues.*	End of the second five weeks of the term. Students may not drop first-term subjects after this date.
Dec. 8, *Wed.*	Stated meeting of the Corporation.
Dec. 26, *Mon.*	Third-year students file choice of second-term General Study.

CHRISTMAS RECESS OF ONE WEEK DETERMINED BY VOTE OF THE FACULTY.

Members of the Corporation.

Acting President.

ARTHUR A. NOYES.

Secretary.[1]

JAMES P. MUNROE.

Treasurer.

FRANCIS R. HART.

Life Members.

WILLIAM ENDICOTT.
HOWARD A. CARSON.
CHARLES J. PAINE.
CHARLES FAIRCHILD.
DAVID R. WHITNEY.
FRANCIS H. WILLIAMS.
JAMES P. TOLMAN.
HOWARD STOCKTON.
NATHANIEL THAYER.
CHARLES F. CHOATE.
HIRAM F. MILLS.
PERCIVAL LOWELL.
CHARLES C. JACKSON.
SAMUEL M. FELTON.
DESMOND FITZGERALD.
FRANCIS BLAKE.
CHARLES W. HUBBARD.
THOMAS L. LIVERMORE.
A. LAWRENCE ROTCH.
GEORGE WIGGLESWORTH.
JOHN R. FREEMAN.
WILLIAM H. LINCOLN.
J. B. SEWALL.
A. LAWRENCE LOWELL.
JAMES P. MUNROE.
WILLIAM L. PUTNAM.
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.

Term Members.

Term expires March, 1909.

FREDERICK H. NEWELL.
RICHARD H. SOULE.
EBEN S. STEVENS.

Term expires March, 1910.

FREDERICK P. COPELAND.
JOSEPH P. GRAY.
FRANK L. LOCKE.

Term expires March, 1911.

T. COLEMAN DU PONT.
CHARLES T. MAIN.
FREDERICK W. WOOD.

Term expires March, 1912.

GEORGE W. KITTREDGE.
FRANK G. STANTIAL.
GEORGE E. HALE.

Term expires March, 1913.

JAMES W. ROLLINS, Jr.
EVERETT MORSS.
ARTHUR T. BRADLEE.

On the Part of the Commonwealth.

His Excellency, EBEN S. DRAPER, *Governor.*
Hon. MARCUS P. KNOWLTON, *Chief Justice of the Supreme Court.*
Hon. GEORGE H. MARTIN, *Secretary of the Board of Education.*

[1] Address correspondence to Professor A. L. Merrill, Secretary of the Faculty. (See page 14.)

Committees of the Corporation.

Executive Committee.

ARTHUR A. NOYES. }
FRANCIS R. HART. } *Ex Officio.*

THOMAS L. LIVERMORE.
CHARLES A. STONE
FREDERICK P. FISH.
FREDERICK W. WOOD.
ELIHU THOMSON.

Finance Committee.

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

Committee on the Society of Arts.

HOWARD A. CARSON.
HIRAM F. MILLS.
ROBERT S. PEABODY.

Auditing Committee.

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

Committee on Nominations.

DAVID R. WHITNEY.
HOWARD A. CARSON.
FRANCIS H. WILLIAMS.
JAMES P. MUNROE.
CHARLES C. JACKSON.
CHARLES W. HUBBARD.

Trustees of the Museum of Fine Arts.

A. LAWRENCE ROTCH.
FRANCIS BLAKE.
AUGUSTUS HEMENWAY.

VISITING COMMITTEES.

Department of Civil Engineering.

HOWARD A. CARSON.
CHARLES F. CHOATE.
DESMOND FITZGERALD.
JOHN R. FREEMAN.
LUCIUS TUTTLE.
FREDERICK H. NEWELL.
JOSEPH P. GRAY.

Departments of Mechanical Engineering and Applied Mechanics.

JAMES P. TOLMAN.
HIRAM F. MILLS.
FRANCIS BLAKE.
EBEN S. DRAPER.
ELLIOT C. LEE.
RICHARD H. SOULE.
FREDERICK K. COPELAND.

Departments of Mining and Geology.

THOMAS L. LIVERMORE.
CHARLES FAIRCHILD.
JAMES P. TOLMAN.
JAMES P. STEARNS.
T. COLEMAN DU PONT.
FREDERICK W. WOOD.

Department of Architecture.

ROBERT S. PEABODY.
A. LAWRENCE ROTCH.
FRANCIS L. HIGGINSON
JOHN R. FREEMAN.
GEORGE W. KITTREDGE.

Department of Physics.

A. LAWRENCE ROTCH.
FRANCIS BLAKE.
CHARLES W. HUBBARD.
ELIHU THOMSON.
GEORGE E. HALE.

Department of Electrical Engineering.

ELIHU THOMSON.
FRANCIS BLAKE.
FREDERICK P. FISH.
CHARLES A. STONE.
PERCIVAL LOWELL.
CHARLES T. MAIN.
EVERETT MORSS.

Departments of Literature, History, and Political Economy.

GEORGE H. MARTIN.
A. LAWRENCE LOWELL.
JAMES P. MUNROE.
J. B. SEWALL.
JAMES W. ROLLINS, Jr.

Departments of Modern Languages and English.

JAMES P. MUNROE.
J. B. SEWALL.
FRANK L. LOCKE.
DESMOND FITZGERALD.
ARTHUR T. BRADLEE.

Department of Mathematics.

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

Department of Chemistry and Chemical Engineering.

CHARLES W. HUBBARD.
HIRAM F. MILLS.
ELIHU THOMSON.
ELLIOT C. LEE.
W. MURRAY CRANE.
EBEN S. STEVENS.
FRANK G. STANTIAL.

Department of Biology.

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

Department of Naval Architecture.

CHARLES J. PAINE.
HOWARD STOCKTON.
WILLIAM H. LINCOLN.
ARTHUR T. BRADLEE.

Officers of Administration.

OFFICERS OF THE INSTITUTE.

President (*Acting*)	ARTHUR A. NOYES.
Secretary of the Corporation	JAMES P. MUNROE.
Treasurer	FRANCIS R. HART.
Bursar	FRANK H. RAND.
Librarian	ROBERT P. BIGELOW.
President's Assistant	HARRY A. RAPELYE.

OFFICERS OF THE FACULTY.

Chairman	ARTHUR A. NOYES.
Dean	ALFRED E. BURTON.
Secretary	ALLYNE L. MERRILL.
Registrar	WALTER HUMPHREYS.
Recorder	O. F. WELLS.

Correspondence should be addressed to the Secretary of the Faculty.

Officers of Instruction.

Offices or Lecture-rooms.[1]

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

ROBERT H. RICHARDS, S.B., LL.D. . . . . 1 Rogers.
Professor of Mining Engineering and Metallurgy; in charge of the Department.

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; in charge of the Department; Director of the Rogers Laboratory.

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

GEORGE F. SWAIN, S.B., LL.D. . . . . 43 Engineering A.
Hayward Professor of Civil Engineering; in charge of the Department of Civil and Sanitary Engineering.

FRANCIS W. CHANDLER . . . . 35 Pierce.
Professor of Architecture; in charge of the Department.

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

DAVIS R. DEWEY, PH.D. . . . . 40 Rogers
Professor of Economics and Statistics; in charge of the Department.

WEBSTER WELLS, S.B. (*Absent*).
Professor of Mathematics.

CECIL H. PEABODY, S.B. . . . . 31a Engineering C.
Professor of Naval Architecture and Marine Engineering; in charge of the Department of Naval Architecture.

HARRY W. TYLER, PH.D. . . . . 22 Rogers.
Professor of Mathematics; in charge of the Department.

ARLO BATES, A.M., LITT.D. . . . . 16 Rogers.
Professor of English; in charge of the Department.

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.

[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-rooms.

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

ALFRED E. BURTON, S.B. . . . . 12 Rogers.
Professor of Topographical Engineering; in charge of the Department of Drawing; Dean.

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

HEINRICH O. HOFMAN, E.M., MET.E., PH.D. . . . . . . 8 Rogers.
Professor of Metallurgy.

HENRY P. TALBOT, PH.D. . . . . 30 Walker.
Professor of Inorganic and Analytical Chemistry; in charge of the Department of Chemistry and Chemical Engineering.

ARTHUR A. NOYES, PH.D., LL.D. . . . . President's Office.
Professor of Theoretical Chemistry; Acting President.

THOMAS E. POPE, A.M. . . . . 41 Walker.
Professor of Inorganic Chemistry.

CHARLES F. A. CURRIER, A.M. . . . . 34 Rogers.
Professor of History and Political Science; in charge of the Department.

WILLIAM HOVGAARD . . . . 33 Engineering C.
Professor of Naval Design.

FRED WHEELER, MAJOR, U.S.A. . . . . 35 Rogers.
Professor of Military Science.

THOMAS A. JAGGAR, JR., PH.D. . . . . 10 Pierce.
Professor of Geology; in charge of the Department.

HARRY E. CLIFFORD, S.B. . . . . 16 Lowell.
Professor of Theoretical and Applied Electricity.

JOHN BIGELOW, JR. . . . . 31 Lowell.
Professor of French; in charge of the Department of Modern Languages.

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. . . . . . . 10 Rogers, 30a Engineering A.
Professor of Mechanism; Secretary of the Faculty.

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

WILLIAM H. WALKER, PH.D. . . . . 55 Pierce.
Professor of Industrial Chemistry; Director of the Research Laboratory of Applied Chemistry.

WILLIAM O. CROSBY, S.B. . . . . 12 Engineering B.
Professor of Geology; Retired under the Carnegie Foundation.

FREDERICK S. WOODS, PH.D. . . . . 34 Rogers.
Professor of Mathematics.

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

Offices or Lecture-rooms.

DUGALD C. JACKSON, C.E. . . . . 7 Lowell.
Professor of Electrical Engineering; in charge of the Department.

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

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

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

REGINALD A. DALY, PH.D. . . . . 10a Pierce.
Professor of Physical Geology.

PERCIVAL LOWELL, A.B., LL.D.
Non-resident[1] Professor of Astronomy; Director of the Lowell Observatory.

ELIHU THOMSON.
Non-resident Professor of Applied Electricity.

WILLIS R. WHITNEY, PH.D.
Non-resident Professor of Chemical Research.

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

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

LOUIS DERR, M.A., S.B. . . . . 11 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.

WILLIAM E. MOTT, S.B. . . . . 44 Engineering A.
Associate Professor of Hydraulic Engineering.

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

ARTHUR G. ROBBINS, S.B. . . . . 50 Engineering A.
Associate Professor of Topographical Engineering.

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

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

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

CHARLES F. PARK, S.B. . . . . 20a Engineering A.
Associate Professor of Mechanical Engineering; Director of the Lowell Institute School for Industrial Foremen.

HENRY G. PEARSON, A.B. . . . . 13 Rogers.
Associate Professor of English.

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

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

Offices or Lecture-rooms.

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

GEORGE C. SHAAD, S.B., E.E. . . . . 14 Lowell.
Associate Professor of Electrical Engineering.

EDWIN B. WILSON, PH.D. . . . . 22 Rogers.
Associate Professor of Mathematics.

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

FRANK H. THORP, PH.D. . . . . 22 Engineering B.
Assistant Professor of Industrial Chemistry.

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

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

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

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. . . . . 11, 16 Walker.
Assistant Professor of Physics.

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

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

NATHAN R. GEORGE, JR., A.M. . . . . 21 Rogers.
Assistant Professor of Mathematics.

ARCHER T. ROBINSON, A.B. . . . . 44 Rogers.
Assistant Professor of English.

CHARLES E. LOCKE, S.B. . . . . 1 Rogers.
Assistant Professor of Mining Engineering and Metallurgy.

LEONARD M. PASSANO, A.B. . . . . 48 Engineering A.
Assistant Professor of Mathematics.

GEORGE L. HOSMER . . . . 50 Engineering A.
Assistant Professor of Civil Engineering.

CHARLES B. BREED, S.B. . . . . 51 Engineering B.
Assistant Professor of Civil Engineering.

MAURICE DEK. THOMPSON, PH.D. . . . . 2 Walker.
Assistant Professor of Electro-Chemistry.

Offices or Lecture-rooms.

HENRY L. SEAVER, A.B. . . . . 13 Rogers.
Assistant Professor of English.

MILES S. SHERRILL, PH.D. . . . . 21 Engineering C.
Assistant Professor of Theoretical Chemistry.

GEORGE E. RUSSELL, S.B. . . . . 41 Engineering B.
Assistant Professor of Civil Engineering.

EDWARD E. BUGBEE, S.B. . . . . 7 Rogers.
Assistant Professor of Mining Engineering and Metallurgy.

LEWIS E. MOORE, C.E. . . . . 40 Engineering B.
Assistant Professor of Civil Engineering.

ERVIN KENISON, S.B. . . . . 50a Rogers.
Assistant Professor of Drawing and Descriptive Geometry.

HARRY C. BRADLEY, S.B. . . . . 50a Rogers.
Assistant Professor of Drawing and Descriptive Geometry.

ALPHEUS G. WOODMAN, S.B. . . . . 36 Walker.
Assistant Professor of Food Analysis.

JOSEPH C. RILEY, S.B. . . . . 10 Engineering A.
Assistant Professor of Mechanical Engineering.

CHARLES W. BERRY, S.B. . . . . 10 Engineering A.
Assistant Professor of Mechanical Engineering.

HARRISON W. HAYWARD, S.B. . . . . 10 Engineering A.
Assistant Professor of Applied Mechanics.

ARTHUR A. BLANCHARD, PH.D. . . . . 34 Walker.
Assistant Professor of Inorganic Chemistry.

HERVEY W. SHIMER, A.M., PH.D. . . . . 14 Pierce
Assistant Professor of Paleontology.

HENRY K. BURRISON. S.B. . . . . 43d Rogers.
Instructor in Mechanical Drawing and Descriptive Geometry.

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

THEODORE B. MERRICK . . . . Mech. Lab.
Instructor in Woodwork and Foundry-Work.

JAMES R. LAMBIRTH . . . . Mech. Lab.
Instructor in Forging.

ROBERT H. SMITH . . . . Mech. Lab.
Instructor in Machine-Tool Work.

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

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

ROBERT P. BIGELOW, PH.D. . . . . 15 Rogers, 22 Pierce.
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.

	Offices or Lecture-rooms.
W. FELTON BROWN *Instructor in Freehand Drawing.*	50 Pierce.
JUSTUS ERHARDT, A.B. *Instructor in Modern Languages.*	21, 23, 24 Lowell.
JOSEPH W. PHELAN, S.B. *Instructor in Inorganic Chemistry.*	34a Walker.
FRANCIS H. DIKE, A.B. *Instructor in Modern Languages.*	23 Lowell.
WILLIAM T. HALL, S.B. *Instructor in Analytical Chemistry.*	32 Walker.
FREDERICK R. KNEELAND, S.B. *Instructor in Analytical Chemistry.*	46c Walker.
HERMAN R. KURRELMEYER, PH.D. *Instructor in Modern Languages.*	30 Lowell.
CHARLES E. LITTLEFIELD *Instructor in Chipping and Filing.*	Mech. Lab.
WINFIELD C. TOWNE, A.B. *Instructor in Physical Training.*	Gymnasium.
WALTER H. JAMES, S.B. *Instructor in Mechanical Engineering.*	20 Engineering A.
LAWRENCE S. SMITH, S.B. *Instructor in Mechanical Engineering.*	13 Engineering B.
CLIFFORD M. SWAN, S.B. *Instructor in Physics.*	25 Walker.
PERCY G. STILES, PH.D. *Instructor in Physiology and Personal Hygiene.*	21 Pierce.
ROY G. BURNHAM, S.B. *Instructor in Mechanical Engineering.*	30 Engineering B.
CHAUNCY C. BATCHELOR, A.B. *Instructor in English.*	11 Rogers.
NEWELL C. PAGE, S.B. *Instructor in Physics.*	10 Walker.
CLARENCE L. E. MOORE, PH.D. *Instructor in Mathematics.*	36 Rogers.
ARTHUR L. GOODRICH, S.B. *Instructor in Mechanical Drawing and Descriptive Geometry.*	50a Rogers.
HAROLD A. EVERETT, S.B. *Instructor in Marine Engineering.*	31c Engineering C.
EUGENE D. FORBES, S.B. *Instructor in Physics.*	16 Walker.
GEORGE W. SWETT, S.B. *Instructor in Mechanical Engineering.*	30 Engineering A.
THEODORE H. TAFT, S.B. *Instructor in Mechanical Engineering.*	10 Engineering A.
DANIEL F. COMSTOCK, PH.D. *Instructor in Theoretical Physics.*	11 Walker.

Offices or Lecture-rooms.

JOHN W. HOWARD, S.B. . . . . 50 Engineering A.
Instructor in Civil Engineering.

CHARLES H. PORTER, A.B., S.B. . . . . 14 Lowell.
Instructor in Electrical Engineering.

STEPHEN A. BREED, S.B. . . . . 43d Rogers.
Instructor in Mechanical Drawing and Descriptive Geometry.

SAMUEL E. GIDEON . . . . 43d Rogers.
Instructor in Mechanical Drawing and Descriptive Geometry.

MYRON W. DOLE, S.B. . . . . 30 Engineering A.
Instructor in Mechanical Engineering.

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

CHARLES FIELD, 3d, S.B. . . . . 44 Walker.
Instructor in Organic Chemistry.

CARLE R. HAYWARD, S.B. . . . . 8 Rogers.
Instructor in Mining Engineering and Metallurgy.

GERALD F. LOUGHLIN, PH.D. . . . . 12 Engineering B.
Instructor in Geology.

GEORGE R. B. MEISTER . . . . 21 Lowell.
Instructor in Modern Languages.

WALTER HUMPHREYS, S.B. . . . . 18 Rogers.
Instructor in Mechanism; Registrar.

CLINTON H. COLLESTER, A.M. . . . . 11 Rogers.
Instructor in English.

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

HAROLD G. CRANE, S.B. . . . . 28a Lowell.
Instructor in Electrical Engineering.

WALDO V. LYON, S.B. . . . . 8 Lowell.
Instructor in Electrical Engineering.

ROYALL D. BRADBURY, S.B. . . . . 40 Engineering B.
Instructor in Civil Engineering.

HERBERT T. KALMUS, PH.D. . . . . 25 Walker.
Instructor in Physics.

ELLWOOD B. SPEAR, B.A., PH.D. . . . . 47a Walker.
Instructor in Inorganic Chemistry.

HERMAN R. HUNT, S.B. . . . . 33a Engineering C.
Instructor in Naval Architecture.

HENRY B. PHILLIPS, PH.D. . . . . 9 Engineering C.
Instructor in Mathematics.

RICHARD C. TOLMAN, S.B. . . . . 21 Engineering C.
Instructor in Theoretical Chemistry.

ROBERT S. WILLIAMS, PH.D. . . . . 46 Walker.
Instructor in Analytical Chemistry.

JOHN MILLS, A.M. . . . . 43d Rogers.
Instructor in Mechanical Drawing and Descriptive Geometry.

	Offices or Lecture-rooms.
IRVING H. COWDREY, S.B. *Instructor in Mechanical Engineering.*	20 Engineering A.
ROYAL R. HEUTER, S.B. *Instructor in Mechanical Engineering.*	24 Engineering B.
MALCOLM C. MACKENZIE *Instructor in Mechanical Engineering.*	33 Engineering B.
CHARLES H. CLAPP, S.B. *Instructor in Geology.*	10a Pierce.
SIDNEY GUNN, A.M. *Instructor in English.*	11 Rogers.
JOSEPH LIPKE, B.S., A.M. *Instructor in Mathematics.*	31 Rogers.
GEORGE E. BRADLEY *Assistant in Machine-Tool Work.*	Mech. Lab.
FRANK A. BROWN *Assistant in Forging.*	Mech. Lab.
ALBERT L. MOULTON *Assistant in Woodwork and Foundry-Work.*	Mech. Lab.
CHARLES E. LEAVITT, S.B. *Assistant in Mechanical Engineering.*	30 Engineering B.
CHARLES E. ALLEN, S.B. *Assistant in Civil Engineering.*	50 Engineering A.
HENRY B. ALVORD, S.B. *Assistant in Civil Engineering.*	51 Engineering B.
JAMES M. BARKER, S.B. *Assistant in Civil Engineering.*	42 Engineering A.
RAYMOND F. CONRON, S.B. *Assistant in Civil Engineering.*	42 Engineering A.
ALLAN R. CULLIMORE, S.B. *Assistant in Civil Engineering.*	50 Engineering A.
ERNEST CURLEY *Assistant in Machine-Tool Work.*	Mech. Lab.
EVIE J. EDWARDS, B.S. *Assistant in Electrical Engineering.*	28a Lowell.
PAUL S. FISKE, A.B. *Assistant in Inorganic Chemistry.*	34a Walker.
ROBERT S. GARDNER, S.B. *Assistant in Mechanical Engineering.*	10 Engineering A.
J. ERNEST GARRATT, S.B. *Assistant in Civil Engineering.*	46 Engineering A.
CHARLES W. GREEN, B.S. *Assistant in Electrical Engineering.*	28a Lowell.
RALPH G. HUDSON, S.B. *Assistant in Electrical Engineering.*	4 Lowell.
ARTHUR H. JANSSON, S.B. *Assistant in Naval Architecture.*	33a Engineering C.

	Offices or Lecture-rooms.
ALFRED R. HUNTER *Assistant in Chipping and Filing.*	Mech. Lab.
CLARENCE C. KNIPMEYER, B.S. *Assistant in Electrical Engineering.*	28a Lowell.
KENNETH MOLLER, A.B., S.B. *Assistant in Mechanical Engineering.*	10 Engineering A.
CARLETON B. NICKERSON, A.M. *Assistant in Analytical Chemistry.*	30 Walker.
OCTAVUS L. PEABODY, S.B. *Assistant in Technical Analysis.*	38 Walker.
EDMUND H. SQUIRE, S.B. *Assistant in Heat Measurements.*	4 Walker.
ELLIOT W. TAYLOR, B.S. *Assistant in Mechanical Engineering.*	10 Engineering A.
GEORGE B. THOMAS, E.E. *Assistant in Electrical Engineering.*	4 Lowell.
JOHN J. THOMAS, S.B. *Assistant in Mechanical Engineering.*	10 Engineering A.
HAROLD S. WONSON, S.B. *Assistant in Naval Architecture.*	31b Engineering C.
ALFRED B. BABCOCK, S.B. *Assistant in Theoretical Chemistry.*	14 Engineering C.
HARRY S. CHANDLER, S.B. *Assistant in Organic Chemistry.*	44 Walker.
CLARENCE W. CLARK, S.B. *Assistant in Industrial Chemistry.*	54 Pierce.
JOHN H. LOCKE, S.B. *Assistant in Physics and Electro-Chemistry.*	2 Walker.
WILLIAM H. TOPPAN, S.B. *Assistant in Theoretical Chemistry.*	21 Engineering C.
JOHN A. ALLEN, B.A., M.Sc. *Assistant in Geology.*	12 Engineering B.
LOWRY D. W. BENDER. *Assistant in Mining Engineering and Metallurgy.*	1 Rogers.
HAROLD A. BRUCE *Assistant in Physical Training.*	Gymnasium.
CHESNEY H. CRISWELL, S.B. *Assistant in Analytical Chemistry.*	28 Walker.
LEON A. DICKINSON, S.B. *Assistant in Mining Engineering and Metallurgy.*	8 Rogers.
HERBERT S. EAMES, S.B. *Assistant in Physics.*	16 Walker.
HAROLD C. FAXON, S.B. *Assistant in Physics.*	25 Walker.
CHARLES A. GIBBONS, Jr. *Assistant in Mining Engineering and Metallurgy.*	1 Rogers.

Offices or Lecture-rooms.

SAMUEL F. HATCH, S.B. . . . . 10 Engineering A.
Assistant in Mechanical Engineering.

ARTHUR T. HINCKLEY, S.B. . . . . 47a Walker.
Assistant in Inorganic Chemistry.

HOWARD B. LUTHER, S.B. . . . . 50 Engineering A.
Assistant in Civil Engineering.

EDGAR P. SLACK, S.B. . . . . 10 Walker.
Assistant in Physics.

LOYD H. SUTTON, S.B. . . . . 31 Engineering C.
Assistant in Mechanical Engineering.

ARMEN H. TASHJIAN, A.B., S.M. . . . . 4 Walker.
Assistant in Heat Measurements.

ROBERT E. THAYER, S.B. . . . . 13 Engineering B.
Assistant in Mechanical Engineering.

RUDOLPH B. WEILER, S.B. . . . . 10 Engineering A.
Assistant in Mechanical Engineering.

MASON T. WHITING, A.B., S.B. . . . . 50 Engineering A.
Assistant in Civil Engineering.

RUFUS W. G. WINT, S.B. . . . . 46 Walker.
Assistant in Analytical Chemistry.

STAFF OF THE RESEARCH LABORATORY OF PHYSICAL CHEMISTRY.

ARTHUR A. NOYES, PH.D., LL.D. . . . . 17 Engineering C.
Professor of Theoretical Chemistry.

GILBERT N. LEWIS, PH.D. . . . . 17 Engineering C.
Associate Professor of Physico-Chemical Research; Acting Director.

ARTHUR C. MELCHER, S.B. . . . . 11 Engineering C.
Research Associate in Physical Chemistry.

ROY D. MAILEY, S.B. . . . . 10 Engineering C.
Research Associate in Physical Chemistry.

WILLIAM C. BRAY, PH.D. . . . . 16 Engineering C.
Research Associate in Physical Chemistry.

CHARLES A. KRAUS, Ph.D. . . . . 2 Engineering C.
Research Associate in Physical Chemistry.

ROGER D. GALE, S.B. . . . . 12 Engineering C.
Research Assistant in Physical Chemistry.

STAFF OF THE RESEARCH LABORATORY OF APPLIED CHEMISTRY.

	Offices or Lecture-rooms.
WILLIAM H. WALKER, PH.D. *Professor of Industrial Chemistry; Director.*	55 Pierce.
HENRY P. TALBOT, PH.D. *Professor of Inorganic and Analytical Chemistry.*	30 Walker.
WILLIS R. WHITNEY, PH.D. *Non-resident Professor of Chemical Research.*	
AUGUSTUS H. GILL, PH.D. *Associate Professor of Technical Analysis.*	38 Walker.
FRANK H. THORP, PH.D. *Assistant Professor of Industrial Chemistry.*	22 Engineering B.
PETER S. BURNS, PH.D. *Research Associate in Applied Chemistry.*	51 Pierce.
WARREN K. LEWIS, PH.D. *Research Associate in Applied Chemistry.*	51 Pierce.
WILLIAM GUERTLER, PH.D. *Research Associate in Applied Chemistry.*	51 Pierce.

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 Sanitary Biology; Biologist in Charge.*	28a Pierce.
EARLE B. PHELPS, S.B. *Assistant Professor of Research in Chemical Biology.*	27 Pierce.

MEDICAL ADVISER, LECTURER ON PERSONAL HYGIENE.

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

[1] Mondays and Thursdays only, 4–5 P.M.

SPECIAL TEACHERS AND LECTURERS.

HOMER ALBERS, LL.B., *Business Law.*
JOHN ALDEN, S.B., *Textile Printing.*
TRUMAN H. BARTLETT, *Modelling.*
ALLEN H. COX, *Architectural Design.*
DAVID A. GREGG, *Pen-and-Ink Drawing.*
ELEAZER B. HOMER, S.B., *Architectural History.*
JOHN GEORGE JACK, *Landscape Horticulture.*
CHARLES D. JENKINS, S.B., *Illuminating Gas and Pottery.*
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.*
SAMUEL W. MEAD, *Architectural Design.*
WALTER E. PIPER, S.B., *Rubber.*
BURT R. RICKARDS, S.B., *Public Health Laboratory Practice.*
ODIN B. ROBERTS, LL.B., *the Nature and Function of Patents for Inventions.*
TIMOTHY W. SPRAGUE, S.B., *Electricity in Mining.*
ROSS TURNER, *Water Color.*
W. LYMAN UNDERWOOD, *Biology.*
C. HOWARD WALKER, *History of Ornament.*
S. W. WILDER, JR., S.B., *Alumina and Alumina Compounds.*
FREDERICK A. WOODS, M.D., *Theoretical Biology.*

LECTURERS FOR THE CURRENT YEAR.

W. S. BURKE, *Heating and Ventilation.*
ROBERT S. HALE, *The Price of Electricity.*
WALDEMAR LINDGREN, *Economic Geology.*
ALPHEUS A. PACKARD, S.B., *Yacht Designing.*
THOMAS G. RICHARDS, S.B., *Shop Economy.*
WILLIAM G. SNOW, S.B., *Heating and Ventilation.*
HENRY E. WARREN, S.B., *the Governing of Turbines.*
M. C. WHITAKER, S.M., *Factory Organization and Management.*
C. J. H. WOODBURY, A.M., Sc.D., *Telephone Engineering.*

Faculty.

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.
ARLO BATES.
DESIRÉ DESPRADELLE.
PETER SCHWAMB.
C. FRANK ALLEN.
ALFRED E. BURTON, *Dean.*
DWIGHT PORTER.
HEINRICH O. HOFMAN.
HENRY P. TALBOT.
ARTHUR A. NOYES, *Chairman.*
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, *Secretary.*
EDWARD F. MILLER.
WILLIAM H. WALKER.
WILLIAM O. CROSBY.
FREDERICK S. WOODS.
HARRY M. GOODWIN.
DUGALD C. JACKSON.
JOHN O. SUMNER.
FREDERICK H. BAILEY.
HENRY FAY.
REGINALD A. DALY.
S. HOMER WOODBRIDGE.
WILLIAM H. LAWRENCE.
LOUIS DERR.
CHARLES L. ADAMS.
CHARLES L. NORTON.
WILLIAM E. MOTT.
AUGUSTUS H. GILL.
ARTHUR G. ROBBINS.
FRANK A. LAWS.
CHARLES E. FULLER.
WILLIAM A. JOHNSTON
CHARLES F. PARK.
HENRY G. PEARSON.
RALPH R. LAWRENCE
HARRISON W. SMITH.
GEORGE C. SHAAD.
EDWIN B. WILSON.
GILBERT N. LEWIS.
FRED L. BARDWELL.
FRANK H. THORP.
F. JEWETT MOORE.
HARRY W. GARDNER.
SAMUEL C. PRESCOTT.
CHARLES H. WARREN.
SAMUEL P. MULLIKEN
GEORGE B. HAVEN.
WALTER S. LELAND.
WILLIAM J. DRISKO.
C.-E. A. WINSLOW.
CARROLL W. DOTEN.
NATHAN R. GEORGE, JR.
ARCHER T. ROBINSON.
CHARLES E. LOCKE.
LEONARD M. PASSANO.
GEORGE L. HOSMER.
CHARLES B. BREED.
MAURICE DE K. THOMPSON
HENRY L. SEAVER.
MILES S. SHERRILL.
GEORGE E. RUSSELL.
EARLE B. PHELPS.
EDWARD E. BUGBEE.
LEWIS E. MOORE.
ERVIN KENISON.
HARRY C. BRADLEY.
ALPHEUS G. WOODMAN.
JOSEPH C. RILEY.
CHARLES W. BERRY.
HARRISON W. HAYWARD.
ARTHUR A. BLANCHARD.
HERVEY W. SHIMER.

Committees of the Faculty.

(Partial List.)

Faculty Business.

ARTHUR A. NOYES, *Chairman.*

Petitions.

ALLYNE L. MERRILL, *Chairman.*

Courses of Instruction.

HARRY W. TYLER, *Chairman.*

Special Students.

F. JEWETT MOORE, *Chairman.*

Five-Year Courses.

CHARLES F. PARK, *Chairman.*

Provisional Students.

FREDERICK S. WOODS, *Chairman.*

Summer Courses.

WILLIAM H. LAWRENCE, *Chairman.*

Summer Reading.

WILLIAM T. SEDGWICK, *Chairman.*

Graduation Exercises.

HENRY G. PEARSON, *Chairman.*

Recommendation of Graduates for Appointment.

ALLYNE L. MERRILL, *Chairman.*

Advanced Degrees and Fellowships.

ARTHUR A. NOYES, *Chairman.*

Undergraduate Scholarships.

DAVIS R. DEWEY, *Chairman.*

Relations with Secondary Schools.

CHARLES F. A. CURRIER, *Chairman.*

Entrance Examinations.

ALLYNE L. MERRILL, *Chairman.*

Publications.

DANA P. BARTLETT, *Chairman.*

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

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

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

By the Act of April 27, 1863, of the Legislature of the State of Massachusetts, the Institute was constituted the Land-Grant College of Mechanic Arts of the State, and was awardeo one-third of the appropriation provided by the United States Land Grant Act of July 2, 1862, for the "endowment, support and maintenance of at least one college [in each State] where the leading object shall be, without excluding other scientific and classical studies, and including military tactics, to teach such branches of learning as are related to agriculture and the mechanic arts. . . ." The same proportion of the proceeds of the land grants authorized by the Acts of Congress of August 30, 1890, and March 4, 1907, is also assigned to the Institute. These grants are subject to the condition that instruction in military tactics shall be provided, and that the Governor, the Chief Justice of the Supreme Court, and the Secretary of the State Board of Education shall be each a member *ex-officio* of the government of the Institute. In addition, the Institute receives direct support from the State through an annual grant of $25,000 to be used for its general purposes. The State has also established at the Institute forty free scholarships for the benefit of students from the various Senatorial districts of the State (see page 348).

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

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

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

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

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

The Society of Arts.—This is a department of the Institute which is especially devoted to the general dissemination of scientific knowledge. It aims to awaken and maintain an interest in the recent advances and practical applications of the sciences. For this purpose meetings, over which the President of the Institute presides, are held semi-monthly from October to May, at which reports of inventions, discoveries, and matters of scientific and technical interest are presented. These meetings are open to students of the Institute and to other persons interested in the aims of the Society. The Society publishes Proceedings which are regularly circulated to its members. All persons interested in the promotion of science or its applications are eligible to membership.

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

The School consists of the Departments of Mathematics, Theoretical and Applied Mechanics, Drawing and Descriptive Geometry, Mechanic Arts, English, History and Political Science, Economics and Statistics, Modern Languages, Civil and Sanitary Engineering, Mechanical Engineering, Mining Engineering and Metallurgy, Architecture, Chemistry and Chemical Engineering, Electrical Engineering, Biology, Physics, Geology and Geodesy, Naval Architecture, Military Science, and Physical Training. A description of the organization of these separate Departments, of the general character and purposes of the instruction afforded, and of the specific subjects of instruction offered by them will be found on pages 135 to 314 of this publication.

In connection with the School the Institute also maintains a Research Laboratory of Physical Chemistry, a Research Laboratory of Applied Chemistry, and a Sanitary Research Laboratory and Sewage Experiment Station.

The Institute offers to its students both Undergraduate and

Advanced Courses of Study. The former lead to the degree of Bachelor of Science; the latter, to the degrees of Master of Science, Doctor of Philosophy, or Doctor of Engineering. It also affords to advanced students and to more experienced investigators excellent opportunities for the pursuit of original scientific investigations in its departmental laboratories and in the special research laboratories above mentioned.

Women are admitted to any of the Courses of the School.

The Undergraduate Courses of Study.—In these Courses, which are its most important and largely attended ones, the Institute aims to afford to students with the preparation furnished by the better High Schools, the additional instruction in English, Modern Language, History, and Political Science which are essential to a liberal education; to give them a thorough training in the fundamental sciences of Mathematics, Chemistry, and Physics, and in the important applications of the principles of these sciences to the various branches of engineering and applied science. It lays far more stress on the development of the power to deal effectively with new engineering or scientific problems than on the acquirement of an extensive knowledge of details. In order to attain these results, most of its class-room instruction is given to small sections of students, and in its laboratories and drawing-rooms students receive a large amount of personal attention. The independent solution of assigned problems forms a large part of nearly all its Courses. Its curriculum differs from that of technical schools of the narrower type in the respect that a large proportion of liberal studies of a literary and general scientific character are insisted upon, and in the respect that courses upon technical methods and other highly specialized subjects are largely excluded; for, while the latter are sometimes important in special industries, they are not essential to a broadly trained engineer, who can readily acquire later the necessary technical knowledge. Its system of instruction differs from the University plan of education in that cultural studies are closely correlated and interwoven with the professional work, while under the latter plan the two groups of studies are ordinarily pursued successively, in separate undergraduate and graduate schools. The Institute lays, moreover, especial emphasis on training in science and scientific method, not only as an essential to professional success, but as an important element in culture and in life. Its Courses differ, too, from those of many colleges in that electives are introduced to a much less extent, in the belief that better results are obtained by prescribing, after the student has selected the profession for which he desires to prepare himself, the principal studies which he is to pursue. He is given, however, the choice between groups of optional studies relating to different branches of his profession and between a variety of electives in the group of general studies. While the Faculty encourages a moderate participation of students in social and athletic activities and while it has welcomed the development of student life which has taken place in these directions in the past few years, it demands of its regular students a standard of scholarship which is inconsistent with an excessive devotion to such pursuits.

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

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

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

CIVIL ENGINEERING.	1. *Hydraulic Engineering.* 2. *Railroad Engineering.*
MECHANICAL ENGINEERING.	1. *Marine Engineering.* 2. *Locomotive Construction.* 3. *Mill Engineering.* 4. *Heating and Ventilation.* 5. *Steam Turbine Engineering.*
MINING ENGINEERING AND METALLURGY	1. *Mining and Metallurgy.* 2. *Metallurgy.* 3. *Mining Geology.*
ARCHITECTURE.	1. *Architecture.* 2. *Architectural Engineering.*
CHEMISTRY.	1. *Analytical and Industrial Chemistry.* 2. *Sanitary and Municipal Chemistry.* 3. *Physical Chemistry.*
BIOLOGY.	1. *Anatomy and Physiology.* 2. *Sanitary and Industrial Biology.*
PHYSICS.	1. *Chemistry.* 2. *Mathematics.* 3. *Electrochemistry.*
GEOLOGY AND GEODESY.	1. *Geology.* 2. *Geodesy.*

Descriptions of these Courses and of the professional work for which they afford a preparation, as well as schedules showing the subjects of instruction included and their arrangement, will be found on pages 70 to 103.

It will be observed that in addition to the Courses in the various branches of Engineering, the Institute offers Courses in the other important branches of Applied Science. Thus the Courses in Applied Chemistry, Metallurgy, Electrochemistry, and Sanitary and Industrial Biology serve to prepare students as scientific experts and for professional positions in manufacturing establishments and government laboratories. Thorough courses in pure science, namely in Chemistry, Physics, Biology, Geology, and General Science, are also offered. These give the training required for teaching positions in technological institutions, colleges, and preparatory schools, and for research positions in the departments of the government and in private laboratories. The Course in Biology furnishes, too, an exceptional training for the subsequent study of Medicine in Medical Schools of the graduate type.

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

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

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

First, those who wish to complete in five years the work of two allied Courses;

Second, those who wish to combine with the work of a single professional Course a larger proportion of humanistic studies and of work in general science;

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

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

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

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

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

Under the second plan the Five-Year Course is arranged so as to include all the subjects of one of the regular professional Courses distributed over a period of five years, and supplemented by the introduction in the extra time thus made available of much additional work, which is in part elective, in General Science, History, Language, Literature, Art, and Economics. This Course provides in large measure the breadth of scholarship which a college course is designed to supply; but it does this by the methods and in the atmosphere of the scientific school and with special emphasis upon general scientific studies as a part of a liberal education. Upon students who complete such a Course is conferred the degree of Bachelor of Science in two departments of study, namely, in General Science, and in the branch of engineering in which the professional work has been completed.

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

Definite schedules have been prepared for such Five-Year Courses in Civil, Mechanical and Electrical Engineering, and will be furnished upon application to the Secretary of the Faculty.

Similar schedules will, so far as possible, be arranged for individual students in the other branches of engineering.

Students desiring to pursue any of these types of Five-Year Courses should consult the Secretary of the Faculty.

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

Summer Schools.—The Institute conducts summer school work of two kinds. Courses of instruction are offered which correspond to some of those given during the regular school year. The object and arrangement of these courses are described in detail on page 108, and in a special circular issued each year in March. Secondly, professional summer schools are carried on either regularly or at intervals in some Departments. This work is supplementary to and different in character from that given during the regular terms, and in general is elective and not required. Further details will be found on pages 111 to 115.

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

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

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

More detailed information may be found on pages 116 to 134 of this Catalogue and in a special Bulletin on Advanced Study and Research.

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

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

There is an athletic field on the Institute's property in Brookline where opportunity is afforded for track-team contests and inter-class games. See page 314 for further information.

Requirements for Admission.—Detailed information in regard to the requirements for admission to the courses of instruction in the Institute will be found on pages 50 to 69. In general the preparation necessary to enable an applicant to pursue successfully one of the regular Undergraduate Courses corresponds with that afforded by high schools or academies of the better grade offering a four-years course of study. Applicants for admission as special students must be prepared in all subjects that are required for admission to the particular courses desired.

School Year.—The first term begins on the 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, for one week at Christmas, and the first or last half of the week in which the 19th of April occurs, according as the 19th falls in the former or in the latter, the exercises of the school are suspended.

Registration; Attendance Card.—At the opening of each term the student is required to fill out and present to the Registrar an attendance card, blank forms for which are supplied. The attendance card is the direct means by which the student places before the Faculty his wishes in regard to his professional Course or selection of studies. The card must be presented at the earliest possible moment, to give opportunity for the immediate determination of qualifications and status. 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.

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. With the exception of an interval of one hour in the middle of the day, exercises are held and students are in general expected to devote themselves to the work of the school between the hours of 9 A.M. and 5 P.M. There are no exercises on Saturday after 1 P.M., and the rooms are closed

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. 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. 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 preceding the September entrance examinations and following days, and for first-term subjects at the time of the May examinations.

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

Students conditioned in any subject and failing to make up the condition at the time appointed for the examination are not entitled to another examination, 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 the first term of the first year are allowed to choose their Courses without restriction. Students will not be admitted to professional work of the several Courses without satisfactory records in those previous subjects on which the former especially depend. Exceptions to this rule may be made in individual cases after special consideration by the Faculty.

Any special student attaining a proper standing in all subjects required of a regular student, up to any given period of the Course, will 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 twice during each term; formal semi-annual reports are sent at the close of each term; and special votes of the Faculty are transmitted in cases requiring consideration. These reports are sent to students, and to the parents or guardians of those not of age, but reports will be sent to a parent or guardian in any other case also on application to the Registrar, and notification will be made to parents or guardians in all cases of students advised or required to withdraw, or placed on probation.

Conduct.—It is assumed that students come to the Institute for a serious purpose, and that they will cheerfully conform to such regulations as may be from time to time made by the Faculty. In case of injury to any building, or to any of the furniture, apparatus, or other property of the Institute, the damage will be charged to the student or students known to be immediately concerned; but, if the persons who caused the damage are unknown, the cost of repairing the same may be assessed equally upon all the students of the school.

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

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

Advisers.—The Dean is the general consulting officer for students, and 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, is the medical adviser for students, and will address them during the year on personal hygiene. He may be consulted by students any Monday or Thursday afternoon between four and five o'clock in Room 13, Pierce, without payment of fee.

Requirements for Graduation.—To receive the degree of Bachelor of Science the student must have attended the Institute not less than one year, which must be that 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.

The student must, moreover, prepare a thesis on some subject included in his course of study; or an account of some research made by him; or an original report upon some machine, work of engineering, industrial works, mine, or mineral survey; or an original design accompanied by an explanatory memoir. This thesis or design must be approved by the Faculty. Theses are to be written on one side only of paper of good quality, $8 \times 10\frac{1}{2}$ 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 day on which the first annual examination occurs.

All theses and records of work done in preparation of theses are the permanent property of the Institute, and 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.

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

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

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

For requirements for higher degrees, see pages 116 to 122.

Fees.—The tuition fee for regular students is $250 per year, and must be paid *in advance* as follows,—$150[1] on or before the first Wednesday after September 25, and $100 on or before the first Tuesday after February 4. 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 with the Chairman of the Faculty Committee on Undergraduate Scholarships. For detailed information in regard to scholarships and fellowships see pages 347 to 353.

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 laboratory $10. Any balance remaining at the end of each year will be refunded *on application*, or, if the student chooses, will be held to his credit for the succeeding year. All deposits must be made at the time when the tuition fee for the first term is paid.

Payments.—All payments should be made to F. H. Rand, Bursar. If by check, remittance from points out of New England should be in New York or Boston funds.

[1] Students entering the first year who have paid the entrance examination fee of five dollars mentioned on page 51, will be credited with this amount on presentation of their receipt.

Residence and Expenses.—As the exercises of the school begin at nine o'clock in the morning, and end by five o'clock in the afternoon, students may conveniently live in any of the nearer cities or towns, on the lines of the various railroads, if they prefer to do so.

The cost of board and rooms in 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.

Location.—The buildings of the Institute are located in the neighborhood of Copley Square, in close proximity to the chief collections and libraries of Boston, in particular to the Museum of Fine Arts, the Public Library, and the Boston Society of Natural History. The Back Bay railroad stations and many street-car lines afford easy access from the southern and western suburbs. The North Station is also within walking distance of the Institute, and is very quickly reached through the Subway of the Boston Elevated Railway Company. The free lecture courses of the Lowell Institute are held in the main buildings of the Institute. The location in the neighborhood of a great manufacturing district, with which the Institute maintains close relations, is of great advantage 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, and they are constantly brought into close contact with eminent men engaged in the active practice of various professions.

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 tc the Departments of Civil and Mechanical Engineering; the Engineering Building C, on Trinity Place, devoted to the instruction in Mineralogy 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 and Geology, the Laboratory of Industrial Chemistry and the Research Laboratory of Applied Chemistry; the Lowell Building, on Clarendon Street, devoted mainly to the laboratories of 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.

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 315 to 346.

The Technology Union.—In order to make better provision for the social life of the students, and to enable them to secure meals of wholesome quality at a moderate price, a building has been erected upon the Institute's land on Trinity Place. This building, which is known as the Technology Union, contains a large dining-room, two smaller dining-rooms for the meetings of the various student organizations, a social room, a library and writing room, a mail delivery office, toilets, coat rooms, etc. It is open to all students free of charge, and is largely under the management of a special committee elected by the student body for that purpose.

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 on pages

55 to 65 are regarded as a minimum in all ordinary cases, and only exceptional circumstances will justify any relaxation. Parents and guardians are advised that it is generally for the ultimate advantage of the student not to enter under the age of eighteen years, unless for a five-year course.

Entrance Examinations 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 8.)

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.

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

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

Order of Examinations in Boston.—The order of examinations for June, 1909, will be as follows:—

WEDNESDAY, JUNE 30, 1909.

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 12.45 P.M.	History.
2.00 P.M. to 4.00 P.M.	Physics.

THURSDAY, JULY 1, 1909.

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

FRIDAY, JULY 2, 1909.

9.00 A.M. to 10.45 A.M.	Algebra B.
11.00 A.M. to 1 P.M.	German.
2.15 P.M. to 4 P.M.	Algebra A.

SATURDAY, JULY 3, 1909.

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

The order of examinations for September, 1909, will be as follows:—

TUESDAY, SEPTEMBER 21, 1909.

9.00 A.M. to 11 A.M.	Solid Geometry.
11.15 A.M. to 12.45 P.M.	History.
2.00 P.M. to 4.00 P.M.	Physics.

WEDNESDAY, SEPTEMBER 22, 1909.

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

THURSDAY, SEPTEMBER 23, 1909.

9.00 A.M. to 10.45 A.M.	Algebra B.
11.00 A.M. to 1.00 P.M.	German.
2.15 P.M. to 4 P.M.	Algebra A.

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

Examinations at Other Points.—*Examinations are now held by the Institute in Boston only. Candidates desiring exami-*

nation 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 1909 will be held June 14–19. 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, May 31, 1909.

Applications for examination elsewhere in the United States or in Canada must be received not later than May 24, 1909.

Applications for examination at points outside of the United States and Canada must be received not later than May 10, 1909.

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 must accompany but 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 1909 is as follows:—

MONDAY, JUNE 14, 1909.

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 P.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]

TUESDAY, JUNE 15, 1909.

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 16, 1909.

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 17, 1909.

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 18, 1909.

9.00 A.M. to 11.00 A.M.	English a (Reading).
1.30 P.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.
ELECTIVES.	HISTORY a or d; HISTORY b; HISTORY c; LATIN a, i and ii; LATIN b, c, or d; FRENCH b; FRENCH b c; GERMAN b; GERMAN b c; SPANISH; CHEMISTRY; BOTANY; DRAWING.

Records below 60 will not be accepted.

Certificates covering fewer than three of the Institute requirements are accepted only for final candidates, but a certificate for two subjects may be accepted in connection with a satisfactory elective.

[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.

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. 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 62. 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." A candidate incurring conditions in June must repeat in September examinations in those subjects in which he has failed. Conditions incurred in September, except in History and Physics, must be made up in January for continuance in dependent work. A condition in History incurred in September is removed by passing an examination in June or September following, or by a satisfactory record in United States History. A September condition in Physics must be removed by passing a satisfactory examination the following June or September.

DIVISION OF ENTRANCE EXAMINATIONS.

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

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

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

Preliminary candidates are advised not to offer English or the second part of Algebra (see page 57). Algebra B, if passed by a preliminary candidate, will be counted with Algebra A as a single subject. Solid Geometry may be taken by a preliminary applicant, provided he presents, before entrance, evidence that he has continued mathematical study during the intervening year. A preliminary candidate passing English will also be required to present a statement from his teacher that he has continued the study of English.

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

A complete or partial candidate having credit for three or more subjects may be credited with them for admission the following year, subject to presenting the teacher's certificate required of a preliminary candidate. Credit for examinations passed will not remain valid for more than one year unless by special permission.

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 A.	**French I.** (elementary).
Algebra B.	**German I.** (elementary).
Plane Geometry.	**English.**
Solid Geometry.	**History.**
Physics.	

Applicants for admission must also present satisfactory evidence of preparation in two of the following **Electives** (see page 62):—

French (intermediate).	**Chemistry.**
German (intermediate).	**Mechanical Drawing.**
Spanish.	**Mechanical Drawing and Mechanic Arts.**
Latin I.	**Biology.**
Latin II.	
English (additional).	
History (additional).	

A satisfactory examination in Intermediate French or Intermediate German is accepted at present for the entire elective requirement.

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

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

B. Quadratic equations, both numerical and literal; simple cases of equations with one or more unknown quantities, that can be solved by the methods of linear or quadratic equations;

problems depending upon quadratic equations; the binomial theorem for positive integral exponents; the formulas for the *n*th term and the sum of the terms of arithmetic and geometric progressions, with applications. The examination in Algebra B may also include questions of a less elementary character on topics in Algebra A.

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

Plane Geometry.—The usual theorems and constructions of good text-books, including the general properties of plane rectilinear figures; the circle and the measurement of angles; similar polygons; areas; regular polygons and the measurement of the circle. The solution of numerous original exercises, including loci problems. Applications to the mensuration of lines and plane surfaces.

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

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

Importance will be attached to accuracy in the numerical work of the papers in Algebra and Geometry. 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. (Elementary).—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 forms and use of numerals; the use of the subjunctive, except unusual cases; the conjugation of the regular and of the more common irregular verbs, 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.

Provision will be made for students prepared to pass an examination for advanced standing. See page 66.

German I. (Elementary).—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 questioning 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 an examination for advanced standing.

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.

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 formation of 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 National Conference on Uniform Entrance Requirements 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. Copies of recent entrance examination papers may be had of the Secretary of the Faculty, and will give an accurate idea of what is expected of the candidate.

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.

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

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

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

Physics.—The candidate will be expected to be familiar with the fundamental principles of Physics. It is especially desirable that he should have a good knowledge of general mechanics and of the mechanics of solids, liquids, and gases. A knowledge of physical hypotheses is comparatively unimportant. Text-book instruction should be supplemented by lecture-room experiments. A sufficiently extended treatment of the subject will be found in any of the principal text-books now in use in secondary schools.[1] Ability to solve simple problems will be expected. It is furthermore expected that the student will receive training in laboratory work. For the pres-

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

ent, however, no student will be rejected because of deficiency in laboratory work, if the school from which he comes is unable to furnish such instruction, a certificate to which effect from the principal of the school will be required.

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

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

Laboratory notebooks should be presented at the Registrar's office during the week preceding the examination if practicable.

ELECTIVE SUBJECTS.

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

These requirements are to be met by the presentation of certificates made out on forms supplied by the Institute; but an applicant passing an examination for advanced standing in Intermediate French, in Intermediate German, or in both United States History and Ancient History, need not present a certificate in the corresponding subject. Certificates are also not required of candidates passing certain College Entrance Board Examinations. (See page 54.)

Excuse from the elective requirements, or the acceptance of equivalents may be allowed in the case of applicants considerably above the usual age, or those coming from foreign countries. Applications for the substitution of work other than that given in the list of electives will also be entertained.

Examinations are in general required in the case of applicants desiring excuse from work in the Institute on the ground of electives offered at entrance. The subjects in which excuse may be granted on examination are French, 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 Course in Chemistry or that in Chemical Engineering Courses are advised to present Chemistry as an elective subject if practicable.

Elective French.[2]—Translation from English into French; review of Grammar; additional and more varied reading.

Elective German.[2]—Translation from English into German; review of Grammar; additional and more varied reading.

Elective Spanish.—Evidence should be presented that the applicant has mastered the Grammar in its esstentials and read intelligently with translation into English about 150 duodecimo pages of graded Spanish text. Also translation from English into Spanish.

The additional reading in French, German, or Spanish may be selected from the works read in the Institute classes, but no requirement of particular text-books is intended.

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

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

[1] See footnote, page 162.

[2] In addition to the uniform requirements stated on page 59.

and has had an elementary course in Latin Composition, or that he has read four books of Cæsar.

Elective Latin II.—Satisfactory evidence should be presented that the applicant has read six orations of Cicero, or the first six books of Virgil's Æneid.

The study of Latin is 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 facilitates the acquisition of the Modern Languages.

Elective English or History.[1]—The work of secondary schools differ 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 60 and 61 may present for approval as as his elective a statement of the amount and kind of work done.

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

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

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

[1] In addition to the uniform requirements stated on pages 60 and 61.

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.—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 these courses at the Institute.

Elective Mechanical Drawing and Mechanic Arts.—These subjects may be offered in combination. For the requirement in Mechanical Drawing see above.

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.

In the case of students passing examinations for advanced standing, in addition to obtaining *a clear record* in entrance requirements, the Faculty endeavors to facilitate the substitution of alternative work. A candidate passing more than the required work in Modern Languages may arrange to complete any remainder during his first year. A candidate passing Trigonometry or other subjects for advanced standing may, with the approval of the Faculty, substitute second-year European History or Mechanic Arts, or take additional work in English Composition or in the Chemical Laboratory. A candidate who has passed off Descriptive Geometry and Mechanical Drawing[1] may take second-year Descriptive Geometry. Graduates of Manual Training Schools may be excused in particular cases from the Mechanic Arts required in some of the engineering Courses. It is in general preferred that English and Mathematics be not anticipated.

To be admitted as a 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 8. (See pages 56 to 62 and pages 70 to 107.)

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 70 to 107, and to the description of Subjects of Instruction, pages 135 to 314. 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

[1] See foot-note, p. 162.

that applicants have preparation in Analytic Geometry and the elements of the Calculus, and highly desirable that they be familiar with Mechanical Drawing and Descriptive Geometry. For admission to third-year engineering work, they must be prepared in Mathematics through the Calculus, in Mechanical Drawing, in Descriptive Geometry, in Physics and in that part of Applied Mechanics given in the second year. Summer courses of appropriate scope are offered in most of these subjects, and applicants proposing to enter with advanced standing are advised to correspond with the Secretary of the Faculty in regard to their credits as early as June 1, if in doubt as to what studies, if any, should be pursued during the summer preceding entrance. (See page 108.) 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 besides presenting official records.

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

ADMISSION OF SPECIAL STUDENTS.

To be admitted to one or more selected subjects in any of the regular Courses except that in Architecture,—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.

Applicants desiring admission as special students in Architecture must be college graduates, or twenty-one years of age, with not less than two years' office experience. All applicants (except college graduates) will be required to pass, before entrance, either the regular entrance examinations[1] in Plane and Solid Geometry, or a special examination in Geometry, which will be of a somewhat practical character, emphasizing geometrical construction, and as far as possible be a test of fitness for the courses in Mechanical Drawing and Descriptive Geometry; and they must include in their work at the Institute the regular first-year courses in Freehand Drawing, Descriptive Geometry, and Mechanical Drawing, unless these subjects have been passed at the September examinations for advanced standing.[2]

By means of the description of Subjects of Instruction, pages 135 to 314, 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.

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.

[1] See "Advanced Standing Examinations," Calendar, page 8.

[2] See foot-note, pp. 162 and 163.

Undergraduate Courses of Study.

GENERAL INFORMATION.

On the following pages are given the Schedules of the various Undergraduate Courses of Study. For information in regard to their general character and purposes see pages 33 to 39.

The sum of the time assigned to exercises and of that estimated as being required for the outside preparation for them in all Courses is ordinarily seven hundred and twenty hours for each term of fifteen weeks. In the following Course Schedules, the 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 137 to 142.

Numbers in parentheses refer to the description of Subjects of Instruction, pages 135 to 314, 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 are required to complete assigned courses of reading of a literary, historical, and general scientific character. See page 107.

A special course in English Composition may be required at any time after the first year of any student who shows inability to write clear and correct English. (See course 141.)

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. For the details of this requirement see page 106.

FIRST YEAR.

FIRST TERM.

COMMON TO ALL COURSES.

	Hours of Exercise
Mathematics (20)	30
Plane Trigonometry (23)	30
Inorganic Chemistry (550); Laboratory, Lectures, and Recitations; Chemical Laboratory	105
Mechanical Drawing (100) and Descriptive Geometry (101)	90
Freehand Drawing (110)	15
French II.[1] (221)	45
Rhetoric and English Composition (140)	30
Military Science (990)	45
Physical Training (995)	25

SECOND TERM.

COURSES I, II, III, VI, $VIII_3$, X, XI, XII, XIII.	Hours of Exercise
Mathematics (21)	60
Inorganic Chemistry (551); Laboratory, Lectures, and Recitations	105
Mechanical Drawing (102) and Descriptive Geometry (103)	90
Freehand Drawing (111)	30
French II.[1] (221)	45
English (140)	30
United States History (170)	30
Military Science (990)	45
Physical Training (995)	15

COURSE IV.

Shades and Shadows (470)	15
Mathematics (21)	60
Mechanical Drawing (104) and Descriptive Geometry (105)	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
Physical Training (995)	15

COURSE V.

Inorganic Chemistry (551); Laboratory, Lectures, and Recitations	150
Mathematics (22)	45
Mechanical Drawing (102) and Descriptive Geometry (103)	90
Freehand Drawing (111)	30
French II.[1] (221)	45
English (140)	30
United States History (170)	30
Military Science (990)	45
Physical Training (995)	15

COURSE VII.	Hours of Exercise
Inorganic Chemistry (551); Laboratory, Lectures, and Recitations	150
Industrial Microscopy (708)	30
Mathematics (22)	45
Freehand Drawing (111)	30
French II.[1] (221)	45
English (140)	30
United States History (170)	30
Military Science (990)	45
Physical Training (995)	15

COURSE $VIII_{1, 2}$.

Mathematics (21)	60
Inorganic Chemistry (551); Laboratory, Lectures, and Recitations	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
Physical Training (995)	15

COURSE IX.

See page 94.

[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 182. Students expecting to take Courses I., II., VI., XI., or XIII. may substitute German II. for French II. in the first year. In Courses II. and VI. this substitution is advised.

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 Advanced Courses.

For further details see pages 187 to 201, 316 to 321, and 338.

I.—CIVIL ENGINEERING.

FIRST YEAR. SEE PAGE 71.

SECOND YEAR.

FIRST TERM.	Hours of Exercise	SECOND TERM.	Hours of Exercise
Surveying and Plotting (300)	90	Surveying (300) and Plotting (301)	75
Mathematics (30)	45	Topographical Drawing (302)	30
Spherical Trigonometry (24)	10	Mathematics (31)	45
Physics: Mechanics, Wave-motion, Electricity (770)	75	Physics: Electricity, Optics (770)	75
Mechanism (364)	30	Physical Laboratory (773)	30
Descriptive Geometry (107)	60	Applied Mechanics (60)	45
English Literature (150)	30	Stereotomy (325)	60
European History (173)	30	English Literature (150)	30

SUMMER READING, SEE PAGE 107.

THIRD YEAR.

FIRST TERM.	Hours of Exercise	SECOND TERM.	Hours of Exercise
Railroad Engineering: Field-work and Drawing (313, 315)	90	Railroad Engineering; Field-work and Drawing (313, 315)	105
Highway Engineering (314)	15	Advanced Surveying (303)	30
Advanced Surveying (303)	30	Astronomy and Geodesy (308)	45
Dynamical Geology (855)	30	Theory of Structures (345)	45
Structural and Field Geology (857)	30	Materials (352)	30
Physics: Heat (771)	15	Building Stones and Lithology (895)	30
Physical Laboratory (774)	15	Strategraphic Geology (875)	15
Dynamo Electric Machinery (661)	30	Testing Materials (78)	30
Applied Mechanics (66)	60	Business Law (186)	15
Political Economy (190)	45	General Studies (see page 106).	
General Studies (see page 106).			

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
Theoretical Hydraulics (330)	45	Steam Engineering (387)	45
Steam Engineering (387)	45	Hydraulic Laboratory (342)	15
Engineering Laboratory (399)	15	Thesis.	
Options.		*Options.*	
1. Sanitary and Hydraulic Eng. (334)	60	1. Hydraulic Engineering (335)	45
1. Hydraulic Measurements (333)	20	1. Hydraulic and Sanitary Designing (337)	30
2. Railroad Engineering (319)	30	1. Sanitary Science and Public Health (754)	15
2. Railroad Designing (321)	60	2. Railroad Engineering (319)	45
		2. Railroad Designing (321)	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, Heating and Ventilation, and Steam Turbine Engineering. 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 202 to 214 and 316 to 321.

II.—MECHANICAL ENGINEERING.

First Year. See page 71.

SECOND YEAR.

FIRST TERM.	Hours of Exercise
Carpentry and Wood-turning (120)	60
Descriptive Geometry (107)	45
Mathematics (30)	45
English Literature (150)	30
European History (173)	30
Mechanical Engineering Drawing (372)	90
Mechanism (360)	45
Physics (770)	75

SECOND TERM.	Hours of Exercise
Applied Mechanics (60)	45
English Literature (150)	30
Mathematics (31)	45
Mechanical Engineering Drawing (373)	30
Mechanism and Valve-gears (360)	45
Pattern Work (122)	30
Physical Laboratory (773)	30
Physics (770)	75
Precision of Measurements (772)	10

Summer Reading, see page 107.

THIRD YEAR.

FIRST TERM.	Hours of Exercise
Applied Mechanics (65)	45
Electrical Engineering (653)	30
Mathematics (40)	30
Forging (127)	60
General Studies (see page 106).	
Machine Drawing (377)	75
Metallurgy of Iron (441)	15
Physical Laboratory (774)	15
Physics (771)	15
Political Economy (190)	45
Steam Engineering: Thermodynamics (385)	45

SECOND TERM.	Hours of Exercise
Applied Mechanics (70)	45
Applied Mechanics Laboratory (77)	25
Business Law (186)	15
Electrical Engineering (653)	30
Engineering Laboratory (396)	15
Forging (127); Chipping and Filing (130)	90
General Studies (see page 106).	
Heating and Ventilation (414)	15
Mechanical Engineering Drawing (378), and Boiler Drawing (379); Use of Surveying Instruments (304)	90
Steam Engineering: Boilers (385)	60

FOURTH YEAR.[2]

FIRST TERM.	Hours of Exercise
Applied Mechanics (80)	45
Chipping and Filing (130); Machine-tool Work (132)	90
Dynamics of Machines (401)	25
Engineering Laboratory (397) (639)	60
Heating and Ventilation (414)[1]	15
Machine Design (404)	135
Metallurgy of Iron (441)	15
Theoretical Hydraulics (331)	15

Options.

1.	Marine Engineering (420)	35
2.	Locomotive Construction (421)	35
3.	Mill Engineering (422)	35
4.	Heating and Ventilating Eng. (423)	30
	Hygiene of Ventilation and Heating (758)	5
	Dynamo Electric Machinery (662)	25
5.	Steam Turbine Engineering (424)	35

SECOND TERM.	Hours of Exercise
Applied Mechanics (81)	45
Engineering Laboratory (397, 784)	60
Foundations (407)	15
Hydraulic Motors (338)	30
Industrial Management (409)	10
Machine-tool Work (132)	90
Thesis.	

Options.

1.	Marine Engineering (420)	75
2.	Locomotive Construction (421)	40
3.	Mill Engineering and Drawing (422)	75
4.	Heating and Ventilating Eng. (423)	40
5.	Steam Turbine Engineering (424)	75

[1] Not taken by Option 4.

[2] For class of 1909 only.

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 112 and 321.)

For students able to devote an additional year to professional study, subjects for an Advanced Course of one year, which may lead to the degree of Master of Science, have been arranged. (See page 125.) 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 215 to 222.

III.—MINING ENGINEERING AND METALLURGY.

(Option 1, Mining and Metallurgy.)

FIRST YEAR. SEE PAGE 71.

SECOND YEAR.

FIRST TERM.	Hours of Exercise	SECOND TERM.	Hours of Exercise
Elements of Mining Engineering (430)	15	Mineralogy (840)	60
Mineralogy (840)	60	Quantitative Analysis (558)	105
Qualitative Analysis (552)	105	Stratigraphic Geology (858)	30
General Geology (856)	30	Structural and Field Geology (870)	45
Surveying and Plotting (300)	90	Surveying (300) and Plotting (301)	60
Mathematics (30)	45	Topographical Drawing (302)	30
Physics: Mechanics, Wave-motion, Electricity (770)	75	Mathematics (31)	45
English Literature (150)	15	Physics: Electricity, Optics (770)	75
European History (173)	30	English Literature (150)	30

SUMMER READING, SEE PAGE 107.
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)	30	Physical Laboratory (773, 774)	30
Field Geology (869)	15	Applied Mechanics (72)	45
Physics: Heat (771)	15	German (231)	45
Physical Laboratory (773 partial)	10	Business Law (186)	15
Precision of Measurements (772)	10		
Applied Mechanics (68)	20		
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)	45	Mining Engineering: Mining and Metallurgical Machinery (459)	45
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	Geological Surveying (871)	30
Metallurgical Laboratory (435)	100	Quantitative Analysis (559)	105
Metallography (452)	10	Theoretical Hydraulics (331)	15
Geological Surveying (871)	30	General Studies (see page 106).	
Quantitative Analysis (559)	60	Thesis.	
Heat Measurements (781)	30		
Dynamo Electric Machinery (661)	30		
Applied Mechanics (80)	45		
General Studies (see page 106).			

III.—MINING ENGINEERING AND METALLURGY.

(Option 2, Metallurgy.)

FIRST YEAR. SEE PAGE 71.

SECOND YEAR.

FIRST TERM.	Hours of Exercise	SECOND TERM.	Hours of Exercise
Elements of Mining Engineering (430)	15	Mineralogy (841)	30
Mineralogy (841)	60	Mechanism and Valve-gears (361)	30
Qualitative Analysis (552)	105	Mechanical Engineering Drawing (373)	45
Mechanism (361)	45	Theoretical Chemistry (618)	30
Descriptive Geometry (107)	45	Quantitative Analysis (558)	120
Mathematics (30)	45	Mathematics (31)	45
Physics: Mechanics, Wave-motion, Electricity (770)	75	Physics: Electricity, Optics (770)	75
English Literature (150)	15	English Literature (150)	30
European History (173)	30		

SUMMER READING, SEE PAGE 107.
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	Steam Engineering: Boilers (385)	60
Steam Engineering, Thermodynamics (385)	30	Engineering Laboratory (396)	14
Mechanical Engineering Drawing and Machine Drawing (372, 377)	90	Quantitative Analysis (559)	120
Quantitative Analysis (559)	90	Physical Laboratory (773, 774)	30
Physics: Heat (771)	15	Applied Mechanics (72)	45
Physical Laboratory (773 partial)	10	German (231)	45
Precision of Measurements (772)	10	Business Law (186)	15
Applied Mechanics (68)	20		
German (231)	45		
Political Economy (100)	45		

SUMMER COURSE IN PRACTICAL METALLURGY OR MINING (ELECTIVE).

FOURTH YEAR.

FIRST TERM.	Hours of Exercise	SECOND TERM.	Hours of Exercise
Memoirs (465)	15	Memoirs (465)	15
Mining Engineering: Ore-dressing (459)	45	Laboratory Reports (437)	15
Laboratory Reports (437)	15	Metallurgy (non-ferrous) (442)	45
Metallurgy (non-ferrous) (442)	30	Engineering Laboratory (398)	60
Metallurgy of Iron (441)	15	Quantitative Analysis (559)	60
Metallurgical Laboratory (435)	100	Theoretical Hydraulics (331)	15
Metallography (452)	10	Forging (128)	45
Quantitative Analysis (559)	90	Foundry (125)	30
Heat Measurements (781)	30	General Studies (see page 106).	
Dynamo Electric Machinery (661)	30	Thesis.	
Applied Mechanics (80)	45		
General Studies (see page 106).			

III.—MINING ENGINEERING AND METALLURGY.

(Option 3, Mining Geology.)

FIRST YEAR. SEE PAGE 71.

SECOND YEAR.

FIRST TERM.	Hours of Exercise	SECOND TERM.	Hours of Exercise
Qualitative Analysis (552)	105	Quantitative Analysis (558)	105
Elements of Mining Engineering (430)	15	Mineralogy (840)	60
Mineralogy (840)	60	Stratigraphic Geology (858)	30
General Geology (856)	30	Structural and Field Geology (870)	45
Mathematics (30)	45	Surveying and Plotting (300)	60
Physics: Mechanics, Wave-motion, Electricity (770)	75	Topographical Drawing (302)	30
Surveying and Plotting (300)	90	Mathematics (31)	45
English Literature (150)	15	Physics: Electricity, Optics (770)	75
European History (173)	30	English Literature (150)	30

SUMMER READING, SEE PAGE 107.
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	Petrography (843)	60
Economic Geology (859)	30	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	Applied Mechanics (72)	45
Applied Mechanics (68)	20	German (231)	45
Physics: Heat (771)	15	Business Law (186)	15
Physical Laboratory (773 partial)	10	General Studies (see page 106).	
Precision of Measurements (772)	10		
German (231)	45		
Political Economy (190)	45		
General Studies (see page 106).			

SUMMER COURSE IN PRACTICAL METALLURGY OR MINING (ELECTIVE).

FOURTH YEAR.

FIRST TERM.	Hours of Exercise	SECOND TERM.	Hours of Exercise
Geological Surveying (871)	60	Geology of North America (890)	90
Economic Geology (889)	30	Economic Geology (860)	30
Petrography (843)	45	Mining Engineering: Mining and Metallurgical Machinery (459)	45
Index Fossils (880)	60	Metallurgy (non-ferrous) (442)	45
Mining Engineering: Ore-dressing (459)	45	Theoretical Chemistry (618)	30
Laboratory Reports (437)	15	Theoretical Hydraulics (331)	15
Metallurgical Laboratory (435)	100	Thesis.	
Metallurgy (non-ferrous) (442)	30		
Metallurgy of Iron (441)	15		
Dynamo Electric Machinery (661)	30		

IV.—ARCHITECTURE.

Architecture is essentially a fine art. Its successful practice demands the possession of a broad general cultivation, a liberal training in design, and a thorough knowledge of the principles underlying sound construction. The curriculum of the Course in Architecture recognizes that in a profession of so many aspects the true function of school training is primarily to inculcate high ideals and to prepare the foundation upon which the student is to erect his superstructure of architectural capacity; that the student's mind must be educated to reason and to think clearly and logically, his sense of beauty must be trained and educated, his imagination stimulated, his point of view made flexible, and his skill in expression in the mediums of the profession cultivated.

Architecture demands a professional equipment that includes artistic and historic studies in an even larger measure than those purely scientific, and the strong position which cultural subjects hold in our Course is shown in the large amount of time given to studies directed toward breadth and thoroughness throughout the entire four years.

The professional work begins with Drawing from the cast and from life, growing in importance through the four years, till in the graduate year Decorative Figure Design is studied in its varied relations to painting and sculpture. Supplementing this there are courses in Water-color, Pen, Pencil, and Color Rendering, and Modelling. Design and Architectural History are taken up simultaneously, and a course in Shades and Shadows is given concurrently with the study of the orders, so that at once the student begins to get an appreciation of what Architecture stands for, to learn the proper use of precedent, and to see the importance of light and shade as a factor in the composition of design. The practice of design is in charge of instructors who are actively engaged in their profession. The history of European Civilization and Art, which follows that of Architecture, is in recognition of the necessity of the broadest æsthetic and historical training, as necessary as Architectural History itself, to fully grasp the essential spirit of Classical, Gothic and Renaissance art. The History of Ornament explains the historical development of ornament.

Scientific construction is continually becoming a more necessary part of the architect's profession, and the student's training

IV.—ARCHITECTURE.

(Option 1, General Course.)

First Year. See page 71.

SECOND YEAR.

FIRST TERM.	Hours of Exercise	SECOND TERM.	Hours of Exercise
Elementary Design. Elements of Architecture (526)	75	Design and Theory of Architecture (526)	165
Architectural History (490)	15	Architectural History (490)	15
Specifications and Working Drawings (480)	90	Freehand Drawing (116)	60
Freehand Drawing (116)	60	Mathematics (31)	45
Mathematics (30)	45	Physics: Electricity, Optics (770)	75
Physics: Mechanics, Wave-motion, Electricity (770)	75	German (231)	45
German (231)	45	English Literature (150)	30
English Literature (150)	15		
European History (173)	30		

Summer Reading, see page 107.

THIRD YEAR.

FIRST TERM.	Hours of Exercise	SECOND TERM.	Hours of Exercise
Design (527)	130	Design (527)	210
Architectural History (491)	30	Architectural History (491)	30
Freehand Drawing (117)	60	Freehand Drawing (117)	60
Perspective (471)	15	Pen and Pencil (515)	15
Heating and Ventilation (413)	45	Building Stones (892)	30
Applied Mechanics (69)	40	History of Ornament (495)	15
Color (814)[1]	5	Water Color (520)	30
Acoustics (824)[1]	5	Graphical Statistics: Applied Mechanics (74, 75)	45
Political Economy (190)	45	Business Law (186)	15
General Studies (see page 106).		General Studies (see page 106).	

FOURTH YEAR.

FIRST TERM.	Hours of Exercise	SECOND TERM.	Hours of Exercise
Design (528)	315	Design: Thesis (528)	405
Constructive Design (532)	90	Business Relations (488)	15
European Civilization and Art (175)	60	European Civilization and Art (175)	45
Life Class (118)	90	Life Class (118)	90
Water Color (520)	30	Modelling (523)	45
Pen and Pencil (516)	15	Pen and Pencil (516)	15
Influence of Materials on Architecture (486)	15	Sanitary Science and Public Health (754)	15
Color (814)[1]	5		
Acoustics (824)[1]	5		

[1] Given alternate years beginning 1908.

IV.—ARCHITECTURE (*continued*).

is such as to enable him to control intelligently the usual structural questions. For his office practice he is taught the different methods of Perspective, and is given practical instruction in Heating and Ventilation, and in the study of Working Drawings and Specifications, so as to enable him to take immediate advantage of office opportunities upon graduation. A course in Building Stones, specially prepared for the architectural student, describes the varieties and properties of stone used in building and decoration, their proper uses and distinguishing features, methods of quarrying and dressing, etc.

For those who prefer the constructive to the æsthetic side of Architecture, Option 2, Architectural Engineering, has been introduced. This Option meets the demands for men specially trained in the computation of all the details of modern construction which occur in the practice of Architecture. It is the same as Option 1, Architecture, to the middle of the third year, the general architectural training which the student has had being an important aid to him in his future career. His field of employment will be broader for this knowledge; for as an architectural draughtsman his familiarity with the uses to which a building is to be put, and his ability to take part in the regular routine of the architect's office, will make his services additionally valuable.

In both Options opportunities are offered for one or two years of graduate professional work. The value of continuous and uninterrupted study which is possible in these graduate years at a period when the student is best fitted for it cannot be overestimated.

For schedule of an Advanced Course in Architecture see page 126.

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. All applicants (except college graduates) will be required to pass, before entrance, an examination[1] in Geometry; and must include in their work at the Institute the regular first-year courses in Freehand Drawing, Descriptive Geometry, and Mechanical Drawing, unless these subjects have been passed at the September examinations for advanced standing.[2]

[1] For a description of this requirement see page 67.
[2] See foot-note, pp. 162 and 163.

IV.—ARCHITECTURE.

(Option 2, Architectural Engineering.)

FIRST YEAR. SEE PAGE 71.

SECOND YEAR.

FIRST TERM.	Hours of Exercise	SECOND TERM.	Hours of Exercise
Elementary Design. Elements of Architecture (526)	75	Design and Theory of Architecture (526)	165
Architectural History (490)	15	Architectural History (490)	15
Specifications and Working Drawings (480)	90	Freehand Drawing (116)	60
Freehand Drawing (116)	60	Mathematics (31)	45
Mathematics (30)	45	Physics: Electricity, Optics (770)	75
Physics: Mechanics, Wave-motion, Electricity (770)	75	German (231)	45
German (231)	45	English Literature (150)	30
English Literature (150)	15		
European History (173)	30		

SUMMER READING. SEE PAGE 107.

THIRD YEAR.

FIRST TERM.	Hours of Exercise	SECOND TERM.	Hours of Exercise
Design (527)	130	Structural Design (538)	100
Architectural History (491)	30	Architectural History (491)	30
Freehand Drawing (117)	60	Freehand Drawing (117)	60
Perspective (471)	15	Pen and Pencil (515)	15
Heating and Ventilation (413)	65	Graphical Statics: Applied Mechanics (74, 75)	50
Applied Mechanics (69)	40	Theory of Structures (346)	30
Political Economy (190)	45	Building Stones (892)	30
Influence of Materials on Architecture (486)	15	Materials (352)	30
General Studies (see page 106).		Business Law (186)	15
		General Studies (see page 106).	

FOURTH YEAR.

FIRST TERM.	Hours of Exercise	SECOND TERM.	Hours of Exercise
Structural Design (539)	310	Design: Thesis (539)	435
European Civilization and Art (175)	60	European Civilization and Art (175)	45
Pen and Pencil (516)	15	Business Relations (488)	15
Theory of Structures (351)	45	Theory of Structures (351)	45
Applied Mechanics (86)	25	Sanitary Science and Public Health (754)	15
Laboratory Tests of Building Materials (87)	15		
Foundations (349)	15		

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, Physical Chemistry (Option 1), General Analytical practice (Option 2), sanitary or municipal Chemistry (Option 3). 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. The laboratory practice of the second term includes a study of synthetic methods as applied to the preparation of certain typical inorganic compounds. Qualitative Chemical Analysis is begun in the first term of the second year and Quantitative Analysis follows in the second term and continues throughout the Course. Practice in the Sanitary, Organic, Industrial, 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 233 to 249 and 324. For the schedule of an Advanced Course in Chemistry see page 126.

V.—CHEMISTRY.

FIRST YEAR. SEE PAGE 71.

SECOND YEAR.

FIRST TERM.

FIRST TERM.	Hours of Exercise
Qualitative Analysis (552)	165
Mineralogy (841) Opt. 1; (840), Opts. 2, 3	60
Physics: Mechanics, Wave-motion, Electricity (770)	75
German (231)	45
English Literature (150)	15
European History (173)	30
Options.	
1. Mathematics (30)	45
2, 3. Mathematics (32)	45

SECOND TERM.

SECOND TERM.	Hours of Exercise
Quantitative Analysis (558) Opt. 1	150
Quantitative Analysis (558) Opts. 2, 3	180
Physics: Electricity, Optics (770)	75
Physical Laboratory (773)	30
Precision of Measurements (772)	10
German (231)	45
English Literature and Composition (150)	30
Options.	
1. Mathematics (31)	45
2, 3. Industrial Microscopy (708)	30
2, 3. Mineralogy (840)	60

SUMMER READING, SEE PAGE 107.

THIRD YEAR.

FIRST TERM.

FIRST TERM.	Hours of Exercise
Quantitative Analysis (559) Opt. 1	210
Quantitative Analysis (559) Opts. 2, 3	270
Theoretical Chemistry (610)	45
Theoretical Chemical Laboratory (619)	45
Physics: Heat (771)	15
Physical Laboratory (774)	15
Political Economy (190)	45
General Studies (see page 106).	
Options.	
1. Mathematics (40)	30
2, 3. Microscopical Organisms (709)	15
2, 3. General Biology (701)	15

SECOND TERM.

SECOND TERM.	Hours of Exercise
Quantitative Analysis (509) Opt. 1	135
Quantitative Analysis (509) Opt. 2	150
Organic Chemistry (592)	60
Organic Chemical Laboratory: Preparations, Reactions, and Analysis (598)	120
Theoretical Chemistry (610)	30
Theoretical Chemical Laboratory (619)	45
Assaying (433)	30
Business Law (186)	15
General Studies (see page 106).	
Options.	
1. Electrical Measurements (782)	30
2. Electro-Chemistry (613)	15
3. Bacteriology (744)	60
3. Air, Water and Food Analysis (565) (569) (570)	90
3. Electro-Chemistry (613)	15

FOURTH YEAR.

FIRST TERM.

FIRST TERM.	Hours of Exercise
Industrial Chemistry (580)	45
Organic Chemistry (592)	40
Organic Chemical Laboratory: Preparations Reactions, and Analysis (598)	140
Inorganic Chemistry (561)	30
Heat Measurements (781)	30
Options.	
1. Electro-Chemistry (796)	30
1. Electro-chemical Laboratory (799)	105
1. Advanced Theoretical Chemistry (620)	15
2. Industrial Chemical Laboratory (582)	105
2. Electrical Measurements (782)	30
2. *a.* Proximate Technical Analysis (629)	90
2. *b.* Textile Coloring (630)	90
3. Bacteriology of Water and Sewage (748)	30
3. Industrial Biology (746)	60
3. Advanced Food Analysis (649)	75
3. Sugar Analysis (573)	20
3. Electrical Measurements (782)	30

SECOND TERM.

SECOND TERM.	Hours of Exercise
Industrial Chemistry (580)	45
History of Chemistry (645)	15
Gas Analysis (638)	20
Thesis Reports (647)	15
Thesis.	
Options.	
1. Energetics (829)	30
1. Advanced Theoretical Chemistry (620)	15
2. Air, Water and Food Analysis (565) (569) (570)	90
2. Sugar Analysis (573)	20
3. Microscopic Analysis of Water and Sewage (711)	30
3. Sanitary Science and Public Health (754)	15
3. Proximate Technical Analysis (629)	90

VI.—ELECTRICAL ENGINEERING.

The Course in Electrical Engineering aims to give a broad knowledge of the Theory of Electricity and of its applications in 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 Mathematics, Chemistry, Physics and Applied Mechanics in the earlier years and of the Theory of Electricity, beginning in the third year and continuing throughout the remainder of the Course. The electrical engineering lectures of the junior and senior years also take on a distinctly professional character, involving the applications of electricity to the various problems in railroad work, station-design, power-transmission, lighting, telephony, etc., the work of the Department being supplemented by lectures delivered by engineers not connected with the Institute.

The theoretical work runs parallel with an extended course in the laboratories, which begins with the work in Chemistry and Physics and extends through all of the scientific branches studied. The Electrical Testing laboratories and the laboratories devoted to Electrical Machinery are component parts of the equipment and are in charge of professors of the Department. These laboratories are described on page 326 under the title of The Augustus Lowell Laboratories of Electrical Engineering. They are extensively equipped with apparatus equally adapted to the needs of undergraduate and advanced study. The laboratory work is carried on with the purpose of developing in the student habits of accurate observation, and of bringing to his consideration not only the methods and tests of fundamental importance, but questions of economy of time and precision of results. The electrical laboratory work is supplemented by a system of conferences in which these matters are especially emphasized.

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

For further details see pages 252 to 260 and 326 to 330. For the schedule of an Advanced Course in Electrical Engineering see page 127.

VI.—ELECTRICAL ENGINEERING.

FIRST YEAR. SEE PAGE 71.

SECOND YEAR.

FIRST TERM.	Hours of Exercise	SECOND TERM.	Hours of Exercise
Physics: Mechanics, Wave-motion, Electricity (770)	75	Physics: Electricity, Optics (770)	75
Mechanism (362)	45	Physical Laboratory: Mechanics, Optics (773)	30
Mechanical Engineering Drawing (372)	60	Precision of Measurements (772)	10
Mathematics (30)	45	Mechanism and Valve-gears (362)	20
Descriptive Geometry (107)	45	Mechanical Engineering Drawing (373)	20
Joinery and Pattern-work (123) or Metal-turning (134)	60	Surveying (305)	30
German (233) or French (223)[1]	30	Mathematics (31)	45
English Literature (150)	15	Power and its Transformations (699)	5
European History (173)	30	Applied Mechanics (60)	45
		Metal-turning (134) or Joinery and Pattern-work (123)	60
		English Literature and Composition (150)	30

SUMMER READING, SEE PAGE 107

THIRD YEAR.

FIRST TERM.	Hours of Exercise	SECOND TERM.	Hours of Exercise
Physics: Heat (771)	15	Elements of Electrical Engineering (655)	15
Physical Laboratory: Heat (774)	15	Electrical Engineering Lab. (692)	45
Elements of Electrical Engineering (655)	60	Alternating Currents (656)	45
Electrical Measuring Instruments and Methods (778)	10	Technical Electrical Measurements (685)	30
Electrical Laboratory (779)	15	Standardizing Laboratory and Electrical Testing (686, 779)	50
Steam Engineering: Thermodynamics (385)	30	Steam Engineering (385)	60
Mathematics (40)	30	Machine Drawing (377)	60
Applied Mechanics (67)	45	Mechanical Engineering Laboratory (396)	20
Political Economy (190)	45	Business Law (186)	15
General Studies (see page 106).		General Studies (see page 106).	

FOURTH YEAR.

FIRST TERM.	Hours of Exercise	SECOND TERM.	Hours of Exercise
Alternating Current Machinery (650)	45	Alternating Current Machinery (650)	45
Electrical Engineering (657)	45	Electrical Engineering (657)	45
Electric Light and Transmission of Power (663)	30	Electric Light and Transmission of Power (663)	30
Technical Electrical Measurements (685)	10	Electrical Engineering Laboratory and Reports (693)	40
Standardizing Laboratory (686)	40	Dynamo Design (667)	20
Electrical Engineering Lab. and Reports (693)	80	Journal Meetings and Engineering Excursions (673)	30
Journal Meetings and Engineering Excursions (673)	30	Engineering Laboratory (397, 784)	40
Theoretical Hydraulics (332)	30	Economics of Corporations (193)	30
Engineering Laboratory (397) (639)	45	Thesis.	
Applied Mechanics (82); Laboratory (87)	25		

[1] Students continue during this term the same language that they studied during the first year.

VII.—BIOLOGY.

INCLUDING SANITARY SCIENCE AND INDUSTRIAL BACTERIOLOGY.

Midway between a strictly professional or technical Course, such as that in Civil or Mechanical Engineering, and one more purely scientific, such as Physics, stands the Course in Biology (including Sanitary Science and Bacteriology). Although a comparatively new field of scientific investigation and professional employment, Biology already offers to young men an inviting career in the applications of science to the living world. In connection with various public works and private undertakings, and in the fields occupied by Boards of Health, State Water Supply or Sewerage Commissions, Municipal Laboratories, Purification Plants, and the like, there is a large and increasing demand for men technically trained in Sanitary Biology. There is also a growing demand for men equipped in Industrial Biology, *i.e.* qualified to make, interpret, and report upon, inspections of milk and milk supplies, vinegar and lactic acid manufactures, yeast supplies, and other branches of the Dairy, Fermentation or Food-preserving Industries. Graduates of the Course in Biology are well prepared for undertaking these positions and for several years the demand for them has constantly exceeded the supply.

This Course also offers attractive opportunities for those who desire to become teachers or investigators and, either in whole or in part, affords an excellent preparation for the work of those higher medical schools which now require for entrance, besides the usual bachelor's degree, special preparation in biological subjects. Although, as shown on the opposite page, Sanitary Science and Industrial Bacteriology occupy a large place in this Course, it is arranged that these subjects shall be firmly established upon a broad and strong foundation of Chemistry, Physics, General Biology, Zoölogy, Botany, Anatomy and Physiology.

Unusual opportunities are provided in the Sanitary Research Laboratory and Sewage Experiment Station of the Institute, on Albany Street, and (by the kindness of Professor Prescott) for Industrial Biology in the Boston Bio-Chemical Laboratory, on Boylston Street, as well as in the Research Laboratory of the Department, for graduate students and advanced workers in Bacteriology, Industrial Biology, and Sanitary Science; in Physiology, and in some departments of Hygiene. For more detailed information see pages 261 to 276, 330; and the special circular on Biology.

VII.—BIOLOGY.

FIRST YEAR. SEE PAGE 71.

SECOND YEAR.

FIRST TERM.	Hours of Exercise	SECOND TERM.	Hours of Exercise
General Biology (700)	75	Cryptogamic Botany (735)	75
Qualitative Analysis (552)	120	General Zoölogy (716)	45
Mathematics (32)	45	Quantitative Analysis (558)	120
Physics: Mechanics, Wave-motion, Electricity (770)	75	Precision of Measurements (772)	10
German (231)	45	Physical Laboratory (773)	30
English Literature (150)	15	Physics: Electricity, Optics (770)	75
European History (173)	30	German (231)	45
		English Literature (150)	30

SUMMER READING, SEE PAGE 107.

THIRD YEAR.

FIRST TERM.	Hours of Exercise	SECOND TERM.	Hours of Exercise
General Bacteriology (744)	75	Microscopic Anatomy (722)	60
Dynamical Geology (855)	30	Vertebrate Anatomy (717)	90
Organic Chemistry (590)	30	Anthropology (720)	15
Theoretical Chemistry (610)	30	Microscopical Analysis of Water and Sewage (711)	30
Air, Water, and Food Analysis (565) (569) (570)	90	General Physiology (725)	60
Physics: Heat (771)	15	Physiological Laboratory (728)	45
Physical Laboratory (774)	15	Business Law (186)	15
Political Economy (190)	45	General Studies (see page 106).	
General Studies (see page 106).		*Options.*	
Options.		1. Embryology (723)	60
1. Comparative Anatomy (719)	90	2. Surveying and Plotting (300)	75
2. Surveying and Plotting (300)	90		

FOURTH YEAR.

FIRST TERM.	Hours of Exercise	SECOND TERM.	Hours of Exercise
Protozoölogy (724)	30	Chemical Biology (749)	30
Industrial Biology (746)	60	Sanitary Science and Public Health (754)	15
Theoretical Biology (704)	30	Personal Hygiene (729)	15
Biology of Infectious Diseases (745)	30	Theoretical Biology (704)	30
Zymology (747)	15	Journals (764)	30
Organic Chemical Laboratory (599)	105	*Options.*	
Journals (764)	15	1. Experimental Zoölogy (734)	90
Options.		1. Research Seminar (750)	30
1. Plant Physiology (738)	15	1. Thesis	300
1. Comparative Physiology (727)	75	2. Municipal Sanitation (753)	60
1. Physiological Laboratory (728)	30	2. Public Health Problems (757)	15
2. Public Health Problems (757)	15	2. Municipal Laboratory Methods (755)	45
2. Vital Statistics (198)	30	2. Industrial Hygiene and Sanitation (752)	30
2. Elementary Hydraulic Measurements (333)	20	2. Research Seminar (751)	30
2. Heating and Ventilation (415)	30	2. Thesis	150
2. Thesis	45		

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

The Course is laid out with two Options. 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 or mathematical 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 277 to 291 and 332 to 336.

VIII.— PHYSICS.— (*Options 1, 2.*) (See also page 93.)

FIRST YEAR. SEE PAGE 71.

SECOND YEAR.

FIRST TERM.	Hours of Exercise	SECOND TERM.	Hours of Exercise
Physics: Mechanics, Wave-motion, Electricity (770)	75	Physics: Electricity, Optics (770)	75
Acoustics (823)	30	Physical Laboratory: Mechanics, Optics (773)	30
Qualitative Analysis (552)	130	Precision of Measurements (772)	10
Organic Chemistry (590)	30	Quantitative Analysis (558)	110
Mathematics (30)	45	Mathematics (31)	45
German (231)	45	Least Squares (49)	20
English Literature (150)	15	German (231)	45
European History (173)	30	English Literature (150)	30

SUMMER READING, SEE PAGE 107.

THIRD YEAR.

FIRST TERM.	Hours of Exercise	SECOND TERM.	Hours of Exercise
Physics: Heat (771)	15	Theoretical Physics I. (790)	45
Physical Laboratory: Heat (774)	15	Electrical Laboratory (779) / Standardizing Laboratory (686)	45
Electrical Laboratory (779)	15	Electricity (787)	30
Theoretical Physics I. (790)	45	Heat Measurements (781)	30
Theoretical Chemistry (610)	45	Electrical Engineering Laboratory (691)	45
Dynamo-Electric Machinery (661)	30	Theoretical Chemistry (610)	30
Political Economy (190)	45	Business Law (186)	15
General Studies (see page 106)	45	General Studies (see page 106)	75
Options.		*Options.*	
1. Mathematics (40)	30	1a. Gas Analysis (638)	20
1. Quantitative Analysis (559)	90	1a. Physico-Chemical Laboratory (803)	90
2. Advanced Calculus and Geometry (36)	60	1b. Advanced Physical Laboratory (776)	90
		2. Differential Equations (44)	30
		2. Vector Analysis (46)	15

FOURTH YEAR.

FIRST TERM.	Hours of Exercise	SECOND TERM.	Hours of Exercise
Theoretical Physics II.: Electrostatics (791)[1]	45	Theoretical Physics II.: Electrokinetics (791)[1]	45
Theoretical Physics III.: Optics (808)	45	Theoretical Physics IV.: Heat. Energetics (829)	30
Optical Laboratory (807)	60	Theoretical Physics IV.: Heat. Kinetic theory (830)	15
Electro-chemistry (796)	30	Fourier's Series; Laplace's Coefficients (47)	30
Fourier's Series; Laplace's Coefficients (47)	30	Physical Colloquium (838)	15
Descriptive Astronomy (819)	30	Principles of Scientific Investigation (837)	
Physical Colloquium (838)		Physical Research: Thesis.	
Standarizing Laboratory (686)[2]	15		
Options.		*Options.*	
1. Advanced Theoretical Chemistry (620)	15	1. Advanced Theoretical Chemistry (620)	15
1. Organic Laboratory (599)[2]	75	1. Advanced Physics (833)[2]	75
2. Analytical Mechanics (96)[2]	45	2. Analytical Mechanics (96)[2]	45
2. Advanced Mathematics[1] (50 to 57)	30	2. Advanced Mathematics[1] (50 to 57)	30

[1] Offered in 1909 and thereafter.

[2] Omitted after 1908.

VIII.— PHYSICS.

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 are for the most part identical with those taken by students in Electrical Engineering, and include courses in the Theory of Direct and Alternating Currents, 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 are included shorter courses in Gas Analysis, Assaying, and Metallurgical Laboratory, and courses in Mechanism and Steam 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. 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 71.

SECOND YEAR.

FIRST TERM.	Hours of Exercise	SECOND TERM.	Hours of Exercise
Physics: Mechanics, Wave-motion, Electricity (770)	75	Physics: Electricity, Optics (770)	75
Qualitative Analysis (552)	105	Physical Laboratory: Mechanics, Optics (773)	30
Mathematics (30)	45	Precision of Measurements (772)	10
Descriptive Geometry (107)	45	Quantitative Analysis (558)	145
Mechanical Engineering Drawing (374)	30	Gas Analysis (638)	20
Metal-turning (134)	60	Mathematics (31)	45
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
Physics: Heat (771)	15	Alternating Currents (656)	45
Physical Laboratory: Heat (774)	15	Elements of Electrical Engineering (655)	15
Electrical Laboratory (779)	15	Electrical Laboratory (779)	25
Elements of Electrical Engineering (655)	60	Standardizing Laboratory (686)	20
Quantitative Analysis (559)	65	Electrical Engineering Laboratory (692)	45
Theoretical Chemistry (610)	45	Theoretical Chemistry (610)	30
Organic Chemistry (590)	30	Organic Chemical Laboratory (599)	75
Mathematics (40)	30	Assaying (433)	30
Political Economy (190)	45	Heat Measurements (781)	30
General Studies (see page 106).		Mechanism (364)	30
		Business Law (186)	15
		General Studies (see page 106).	

FOURTH YEAR.

FIRST TERM.	Hours of Exercise	SECOND TERM.	Hours of Exercise
Electro-chemistry (796)	30	Applied Electro-chemistry (797)	20
Electro-chemical Laboratory (799)	105	Electro-chemical Laboratory (800)	45
Electrical Engineering (657)	45	Electro-metallurgy (446)	30
Electrical Engineering Laboratory (693)	50	Steam Engineering (385)	30
Standardizing Laboratory (686)	25	Industrial Chemistry (580)	45
Alternating Current Machinery (650)	45	Physical Colloquium (838)	15
Steam Engineering (385)	30	Economics of Corporations (193)	30
Industrial Chemistry (580)	45	Thesis.	
Metallurgical Laboratory (436) and Reports (437)	27	*Options.*	
Colloquium (838).		A. { Alternating Current Machinery (650)	45
		A. { Electrical Engineering Laboratory (693)	25
		B. Industrial Chemical Laboratory (582)	75

IX.—GENERAL SCIENCE.

In place of the Course in General Studies formerly maintained by the Institute, there has been established an Elective Course in General Science.

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

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

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

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

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

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

Second year, first term: Physics, English Literature, European History.

Second year, second term: Physics, Physical Laboratory, English Literature and Composition.

Third year, first term: Physics, Political Economy, General Studies.

Third year, second term: Business Law, General Studies.

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 Industrial 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.

In this Course the larger proportion of the time is devoted to chemical subjects and the training is correspondingly more complete on that side. The Mechanical Engineering subjects included are, however, fundamental and afford an excellent foundation for later development through graduate study, or individual effort. For the schedule of an Advanced Course in Chemical Engineering see page 129.

A description of the subjects of instruction will be found on pages 152 to 160, 198 to 214 and 233 to 249.

X.—CHEMICAL ENGINEERING.

FIRST YEAR. SEE PAGE 71.

SECOND YEAR.

FIRST TERM.	Hours of Exercise	SECOND TERM.	Hours of Exercise
Qualitative Analysis (552)	120	Quantitative Analysis (558)	120
Mechanism (362)	30	Mechanism and Valve-gears (362)	30
Mathematics (30)	45	Mechanical Engineering Drawing (373)	30
Physics: Mechanics, Wave-motion, Electricity (770)	75	Mathematics (31)	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		

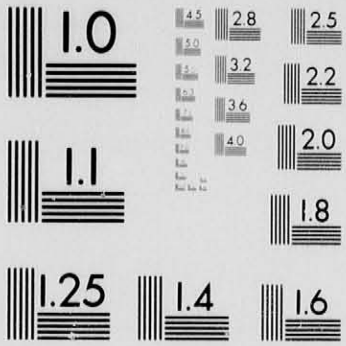
SUMMER READING, SEE PAGE 107.

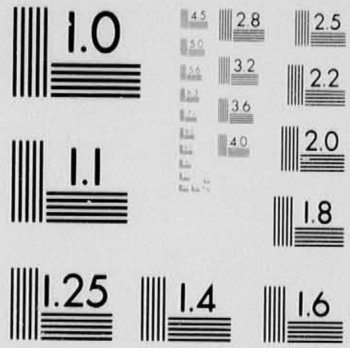
THIRD YEAR.

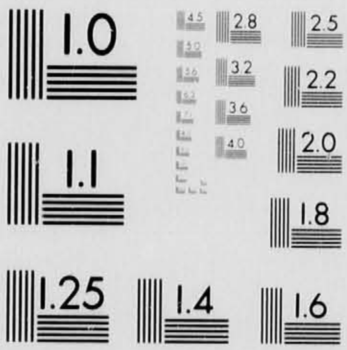
FIRST TERM.	Hours of Exercise	SECOND TERM.	Hours of Exercise
Quantitative Analysis (559)	195	Organic Chemistry (592)	60
Steam Engineering: Thermodynamics (385)	45	Organic Chemical Laboratory (598)	90
Mechanical Engineering Drawing (372), Machine Drawing (377)	105	Special Analytical Methods (560)	75
Physics: Heat (771)	15	Steam Engineering: Boilers (385)	30
Physical Laboratory (773)	15	Mechanical Engineering Drawing (378) and Boiler Drawing (379)	60
Applied Mechanics (68)	20	Physical Laboratory (773, 774)	30
Political Economy (190)	45	Applied Mechanics (72)	45
General Studies (see page 106)		Business Law (186)	15
		General Studies (see page 106).	

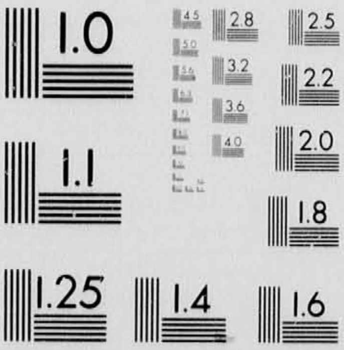
FOURTH YEAR.

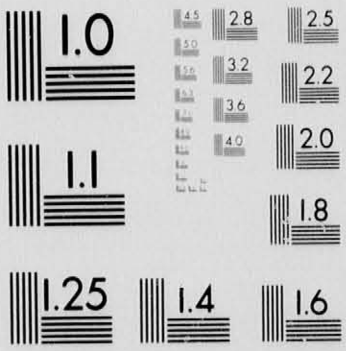
FIRST TERM.	Hours of Exercise	SECOND TERM.	Hours of Exercise
Organic Chemistry (592)	40	Industrial Chemistry (580)	45
Organic Chemical Laboratory (598)	80	Industrial Chemical Laboratory (582)	105
Industrial Chemistry (580)	45	Theoretical Chemistry (610)	30
Theoretical Chemistry (610)	45	Theoretical Chemical Laboratory (619)	45
Theoretical Chemical Laboratory (619)	45	Electro-chemistry (613)	15
Dynamo Electric-machinery (661)	30	Electrical Engineering Laboratory (691)	45
Applied Mechanics (80)	45	Thesis Reports and Memoirs (648)	30
Theoretical Hydraulics (331)	15	Thesis.	
Engineering Laboratory (397)	30		
Metal-turning (235)	30		


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


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


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


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


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

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 72, in the following particulars.

There is a reduction in the time devoted to railroads and bridges, and an entire omission of Dynamo Electric Machinery, Astronomy and Geodesy.

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 Steam Engineering. 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 193.)

For the Schedule of an Advanced Course in Sanitary Engineering see page 129.

XI.—SANITARY ENGINEERING.

First Year. See page 71.

SECOND YEAR.

FIRST TERM.	Hours of Exercise
Surveying and Plotting (300)	90
Qualitative Analysis (552)	60
Mathematics (30)	45
Physics: Mechanics, Wave-motion, Electricity (770)	75
Mechanism (364)	30
Descriptive Geometry (107)	60
English Literature (150)	30
European History (173)	30

SECOND TERM.	Hours of Exercise
Surveying (300) and Plotting (301)	75
Quantitative Analysis (558)	45
Mathematics (31)	45
Physics: Electricity, Optics (770)	75
Physical Laboratory (773)	30
Applied Mechanics (60)	45
Stereotomy (325)	60
English Literature (150)	30

Summer Reading, see page 107.

THIRD YEAR.

FIRST TERM.	Hours of Exercise
Railroad Engineering: Field-work and Drawing (313, 315)	50
Highway Engineering (314)	15
Advanced Surveying (303)	30
Topographical Drawing (302)	30
Organic Chemistry (590)	30
General Biology (701)	15
Microscopical Organisms (709)	15
Dynamical Geology (855)	30
Structural and Field Geology (857)	30
Physics: Heat (771)	15
Physical Laboratory (774)	15
Applied Mechanics (66)	60
Political Economy (190)	45
General Studies (see page 106).	

SECOND TERM.	Hours of Exercise
Railroad Engineering: Field-work and Drawing (313, 315)	95
Advanced Surveying (303)	30
Theory of Structures (345)	45
Materials (352)	30
General Bacteriology (744)	60
Industrial Water Analysis (567)	30
Applied Mechanics (78)	30
Heating and Ventilation (414)	15
Building Stones and Lithology (895)	30
Stratigraphic Geology (875)	15
Business Law (186)	15
General Studies (see page 106).	

FOURTH YEAR.

FIRST TERM.	Hours of Exercise
Theory of Structures; Bridges and Similar Structures (348)	45
Theoretical Hydraulics (330)	45
Hydraulic Measurements (333)	20
Sanitary and Hydraulic Engineering (334)	60
Bridge Design (356)	60
Bacteriology of Water and Sewage (748)	30
Water Analysis and Water Supplies (568)	45
Steam Engineering (387)	45

SECOND TERM.	Hours of Exercise
Theory of Structures; Bridges and Similar Structures (348)	45
Hydraulic Engineering (335)	45
Sanitary and Hydraulic Designing (337)	85
Municipal Sanitation (753)	30
Air Analysis (569)	15
Sanitary Science and Public Health (754)	15
Microscopical Analysis of Water and Sewage (711)	30
Hydraulic Laboratory (342)	15
Steam Engineering (387)	45
Thesis	

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, stratigraphic 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 292 to 303 and 336.

XII.—GEOLOGY AND GEODESY.

FIRST YEAR. SEE PAGE 71.

SECOND YEAR.

FIRST TERM.	Hours of Exercise	SECOND TERM.	Hours of Exercise
Mineralogy (840)	60	Mineralogy (840)	60
General Geology (856)	45	Stratigraphic Geology (858)	80
Qualitative Analysis (552)	105	Quantitative Analysis (558)	135
Physics: Mechanics, Wave-motion, Electricity (770)	75	Physics: Electricity, Optics (770)	75
Mathematics (32)	45	Physical Laboratory (773)	20
German (231)	45	Precision of Measurements (772)	10
English Literature (150)	15	German (231)	45
European History (173)	30	English Literature (150)	30

SUMMER COURSE IN SURVEYING REQUIRED IN OPTION 2, ELECTIVE IN OPTION 1.
SUMMER READING, SEE PAGE 107.

THIRD YEAR.

FIRST TERM.	Hours of Exercise	SECOND TERM.	Hours of Exercise
Economic Geology (859)	45	Petrography (843)	60
Topographic Geology (874)	30	Geological Surveying (871)	90
Introductory Paleontology (878)	45	Topographical Drawing (302)	30
General Biology (701)	15	Astronomy (308)	30
Physics: Heat (771)	15	Zoölogy (716)	45
Physical Laboratory (774)	30	Electrical and Heat Measurements (782)	30
Freehand Drawing (116)	75	Business Law (186)	15
Political Economy (190)	45	General Studies (see page 106).	
General Studies (see page 106).			
Options.		*Options.*	
1. Surveying and Plotting (300)	90	1. Surveying (300) and Plotting (301)	75
1. Geological Surveying (871)	55	1. Introductory Paleontology (878)	90
2. Advanced Surveying (303)	30	2. Advanced Surveying (303)	30
2. Descriptive Geometry (107)	60	2. Introductory Paleontology (878)	60
2. Spherical Trigonometry (24)	10	2. Geological Surveying (871)	30
2. Geological Surveying (871)	30	2. Method of Least Squares (49)	20

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 (889)	60	Geological Surveying (871)	60
Index Fossils (880)	60	Geology of North America (890)	90
Glacial Geology (863)	15	Economic Geology (860)	60
Petrography (843)	60	Theoretical Chemistry (610)	30
Mining Engineering (458)	45	Geodesy (310)	15
Hydraulic Measurements (333)	20	*Options.*	
Theoretical Chemistry (610)	45	1. Advanced Surveying (303)	30
Options.		1. Thesis and professional studies continued from first term	285
1. Advanced Surveying (303)	30	2. Thesis and professional studies continued from first term	315
1. Professional work leading to a Thesis[1]	55		
2. Geological Surveying (871)	60		
2. Professional work leading to a Thesis[1]	85		

[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, or who desire to enter allied industries. 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 304 to 311 and 340.)

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 71.

SECOND YEAR.

FIRST TERM.	Hours of Exercise	SECOND TERM.	Hours of Exercise
Mechanism (361)	45	Ship Construction (900)	15
Mechanical Engineering Drawing and Machine Drawing (372, 376)	75	Applied Mechanics (60)	45
Metallurgy of Iron (441)	15	Mechanism and Valve-gears (361)	30
Forging (127)	60	Mechanical Engineering Drawing and Machine Drawing (373, 376); Surveying (304)	75
Mathematics (30)	45	Mathematics (31)	45
Physics: Mechanics, Wave-motion, Electricity (770)	75	Physics: Electricity, Optics (770)	75
Descriptive Geometry (107)	45	Physical Laboratory (773)	30
English Literature (150)	30	Precision of Measurements (772)	10
European History (173)	30	English Literature (150)	30

SUMMER READING, SEE PAGE 107.

THIRD YEAR.

FIRST TERM.	Hours of Exercise	SECOND TERM.	Hours of Exercise
Ship Drawing and Design (910)	105	Naval Architecture (901)	45
Steam Engineering; Thermodynamics (385)	45	Ship Construction (900)	20
Mathematics (40)	30	Ship Drawing and Design (910)	60
Physics: Heat (771)	15	Steam Engineering (385)	60
Physical Laboratory (774)	15	Engineering Laboratory (396)	15
Applied Mechanics (65)	45	Chipping and Filing (130) and Forging (127)	50
Hydraulics (331)	20	Applied Mechanics (71)	30
Political Economy (190)	45	Business Law (186)	15
General Studies (see page 106).		General Studies (see page 106).	

FOURTH YEAR.[1]

FIRST TERM.	Hours of Exercise	SECOND TERM.	Hours of Exercise
Naval Architecture (902)	30	Naval Architecture (902)	15
Ship Design (911)	90	Ship Design (911)	105
Marine Engines (913)	30	Ship Construction (905)	15
Ventilation and Drainage (914)	15	Marine Engines (913)	90
Metallurgy of Iron (441)	15	Applied Chemistry (640)	15
Theoretical Hydraulics (331)	15	Engineering Laboratory (397, 781)	60
Engineering Laboratory (397, 639)	60	Applied Mechanics (81)	45
Dynamics of Machines (401)	20	Machine-tool Work (133)	60
Applied Mechanics (80)	45	Thesis.	
Chipping and Filing (130); Machine-tool Work (133)	90		

[1] This schedule for the Class of 1909 only.

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, Steam Turbines, 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, 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.

JUNIOR YEAR.[1]

FIRST TERM.	Hours of Exercise	SECOND TERM.	Hours of Exercise
Theory of Warship Design (915)	30	Naval Architecture (901) . . .	45
Warship Design, preliminary work (920)	120	Theory of Warship Design (915)	30
Advanced Calculus and Geometry (36)	60	Warship Design (920)	90
Applied Mechanics (65) . . .	45	Differential Equations (44) . .	30
Drawing with Steam Engineering (380)	20	Applied Mechanics (71) . . .	30
Steam Engineering (386) . . .	30	Precision of Measurements (772)	10
Technical Chemistry (635) . .	30	Steam Engineering (386) . . .	30
Spanish II. (241)	30	Chemical Laboratory (635) . .	90
		Spanish II. (241)	30

SENIOR YEAR.

FIRST TERM.	Hours of Exercise	SECOND TERM.	Hours of Exercise
Naval Architecture (902) . . .	30	Naval Architecture (902) . . .	15
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 (81) . . .	45
Applied Mechanics (80) . . .	45	Alternating Currents (656) . .	45
Elements of Electrical Engineering (655)	45	Standardizing Laboratory (689) .	20
Metallurgy of Iron (441) . . .	15	Sanitation of Ships (756) . . .	30
Metallography (452)	10	Foundations (407)	15
Spanish III. (242)	30	Spanish III. (242)	30

GRADUATE YEAR.

FIRST TERM.	Hours of Exercise	SECOND TERM.	Hours of Exercise
Theory of Warship Design (917)	30	Hydrodynamics (51)	20
Warship Design (922)	90	Theory of Warship Design (917)	30
Marine Engines (913)	30	Warship Design (922)	90
Heating and Ventilation (416) .	15	Marine Engines (913)	90
Dynamics of Machines (401) .	20	Alternating Current Machinery (650)	30
Engineering Laboratory (397) .	60	Electrical Engineering (680) .	15
Theory of Structures (347) . .	60	Electrical Engineering Laboratory (694)	30
Alternating Current Machinery (650)	45	Engineering Laboratory (397), .	60
Electrical Engineering Laboratory (694)	40	Thesis.	
Memoirs (925)	20		

[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:—

ECONOMICS.

FIRST TERM.	Hours. Ex.	Prep.	SECOND TERM.	Hours. Ex.	Prep.
Economic History (191) . .	15	30	Railroad Economics (194) .	45	30
			Banking and Finance (195) .	45	30
			Labor Problems (196) . . .	45	30
			Organization of Industry (197)	45	30

ENGLISH.

FIRST TERM.	Ex.	Prep.	SECOND TERM.	Ex.	Prep.
Advanced English Composition (143)	15	30	English Literature of the Nineteenth Century (157) .	45	30
American Literature (158) .	30	15	Argumentation and Debate (145)	45	30
English Literature of the Eighteenth Century (156) .	30	15			
The English Bible (160) . .	30	15			

MODERN LANGUAGES.

FIRST TERM.	Ex.	Prep.	SECOND TERM.	Ex.	Prep.
Advanced French (222) . .	15	30	Advanced French (222) . .	15	30
French Colloquium (228) . .	45	0	French Colloquium (228) . .	30	0
Advanced German (232) . .	15	30	Advanced German (232) . .	15	30
German Colloquium (238) .	45	0	German Colloquium (238) .	30	0

HISTORY.

FIRST TERM.	Ex.	Prep.	SECOND TERM.	Ex.	Prep.
Colonial Systems (180) . . .	15	30	Municipal Government (181)	30	45
Comparative National Government (182)	15	30	European Civilization and Art (177)	30	45
International Law (185) . .	15	30	History of Science (761) . .	30	45
History of Science (761) . .	15	30			

[1] Options 1 and 2 of Course III., take this work in the fourth year

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

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

SUMMER READING.

All students who are candidates for the degree of the Institute are required by the Faculty to complete prescribed courses of reading of a non-professional character during the summers following the first and the second school-years. A statement of the works read during the summer is required at the beginning of the next school-year. The first-year reading is 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 are selected for their value from the point of view of general training, but the attempt is made to include only readable and attractive works.

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

Summer Courses are undertaken primarily for the benefit of two classes of students: first, for those who wish to prolong their stay in summer, in order to distribute their work over a 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. Applicants for admission to the first year may take French or German. College graduates or others desiring to enter the second or third year will find it greatly to their advantage to make up deficiencies in Mathematics, Drawing, etc., in this way, and they are advised to communicate as early as possible with the Secretary of the Faculty with reference to plans of study.

SCHEDULE OF SUMMER COURSES

Offered for 1908.

Mathematics.

(*a*) Mathematics (21 or 22).
(*b*) Integral Calculus.

Applied Mechanics.

Drawing.

(*a*) Mechanical Drawing and Descriptive Geometry.

Mechanic Arts.

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

Modern Languages.

(*a*) French I. (Elementary).
(*b*) French II. (Intermediate).
(*c*) German I. (Elementary).
(*d*) German II. (Intermediate).

Chemistry.

(*a*) Inorganic and Analytical Chemistry.
(*b*) Quantitative Analysis.
(*c*) Organic Chemistry.

Physics.

(*a*) Mechanics, Electricity, and Optics.
(*b*) Physical Laboratory.
(*c*) Precision of Measurements.

Civil Engineering.

(*a*) Surveying.
(*b*) Structures.

Mechanical Engineering.

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

Architecture.

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

Biology.

(*a*) Industrial Bacteriology.
(*b*) Sanitary Research.
(*c*) The Human Mechanism.

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 135 to 314. Applicants not already connected with the Institute should correspond with the Secretary of the Faculty in regard to their qualifications.

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

Registration and Fees.—Each student will be required to register in advance at the Registrar's office for every course he desires to attend. Admission will be contingent upon approval of attendance cards.

A fee of $25 for each course (with certain exceptions noted in the special circular) will be collected by the Bursar at the time fixed for beginning the course. For one-half or any smaller portion of a course the fee will be three-fifths that of the full course, and for any fraction of a course greater than one-half the full fee will be charged. For the courses in the Chemical Laboratories a deposit of $20 will be required, to cover the cost of gas, water, and chemicals, as well as a charge for apparatus damaged or destroyed; and in the Mechanical Laboratories additional charges will be made for materials, power and service.

A special circular (issued in March) 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

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 1907 the Summer School of Metallurgy was held in New York, New Jersey, Maryland and Pennsylvania. In New York the works of the Nichols Copper Company furnished an ample opportunity to become acquainted with the leading features of the smelting of copper ores, the converting of copper matte, and the fire-refining of cathode copper. The study of electrolytic refining of copper and of doré silver was reserved for the visit to the works of the Raritan Copper Company, at Perth Amboy, New Jersey. Lead-smelting and lead-refining were taken up in Newark at the works of the Balbach Smelting and Refining Company. In the same city a visit was paid to the Atha Steel Casting Company to inspect the casting from open-hearth furnaces and Tropenas converters.

At Sparrow's Point, Maryland, metallurgical study was confined to the Otto-Hoffmann coking ovens, the blast furnace, Bessemer and rail-mill departments of the Maryland Steel Company. The sojourn in Pennsylvania was devoted mainly to iron and steel, but considerable time was given to the mining and concentrating of iron ores, to the smelting of zinc ores, to coking and the manufacture of Portland cement.

With the Pennsylvania Steel Company, Steelton, one day was devoted to the new open-hearth steel plant, and the other two days were taken up with the steel-casting plant, the mill for rolling structural iron, the spiegel furnaces and the Semet-Solvay coking ovens. A passing visit was made to the works of the Central Iron & Steel Company to see the plate mills and flanging presses.

At Lebanon the Cornwall Ore Banks Company and the Robesonia Company mining magnetic iron ore by open pit work furnished an excellent example of the magnitude of such operations. The magnetic concentrator of the Lebanon Furnaces and its nodulizing department which agglomerates the concentrates for subsequent smelting in the blast furnaces gave a complete view of the treatment from low-grade ore to pig iron. Puddling was taken up at Lebanon with the American Iron and Steel Manufacturing Company where some of the recent improvements in the old established process were found in operation. The Lebanon Steel Casting Plant with the Nobel oil furnaces showed how steel castings can be made on a very small scale.

At the Bethlehem Steel Company's works, Bethlehem, the interest was centered upon the hydraulic forging of heavy steel ingot. The New Jersey Zinc Company and Lehigh University were the other two establishments visited. From Bethlehem one excursion was made to Hazleton to visit a coal mine and breaker of the Lehigh Valley Coal Company, and another to Northampton to visit the large plant of the Atlas Portland Cement Company.

In 1908 the Summer School of Mining was held in Nova Scotia, which, in a comparatively small area, offers excellent facilities for the study of occurrences and mining methods of coal, and of gold and iron ores.

Landing at Yarmouth, the first stop was made at Middleton to inspect the iron mines of the Londonderry Iron Mining Company; then came Cape Blomidon, celebrated for its fossils. The second longer stay was at Spring Hill where are in operation the extensive mines of the Cumberland Railway and Coal Company. A study of the large regular beds of coal, of the methods of mining and of the surface plant proved valuable. At Joggins, the wonderful geological section along the shore was impressive, while the peculiar occurrence of coal in the mines of the Maritime Coal, Railway & Power Company of the same place offered many new points of interest. On the way from Joggins to New Glasgow a little time was spent at Chignecto where a new power plant, receiving low-grade coal from a neighboring mine, develops electricity for the town of Amherst. At New Glasgow, an industrial centre, visits were made to the rolling mills of the Nova Scotia Steel & Coal Co. to the Government diamond drill prospecting outfit at work upon the land of the Acadia Co., to the New Allan shafts of the Acadia Co., and to the machine-shops of the Sutherland Rifle Sight Co. Several hours by train followed by a sixty-mile stage ride, brought the party to Isaacs Harbor where are located the largest gold mines of Nova Scotia, those of the Boston-Richardson Mining Co., of Goldboro. The mining, amalgamation and leaching of gold ores was of great interest to all. The party saw at Glace Bay the mines and surface plants of the Dominion Coal Co.; at Sydney, the coke ovens, sulphuric acid works and gas plant, the blast-furnaces, converters, open-hearth department and rolling mills of the Dominion Iron & Steel Co.; and at North Sydney the mine and surface plant of the Nova Scotia Steel & Coal Co.

During the whole trip the members of the party received a kindly welcome from the officers of the companies which they visited, and were glad to meet a number of graduates of Course III.

Summer School of Industrial Chemistry.—At the close of the school year in June, opportunity is afforded to students of the fourth year in the courses in Chemical Engineering, Chemistry, and Electro-Chemistry, to visit typical chemical and metallurgical plants, under the guidance of instructors, to study and report upon essential features of the industrial processes involved. These trips usually occupy about fifteen days and include frequent conferences between instructors and members of the school, at which notes are written up and details of the various processes discussed. No tuition fee is charged, but the membership of the party is limited to such number as may be deemed advisable by the Head of the Department of Chemistry and Chemical Engineering.

In 1908 visits were made to manufacturing plants near New York, Jersey City, Bayonne, and Phillipsburg, N.J., Bethlehem, Allentown, Kane, Bradford, Franklin, and vicinity around Pittsburg, Pa. In all some twenty-six plants were inspected during this trip.

Summer Schools of Geology and Mineralogy.—With the view of emphasizing 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.

Advanced Courses of Study.

GENERAL STATEMENT.

The Institute offers courses of advanced study and research leading to the three degrees of Master of Science, Doctor of Philosophy, and Doctor of Engineering. The first degree is awarded upon the satisfactory completion of at least one year's advanced work in either science or engineering. For the other two degrees a residence of not less than two years is required. The degree of Doctor of Philosophy is given when the work has been mainly study and research in some branch of science; that of Doctor of Engineering, when it has consisted principally of engineering subjects and the investigation of industrial problems.

Advanced courses of study may also be pursued without reference to a degree by students who have the necessary preparation. Such courses may be taken with advantage by those who desire either to devote their time almost wholly to a definite line of investigation or to specialize in some limited field of science or technology.

In addition to the facilities for investigation offered in connection with all the departments of the Institute there have been established three laboratories devoted exclusively to research in Physical Chemistry, in Applied Chemistry and in Bacteriology and Municipal Sanitation, which offer unusual opportunities to those wishing to pursue such work. These laboratories are designated respectively the Research Laboratory of Physical Chemistry, the Research Laboratory of Applied Chemistry and the Sanitary Research Laboratory and Sewage Experiment Station. Their organization and equipment and the character of the work pursued are described on pages 131 to 134, 325, 326 and 332.

CANDIDACY FOR ADVANCED DEGREES.

In order to be accepted as a candidate for an advanced degree at the Institute, the applicant must, except in cases of unusual attainments, have taken his first degree in some scientific school, college, or university of good standing; and his preparation must be substantially equivalent to the work required for the Bachelor's degree of the Massachusetts Institute of Technology, except as specially provided below in the case of college graduates who desire to become candidates for the degree of Master of Science in a two-year Course. Only those applicants will be accepted as candidates for an advanced degree whose attainments, as shown by their previous record of scholarship or by other information, are of such a character as to indicate that their proposed course of advanced study and research can be creditably pursued.

The applicant must file with the Secretary of the Faculty, preferably upon the form provided therefor, an application for candidacy for the advanced degree for which he wishes to pursue a course of study. He must give in connection with this application an account of his previous education, stating the extent to which he has completed the requirements for the corresponding Bachelor's degree at the Institute; and he must present as definitely as possible his proposed course of study and research.

The student should, if practicable, enter upon his work at the beginning of the school year. Applications for candidacy will ordinarily be considered at that time and during the latter part of the preceding school year, preferably before April 1.

It is very desirable that college students intending to enter the Institute with the idea of taking fourth year or advanced work should elect their college program with this in view. Correspondence with the Secretary of the Faculty or with the professors in charge of departments is desirable in case of doubt as to preparation required for admission to advanced subjects. A special circular on opportunities for college students will be mailed upon application.

COURSES FOR THE DEGREE OF MASTER OF SCIENCE.

1. *For Graduates in Scientific Courses.*

The course of study leading to the degree of Master of Science consists mainly of advanced study and research in the branch of science or engineering in which the student has already completed an undergraduate course substantially equivalent to one of those given at the Institute. 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.

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

2. *For College Graduates.*

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

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

COURSES FOR THE DEGREE OF DOCTOR OF PHILOSOPHY.

The general character of the courses leading to this degree is indicated by the following faculty rule in regard to it: 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 dealing with 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 not less than two school-years; but in fact three years are generally needed to complete the work.

The candidate for the degree submits for the approval of the Faculty the course of study which he desires to pursue. This must consist mainly of research, but must also comprise a considerable amount of advanced study. Besides taking the subjects specified in his course of study, the candidate will be expected to prepare himself in a broad way upon certain branches of science. Thus a student specializing in Physics will be required to pass a general examination upon that science as major subject, and upon the related sciences of Chemistry and Mathematics as minor subjects. In Chemistry, the candidate may select as his major subject one of the three branches, Inorganic Chemistry, Organic Chemistry, or Physical Chemistry, with the understanding that he is to take the other two branches as minors, as well as Physics and one other subject, such as Mathematics, Geology, or Biology. For those specializing in Physical Chemistry, Mathematics is required.

In planning his course of study, the candidate should refer to the section of this Catalogue entitled "Elective Subjects for Advanced Courses" on page 122, and to the section entitled "Opportunities for Research" on pages 131 to 134.

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 instruction work 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 also will derive great profit from such courses.

COURSES FOR THE DEGREE OF DOCTOR OF ENGINEERING.

The increasing demand for men having not only the engineering training of the technological school, but the attitude of mind inciting them to attack new problems,—men who have not simply a basis of theoretical and practical knowledge, but who have also the spirit and the aptitude for the investigation of technical problems, cultivated to a much higher degree than is possible in an undergraduate course,—has led the Institute to make provision in its Engineering Departments for courses of advanced study and research leading to the degree of Doctor of Engineering. Some of the larger industrial and manufacturing establishments are already conducting independent laboratories of research where men having such advanced training are in demand.

The degree of 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. It will be awarded only to students who show capacity for the investigation of original problems in some branch of engineering or in some of the sciences upon which engineering depends.

In making his application for acceptance as a candidate for the degree of Doctor of Engineering, the applicant will be expected to submit a statement of the subjects of study which he desires to pursue, and to announce his choice of a problem upon which he intends to make an extended original investigation or research and to prepare a thesis. To these subjects, and especially to this problem, he will be expected to devote himself diligently and successfully throughout a period of not less than two consecutive years, during which time he shall work in residence under the direct supervision of a committee of the Faculty. Ordinarily, however, a candidate should expect to devote three years to the work for the degree. It is advisable for a candidate not previously connected with the Institute to qualify himself first for the Master's degree before registering as a candidate for the Doctor's degree. In planning his course of study, the candidate should refer on pages 122 to 130 to the section of this Catalogue entitled "Elective Subjects for Advanced Courses" and to the section entitled "Opportunities for Research" on pages 131 to 134.

The requirements for the degree of Doctor of Engineering and the regulations in regard to it are in general similar to those for the degree of Doctor of Philosophy.

ELECTIVE SUBJECTS FOR ADVANCED COURSES.

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

The Subjects in each Course are classified as follows:—

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

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

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

I.—CIVIL ENGINEERING.

A. MAJOR SUBJECTS.

	Term.	Hours per term Ex.	Prep.
Thesis	1 and 2		
Structural Design (357)	1 and 2	120–	90
Railroad Engineering (323)	1 and 2	30–	60
Railroad Design (322)	1 and 2	90–	0
Sanitary and Hydraulic Design (339)	1 and 2	90–	0
Water Power, Irrigation, and River Works (343)	1 and 2	45–	90
Water Purification and Sewage Disposal (344)	1	60–	60
Specifications and Contracts (359)	2	30–	60

B. MINOR SUBJECTS.

Sanitary and Hydraulic Engineering (334), Hydraulic Measurements (333), Hydraulic Engineering (335), Hydraulic and Sanitary Designing (337), Sanitary Science and Public Health (754), Municipal Sanitation (753), Public Health Problems (757), Purification of Water and Sewage (766).

Railroad Engineering (319), Railroad and Highway Designing (321).

Advanced Calculus (36), Differential Equations (44), Least Squares (49).

European Civilization and Art (175), Economics of Corporations (193).

II.—MECHANICAL ENGINEERING.

A. MAJOR SUBJECTS.

	Term.	Hours per term.
Research	1 and 2	
Advanced Theory of Elasticity (97)	1 or 2	100 to 200
Analytical Mechanics (96)	1 and 2	45– 90
Advanced Machine Design (406)	1 or 2	100 to 200
Advanced Steam and Gas Engineering (388)	1 or 2	100 to 200

B. MINOR SUBJECTS.

Marine Engineering (420), Locomotive Construction (421), Mill Engineering (422), Heating and Ventilating Engineering (423), Hygiene of Ventilation and Heating (758).

Advanced Calculus (36), Differential Equations (44), Vector Analysis (46), Fourier's Series (47).

Alternating Current Machinery (650),[1] Electrical Engineering Laboratory,[3] Technical Electrical Measurements (685),[2] Standardizing Laboratory.[3]

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

[2] References to be studied prior to admission to this course will be furnished by Professor Laws to those who have not had the first part of course 685 in the third year or its equivalent.

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

III.—MINING ENGINEERING AND METALLURGY.

A. MAJOR SUBJECTS.

	Term.	Hours per term Ex.	Prep.
Research	1 and 2	200	
Advanced Mining Engineering[1] (460)	1 and 2	60–	60
Advanced Ore Dressing (461)	1 and 2	75–	75
Mining Plant Design (462)	2	80–	80
General Metallurgy { Lectures (453)	2	15–	30
General Metallurgy { Laboratory (454)	2	45–	35
Minor Metals (455)	1	30–	30
Metallurgical Calculations (456)	1	30–	75
Metallurgical Design (457)	2	150–	100
Advanced Economic Geology (861)	1 and 2	90–	
Advanced Field Geology (873)	1 and 2	90–	
Geology of the Igneous Rocks (877)	2	90–	
Chemical Mineralogy and Geology (850)	1 and 2	90–	
Advanced Petrography (844)	1 and 2	90–	
Advanced Paleontology (884)	1 and 2	120–	
Distillation of Fuels (449)	2	6–	
Heat Measurement (783)	2	45–	

B. MINOR SUBJECTS.

Glacial Geology (863), Experimental Geology (865), Principles of Paleontology (883).

Electrical Engineering Lectures (658), Electrical Engineering Laboratory,[2] Technical Electrical Measurements (688), Electro-Chemistry, lectures and laboratory (796) (799), Electro-Metallurgy (446).

Steam Engineering (385), Gas Analysis (638).

Advanced Surveying (303).

[1] Students electing Advanced Mining Engineering will be expected to take Mechanism and Mechanical Engineering Drawing prior to beginning graduate work.

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

IV.—ARCHITECTURE.

A. MAJOR SUBJECTS.

	Term.	Hours per term Ex.	Prep.
Advanced Architectural Design / Advanced Composition lectures (529)	1	370	–
Advanced Architectural Design Thesis / Philosophy of Art lectures (529)	2	465	–
European Civilization and Art, advanced Course (176)	1 and 2	45	–
Advanced Life Class and Decorative Design (119)	1 and 2	90	–
Advanced Pen and Pencil Rendering (517)	1 and 2	15	–
Advanced Constructive Design / Building Laws and Contracts (533)	1	120	–
Æsthetics (165)	1	30	–
Landscape Architecture lectures (542)	1	10	–
Landscape Design (541)	1	120	–
History and Archæology (492)	2	30	–

B. MINOR SUBJECTS.

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

V.—CHEMISTRY.

A. MAJOR SUBJECTS.

	Term.	Hours per term Ex.	Prep.
Chemical Research	1 and 2		
Research Reports	1 and 2	15	–
Advanced Theoretical Chemistry (620)	1 and 2	15	60
Advanced Inorganic Chemistry (623)	1 and 2	15	60
Advanced Industrial Chemistry (581)	2	15	60
Advanced Organic Chemistry (624)	1 and 2	15	60
Qualitative Analysis of Rare Metals (553)	1 or 2	165	–
Organic Qualitative Analysis (597)	1 or 2	135	–
The Relations between Physical Properties and Chemical Constitution[1]	1	15	60
The Phase Rule and its Applications[1]	2	15	60
Polarized Light and its Applications (813) or Radiation given in alternate years	1 or 2	15	30
Advanced Mathematics (50) (53)	1 and 2	30	60

B. MINOR SUBJECTS.

Industrial Chemical Laboratory (582), Proximate Technical Analysis (629), Textile Coloring (630), Advanced Food Analysis (649), Air, Water, and Food Analysis (565), Sugar Analysis (573).

Kinetic Theory of Gases (830), Energetics (829), General Theory of Light (808), Descriptive Astronomy (819), Electrical Measurements (781), Electro-Chemistry, lect. and lab. (796) (799), Applied Electro-Chemistry, lect. and lab. (797) (800).

Advanced Calculus (36), Differential Equations (44), Least Squares (49).

Metallurgy of Iron (441), Metallurgy (443), Electro-Metallurgy (446).

Bacteriology of Water and Sewage (748), Industrial Biology (746), Microscopic Analysis of Water and Sewage (711), Sanitary Science and Public Health (754), Zymology (747), Chemical Biology (749), Vital Statistics (198), Municipal Laboratory Methods (755).

European Civilization and Art (175).

[1] Courses offered in the Research Laboratory of Physical Chemistry vary from year to year.

VI.—ELECTRICAL ENGINEERING.

A. MAJOR SUBJECTS.

	Term.	Hours per term.
Research	1 and 2	
Alternating Currents (Advanced) (652)	1 and 2	135 to 180
Electrical Engineering Laboratory (696)	1 and 2	75 to 150
Advanced Dynamo Design (668)	1	75 to 150
Design of Stations and Distribution of Systems (679)	1 and 2	75 to 150
Advanced Electrical Testing (687)	1	75 to 150
Electrical Engineering Seminar (697)	1 and 2	75–
Organization and Administration of Public Service Companies (698)	1 and 2	135 to 180
Advanced Mathematics (50)	1 and 2	30– 60

B. MINOR SUBJECTS.

Structures (348),[1] Machine Design (404),[2] Mill Engineering (422),[2] Fourier's Series (47), Least Squares (49).

Electrostatics and Electrokinetics (791), Electro-Chemistry, lectures and laboratory[3] (796) (799), Applied Electro-Chemistry, lect. and lab. (797) (800).

European Civilization and Art (175).

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

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

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

VII.—BIOLOGY.

A. MAJOR SUBJECTS.

	Term.	Hours per term Ex.	Prep.
Research	1 and 2	30–	60
Epidemiology (765)	1	30–	30
Purification of Water and Sewage (766)	1 and 2	60–	60
Sewage Disposal Practice (767)	2	45–	45
Public Health Laboratory Practice (768)	2	90–	15
Dairy Bacteriology (762)	1	90–	90
Sanitation of Water Supplies (769)	1	60–	60
Sanitary Statistics[1] (769a)	1	30–	60
Sanitation of Houses and Public Buildings (760)	2	15–	15
Bacteriology of Fermentation Industries (763)	1	60–	60

B. MINOR SUBJECTS.

Vital Statistics (198), Hydraulic Measurements (333), Heating and Ventilation (415), Public Health Problems (757), Industrial Hygiene and Sanitation (752), Municipal Laboratory Methods (755), Municipal Sanitation (753), Sanitary and Hydraulic Engineering (334),[2] Water Analysis and Water Supplies (568).

[1] Previous preparation in Vital Statistics (198) required for admission.

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

VIII.—PHYSICS.

A. MAJOR SUBJECTS.

	Term.	Hours per term Ex.	Prep.
Physical Research			
Electrical Discharge in Gases; Radioactivity[1] (816)	2	15-	†
Hertz Waves; Wireless Telegraphy[2] (817)	2	15-	†
Principles and Methods of Physical Measurement[1] (831)	1	15-	60
Radiation (832)[2]	1	15-	60
Microscope Theory and Photomicrography (806)	1 or 2	60-	30
Wave Theory and Polarization[1, 2] (812)	1	15-	60
Constitution of Matter in the Light of Recent Discovery[2] (811)	2	15-	60
Polarized Light and its Applications[2] (813)	1	15-	†
Advanced Mathematics (50) (57)	1 and 2	30-	60
Thermodynamics; Seminar[1, 3]	1 and 2	15-	60
Relations between Physical Properties and Chemical Constitution; Seminar[1, 3]	1	15-	60
The Phase Rule and its Applications; Seminar[1, 3]	2	15-	60
Physico-Chemical Colloquium[1, 3]	1 and 2	15-	

B. MINOR SUBJECTS.

Electro-Chemical Laboratory (799), Applied Electro-Chemistry, lect. and lab. (797) (800), Electrical Engineering (658), Electrical Engineering Laboratory.[4]

History of Chemistry (645), Organic Chemistry Laboratory (599).

Vector Analysis (46), Advanced Calculus (36), Analytical Mechanics (96).

European Civilization and Art (175).

[1] Given in 1908–1909. [2] Given in 1909–1910. These courses are given in alternate years.

[3] Subjects offered in the Research Laboratory of Physical Chemistry vary from year to year.

[4] Special course given to two or more students.

† Assigned reading and an examination will be required.

VIII.—OPTION IN ELECTRO-CHEMISTRY.

A. MAJOR SUBJECTS.

	Term.	Hours per term Ex.	Prep.
Research	1 and 2		
Applied Electro-Chemistry (798)	1 or 2	15-	60
Principles and Methods of Physical Measurements (831)	1	15-	60
Thermodynamics; Seminar	1 and 2	15-	60
Advanced Industrial Chemistry (581)	1 and 2	15-	60
Advanced Inorganic Chemistry (623)	1 and 2	15-	60
Advanced Theoretical Chemistry (620)	1 and 2	15-	60
Chemical Engineering (583)	1 and 2	15-	45
Alternating Currents (Advanced) (652)	1 and 2	135 to 180	
Electrical Engineering Laboratory (696)	1 and 2	75 to 150	

B. MINOR SUBJECTS.

Industrial Chemical Laboratory (582), History of Chemistry (645).

Metallurgy of Iron (441), Metallurgy (442), Metallography (452), Mining Engineering, lectures and laboratory (459) (435).

Alternating Current Machinery (650), Power Transmission (663).

Theoretical Hydraulics (332)[1] and Hydraulic Laboratory (342), Engineering Laboratory (396) or (397) (selected work).

Economics of Corporations (193), European Civilization and Art (175).

[1] The preparation in Applied Mechanics required may be had in Summer School.

X.—CHEMICAL ENGINEERING.

A. MAJOR SUBJECTS.

	Term.	Hours per term Ex.	Prep.
Research	1 and 2		
Research Reports	1 and 2		
Chemical Engineering (583)	1 and 2	15-	45
Advanced Inorganic Chemistry (623)	1 and 2	15-	60
Advanced Organic Chemistry (624)	1 and 2	15-	60
Advanced Theoretical Chemistry (620)	1 and 2	15-	60
Qualitative Analysis of Rare Metals (553)	1 or 2	165	
Organic Qualitative Analysis (597)	1 or 2	135	
Principles and Methods of Physical Measurements (831)	1	15-	60

B. MINOR SUBJECTS.

Air and Water Analysis (part) (565), Textile Coloring (630), Proximate Technical Analysis (629), History of Chemistry (645), Electro-Chemistry, lectures and laboratory (796) (799), Applied Electro-Chemistry, lectures and laboratory (797) (800), Heat Measurements (781).

Machine Design (404),[1] Mill Engineering (422),[1] Industrial Management (409).

Electrical Engineering (658), Electrical Engineering Laboratory,[2] Technical Electrical Measurements (688).

Advanced Calculus (36), Differential Equations (44).

Economics of Corporations (193), European Civilization and Art (175).

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

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

XI.—SANITARY ENGINEERING.

A. MAJOR SUBJECTS.

	Term.	Hours per term Ex.	Prep.
Thesis	1 and 2		
Structural Design (357)	1 and 2	120-	90
Sanitary and Hydraulic Design (339)	1 and 2	90-	0
Sanitary Statistics[1] (769a)	1	30-	60
Water Power, Irrigation and River Work (343)	1 and 2	30-	60
Sanitation of Water Supplies (769)	1	60-	60
Water Purification and Sewage Disposal (344)	1	60-	60
Purification of Water and Sewage (766)	1 and 2	60-	60
Sewage Disposal Practice (767)	2	45-	45
Specifications and Contracts (359)	2	30-	60
Sanitation of Houses and Public Buildings (760)	2	15-	15

B. MINOR SUBJECTS.

Railroad Engineering (319), Railroad and Highway Designing (321).

Advanced Calculus (36), Differential Equations (44), Least Squares (49).

Air, Water and Food Analysis (565), Gas and Fuel Analysis (639), Applied Chemistry (640).

Personal Hygiene[2] (729), Public Health Problems (757), Vital Statistics (198), Zymology (747).

European Civilization and Art (175), Economics of Corporations (193).

[1] Previous preparation in Vital Statistics (198) required for admission.

[2] Previous preparation in General Physiology (725) required for admission.

MATHEMATICS.

Special provision will be made for graduates of scientific schools or colleges who may desire to prepare themselves for the teaching of Mathematics, or to pursue advanced mathematical work in connection with other sciences. The list of subjects available for election includes Advanced Calculus, Fourier's Series, Vector Analysis, Hydrodynamics, Higher Geometry, Applications of Differential Equations including Discrete Systems, Continuous Media, and Mathematics of Wireless Telegraphy, the Potential Function, Elements of the Theory of Functions of a Complex Variable, and a course on the Teaching of Elementary Mathematics. Brief descriptions of these courses may be found on pages 149 to 151, and the professor in charge of the department may be consulted in regard to arrangement of work or possible additions to the list. College graduates may find it practicable in two years to combine with the requirements for the Master's degree in Mathematics a valuable amount of undergraduate work in some one of the professional departments.

Opportunities for Research.

IN DEPARTMENTAL LABORATORIES.

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

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

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

In Mechanical Engineering researches may be conducted upon subjects connected with the strength of materials, the theory of elasticity, and with thermodynamics, as well as in other lines. As examples of subjects in these first two lines may be mentioned: Investigations upon reinforced concrete, of the stresses in flat and in curved plates, of the stresses in pieces subjected to transverse or to compound stresses, of springs and spring steel, of the effects of repeated and of alternate stresses, and of the change of density under stress; also along thermodynamic lines upon the flow of steam in nozzles and pipes and reaction of the jet; steam losses in turbines and engines; flow of air and other gases; the properties of superheated steam, ammonia, sulphurous anhydride, etc.

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

In Electrical Engineering opportunities for research are offered in such subjects as transmission-line problems, the effect of wave form on the performance of the various types of alternating current motors, electrical measuring instruments, condenser losses, the various properties, magnetic and other, of the materials used in electrical construction; the effect of high tension currents on insulation; the energy transformations in rotary converters, etc.

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

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

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

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

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

RESEARCH LABORATORY OF PHYSICAL CHEMISTRY.

This laboratory, which was established in 1903, is devoted exclusively to research work and advanced instruction in Physical Chemistry. It consists of a group of small laboratories, accommodating in all eighteen research workers. It is equipped with every convenience for physico-chemical investigations. A fuller description will be found on page 325.

The researches are carried on in large part by a staff of Research Assistants and Associates working under the direction of those professors of the Institute who are connected with the subjects of Theoretical or Physical Chemistry. The Laboratory offers also to students who are properly prepared unusual opportunities for a thorough training in Physical Chemistry. Besides pursuing research work, all candidates for higher degrees attend advanced lecture courses and weekly seminars, given by members of the Research Laboratory staff, in which different phases of Physical Chemistry are taken up for study and discussion, or in which reports are given upon current literature and upon the investigations in progress in the laboratory. During every year since its establishment, from ten to sixteen men have been engaged upon physico-chemical researches in the laboratory.

RESEARCH LABORATORY OF APPLIED CHEMISTRY.

In order that opportunity may be provided for the study of some of the general problems of a chemical nature constantly confronting the manufacturing public, that there may be offered to the individual manufacturer facilities for the investigation of his special problems, and that the Institute may be brought more intimately into connection with the industries of the country, there has been established a Research Laboratory of Applied Chemistry. A description of the laboratory will be found on page 326.

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

SANITARY RESEARCH LABORATORY AND SEWAGE EXPERIMENT STATION.

By the generosity of an anonymous donor the Institute has since 1903 maintained a Sanitary Research Laboratory and Sewage Experiment Station for the investigation of problems relating particularly to the purification of the sewage of large cities, for the demonstration of sanitary methods and appliances, and ultimately for the advancement of popular education in public health subjects. For a description of the laboratory and experiment station see page 332.

Investigations are carried on by a regular staff of biologists and chemists. Students or others who have had the necessary preparation in Chemistry, Bacteriology, or Sanitary Engineering, who desire to take up problems relating to sanitary science or the public health, and who desire to become familiar with the methods and processes employed in sanitary research, especially as related to the purification of sewage and water, will be received at any time.

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 existing between the work of the various Departments of the Institute, it not infrequently appears in the following classification of subjects that the same instructor gives courses in several divisions other than his own.

The subjects are numbered for convenience of reference in consulting the various Course Schedules, pages 71 to 105, and the Alphabetical Subject Index, pages 137 to 142. 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 2, 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 137 to 142, 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 60 (Applied Mechanics) are 31 and 770; that for 31 is 30; that for 30 is 21; that for 21 is 20; those for 20 are 1 and 2 (Algebra and Plane Geometry required for admission, page 101); the requirement for 770 is 21 (or 22, which, again, depends upon 20). So that to take up 60, Applied Mechanics, the applicant must be prepared to pass, or must have passed, examinations in 20, 21, 30, 31, 770 and in 1 and 2. The reason for this is that in subject 60 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 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 144 to 314.

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 (3, 4)	5–	5
Æsthetics 165 (G)	30–	0
Air, Water & Food Anal. 565, 569, 570 (3, 4)	90–	0
Alternating Currents 652 (G)		
Alternating Current Mach. 650 (4, G)	30– 15–	30
American Literature 158 (E) (3)	30–	15
Analytical Mechanics 96 (G)	45–	90
Applied Chemistry 640	15–	
Applied Electro-Chemistry 798 (G)	15–	60
Applied Mechanics 65 (3) II, XIII, XIIIA	45–	90
Applied Mechanics 66 (3) I, XI	60–	90
Applied Mechanics 67 (3) VI	45–	90
Applied Mechanics 68 (3) III, X	20–	40
Applied Mechanics 69 (3) IV	40–	80
Applied Mechanics 80 (4) II, III$_{1, 2}$, X, XIII, XIIIA	45–	90
Applied Mechanics 82 (4) VI	15–	30
Applied Mechanics 86 (4) IV$_2$	25–	50
Applied Mechanics (Lab.) 87 (4) VI,	10–	5
IV,	14–	7
Architectural History 490 (2)	15–	15
Architectural History 491 (3)	30–	60
Architectural History: Research 492 (G)		
Assaying 432 (3) (III$_3$, 60–0)	60–	15
Astronomy 819 (4)	30–	45
Bacteriology 744 (3)	75–	30
Bacteriology of Fermentation Industries 763 (G)	60–	60
Bacteriology of Water & Sewage 748 (4)	30–	15
Biology, General 700 (2)	75–	45
Biology, General 701 (3) (XII, 15–15)	15–	0
Biology of Infectious Diseases 745 (4)	30–	15
Bridge Design 355 (4)	90–	0
Bridge Design 356 (4)	60–	0
Calculating Machines 836 (E)	7–	
Calculus, Advanced and Geometry 36 (3)	60–	120
Carpentry 120 & Wood Turning 121 (2)	60–	0
Chemical Engineering 583 (G)	15–	45
Chemical Mineralogy and Petrology 850 (G)		
Chemistry 550 (1) . { Laboratory 60, Lectures 30, Recitations 15 }	–	90
Chemistry, Anal. & Tech. 635 (3)	30–	30
Chipping and Filing (cont.) 130 (4)	30–	0
Colonial Systems (180) (E)	15–	30
Color 814 (3, 4)	5–	5
Comparative Anatomy 719 (3)	90–	15
Comparative National Government (182) (E) (3)	15–	30
Comparative Physiology 727 (4)	75–	60
Constructive Design 532 (4)	90–	0

Subject.	Hours Ex.	Hours Prep.
Constructive Design, Advanced 533 (G)		
Dairy Bacteriology 762 (G)	90–	
Descriptive Geometry 101 (1) (see Mech. Draw.)		
Descriptive Geometry 107 (2, 3)		
I	60–	45
II, III, VI, VIII$_3$, X, XIII	45–	0
XI	60–	30
XII	60–	0
Descriptive Geometry (Special) (2)		
Design I 526 (2)	75–	0
Design II 527 (3)	130–	0
Design III 528 (4)	315–	10
Design (Architectural, Advanced) 529 (G)		
Design of Stations and Distribution Systems 679 (G)		
Differential Calculus (see Mathematics 30)		
Differential and Integral Calculus (see Mathematics 32)		
Differential Equations (see Mathematics 40)		
Differential Equations, Applications 53–55 (E)	30–	90
Discrete Systems 53 (E)	30–	60
Drawing with Steam Eng. 380 (4)	20–	
Dynamics of Machines 401 (4) (XIII, XIIIA, 20–40) (G)	25–	50
Dynamo Design 668 (G)		
Dynamo-electric Machinery 661 (3, 4)	30–	30
Dynamo-electric Machinery 662 (4)	25–	0
Economic Geology 859 (3) . . III$_1$	30–	30
III$_3$	30–	15
XII	60–	30
Economic Geology 861, Advanced (G)	90–	0
Economic Geology 889 (4) (III$_3$, 30–60)	60–	30
Economic History 191 (E) (3)	15–	30
Electric Light and Transmission of Power 663 (4)	30–	30
Electrical Engineering 657 (4)	30– 15–	30
Electrical Engineering 658 (G)	30–	30
Electrical Engineering, Elements of 655 (3)	60–	100
Elect. Eng. Lab. 693 (4) (VIII$_3$)	50–	50
Electrical Engineering 693 (4)	50–	
Elect. Eng. Lab. Rep. 693 (4)	30–	40
Electrical Engineering Lab. 694 (G)	40–	40
Electrical Engineering Laboratory 696 (G)		
Electrical Engineering 697 (G)		
Electrical Laboratory 779 (3)	15–	15
Electrical Measurements 782 (4)	30–	30
Electrical Testing, Advanced 687 (G)		
Electrical Measuring Instruments 778 (3)	10–	10

Subject.	Hours Ex. Prep.
Electro-chem. Lab. 799 (4) (V_5, 105–30)	105–
Electro-Chemistry 796 (4) . . . V	30– 60
VIII	30– 45
Engineering Laboratory 397 (4) (G) II, XIII, XIIIA	60– 30
VI	45– 25
X	30– 15
Engineering Laboratory 399 (4) . . .	15– 15
English 140 (1)	30– 30
English Bible 160 (E) (3)	30– 15
English Composition, Adv. 143 (E) (3)	15– 30
English Literature of 18th Century 156 (E) (3)	30– 15
English Literature 150 (2) { I, II, XIII, 30–30; XI, 30–20 }	15– 5
Epidemiology 765 (G)	30– 30
European Civilization and Art I 175 (4)	60– 60
European Civilization and Art II 176 (G)	
European History 173 (2) (I, II, VI, $VIII_{1,2}$, XIII, 30–30)	30– 10
Experimental Geology 865 (4) (E) . .	
Field Geology 869 (3)	15– 15
Field Geology Advanced 873 (G) . .	90–
Food Analysis 570 (3)	45– 0
Food Analysis, Adv. 649 (4)	75– 15
Forging 127 (2, 3)	60– 0
Foundations 349 (4)	15– 30
Fourier's Series 47 (4).	30– 60
Freehand Drawing 110 (1)	15– 0
Freehand Drawing 116 (2, 3) (XII, 75–0)	60– 0
Freehand Drawing 117 (3)	60– 0
French II 221 (1)	45– 90
French IIIA 222 (E) (3)	15– 30
French IIIB 223 (2) VI	30– 40
French, Colloquium 228 (E) (3) . . .	45– 0
Gas and Fuel Analysis 639 (4)	8–
Geological Surveying 871 (3, 4) $III_{1,2}$ (4)	30– 0
III_3 (4)	60– 60
XII_1 (3)	55– 0
XII_2 (3)	30– 15
XII_2 (4)	60– 30
Geology, Dynamical 855 (3) (VII, 30–15)	30– 30
Geology, General 856 (2, 3) (III, 30–30 XII, 45–15)	30– 15
Geology, Glacial 863 (4)	15– 15
Geology, Structural and Field 857 (3) .	30– 0
German II, 231 (2, 3)	45– 90
German IIIA 232 (E) (3)	15– 30
German IIIB 233 (2) VI	30– 40
German, Colloquium 238 (E) (3) . . .	45– 0
Glass-Blowing, page 251 (G).	
Heating and Ventilation 413 (3) Op. 1	45– 45
Op. 2	65– 45
Heating and Ventilation 414 (4) . . .	15– 0
Heating and Ventilation 415 (4) . . .	30– 45
Heating and Ventilation 416 XIIIA (G)	15– 15
Heating & Ventil. Eng. 423 (4) . . .	30– 55
Heat Meas'ts 781 (4) . . . . $III_{1,2}$	30– 0
V	30– 30
Highway Engineering 314 (3)	15– 15
History of Science 761 (E) (3)	15– 30
Horticulture 501 (E)	60– 30
Horticulture 502 (E)	60– 0
Hydraulic Measurements 333 (4) (XII, 20–30)	20– 10
Hydraulics 330 (4) I, XI	45– 90
Hydraulics 331 (3, 4) (XIII 20–40) . .	15– 30
Hydraulics 332 VI (4).	30– 60
Hydrodynamics 58 (E) (G)	
Hygiene of Ventilation 758 (4)	5– 5
Index Fossils 880 (4)	60– 30
Industrial Biology 746 (4)	60– 45
Industrial Chemical Laboratory 582 (4)	105– 15
Industrial Chemistry 580 (4)	45– 45
Influence of Materials on Arch. 486 (3, 4)	15– 15
Inorganic Chemistry 561 (4)	30– 30
Inorganic Chemistry Advanced 623 (G)	

Subject.	Hours Ex. Prep.
International Law 185 (E) (3)	15– 30
Italian I 248 (E)	30– 60
Joinery and Pattern Work 123 (2) . .	60– 0
Journal Meet. & Eng. Exc. 673 (4) . .	30– 0
Journals 764 (4)	15– 30
Laboratory Reports 437 (4) . . III	15– 0
VIII	3– 0
Landscape Architecture 542 (E) . . .	15– 15
Landscape Design 541 (E)	220– 0
Life Class 118 (4)	90– 0
Life Class and Decorative Design 119 (G)	
Locomotive Engineering 421 (4) . . .	35– 70
Machine Design 404 (4)	135– 0
Machine Design 406 (G)	
Machine Drawing 376 (2) XIII . . .	45– 0
Machine Drawing 377 (3) . . II, III	75– 00
X	90–
Machine Tool Work 132 (4)	60– 0
Machine Tool Work 133 (4) XIII . .	60– 0
Marine Engineering 420 (4)	35– 70
Marine Engines 913 (4, G)	30– 30
Mathematics 20 (1)	30– 60
Mathematics 30 (2)	45– 90
Mathematics 32 (2) V_1, VII	45– 90
Mathematics 40 (3)	30– 60
Mechanical Draw. 100 (1)	90– 0
Mech. Eng. Draw. 372 (2, 3) { II, VI 60–0; III_2, X 15–0; XIII 30–0 }	30– 0
Mechanical Eng. Drawing 374 (2) . .	30– 0
Mechanism 360 (2) II	45– 90
Mechanism 361 (2) III, XIII	45– 75
Mechanism 362 (2) VI	45– 90
X	30– 45
Mechanism 364 (2) I, XI	30– 60
Memoirs 465 (4)	15– 30
Memoirs 925 (G)	20– 50
Metallography 452 (4)	10– 10
Metallurgical Calculations 456 (G) . .	
Metallurgical Laboratory 435 (4) III .	100– 0
Metallurgical Laboratory 436 (4) . . .	24– 0
Metallurgy 442 (4)	30– 30
Metallurgy of Iron 441 (2, 3, 4) . . .	15– 15
Metal Turning 134 (2)	60– 0
Metal Turning 135 (4)	30– 0
Microscopical Organisms 709 (3) . . .	15– 0
Military Science 990 (1) . . . . . A	45– 0
B	30– 15
Mill Engineering 422 (4)	35– 70
Mineralogy 840 (2)	60– 15
Mineralogy 841 (2)	60– 15
Mineralogy Adv. 842 (E)	60– 15
Mining Engineering, Elements of 430 (2)	15– 15
Mining Engineering 458 (3, 4) (III_3, 45–30)	45– 45
Mining Engineering 459 (4)	45– 30
Mining Engineering, Advanced 460 (G)	30– 30
Minor Metals 455 (G)	30– 30
Naval Architecture 902 (4)	30– 60
Oil Testing 628 (E, 4)	25– 5
Optical Laboratory 807 (4)	60– 30
Ore-dressing 461 (G)	
Org. Chem. Lab. 599 (4) . . VII	105– 15
$VIII_1$	75– 0
Organic Chem. Lab. Preparations React. & Anal. 598 (X, 80–0)	140– 0
Org. Chem. 590 (2, 3) . . . VII, VIII	30– 30
XI	30– 30
Org. Chemistry 592 (4)	40– 30
Organic Chemistry, Advanced 624 (G)	
Organic Laboratory, Adv. 600 (E) . .	
Organization and Administration of Public Service Companies 698 (G)	
Paleontology 884 (G)	
Paleontology, Introductory 878 (3) . .	45– 30
Pen and Pencil 516 (4)	

Subject.		Hours Ex. Prep.
Pen-and-Pencil Rendering 517 (G)		15– 0
Perspective 471 (3)		15– 30
Petrography 843 (4) (III, 45–15)		60– 15
Petrography 844 (G)		
Phase Rule and its Applications, page 251 (G)		
Photography 815 (4)		15– 0
Physical Colloquium 838 (4)		—– 30
Physical Laboratory 773 (3), (Partial)	X	15– 10
	III	10– 10
Physical Laboratory 773, 774 (3) XII		30– 30
Physical Laboratory 774 (3)		15– 10
Physical Training 995 (1)		20– 0
Physico-Chemical Colloquium, page 251 (G)		
Physico-Chemical Research Reports and Reviews (G)		
Physics 770 (2)	Lectures 45, Recitations 30	– 60
Physics 771 (Heat) (3)		15– 20
Physiological Laboratory 728 (4)		30–
Plant Physiology 738 (4)		30– 30
Polarized Light 813 (E)		15–
Political Economy 190 (3)		45– 45
Precision of Measurements 772 (3)		10– 10
Protozoölogy 724 (4)		30– 15
Proximate Technical Analysis 629 (4)		90– 30
Pub. Health Prob. 757 (4)		15– 30
Purification of Water and Sewage 766 (G)		
Qualitative Analysis 552 (2)	III	105– 15
	V	165– 15
	VII	120– 15
	VIII$_{1, 2}$	130– 15
	VIII$_3$	105– 15
	X	120– 15
	XI	60– 15
	XII	105– 15
Qualitative Analysis of Rare Metals 553 (G)		
Quantitative Analysis 559 (3, 4)	III (3)	90– 15
	III$_2$ (4)	90– 15
	III$_1$ (4)	60– 15
	V$_{2, 3}$	270– 45
	V$_1$	210– 45
	VIII$_1$	90–
	VIII$_3$	65–
	X	195– 30
R.R. Design 321 (4)		60– 0
R.R. Design 322 (G)		
R.R. Drawing & Fieldwork 315 (3)	I	60– 0
	XI	30– 0
Railroad Engineering 313 (3)	I	30– 60
	XI	20– 40
R.R. Engineering 319 (4)		30– 60
R.R. Engineering 323 (G)		
Research Conferences, page 251 (G)		
Sanitary and Hydraulic Design 339 (G)		
Sanitary & Hydraulic Engineering 334 (4)		60– 60
Sanitary Engineering 336 (G)		
Sanitary Statistics 769a (G)		
Sanitation of Water Supplies 769 (G)		
Shades and Shadows (Special) (2)		
Ship Design 911 (4)		90–
Ship Drawing and Design 910 (3)		105– 0

Subject.		Hours Ex. Prep.
Spanish I 240 (E)		30– 60
Spanish II 241		30– 60
Spanish III 242		30– 60
Spec. & Work. Drawing 480 (2)		90– 0
Spec. & Work. Drawing 483 (G)		
Spherical Trigonometry 24 (2, 3)		10– 20
Standardizing Lab. 686 (4)	VI	40– 80
	VIII$_{1, 2}$	15– 15
	VIII$_3$	25– 15
Steam and Gas Engineering 388 (G)		
Steam Eng. 385 (3, 4) (III$_2$, VI, VIII$_3$, 30–60)		45– 90
Steam Engineering 386 (3, 4) XIIIA		30– 30
Steam Engineering 387 (4) (XI 45–75)		45– 90
Steam Turbine Engineering 424 (4)		35– 70
Structural Design 539 (4)		310– 0
Structural Design 357 (G)		
Structures 348 (4)		45– 90
Structures 351 (4) (IV$_2$)		45– 90
Structures 347 (G)		60– 60
Sugar Analysis 573 (4)		20– 10
Surveying and Plotting 300 (2, 3)		90– 15
Surveying, Adv. 303 (3, 4) (XII 30–0)		30– 15
Teaching of Elementary Mathematics 57 (E)		15– 30
Technical Chemistry 635 (3)		30– 30
Technical Electrical Measurements 685 (4)		10– 10
Textile Coloring 630 (4)		90– 30
Theoretical Biology 704 (4)		30– 30
Theoretical Chemistry Laboratory 619 (3, 4)		35– 25
Theoretical Chemistry 610 (3, 4)		45– 75
Theoretical Chemistry Advanced 620 (4) (VIII$_1$ 15–45)		15– 60
Theoretical Physics I, Dynamics 790 (3)		45– 90
Theoretical Physics II, Electrostatics and Electrokinetics 791 (4)		45– 90
Theoretical Physics III, Optics 808 (4)		45– 90
Theory of Elasticity 97 (G)		
Theory of Functions 50 (E)		30– 60
Theory of Warship Design 915 (3)		30– 30
Theory of Warship Design 916 (4)		30– 30
Theory of Warship Design 917 (G)		30– 30
Thermodynamics Elementary, page 251 (G)		
Topographical Drawing 302 (3)		30–
Topographical Geology 874 (3)		30– 30
Trigonometry Plane 23 (1)		30– 60
Ventilation and Drainage 914 (4)		15– 15
Vital Statistics 198 (4)		30– 30
Warship Design 920 (3)		120–
Warship Design 921 ([illegible])		90–
Warship Design 922 ([illegible])		90–
Water Analysis 565 ([illegible])		30– 0
Water Analysis and Water Supplies 568 (4)		45– 30
Water Color 520 (4)		30– 0
Water Power, Irrigation and River Works 343 (G)		
Water Purification and Sewage Disposal 344 (G)		
Wave Theory and Polarization 812 (G)		15– 60
Zymology 747 (4)		15– 30

ALPHABETICAL SUBJECT INDEX.

SECOND TERM.

Numbers immediately following the subjects refer to the Subjects of Instruction, pages 144 to 314.
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.
Petrography 843 (3, 4)	60	15
Petrography 844 (G)		
Physical Colloquium 838 (4)	15	15
Physical Laboratory 773 (2) I, VI, $VIII_{1,2}$, XI	30	30
Physical Laboratory 773 (2) II, XIII	30	20
Physical Laboratory 773 (2) V	30	25
Physical Laboratory 773 (2) VII, $VIII_3$	30	15
Physical Laboratory 773 (2) XII	20	20
Physical Laboratory 773, 774 (3) (III, 30–45)	30	30
Physical Laboratory (Advanced) 776 (3)	90	45
Physical Training 995 (1)	20	0
Physico-Chemical Colloquium, page 251 (G)		
Physico-chemical Lab. 803 (3)	90	15
Physico-Chemical Research Reports and Reviews (G)		
Physics 770 (2) { Lectures 45, Recitations 30 }	–	60
Physics, Adv. 833 (4)	75	–
Physiological Lab. 728 (3)	45	15
Physiology, General 725	60	60
Polarized Light 813 (E)	30	—
Power and its Transformations 699 (2)	5	0
Precision of Measurements 772 (2)	10	10
Principles and Methods of Physical Measurements 831 (G)		
Principles of Scientific Investigation 837 (4)	–	45
Proximate Technical Analysis 629 (4)	90	30
Public Health Laboratory Problems 768 (G)	90	15
Public Health Problems 757 (4)	15	30
Purification of Water & Sewage 766 (G)	60	60
Quantitative Analysis 558 (2) III	105	15
Quantitative Analysis 558 (2) VII	120	15
Quantitative Analysis 558 (2) $V_{2,3}$	180	15
Quantitative Analysis 558 (2) V_1	150	15
Quantitative Analysis 558 (2) $VIII_{1,2}$	110	15
Quantitative Analysis 558 (2) $VIII_3$	145	15
Quantitative Analysis 558 (2) X	120	15
Quantitative Analysis 558 (2) XI	45	0
Quantitative Analysis 558 (2) XII	135	15
Quantitative Analysis 550 (3,4) III_1	150	15
Quantitative Analysis 550 (3,4) III_2	120	15
Quantitative Analysis 550 (3,4) III_3	105	15
Quantitative Analysis 550 (3,4) V_2	150	25
Quantitative Analysis 550 (3,4) V_1	135	15
Quantitative Analysis 550 (3,4) III_1 (4)	105	15
Quantitative Analysis 550 (3,4) III_2 (4)	60	15
Radiation 832 (G)		
R.R. Design 321 (4)	30	0
R.R. Design 322 (G)		
R.R. Drawing & Field-work 315 (3)	75	0
R.R. Economics 194 (E) (3)	45	30
R.R. Engineering 313 (3) (XI, 20–20)	30	30
R.R. Engineering 319 (4)	45	90
R.R. Engineering 323 (G)		
Relations between Physical Properties and Chemical Constitution, page 250 (G)		
Research Conferences, page 251 (G)		
Sanitary & Hydraulic Design 337 (4) I	30	0
Sanitary & Hydraulic Design 337 (4) XI	85	0
Sanitary and Hydraulic Design 339 (G)		
Sanitary Science & Public Health 754 (4)	15	0
Sanitation of Houses and Public Buildings 760 (G)	15	15
Sanitation of Ships 756 (4)	30	30
Sewage Disposal Practice 767 (G)		
Shades and Shadows 470 (1)	15	30

Subject.	Hours Ex.	Hours Prep.
Ship Construction 900 (2)	15	25
Ship Construction 904 (3)	20	30
Ship Construction 905 (4)	15	0
Ship Design 911 (4)	105	0
Ship Draw. & Design 910 (3)	60	0
Spanish I 240 (E)	45	30
Spanish II 241 (E) (3)	30	60
Spanish III 242 (E) (4)	30	60
Specifications and Contracts 359 (G)		
Standardizing Laboratory 686 (3) VI See Electrical Testing		
Standardizing Laboratory 686 (3) $VIII_3$	20	20
Standardizing Lab. 689 (4)	20	20
Steam Engineering 385 (3, 4) II, III_2, VI, XIII	60	120
Steam Engineering 385 (3, 4) $VIII_3$, X	30	60
Steam Engineering 386 (3, 4)	30	60
Steam Engineering 387 (4)	45	90
Steam and Gas Engineering 388 (G)		
Steam Turbine Engineering 424 (4)	75	45
Stereotomy 325 (2) I	60	15
Stereotomy 325 (2) XI	60	0
Structural & Field Geology 870 (2)	15	15
Structural Design 538 (3)	100	0
Structural Design 539 (4)	435	0
Structural Design 357 (G)	120	90
Structures, Theory of 345 (3) (I, XI)	45	120
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
Sugar Analysis 573 (4)	20	10
Surveying 300 (2, 3) ($III_{1,3}$ 60–0)	75	15
Surveying, Adv. 303 (3, 4)	30	0
Surveying 305 (2) VI	30	0
Surveying Instruments 304 (3) II (Inc. in 378)		
Surveying Instruments 304 (2) XIII (Inc. in 378)		
Teaching of Elementary Mathematics 57 (E)	15	30
Technical Electrical Measurements 685 (3) See Electrical Testing		
Theoretical Biology 704 (4)	30	30
Theoret. Chem. Lab. 619 (3, 4)	35	25
Theoretical Chemistry 610 (3, 4)	30	45
Theoretical Chemistry 618 (2, 3, 4)	30	60
Theoretical Chemistry, Adv. 620 (4, G)	15	60
Theoretical Physics I 790 (3)	45	90
Theoretical Physics II 791 (4)	45	90
Theoretical Physics IV 820–830 (4)	45	90
Theory of Elasticity 97 (G)		
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	15
Thesis Reports and Memoirs 648 (4)	30	15
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
Vector Analysis 46 (3)	15	30
Vertebrate Anatomy 717 (3)	90	30
Warship Design 920 (3)	90	–
Warship Design 921 (4)	90	–
Warship Design 922 (G)	90	–
Water Analysis 565 (3, 4)	30	0
Water Color 520 (3)	30	0
Water Power, Irrigation & River Works 343 (G)		
Wood & Metal Work 137 (1)	60	0
Zoölogy 716 (2, 3) (XII 45–15)	45	30
Zoölogy, Experimental 734 (4)	90	45

ENTRANCE REQUIREMENTS.

The requirements for admission to the Institute are described in detail on pages 50 to 69.

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

1. **ALGEBRA.**
   See page 57.
2. **PLANE GEOMETRY.**
   See page 58.
3. **ENGLISH.**
   See page 60.
4. **HISTORY.**
   See page 60.
5. **SOLID GEOMETRY.**
   See page 58.
6. **FRENCH I.**
   See page 59.
7. **GERMAN I.**
   See page 59.
8. **PHYSICS.**
   See page 61.

DEPARTMENT OF MATHEMATICS.

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

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

WEBSTER WELLS, S.B. (absent).
Professor of Mathematics.

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

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

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

EDWIN B. WILSON, PH.D.
Associate Professor of Mathematics.

NATHAN R. GEORGE, JR., A.M.
Assistant Professor of Mathematics.

LEONARD M. PASSANO, A.B.
Assistant Professor of Mathematics.

Instructors.

BENJAMIN E. CARTER, JR., A.M.
CLARENCE L. E. MOORE, PH.D.
HENRY B. PHILLIPS, PH.D.
JOSEPH LIPKE, B.S., A.M.

Great importance is attached to the study of Mathematics, both as a means of general education and as a necessary basis for further instruction in the engineering and other Courses. Nearly all regular students study Mathematics throughout their first two years, beginning with a course in Plane Trigonometry, and a general course in Algebra, Analytic Geometry, and Calculus which begins in the first term of the first year and continues to the middle or end of the second year, or in some Courses to the middle of the third year.

This consecutive course in Mathematics includes work formerly divided somewhat arbitrarily into Algebra, Analytic Geometry, Differential Calculus, Integral Calculus, and Differential Equations. The sub-titles retained in parentheses indicate merely the approximate distribution under the new plan. Care is taken to present both underlying principles and a great variety of concrete applications, the latter connecting the mathematical instruction closely with the professional studies. The instruction is given in part by lectures, and in part by recitations in small sections, the number of the students in a recitation section being rarely permitted to exceed twenty. Students having time and interest for the study of Mathematics beyond the prescribed limits are offered opportunity for more advanced work.

20. MATHEMATICS. (Algebra, Elements of Analytic Geometry and Calculus.)

Professors Tyler, Bartlett, Woods,[1] *Bailey, Wilson, George, Passano; Messrs. Carter, Moore, Phillips, Lipke.*

PREPARATION: 1; 2; 5.

A course of two recitations a week during the first term, covering the following subjects: graphical representation; the polynomial of the first degree in one variable, including the analytic geometry of the straight line; the polynomial of the nth degree in one variable, including the fundamental theorems of the Theory of Equations; differentiation of the polynomial in one variable, including problems on tangents, normals, maxima and minima, and points of inflection.

[REQUIRED IN ALL COURSES.]

21. MATHEMATICS. (Plane Analytic Geometry, Elements of Calculus.)

Professors Tyler, Bartlett, Woods,[1] *Bailey, Wilson, George, Passano; Messrs. Carter, Moore, Phillips, Lipke.*

PREPARATION: 20.

A course of four exercises a week in the second term in continuation of the preceding and covering the following subjects: the plotting of certain algebraic functions expressed by surds or fractions; the derivation of the equations of curves defined by geometric properties; intersection of curves; differentiation of algebraic functions with applications to geometrical and physical problems; inverse differentiation applied to problems; change of co-ordinate axes; the

[1] In charge.

analytic geometry of curves of the second degree; graphs and derivatives of elementary transcendental functions, and problems; parametric representation; polar co-ordinates; and curvature. Throughout the course special attention is given to the solution of problems, which are introduced as soon as the requisite theory has been developed.

[REQUIRED IN ALL COURSES EXCEPT V., VII.]

22. MATHEMATICS. (Plane Analytic Geometry, Elements of Calculus.)

Professor Passano.

PREPARATION: 20.

This course is an abridgment of course 21, consisting of forty-five exercises during the second term.

[REQUIRED IN COURSES V., VII.]

23. PLANE TRIGONOMETRY.

Professors Bartlett,[1] *George, Passano; Messrs. Carter, Moore, Phillips, Lipke.*

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.

Professor George; Mr. Carter.

PREPARATION: 23.

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

[REQUIRED IN COURSES I. AND XII.]

30. MATHEMATICS. (Integral Calculus.)

Professors Tyler,[1] *Osborne, Bartlett, Woods, Bailey, Wilson, George, Passano; Messrs. Carter, Moore, Phillips, Lipke.*

PREPARATION: 21 or 22.

A course of three hours a week during the first term, devoted mainly to the Integral Calculus of functions of one variable and covering the following subjects: infinitesimals and differentials; methods of integration; definite integrals; integration of simple differential equations; geometrical applications to

[1] In charge.

areas and lengths of plane curves, volumes of solids of revolution, and other volumes which can be found by a single integration; and mechanical applications to work, attraction, pressure, and centers of gravity and pressure.

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

31. MATHEMATICS. (Solid Analytic Geometry, Calculus.)

Professors Tyler,[1] *Osborne, Bartlett, Woods, Bailey, Wilson, George, Passano; Messrs. Carter, Moore, Phillips, Lipke.*

PREPARATION: 30.

A course of three exercises a week during the second term in continuation of course 30, mainly devoted to the study of functions of two variables and covering the following subjects: the elements of solid analytic geometry including a discussion of the plane, the straight line and simple surfaces; partial differentiation; multiple integration, with geometrical applications to areas and volumes, and with mechanical applications to attraction, moments of inertia, and centers of gravity; line integrals and exact differential equations; series including indeterminate forms; and complex numbers.

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

32. MATHEMATICS. (Integral Calculus.)

Professor Passano.

PREPARATION: 21 or 22.

Three recitations a week during the first term. This course is an abridgment of courses 30 and 31.

[REQUIRED IN COURSES V., OPTIONS 2, 3, VII., XII.]

36. ADVANCED CALCULUS AND GEOMETRY.

Professor Woods.

PREPARATION: 31.

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 30 and 31 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

[1] In charge.

surfaces, including curvature, lines upon surfaces, and curvilinear coordinates; envelopes, including singular solutions of differential equations; double and 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.]

40. MATHEMATICS. (Differential Equations.)

Professors Tyler, Bailey,[1] *Wilson; Messrs. Moore, Phillips, Lipke.*

PREPARATION: 31.

A course of two exercises a week during the first term in continuation of course 31, and covering the following subjects: differential equations of the first order; singular solutions; linear differential equations; certain partial differential equations; and geometrical and mechanical applications.

[REQUIRED IN COURSES II., V., OPTION 1, VI., VIII., OPTIONS 1 AND 3, XIII.]

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 40 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 Wilson.

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 Trignometry, Geometry, and Mechanics.

[REQUIRED IN COURSE VIII., OPTION 2.]

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

Professor Bailey.

PREPARATION: 40 or 44.

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

[1] In charge.

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.]

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

Professor Bartlett.

PREPARATION: 31 taken simultaneously.

This course consists of twenty exercises in the second 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.]

HISTORY OF THE MATHEMATICAL SCIENCES.

Professor Tyler.

This course consists of about fifteen lectures during the first and second terms and forms a part of course 761 on the History of Science, under which title a more detailed description may be found.

[ELECTIVE.]

ELECTIVE ADVANCED COURSES.

In addition to the above subjects, which are required in certain Courses, opportunity for further elective work is given, the topics varying from year to year.

Graduates of the Institute, or of other colleges, desiring to prepare themselves under the conditions of a scientific school for the teaching of Mathematics may advantageously include some or all of these subjects, as well as any of the above not previously taken, in programs for the degree of Master of Science.

The Department will also endeavor in particular to meet the needs of graduate students desiring to engage in mathematical investigation of problems of engineering or applied science.

50. ELEMENTS OF THE THEORY OF FUNCTIONS OF A COMPLEX VARIABLE.

Professor Tyler or Professor Woods.

PREPARATION: 31.

This course will consist of two exercises a week during the second term. Emphasis will be placed on the general bearings of the subject in its relation to special branches of Mathematics and their applications, with which the students may be already familiar, and on its significance as an introduction to more advanced subjects.

[ELECTIVE.]

51. 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.

[ELECTIVE. REQUIRED IN COURSE XIII.A.]

52. HIGHER GEOMETRY.

Professor Woods.

PREPARATION: 31.

This course consists of two exercises a week during the second term and is occupied first with a study of various systems of point co-ordinates, including trilinear, tetracyclical, quadriplanar and pentaspherical. Systems of Geometry in which the element is not the point are also studied, including Plücker's Line Geometry and Lie's Sphere Geometry. The principle of duality is emphasized and an introduction given to Projective and Non-Euclidean Geometry.

[ELECTIVE.]

53-55. APPLICATIONS OF DIFFERENTIAL EQUATIONS.

Professor Wilson.

PREPARATION: 40.

53. Discrete Systems.

This course consists of two exercises per week during the first term, and includes the integration of the differential equations with special reference to the dynamical significance of the chief principles of integration, energy, momentum, moment of momentum, etc., also general dynamical methods in Physics.

54. Continuous Media.

This course consists of two exercises per week during the second term, and includes a comparative study of different continuous media, hydromechanics, water waves, sound waves, theory of vortices, elastic media, the ether. (Alternating with 55. Not given in 1908–1909.)

55. Mathematics of Wireless Telegraphy.

This course consists of two hours per week during the second term, and includes a treatment of the simpler and of some of the more difficult theory of the transmission and reception of electromagnetic energy by ether waves. (Alternating with 54.)

[ELECTIVE.]

57. THE TEACHING OF ELEMENTARY MATHEMATICS.

This will consist of fifteen or more exercises conducted by various members of the Department and devoted to the discussion of selected questions with special reference to the history and literature of the subject. No specific requirement as to preparation will be made, but the course will be open only to graduate students.

[ELECTIVE.]

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.
Associate Professor of Mechanical Engineering.

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

HARRISON W. HAYWARD, S.B.
Assistant Professor of Applied Mechanics.

LAWRENCE S. SMITH, S.B.
Instructor in Mechanical Engineering.

The instruction in Applied Mechanics is given in the second, third and fourth years. Courses covering the whole or a part of this time are given 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. Particular attention is given to the solution of problems which involve the application of these principles in engineering practice and test the student's 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 properties 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 graduates in the courses of Mechanical Engineering and Physics and includes an advanced mathematical treatment of Analytical Statics, of the Dynamics of a Particle, of the Dynamics of Rigid Bodies, etc. A course in Advanced Theory of Elasticity is given to graduates of the same courses.

60. APPLIED MECHANICS (Statics—Stresses in Frames—Dynamics).

Professors Fuller, Johnston, Hayward.

PREPARATION: 31 and 770, taken simultaneously.

A course of three lectures (or recitations) per week in the second term of the second year. The course comprises a study of statics, consisting of the general methods and applications of statics including the determination of reactions, stresses in frames; of distributed forces, centre of gravity; of moment of inertia, radius of gyration of plane areas and solids including principal axes and principal moments of inertia; of kinematics and dynamics including the equations for uniform and varying rectilinear and curvilinear motion, centrifugal force, unresisted projectile, pendulum, harmonic motion, rotation, combined rotation and translation, momentum and angular momentum, centre of percussion, impact, work, power and kinetic energy.

[Required in Courses I., II., VI., XI., XIII.]

65. APPLIED MECHANICS (Strength of Materials—Graphic Statics).

Professors Fuller, Johnston, Hayward.

Preparation: 31; 60; 770.

A course of three lectures (or recitations) per week during the first term of the third year.

The course comprises a study of the strength of materials, mathematically treated, including the stresses and strains in bodies subjected to tension, to compression, and to shearing; common theory of beams with thorough discussion of the distribution of stresses, shearing forces, bending moments, slopes, and deflections; stresses in hooks, in columns and in beams subjected to tension or compression as well as bending; torsional stresses; stresses in springs; graphic statics, consisting of a presentation of general methods, involving the force and funicular polygons, followed by a variety of applications to roof-trusses, including the three-hinged arch.

[Required in Courses II., XIII., and XIII.a.]

66. APPLIED MECHANICS (Strength of Materials).

Professors Fuller, Johnston, Hayward.

Preparation: 31; 60; 770.

A course of four lectures (or recitations) per week in the first term of the third year. The course comprises a study of the strength of materials as described in course 65 with additional applications to simple frames subjected to bending stresses; also a brief study of strains and the relations of the stresses on different planes.

[Required in Courses I. and XI.]

67. APPLIED MECHANICS (Strength of Materials).

Professors Fuller, Johnston, Hayward.

Preparation: 31; 60; 770.

A course of three lectures (or recitations) per week in the first term of the third year. The course comprises a study of the strength of materials as described in course 65. Also a study of data on the strength of materials which have been obtained by means of experiments on full-sized pieces, under practical conditions; a study of the tests required in the standard specifications to determine the quality of the materials. The study of the experimental data on the strength of materials is similar to course 82.

[REQUIRED IN COURSE VI.]

68. APPLIED MECHANICS (Statics — Stresses in Frames).

Professors Fuller, Johnston, Hayward; Mr. Smith.

PREPARATION: 31; 770.

A course of two lectures (or recitations) per week for the last ten weeks in the first term of the third year. This course includes a study of statics as described in course 60.

[REQUIRED IN COURSES III. AND X.]

69. APPLIED MECHANICS (Statics — Stresses in Frames — Centre of Gravity — Moment of Inertia — Strength of Materials).

Professors Fuller, Johnston, Hayward.

PREPARATION: 31; 770.

A course of three lectures (or recitations) per week in the first term of the third year. The course includes a study of statics, with applications; of centre of gravity and moment of inertia of plane surfaces; of the strength of materials. The work given is similar to part of that described in courses 60 and 65.

[REQUIRED IN COURSE IV.]

70. APPLIED MECHANICS (Strength of Materials — Theory of Elasticity).

Professors Lanza, Fuller, Johnston.

PREPARATION: 65.

A course of three lectures (or recitations) per week in the second term of the third year. A study of experimental data on the strength of materials and theory of elasticity as described in courses 80 and 81.

[REQUIRED IN COURSE II.]

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

Professors Fuller, Johnston.

PREPARATION: 65.

A course of two lectures (or recitations) per week in the second term of the third year.

The course includes a study of the experimental data on the strength of materials and friction as described in course 80.

[REQUIRED IN COURSES XIII., XIII.A.]

72. **APPLIED MECHANICS (Dynamics—Strength of Materials).**

Professors Fuller, Johnston, Hayward; Mr. Smith.

PREPARATION: 68.

A course of three lectures (or recitations) per week in the second term of the third year. The course includes a study of the centre of gravity, moment of inertia, dynamics and strength of materials. The work given is similar to part of that described in courses 60 and 65.

[REQUIRED IN COURSES III., X.]

74. **APPLIED MECHANICS (Graphic Statics).**

Professors Fuller, Johnston, Hayward.

PREPARATION: 69.

A course of three lectures (or recitations) per week for the first seven weeks, and for Option 2, one lecture (or recitation) per week for the last eight weeks, in the second term of the third year.

The course includes a presentation of general methods involving the force and funicular polygons, followed by a variety of applications to roof-trusses, including the three-hinged arch, to beams and to masonry arches and abutments.

[REQUIRED IN COURSE IV.]

75. **APPLIED MECHANICS (Strength of Materials).**

Professors Fuller, Johnston, Hayward.

PREPARATION: 69.

A course of three lectures (or recitations) per week in the last eight weeks in the second term of the third year. The course is the same as the first portion of course 80, laboratory work and friction omitted.

[REQUIRED IN COURSE IV.]

77. **APPLIED MECHANICS (Laboratory).**

Professors Miller, Fuller, Johnston, Hayward; Mr. Holmes and assistants.

PREPARATION: 70, taken simultaneously.

A course of seven three hour exercises given in the second term of the third year. The course is similar to the laboratory work described in course 80.

[REQUIRED IN COURSE II.]

78. **APPLIED MECHANICS (Testing Materials).**

Professors Miller, Fuller, Johnston, Hayward; Mr. Holmes and assistants.

PREPARATION: 66.

A course of thirty hours lectures and laboratory work during the second term of the third year.

The laboratory work is similar to that given in course 80.

[REQUIRED IN COURSES I. AND XI.]

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

Professors Lanza, Miller, Fuller, Johnston.

PREPARATION: 65 or 72.

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

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*—Specifications in the case of the standard test specimens; tensile, compressive, and transverse 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; test 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.; test 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 1907–1908 being the following:

A test to determine the modulus of elasticity, the limit of elasticity, yield point 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 transverse test on cast-iron.

A test to determine the modulus of elasticity and the tensile strength of wire.

Torsional tests of wire.

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

Tests on cement and cement mortars including practice in laboratory methods.

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 III. and X. In Courses II., XIII., XIII.a., Class of 1909 only.]

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 Course II. All except the stone arch is also required of Courses XIII. and XIII.a. in the Class of 1909.]

82. APPLIED MECHANICS (Strength of Materials).

Professors Lanza, Fuller, Johnston.

Preparation: 72.

This course of two 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., Class of 1909 only.]

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

Professors Lanza, Fuller, Johnston.

PREPARATION: 75.

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, Hayward; Mr. Holmes and assistants.

PREPARATION: 82 or 86 taken simultaneously.

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 COURSES IV., OPTION 2, VI.]

96. ANALYTICAL MECHANICS.

Professor Lanza.

This course is open to graduates of Course II., and to those of Course VIII., Option 2. While the topics treated will be different for different students, according to their needs and their previous preparation, it will in general include the following subjects: virtual work of any system of bodies with Lagrange's equations and methods; theory of attraction, including Laplace's equation; theory of potential, Green's equation, spherical harmonics with applications; moments of inertia of rigid bodies, ellipsoids of inertia, radii of gyration, centre of percussion, etc.; general equations of motion with 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. Also, for those who do not take 97, a shorter course on the theory of elasticity.

97. ADVANCED THEORY OF ELASTICITY.

Professor Lanza.

This course will begin with a detailed study of those portions of the general theory that have not been treated in the undergraduate course. Subsequently, the work will be planned to suit the special needs of the student, one important consideration being the nature of his research work. Some of the topics from which a selection will be made are the theories of torsional and of transverse stress, the theories of impact, the stresses in, and the vibrations of thin rods, plates and shells, the inflexional elastica, thermal effects, etc.

[ELECTIVE IN COURSE II., GRADUATE YEAR.]

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.

Ervin Kenison, S.B.,
Assistant Professor of Drawing and Descriptive Geometry.

Harry C. Bradley, S.B.,
Assistant Professor of Drawing and Descriptive Geometry.

Instructors.

Henry K. Burrison, S.B.
W. Felton Brown.
Arthur L. Goodrich, S.B.
Stephen A. Breed, S.B.
Samuel E. Gideon.
John Mills, A.M.

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 Department 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. MECHANICAL DRAWING.[1]

101. DESCRIPTIVE GEOMETRY.[1]

Professors Adams, Bradley; Messrs. Burrison, Breed, Gideon, Mills.

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.]

102. MECHANICAL DRAWING.[1]

103. DESCRIPTIVE GEOMETRY.[1]

Professors Adams, Kenison, Bradley; Messrs. Burrison, Goodrich, Breed, Gideon, Mills.

PREPARATION: 100, 101.

A course of six hours per week throughout the second half of the first year. The weekly programme is the same as for 100 and 101. The subject-matter of the lectures and drawing, a continuation of 100 and 101, 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] This subject may be taken separately. Applicants for advanced standing should present themselves for examination (except in the case of those offering certified records from other colleges in this subject), and all applicants should submit drawings covering the above ground as fully as possible. In case these drawings are not satisfactory, further work and examination may be required.

104. **MECHANICAL DRAWING.**[1]

105. **DESCRIPTIVE GEOMETRY.**[1]

Professors Adams, Kenison; Mr. Goodrich.

PREPARATION: 100, 101.

A course of nine hours per week throughout the second half of the first year, consisting of lectures and drawing. The course is a continuation of 100 and 101, and includes:

Descriptive Geometry, complete (the ground covered by courses 103 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]

Professors Adams, Kenison, Bradley; Mr. Goodrich.

PREPARATION: 102, 103.

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 Descriptive Geometry 103.

Descriptive Geometry, completed, with applications.

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

110. **FREEHAND DRAWING.**[3]

Professor Adams; Mr. Gideon.

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 letter drawing, which, besides leading to practical lettering in Engineering and Architecture, is regarded as an excellent means for presenting principles and methods underlying Freehand Drawing in general.

[REQUIRED IN ALL COURSES.]

[1] This subject may be taken separately. Applicants for advanced standing should present themselves for examination (except in the case of those offering certified records from other colleges in this subject), and all applicants should submit drawings covering the above ground as fully as possible. In case these drawings are not satisfactory, further work and examination may be required.

[2] Four hours for Courses I. and XI.

[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. Gideon.

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.]

12. FREEHAND DRAWING.[2]

Professor Adams; Mr. Gideon.

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. Students in Course XII. take this subject in the first term of the third year, five hours per week.

[REQUIRED IN COURSES IV., XII.]

117. FREEHAND DRAWING.[3]

Professor Adams; Mr. Brown.

PREPARATION: 116.

This course, of two two-hour lecture and drawing periods per week throughout the third year, is a continuation of course 116. Course XII. takes five hours per week in the first term only.

[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.
ALBERT L. MOULTON.
FRANK A. BROWN.
ERNEST CURLEY.
ALFRED R. HUNTER.

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, Forging, Chipping and Filing, and Machine-tool Work. Briefer courses, covering only a part of the ground outlined above, are given to students in Naval

Architecture, Mining, Electrical and Chemical Engineering, Chemistry, and Physics.

120. CARPENTRY.

121. 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 COURSE II.]

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 102, 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 pattern 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: 102, 111 completed or taken simultaneously.

The course consists of fifteen two-hour exercises, one each week during the second term. 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.

[REQUIRED IN COURSE III., OPTION 2.]

127. FORGING.

Mr. Lambirth and assistant.

PREPARATION: 100 or 102, 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: 102, 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 III., OPTION 2.]

130. **CHIPPING AND FILING.**

Messrs. Smith, Littlefield, and assistant.

PREPARATION: 102, 111, completed or taken simultaneously.

The course consists of twenty-one two-hour exercises in the second term. 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-three exercises of course 132, three each week during the last eleven 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 102, 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: 102, 111, completed or taken simultaneously.

This course consists of fifteen two-hour exercises, one each week during the first 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: 102, 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.]

DEPARTMENT OF ENGLISH.

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

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

ARCHER T. ROBINSON, A.B.
Assistant Professor of English.

HENRY L. SEAVER, A.B.
Assistant Professor of English.

Instructors.

CHAUNCY C. BATCHELOR, A.B. CLINTON H. COLLESTER, A.M.
SIDNEY GUNN, 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, Robinson, Seaver; Messrs. Batchelor, Collester and Gunn.

PREPARATION: 3, 4.

The first-year English Composition is conducted by means of class-room exercises, written work, and consultations; it occupies two class-room hours and two hours of preparation per week in the first term and two class-room hours in the second term. The chief object is to enable the student to write correct, lucid, 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: the work includes drill in reading intelligently and attention to the relation of such reading to composition.

[REQUIRED IN ALL COURSES.]

141. SPECIAL COMPOSITION.

Professors Pearson, Robinson, Seaver.

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.

A course in Advanced Composition, 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.]

145. ARGUMENTATION AND DEBATE.

Professor Pearson.

The purpose of this course is to give training in the preparation and the oral delivery of formal arguments.

[ELECTIVE.]

150. ENGLISH LITERATURE.

Professors Bates, Pearson, Robinson, Seaver.

PREPARATION: 140.

In the English Literature of the second year fifteen lectures are given in the first term and thirty in the second (for Courses I., II., XI., and XIII., thirty in each term). 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. AMERICAN LITERATURE. NATIONAL IDEALS.

Professor Pearson.

PREPARATION: 150.

A course consisting of readings, discussions, and written work. The purpose is to study the presentation of national ideals in American Literature, in the period from 1830 to 1880.

[ELECTIVE.]

160. THE ENGLISH BIBLE.

Professor Seaver.

PREPARATION: 150.

The course is given two hours a week during the first term of the third year. The assigned readings, confined to the text of the Bible, should acquaint the student with the more significant parts of the Old and, especially, of the New Testament. The purpose of the lectures is to show the historical origin and influence of the religious thought of the Jews, and the literary structure and excellence of the Biblical writings; also to give the student, as basis for his subsequent reading and interpretation, knowledge of the conditions under which the books of the Bible were written.

[ELECTIVE.]

165. ÆSTHETICS.

Professor Bates.

The course in Æsthetics covers the first term, and is given in thirty lectures, with assigned reading, and is illustrated by the use of photographs and engravings. 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 AND POLITICAL SCIENCE.

CHARLES F. A. CURRIER, A.M.
Professor of History and Political Science.

JOHN O. SUMNER, A.B.
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 106.)

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. 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.]

176. HISTORY OF EUROPEAN CIVILIZATION AND ART:

II. The Later Middle Ages and the Period of the Italian Renaissance.

Professor Sumner.

PREPARATION: 175.

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.]

177. 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.]

180. COLONIAL SYSTEMS.

Professor Currier.

PREPARATION: 173.

A course of one hour a week, lectures and recitations, during the first 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.]

181. 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.]

182. 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. OMITTED IN 1909–1910.]

185. 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.]

186. BUSINESS LAW.

Mr. Albers.

A course of one lecture a week throughout the second term of the third year.

[REQUIRED IN ALL COURSES.]

DEPARTMENT OF ECONOMICS AND STATISTICS.

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 two lectures 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 VI. AND VIII., OPTION 3.]

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.]

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. OMITTED IN 1908–1909.]

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., OPTION 2.]

DEPARTMENT OF MODERN LANGUAGES.

JOHN BIGELOW, JR.
Professor of French.

FRANK VOGEL, A.M.
Professor of Modern Languages.

Instructors.

JOSEPH BLACHSTEIN.
FRANCIS H. DIKE, A.B.
JUSTUS ERHARDT, A.B.
HERMAN R. KURRELMEYER, PH.D.
GEORGE MEISTER.

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 to use them without the necessity of translating, and as much familiarity with the spoken language as his individual aptitude and the time available permit. 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 the 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.

In the designation of courses the number I., II., or III. signifies the grade of elementary, intermediate, or advanced, as defined by the Modern Language Association of America.

221. FRENCH II. (Intermediate).

Messrs. Blachstein, Erhardt, Dike.

PREPARATION: 6.

This course consists of three exercises a week. The books used are:—

Modern Language Notes, French.
Comfort. Exercises in French Prose Composition.
Guerlac. Selections from Standard French Authors.
Castarède. A Complete Treatise on the Conjugation of French Verbs.
Scientific French Reader.
Each student should have a Whitney's Practical French Grammar and a Gasc's French and English Dictionary, students' edition, or some other standard French Grammar, and French and English Dictionary for reference.

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.

[REQUIRED IN ALL COURSES EXCEPT I., II., VI., XI., and XIII., IN WHICH 231 MAY BE TAKEN INSTEAD.]

222. FRENCH III.A. (Advanced).

Mr. Blachstein.

PREPARATION: 221.

This course is given once a week throughout the year. The work consists of composition, dictation, reading, lectures, and conversation, based mainly upon the following book and current French literature:—

Sainte-Beuve. Seven of the Causeries du Lundi.
Sanderson. Through France and the French Syntax.
Each student should have a Gasc's French and English Dictionary, students' edition, or some other standard French and English dictionary, for reference.

[ELECTIVE.]

223. FRENCH III.B. (Advanced).

Mr. Dike.

PREPARATION: 221.

This course is an abridgment of French III.A. It is given twice a week during the first term only. The same books are used as in French III.A.

[REQUIRED IN COURSE VI., OF STUDENTS WHO TOOK FRENCH THE FIRST YEAR.]

228. FRENCH COLLOQUIUM (Advanced).

Professor Bigelow, Mr. Erhardt.

PREPARATION: 221.

This course is of the same grade as French III. It is given three times a week during the first term and twice a week during the second term. The work consists wholly of exercises without preparation. It comprises composition, dictation, reading, lectures, and conversation.

[ELECTIVE.]

231. GERMAN II. (Intermediate).

Professor Vogel; Messrs. Kurrelmeyer, Meister.

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 lanuguage. 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:—

Bierwirth. An abstract of German Grammar.
Dippold. A Scientific German Reader.
Hauff. Lichtenstein. (Heath edition.)
Prehn. Journalistic German.
Schiller. Gustav Adolf in Deutschland.

[REQUIRED IN ALL COURSES EXCEPT I., II., VI., XI., AND XIII., IN WHICH IT MAY BE TAKEN INSTEAD OF 221.]

232. GERMAN III.A. (Advanced).

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.

The work in this course is based upon the following books:—

Tombo. Deutsche Reden.
Keller. Bilder aus der deutschen Literatur.
Paskowski. Lesebuch zur Einführung in die Kenntnis Deutschlands und seines geistigen Lebens.

[ELECTIVE.]

233. GERMAN III.B. (Advanced).

Professor Vogel.

PREPARATION: 231.

This course is an abridgment of German III.A. It is given twice a week during the first term only. The same books are used as in German III.A.

[REQUIRED IN COURSE VI., OF STUDENTS WHO TOOK GERMAN THE FIRST YEAR.]

238. GERMAN COLLOQUIUM (Advanced).

Professor Vogel.

PREPARATION: 231, with which it may be taken by consent of the instructor.

This course is of the same grade as German III.A. It is given three times a week during the first term and twice a week during the second term. The work consists wholly of exercises, without preparation. It comprises composition, dictation, reading, lectures, and conversation.

[ELECTIVE.]

240. SPANISH I. (Elementary).

Professor Bigelow.

This course is given twice a week throughout the year. The work includes the study of the elements of Spanish Grammar; regular verbs and all common irregular verbs; composition exercises, and the reading of easy Spanish texts.

The work is based upon the following books:—

Hills and Ford. Spanish Grammar.
Howland. Zaragüeta.

[ELECTIVE.]

241. SPANISH II. (Intermediate).

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 practice in writing letters and short essays on topics connected with the regular class work is also offered. The work is based upon the following books:—

Fernan Caballero. La Familia de Alvareda.
Ramsey. A Text-Book of Modern Spanish.
Remy. Spanish Composition.
Cuyás. Spanish and English Dictionary. (Appleton Edition.)

[REQUIRED IN COURSE XIII.A.; ELECTIVE.]

242. SPANISH III. (Advanced).

Mr. Erhardt.

PREPARATION: 241.

This course of two exercises a week throughout the year completes the study of Spanish Grammar, giving special attention to syntax. Composition exercises are required and difficult Spanish texts are read. Practice in writing letters and short essays on topics connected with the regular class work is also required. The following books form the basis of the work:—

Cervantes. Don Quijote.
Fernández y Rodríguez. Lecciones de construcción naval.
Ramsey. A Text-Book of Modern Spanish.
Remy. Spanish Composition.
Cuyás. Spanish and English Dictionary. (Appleton Edition.)

[REQUIRED IN COURSE XIII.A.; ELECTIVE.]

248. ITALIAN I. (Elementary).

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:—

Goldoni. La locandiera.
Motti. Italian Grammar.

[ELECTIVE.]

249. ESPERANTO.

Professor Vogel.

This course comprises two exercises a week during the first half of the second ter[illegible] only. It should enable a student to read the language easily, to speak it slowly and intelligibly, and to understand it when spoken with ordinary clearness and deliberation.

Bullen. Lessons in Esperanto.
Kabe. Unua Legolibro.

[ELECTIVE.]

DEPARTMENT OF CIVIL AND SANITARY ENGINEERING.

George F. Swain, S.B., LL.D.
Hayward Professor of Civil Engineering.

C. Frank Allen, S.B.
Professor of Railroad Engineering.

Alfred E. Burton, S.B.
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.
Associate Professor of Topographical Engineering.

George L. Hosmer.
Assistant Professor of Civil Engineering.

Charles B. Breed, S.B.
Assistant Professor of Civil Engineering.

George E. Russell, S.B.
Assistant Professor of Civil Engineering.

Lewis E. Moore, S.B.
Assistant Professor of Civil Engineering.

Instructors.

John W. Howard, S.B.
Royall D. Bradbury, S.B.

Assistants.

Charles E. Allen, S.B.
Henry B. Alvord, S.B.
James M. Barker, S.B.
Raymond F. Conron, S.B.
Allan R. Cullimore, S.B.
James E. Garratt, S.B.
Howard B. Luther, S.B.
Mason T. Whiting, A.B., 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. The study of Mechanics is also begun in this year, and the course in Mechanism is given. Descriptive Geometry is completed, and followed by the course in Stereotomy.

In the third year the professional work includes the courses in Railroad Engineering, Advanced Surveying, Astronomy, Materials and the Elements of Structures, in which the student is shown the application of Surveying, Descriptive Geometry, Mechanics, and other branches. In the fourth year the work is almost entirely professional, and leads the student into the details of the various branches of Engineering.

In all this work, the object is to enable the student to apply intelligently to practical problems the principles that he has studied; to give power, to avoid rule-of-thumb methods, and to train the student to have courage and self-reliance in solving the problems that the engineer has to meet.

300. SURVEYING AND 301 PLOTTING.

Professors Robbins, Hosmer, Breed; Mr. Howard and assistants.

PREPARATION: 21 or 22; 102, 103 except for Course VII.

This course consists of a series of lectures, supplemented by exercises in the field and the drawing-room, continuing through the second or third 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 the work of Professors Breed and Hosmer, Vol. 1.

[Required in Courses I., III., Options 1, 3, VII., Option 2, XI., XII., Option 1.]

302. TOPOGRAPHICAL DRAWING.

Professors Burton, Robbins, Hosmer; Mr. Howard and assistants.

Preparation: 100 and 101; 111.

This course consists of two hours per week in the drawing-room for one 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 of 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., XII.]

303. ADVANCED SURVEYING.

Professors Robbins, Hosmer; Mr. 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 the work of Professors Breed and Hosmer, Vol. 2.

[Required in Courses I., XI., XII.]

304 or 305. SURVEYING INSTRUMENTS.

Professors Robbins, Hosmer; Mr. Howard and assistants.

Preparation: 100.

This very brief course, in the second term, 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 Courses II. and XIII., as a Part of Mechanical Engineering Drawing. A longer course 305 is given to students in Electrical Engineering.]

308. ASTRONOMY AND GEODESY.

Professor Hosmer, Mr. Howard.

PREPARATION: 24; 303, taken simultaneously.

This course consists of forty-five exercises in the second term of the third year, divided as follows: fifteen lectures on the principles of practical astronomy, illustrated by the lantern, fifteen recitations in astronomy, including the solution of practical problems, and fifteen lectures on geodesy. Special attention is given to those astronomical observations which may be needed in the practice of the surveyor. Observations with the engineer's transit for latitude, longitude, time, and azimuth are a required part of the work. The lectures in geodesy include an outline and a historical sketch of the methods of determining the form of the earth. The methods of conducting a geodetic survey are discussed in detail. The text books are printed notes by Professor Hosmer, and Young's General Astronomy.

[REQUIRED IN COURSES I., XII.]

310. GEODESY.

Professor Hosmer.

PREPARATION: 303 (may be taken simultaneously).

A course of fifteen exercises in the second term 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. Methods of conducting a geodetic survey, the measurements of base lines, and precise levellings, are discussed more in detail.

[REQUIRED IN COURSE XII.]

313. RAILROAD ENGINEERING.

Professors Allen, Breed.

PREPARATION: 31; 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 work on Railroad Curves and Earthwork, and his 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 Breed.

PREPARATION: 313, taken simultaneously.

This course consists of fifteen lectures given during the first 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., XI.]

315. RAILROAD DRAWING AND FIELD-WORK.

Professors Allen, Breed, 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.]

319. RAILROAD ENGINEERING.

Professors Allen, Breed.

PREPARATION: 78; 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.]

321. RAILROAD AND HIGHWAY DESIGNING.

Professors Allen, Breed.

PREPARATION: 319, taken simultaneously.

A course of ninety 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.]

322. RAILROAD DESIGN.

Professors Allen and Breed.

PREPARATION: 321.

This course is a continuation of course 321 and consists of ninety hours of work in the drawing room during the first term.

[ELECTIVE IN COURSE I., GRADUATE YEAR.]

323. RAILROAD ENGINEERING.

Professors Allen and Breed.

PREPARATION: 319, 321.

This course consists of two exercises per week during the entire year and is a continuation of the courses required as preparation. Special attention is given to questions of economics in the various operations which arise in the construction and operation of railroads.

[ELECTIVE IN COURSE I., GRADUATE YEAR.]

325. STEREOTOMY.

Professor Russell and assistants.

PREPARATION: 107.

A series of thirty exercises of two hours each in the second term of the second 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, specially prepared for the use of students in this course by Professor Porter.

[REQUIRED IN COURSES I., XI.]

330. THEORETICAL HYDRAULICS.

Professor Porter.

PREPARATION: 66.

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 laboratory for both Options and in the field for Option 1 (courses 333 and 342). Murwin's Treatise on Hydraulics is used as a text-book.

[REQUIRED IN COURSES I., XI.]

331. THEORETICAL HYDRAULICS.

Professors Mott, Russell.

PREPARATION: 70, 71 or 72.

A brief course of fifteen text-book exercises taking up selected portions of the work given in course 330. Given in the third or fourth years. The text-book used is one prepared by Professor Russell.

[REQUIRED IN COURSES II., III., X., XIII.]

332. THEORETICAL HYDRAULICS.

Professors Mott, Russell.

PREPARATION: 67.

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. The text-book used is one prepared by Professor Russell.

[REQUIRED IN COURSE VI.]

333. HYDRAULIC MEASUREMENTS.

Professors Porter, Mott, Russell and assistants.

PREPARATION: For Courses I., Option 1, and XI., 303; 330, taken simultaneously. For Course XII., 303. For Course VII., 300.

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. Notes prepared by Professor Porter are used in this course in place of a text-book. A more elementary course of twenty hours is given to fourth year students in Course VII.

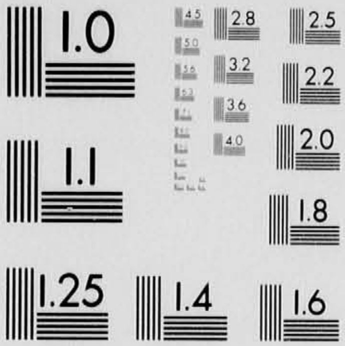
[REQUIRED IN COURSES I., OPTION 1, VII., XI., XII.]

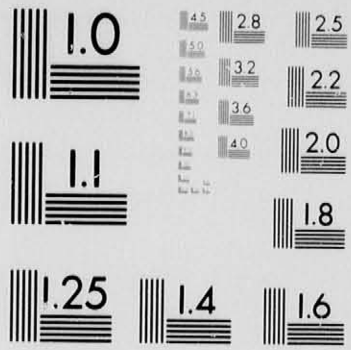
334. SANITARY AND HYDRAULIC ENGINEERING.

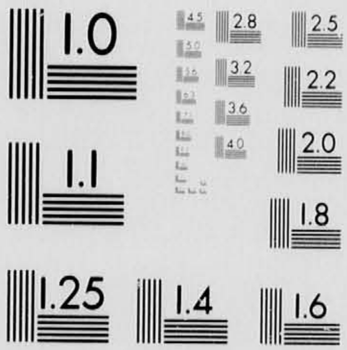
Professor Porter.

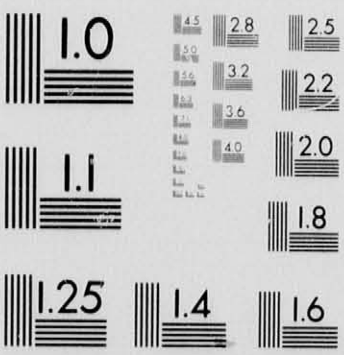
PREPARATION: 330, taken simultaneously.

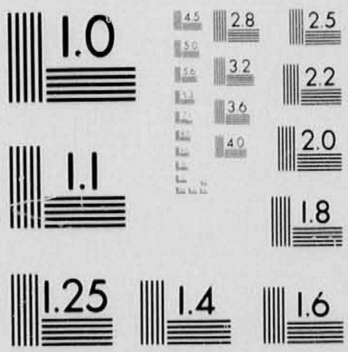
A course of four exercises a week in the first term. This course and that in Hydraulic Engineering, 335, form a continuous series of exercises, three a week, extending throughout the fourth year, and treating of the application of the principles of Hydraulics to engineering, especially to what is classed as


1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
2.8
3.2
3.6
4.0
4.5


1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
2.8
3.2
3.6
4.0
4.5


1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
2.8
3.2
3.6
4.0
4.5


1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
2.8
3.2
3.6
4.0
4.5


1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
2.8
3.2
3.6
4.0
4.5

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 classroom 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-books used are Turneaure and Russel's Public Water Supplies and Church's Hydraulic Motors.

[Required in Courses I., Option 1, XI.]

337. SANITARY AND HYDRAULIC DESIGNING.

Professors Porter, 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 Mott.

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. Church's work on Hydraulic Motors is used.

[REQUIRED IN COURSE II.]

339. SANITARY AND HYDRAULIC DESIGN.

Professors Porter, Mott and Russell.

PREPARATION: 335, 337, 348.

This course is a continuation of course 337, and consists of six hours per week throughout the year devoted to the design of structures connected with water power development, river improvement and water supply installations, such as masonry dams, both simple and reinforced, movable dams, elevated tanks, etc.

[ELECTIVE IN COURSES I. AND XI., GRADUATE YEAR.]

342. HYDRAULIC LABORATORY.

Professor Miller; Mr. Taft and assistants.

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.]

343. WATER POWER, IRRIGATION AND RIVER WORKS.

Professor Mott.

PREPARATION: 335.

This course consists of three class-room exercises per week during the entire year and is a continuation of course 335. The work of the first term embraces a detailed study of rainfall, run-off, storage and delivery of water and the design and construction of structures for water power and irrigation works. The work of the second term consists of a study of canals, and of river and harbor works, particularly with reference to the requirements of navigation. In addition to lectures the course will involve an extended study of the literature of these subjects and reports thereon. Mead's Water Power Engineering is used for reference.

[ELECTIVE IN COURSES I. AND XI., GRADUATE YEAR.]

344. WATER PURIFICATION AND SEWAGE DISPOSAL.

Professor Porter.

PREPARATION: 335, 337.

A course of sixty exercises in the first term dealing with the principles and methods applied in the purification of water supplies and of sewage, with a study in detail of engineering features involved in the construction of filter basins, septic tanks, contact beds, continuous filters and land disposal areas.

[ELECTIVE IN COURSES I. AND XI., GRADUATE YEAR.]

345. THEORY OF STRUCTURES.

Professors Mott, Moore, Russell; Mr. Bradbury.

PREPARATION: 66.

This course consists of forty-five class-room exercises in the second term of the third year, together with work in the drawing-room, 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.

[REQUIRED IN COURSES I., XI.]

346. THEORY OF STRUCTURES.

Professor Moore.

PREPARATION: 74, 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 it is shorter and 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, Mr. Bradbury.

PREPARATION: 81.

This is a specialized course arranged for the Naval Constructors, and consists of forty-five lectures during the first term of the graduate year, together with about sixty 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 simpler 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; 352.

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 reinforced concrete 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 Construction.

[REQUIRED IN COURSES I., XI.]

349. FOUNDATIONS.

Professor Moore.

PREPARATION: 348 or 351, 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 COURSES I., IV., OPTION 2.]

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. The text-book is printed notes by Professor Swain.

[REQUIRED IN COURSE I.]

351. THEORY OF STRUCTURES.

Professor Swain.

PREPARATION: 346; 352.

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: 66 or 69; 345 or 346, taken simultaneously.

This is a course of thirty exercises in the second term of the third year, 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 COURSES I., XI., IV., OPTION 2. COURSE IV., OPTION 2 OMITS 15 HOURS OF PREPARATION.]

355. BRIDGE DESIGN.

Professors Swain, Moore; Mr. Bradbury and assistants.

PREPARATION: 348, taken simultaneously.

A course of six hours a week throughout the fourth year in the drawing-room, with frequent 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, Moore; Mr. Bradbury 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.]

357. STRUCTURAL DESIGN.

Professors Swain and Moore, and Mr. Bradbury.

PREPARATION: 348, 352, 355 or 356.

This course consists of exercises in the drawing room, supplemented by lectures, requiring eight hours per week during the first term and six hours per week during the second term. It is a continuation of courses 348, 350 and 355, and involves a study of more advanced types of structures and particularly of structures of reinforced concrete.

[ELECTIVE IN COURSES I. AND XI., GRADUATE YEAR.]

359. SPECIFICATIONS AND CONTRACTS.

Professor Allen.

PREPARATION: 186.

A course of thirty hours during second term discussing the application of contract and other law to specifications used by the engineer. The course involves a detailed study of the provisions commonly found in engineering specifications from the legal as well as from the engineering point of view.

[Elective in Courses I. and XI., Graduate Year.]

SPECIAL LECTURES.

In addition to the above regular courses of instruction, occasional lectures are given by prominent engineers, in active practice in their profession, upon subjects with which they are especially familiar. Students also have the opportunity to hear many lectures by practising engineers at the meetings of the Society of Arts, and of the Civil Engineering Society.

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 WOODRIDGE, A.M.
Associate Professor of Heating and Ventilation.

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

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

CHARLES F. PARK, S.B.
Associate Professor of Mechanical Engineering.

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

JOSEPH C. RILEY, S.B.
Assistant Professor of Mechanical Engineering.

CHARLES W. BERRY, S.B.
Assistant Professor of Mechanical Engineering.

HARRISON W. HAYWARD, S.B.
Assistant Professor of Applied Mechanics.

Instructors.

WALTER H. JAMES, S.B.
LAWRENCE S. SMITH, S.B.
ROY G. BURNHAM, S.B.
GEORGE W. SWETT, S.B.
THEODORE H. TAFT, S.B.
MYRON W. DOLE, S.B.
ADDISON F. HOLMES, S.B.
WALTER HUMPHREYS, S.B.
IRVING H. COWDREY, S.B.
ROYAL R. HEUTER, S.B.
MALCOLM C. MACKENZIE.

Assistants.

CHARLES E. LEAVITT, S.B.
ROBERT S. GARDNER, S.B.
KENNETH MOLLER, S.B.
JOHN J. THOMAS, S.B.
ELLIOT W. TAYLOR, S.B.
SAMUEL F. HATCH, S.B.
LOYD H. SUTTON, S.B.
ROBERT E. THAYER, S.B.
RUDOLPH B. WEILER, 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 five 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.

Professors Merrill, Haven.

PREPARATION: 30, 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; Mr. James.

PREPARATION: 30, 107, 770, which may be taken simultaneously; 372 (except for Course III.), 373, taken simultaneously.

This course consists of seventy-five lectures and recitations, 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, XIII.]

362. MECHANISM.

Professors Merrill, Park; Mr. James.

PREPARATION: 30; 107; 770; 372 (except for Course X.); 373 taken simultaneously.

A course of sixty lectures and recitations for Course X. and sixty-five for Course VI., extending throughout the year, and similar to course 361.

[REQUIRED IN COURSES VI., X.]

364. MECHANISM.

Professor Merrill; Messrs. Burnham, Swett, Dole, Humphreys.

PREPARATION: 30; 107; 770, which may be taken simultaneously.

Two exercises a week in the first term of the second year or the second term of the third year. A brief course, omitting valve-gears.

[REQUIRED IN COURSES I., VIII., OPTION 3, XI.]

372. MECHANICAL ENGINEERING DRAWING.

Professor Park; Mr. Swett and assistants.

PREPARATION: 360; 361, or 362 taken simultaneously.

This course consists of drawing-room exercises of two to six hours a week during the first term of the second or third 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., III., OPTION 2, VI., X., XIII.]

373. MECHANICAL ENGINEERING DRAWING.

Professor Park; Mr. Swett and assistants.

PREPARATION: 360; 361 or 362, taken simultaneously.

A course of drawing-room exercises of from two to five 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, the Stephenson link, etc. The amount and arrangement of the work vary for the different professional Courses.

[REQUIRED IN COURSES II., III., OPTION 2, VI., X., XIII.]

374. MECHANICAL ENGINEERING DRAWING.

Professor Park; Mr. Mackenzie.

PREPARATION: 107, which may be taken simultaneously.

A course of fifteen two-hour drawing-room exercises in the first term of the second year 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 COURSE VIII., OPTION 3.]

376. MACHINE DRAWING.

Professor Park; Mr. Swett and assistants.

PREPARATION: 372.

A course of drawing-room exercises during the first and second terms of the second year similar to course 377.

[REQUIRED IN COURSE XIII.]

377. MACHINE DRAWING.

Professor Park; Messrs. James, Burnham, Dole and assistants.

PREPARATION: 360, 361, or 362; 373.

This course consists of drawing-room exercises of from four to six hours a week during the first and second terms of the third year. 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 all of this work, in the second term.

[REQUIRED IN COURSES II., III., OPTION 2, VI., X.]

378. MECHANICAL ENGINEERING DRAWING.

Professor Park; Messrs. James, Dole, Cowdrey.

PREPARATION: 70 or 72, taken simultaneously; 377.

This course consists of drawing-room exercises of two 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, quick-return motions, and other mechanism designs; and in the determination of velocity diagrams for special engine or other linkages. It also includes the drawing necessary in connection with the course in steam engineering for Course II. The amount and arrangement of the work are varied for the different professional Courses.

[REQUIRED IN COURSES II., X.]

379. BOILER DRAWING.

Professor Park; Messrs. James, Dole, Cowdrey.

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.]

380. DRAWING DESIGN.

Professor Park; Mr. James.

PREPARATION: 386, 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]

385. STEAM ENGINEERING.

Professors Miller, Riley, Berry.

PREPARATION: 31; 360, 361 or 362; 65 or 67, or 68, 70 or 71 or 72, 376 or 377, 771 taken simultaneously; for Course VIII., Option 3, 31; 364; 771.

The course consists of three lectures or recitations per week in the first term and four in the second term. 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 the different types of gas engine and the method of testing same, of the gas producer, 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. Courses III., Option 2, VI. and X. omit parts of this course.

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

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 Miller.

PREPARATION: 31; 364; 771.

A course of three lectures and recitations a week, extending throughout the fourth year, on valve-gears, steam-engines, power station accessories, thermodynamics, and steam boilers.

[REQUIRED IN COURSES I., XI.]

388. ADVANCED STEAM AND GAS ENGINEERING.

Professors Miller, Riley, Berry.

In cases where the research work of the candidate is such as to require the study and reading of advanced theoretical work upon steam or gas, or of investigations of an advanced character along these lines, such study and reading will be primarily assigned; the amount of any additional study of steam or gas being dependent upon the time required by, and the scope of that necessitated by the research. In cases where the research work is along other lines, a certain amount of such study and reading will be assigned to the candidate.

[ELECTIVE IN COURSE II., GRADUATE YEAR.]

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, ten for Course VI., 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, VI., XIII.]

397. ENGINEERING LABORATORY.

Professors Miller, Riley, Berry; Mr. Taft and assistants.

PREPARATION: 360 or 361 or 362; 385 or 386; 396 (except for Course X.); also for Courses II. and XIII. 331, 401, taken simultaneously; for XIII.A. 401, 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. As Course X. has not had 396, the first four exercises of 397, for Course X. are given to work in engine testing. Courses 639 and 784 are 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.]

399. ENGINEERING LABORATORY.

Professor Miller; Mr. Taft and assistants.

PREPARATION: 330, 387, taken simultaneously.

A course of seven laboratory exercises of two hours each, with ten hours outside calculation, given in the first term of the fourth year.

The time is devoted to testing pumps, water wheels, pulsometers, and other hydraulic machinery, to valve setting, and to work on steam machinery.

[REQUIRED IN COURSE I.]

401. DYNAMICS OF MACHINES.

Professor Lanza; Mr. Smith.

PREPARATION: 385 or 386; 80, which may be 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.]

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.]

406. **MACHINE DESIGN** (Advanced).

Professor Schwamb.

PREPARATION: 404.

This course will be laid out to suit the special needs of the candidate. It may involve the design of a special machine, or piece of apparatus to be used for investigation, or the design of some machine for which experimental investigations are necessary to determine proportions or working stresses for use.

In general, the work will be of a more advanced character than that called for in the undergraduate course.

[ELECTIVE IN COURSE II., 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.]

409. **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 sixty-five lectures in the first term of the third year. 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 20 exercises).]

414. HEATING AND VENTILATION.

Professor Woodbridge.

PREPARATION: 771.

A course of fifteen lectures, given in the second term of the third year (and in the first term of the fourth year in 1908–9) to Course II., and in the second term of the third year to Course XI., on the fundamental features and principles of the subject. See course 413.

[REQUIRED IN COURSES II., OPTIONS 1, 2, 3, 5, XI.]

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 in course 414 and also a study of Heating and Ventilation from the standpoint of hygiene.

[REQUIRED IN COURSE VII., OPTION 2.]

416. HEATING AND VENTILATION.

Professor Woodbridge.

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, 404, 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, 404, 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, 404, taken simultaneously.

A course of lectures, recitations and drawing exercises given thirty-five hours in the first term of the fourth year and seventy-five 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, 404, 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 (at present under the charge of Mrs. Richards); 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.]

424. STEAM TURBINE ENGINEERING.

Professor Peabody; Mr. Everett.

PREPARATION: 80, 331, 401 and 404, taken simultaneously.

A course of lectures, recitations, and drawing exercises given thirty-five hours in the first term of the fourth year, and seventy-five hours in the second term.

The option in Steam Turbine Engineering gives a discussion of the arrangement and construction of various types of steam-turbine and methods of determining sizes and proportions required for the development and distribution of power and to secure sufficient strength and favorable conditions for operation.

[REQUIRED IN COURSE II., OPTION 5.]

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. Henry S. Kolseth, Mr. George H. Martin, and Mr. C. H. Lorimer on Air brakes.

DEPARTMENT OF MINING ENGINEERING AND METALLURGY.

ROBERT H. RICHARDS, S.B., LL.D.
Professor of Mining Engineering and Metallurgy.

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

CHARLES E. LOCKE, S.B.
Assistant Professor of Mining Engineering and Metallurgy.

EDWARD E. BUGBEE, S.B.
Assistant Professor of Mining Engineering and Metallurgy.

Instructors.

CARLE R. HAYWARD, S.B.
RUFUS C. REED, S.B.

Assistants.

LOWRY D. W. BENDER. LEON A. DICKINSON, S.B.
CHARLES A. GIBBONS, JR., S.B.

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 a short course of lectures on mining engineering and metallurgy to introduce the student to his profession, 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. ELEMENTS OF MINING ENGINEERING AND METALLURGY.

Professor Richards.

PREPARATION: 102; 103; 551.

A course of fifteen lectures in the first term of the second year, intended to introduce the students to the main features of the profession of Mining Engineering.

[REQUIRED IN COURSE III.]

432. ASSAYING.

Professor Bugbee; Mr. Reed.

PREPARATION: 840 or 841.

This course consists of lectures and laboratory exercises extending through the first term of the third year, four hours per week. 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 regular assay office in connection with a mine or smelter. The text-book is Lodge, Notes on Assaying and Metallurgical Laboratory Experiments.

[REQUIRED IN COURSE III.]

433. ASSAYING.

Professor Bugbee; Mr. Reed.

PREPARATION: FOR COURSE V., 840 or 841; FOR COURSE VIII., OPTION 3, 551.

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., VIII., OPTION 3.]

435. METALLURGICAL LABORATORY.

Professors Richards, Hofman, Locke, Bugbee; Messrs. Hayward, Reed and assistant.

PREPARATION: 770; 432; 437, 441, 442, 459, taken simultaneously.

A course of laboratory work, eight hours per week for twelve and a half weeks 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 all students except those in Course III., Option 3, devote twelve hours per week to a thesis involving special study of some particular line of work.

[REQUIRED IN COURSE III.]

436. METALLURGICAL LABORATORY.

Professor Hofman; Mr. Hayward and assistant.

PREPARATION: 433; 559; 437, 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, Locke, Bugbee; Messrs. Hayward and Reed.

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 three seminars, which are connected with the work of course 436. Students in Course III., Option 3, take the work only in the first term.

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

441. METALLURGY OF IRON.

Professor Hofman.

PREPARATION: 551.

A series of fifteen lectures in the first term, 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., XIII., XIII.A.]

442. METALLURGY OF NON-FERROUS METALS; GENERAL METALLURGY.

Professor Hofman.

PREPARATION: 559; 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 COURSE III.]

446. ELECTRO-METALLURGY.

Professor Hofman.

PREPARATION: 796; 443.

This course of thirty 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 are taken up in detail; others are outlined. The discussion of a metal is introduced by a brief review of the usual metallurgical treatment.

[REQUIRED IN COURSE VIII., OPTION 3.]

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., Graduate Year.]

452. METALLOGRAPHY.

Professor Hofman; Mr. Hayward and assistant.

Preparation: 771; 441, and for Course III. 781, 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 covered by eight hours in the laboratory.

[Required in Courses III., Options 1, 2, XIII.a.]

453. GENERAL METALLURGY.

Professor Hofman.

Preparation: 452.

A course of fifteen lectures, given in the second term, treating of the physical and chemical properties of metals and their compounds.

[Elective in Course III., Graduate Year.]

454. GENERAL METALLURGY.

Professors Hofman, Bugbee.

Preparation: 453, taken simultaneously.

A laboratory course of forty-five hours in the second term, embodying mostly research-work in the study of the behavior of metals and their compounds when subjected to heating.

[Elective in Course III., Graduate Year.]

455. MINOR METALS.

Professor Hofman.

Preparation: 442.

This course of thirty lectures in the first term deals with the metallurgy of mercury, bismuth, tin, antimony, arsenic, nickel, cobalt, and platinum. The matter is dealt with in a manner similar to that of course 442, which course 455 supplements.

[Elective in Course III., Graduate Year.]

456. METALLURGICAL CALCULATIONS.

Professor Hofman, Mr. Hayward.

Preparation: 441, 442.

A course of thirty exercises in the first term devoted to the solution of metallurgical problems relating mainly to the efficiency of apparatus and processes. The instruction in the class-room is devoted to the discussion of some of the leading calculations and to the criticism of problems solved by the students. Professor J. W. Richards' "Metallurgical Calculations" is used as a book of reference.

[Elective in Course III., Graduate Year.]

457. METALLURGICAL DESIGN.

Professors Hofman, Bugbee; Mr. Hayward.

Preparation: 456.

This course in the second term of one hundred and fifty hours aims to make the student conversant with some construction details of metallurgical plants. It involves the fundamental calculations for a given problem, and the study of detail in working drawings, to be followed by the preparation of drawings of a plant as a whole and of some of the apparatus in detail.

[Elective in Course III., Graduate Year.]

458. MINING ENGINEERING.

Professors Richards, Locke.

Preparation: 300; 770; 840; 771, and for Course III., 68, 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. Course XII. omits second term work.

[Required in Courses III., Options 1, 3 XII.]

459. MINING ENGINEERING.

Professors Richards, Locke.

PREPARATION: 72; 770; 771; 840 or 841; also 80, taken simultaneously for Course III., Options 1, 2.

This course of lectures, three 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. This part of the course in the second term is given by Professor Miller. Course III., Option 2, omits the work of the second term.

[REQUIRED IN COURSE III.]

460. ADVANCED MINING ENGINEERING.

Professors Richards, Locke.

PREPARATION: 458.

This course consists of two lectures per week in the first term and four lectures per week in the second term. It supplements course 458 in that it covers details of subjects omitted in the earlier course on account of lack of time. Particular attention is given to the solving of problems encountered in the different branches of mining.

[ELECTIVE IN COURSE III., GRADUATE YEAR.]

461. ADVANCED ORE-DRESSING.

Professors Richards, Locke.

PREPARATION: 459.

The work consists of reading and conferences on ore-dressing, forty-five hours in the first term and thirty hours in the second. The course may or may not be connected with the design of a plant, according to the subject chosen for a thesis.

[ELECTIVE IN COURSE III., GRADUATE YEAR.]

462. MINING PLANT DESIGN.

Professors Richards, Locke.

PREPARATION: 442; 458; 459.

The course consists of one hundred hours given to lectures, calculation, and design in the second term. Some special conditions for a mine or mill are assumed, and the parts are worked out in detail.

[ELECTIVE IN COURSE III., GRADUATE YEAR.]

465. MEMOIRS.

Professor Hofman.

PREPARATION: 221; 231; 442.

A series of exercises held one hour per 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., OPTIONS 1, 2.]

*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 course on The Influence of Materials on Architecture deals with the methods of construction resulting from the building material used, and the constructive principles involved, in the growth of the great architectural styles. The courses in the History of Architecture afford instruction 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 pencil 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 on page 164.

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 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: 104, 105, 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: 104; 105; 470.

A series of fifteen one-hour exercises in the first 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.]

480. SPECIFICATIONS AND WORKING DRAWINGS.

Professors Chandler, Gardner.

PREPARATION: 100; 101.

A course of ninety hours in the first 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.]

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.

[ELECTIVE IN COURSE IV., GRADUATE YEAR.]

486. INFLUENCE OF MATERIALS ON ARCHITECTURE.

Professor Chandler.

PREPARATION: 480.

A course of fifteen one-hour lectures in the first term of the third and fourth years, given with the aid of the stereopticon. It deals with the methods of construction resulting from the use of materials by the early builders and those of the Middle Ages, and explains how the growth of their architectural styles was due to these causes.

[REQUIRED IN COURSE IV., OPTION 1, FOURTH YEAR, OPTION 2, THIRD YEAR.]

488. BUSINESS RELATIONS, CONTRACTS, ETC.

Professor Chandler.

PREPARATION: 480.

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: 525, 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. HISTORY AND ARCHÆOLOGY; SPECIAL RESEARCH.

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, taken simultaneously.

A course of fifteen one-hour exercises given in the second term of the third year. 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., OPTION 1.]

501. LANDSCAPE HORTICULTURE.

Mr. Jack.

PREPARATION: General Botany.

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.

[ELECTIVE.]

502. LANDSCAPE HORTICULTURE.

Mr. Jack.

PREPARATION: 501.

A course of thirty two-hour lectures and field exercises extending throughout the year.

This course is a continuation of course 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.

[ELECTIVE IN COURSE IV., GRADUATE YEAR.]

515. PEN AND PENCIL.

Mr. Gregg.

PREPARATION: 116.

A course to ensure facility of rendering in pen and pencil 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 PENCIL.

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. ADVANCED PEN-AND-PENCIL 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., OPTION 1.]

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 three-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.

Professors Despradelle, Gardner.

PREPARATION: 100; 101; 470; 116, taken simultaneously.[1]

A course of five hours per week in the first term and eleven in the second term of the second year.

[1] Students otherwise qualified to take the subject may receive the necessary instruction in Shades and Shadows during the first term.

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, taken simultaneously.

A continuation of course 526, given 130 hours during the first term of the third year. 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: 471; 495; 527; 118, taken simultaneously.

A course of twenty-one hours (exercise and preparation) per week during the first term of the fourth year, and twenty-eight hours per week during the second term, forming a continuation of the preceding course, 527. The second term is devoted largely 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.

A course in elementary architectural construction of six hours per week during 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 in 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 twenty hours per week during the first term and twenty-nine 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.

[ELECTIVE.]

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 and eighteen in the second.

[ELECTIVE IN COURSE IV., GRADUATE YEAR.]

542. LANDSCAPE ARCHITECTURE.

Mr. Lowell.

PREPARATION: 540.

One hour a week through the year. Lectures and problems in Landscape Design, with special reference to the intimate association of architectural and landscape problems.

[ELECTIVE IN COURSE IV., GRADUATE YEAR.]

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.
Professor of Analytical Chemistry.

AUGUSTUS H. GILL, PH.D.
Associate Professor of Technical Analysis.

WILLIS R. WHITNEY, PH.D.
Non-resident Professor of Chemical Research.

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

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 Organic Chemical Research.

MILES S. SHERRILL, PH.D.
Assistant Professor of Theoretical Chemistry.

ALPHEUS G. WOODMAN, S.B.
Assistant Professor of Food Analysis.

ARTHUR A. BLANCHARD, 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.
WILLIAM T. HALL, S.B.
FREDERICK R. KNEELAND, S.B.
CHARLES FIELD, 3rd, S.B.
RICHARD C. TOLMAN, S.B.
ROBERT S. WILLIAMS, PH.D.
ELLWOOD B. SPEAR, PH.D.

Assistants.

PAUL S. FISKE, A.B.
CARLETON B. NICKERSON, A.M.
OCTAVUS L. PEABODY, S.B.
ALFRED B. BABCOCK, S.B.
HARRY S. CHANDLER, S.B.
CLARENCE W. CLARK, S.B.
WILLIAM H. TOPPAN, S.B.
CHESNEY H. CRISWELL, S.B.
ARTHUR T. HINCKLEY, S.B.
RUFUS W. G. WINT, 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, Blanchard; Messrs. Burns, Phelan, Spear, 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.

Text-books: Smith, Outlines of Inorganic Chemistry for Colleges; Talbot and Blanchard, Electrolytic Dissociation Theory. Reference books: Holleman-Cooper, Text-book of Inorganic Chemistry; Jones, Principles of Inorganic Chemistry; Smith, A Laboratory Outline of General Chemistry.

[REQUIRED IN ALL COURSES.]

551. INORGANIC CHEMISTRY.

Professors Talbot, Pope, Bardwell, Blanchard; Messrs. Burns, Phelan, 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. The laboratory instruction includes practice in the methods of synthetic inorganic chemistry in the case of those students who continue chemical subjects in the later years, while the students in the other Engineering Courses devote the time to the study of certain applications of Chemistry to engineering practice 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.

Laboratory notes for use in this course have been prepared by Professor Bardwell and Dr. Blanchard. Reference books as under course 550, as well as works on Qualitative Analysis.

[REQUIRED IN ALL COURSES EXCEPT IV.]

552. QUALITATIVE ANALYSIS.

Professors Fay, Thorp; Messrs. Kneeland, Williams, and assistants.

PREPARATION: 6; 7; 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; Dr. Bray.

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 rarer metals.

[ELECTIVE IN COURSE V., GRADUATE YEAR.]

558. QUANTITATIVE ANALYSIS.

Professors Fay, Thorp; Messrs. Kneeland, Williams, 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; Mr. Hall and assistants.

Preparation: 558; 221 or 231.

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, ores, and industrial products 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. The time spent in the laboratory varies in the professional Courses, and the assignment and arrangement of work are adapted to the special needs of the student. Courses VIII., Options 1, 3, and X. take the work of the first term only, and for Course III., Options 1 and 2, the course extends into the fourth year.

[Required in Courses III., V., VIII., Option 3, X. Elective in Course VIII., Option 1.]

560. SPECIAL ANALYTICAL METHODS.

Professor Gill; Mrs. Richards and assistant.

PREPARATION: 559.

A course consisting mainly of laboratory practice in typical methods of water analysis and gas analysis, and, so far as the time permits, the study of procedures applicable to the proximate technical analysis of industrial products.

[REQUIRED IN COURSE X.]

561. INORGANIC CHEMISTRY.

Professor Fay.

PREPARATION: 558.

In this course of thirty lectures, given in the first term of the fourth 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. WATER ANALYSIS.

Mrs. Richards.

PREPARATION: 558.

This course of thirty hours, lectures and laboratory practice in the third or fourth year, deals with chemical methods used in the analysis of potable waters and in the tests of methods of sewage purification. The text-books used are Richards and Woodman, Air, Water and Food from a Sanitary Standpoint, and Standard Methods of the Committee of the American Public Health Association.

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

567. INDUSTRIAL WATER ANALYSIS.

Mrs. Richards.

PREPARATION: 558.

A course of thirty hours, lectures and laboratory practice given in the second term of the third year is intended to illustrate the application of Chemistry to problems of municipal water supplies and their relation to various industries.

[REQUIRED IN COURSE XI.]

568. WATER ANALYSIS AND WATER SUPPLIES.

Mrs. Richards.

PREPARATION: 567.

A course in the first term of the fourth year, consisting of fifteen lectures upon the chemical problems connected with potable water supplies, accompanied by thirty hours of laboratory practice in the methods of sanitary water analysis.

[REQUIRED IN COURSE XI.]

569. AIR ANALYSIS.

Mrs. Richards.

PREPARATION: 558.

A fifteen-hour course of laboratory instruction, given in the first term of the third year and in the first and second terms of the fourth year, upon the methods employed to test the air of public buildings to determine the efficiency of ventilation systems.

[REQUIRED IN COURSES V., OPTIONS 2, 3, VII. AND XI.]

570. FOOD ANALYSIS.

Professor Woodman.

PREPARATION: 558.

A course of forty-five hours of lectures and laboratory exercise in the third or fourth year, designed to introduce the student to the methods generally employed in determining the character, purity and nutritive value of common food materials. The extent, character and legal status of food adulteration is discussed, and analyses made of typical food products.

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

573. SUGAR ANALYSIS.

Mr. Rolfe.

PREPARATION: 558.

This laboratory course, given two hours per week for ten weeks in the fourth 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 or 592, 610, 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, including 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.

Professor Walker and assistants.

PREPARATION: 559; 580, which may be taken simultaneously.

A course of one hundred and five hours' laboratory practice (seventy-five hours for Course VIII., Option 3) 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., OPTION 2, X. OPTIONAL IN COURSE VIII., OPTION 3.]

583. **CHEMICAL ENGINEERING.**

Professor Walker.

PREPARATION: 580; 582.

In this course are considered the principles on which the more important mechanical operations involved in the chemical manufacturing industries depend, together with a study of the types of apparatus available for such operations, and the kind of work for which each is best adapted. The design and construction of chemical plants are considered with special reference to the chemical resistance of the materials employed. The course is designed to supplement courses 580 and 582.

[ELECTIVE IN COURSE X., GRADUATE YEAR.]

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., XI.]

592. **ORGANIC CHEMISTRY.**

Professor Mulliken.

PREPARATION: 559; for Course V. 610, which may be taken simultaneously.

A course of three lectures and one recitation a week throughout the second term of the third year, and two lectures a week in the first term of 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.

[REQUIRED IN COURSES V., X.]

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. OMITTED IN 1908–1909.]

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 CHEMICAL LABORATORY: PREPARATIONS, REACTIONS, AND ANALYSES.

Professor Moore; Mr. Field, and assistant.

PREPARATION: 559; 592, taken simultaneously.

In this course, given eight hours a week in the second term of the third year and ten hours a week in the first term of the fourth year (six in both terms for Course X.), 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. The instruction in this course also includes qualitative tests for all the important elements occurring in organic compounds, and quantitative determinations of carbon, hydrogen, nitrogen, and the halogens.

[REQUIRED IN COURSES V., X.]

599. **ORGANIC CHEMICAL LABORATORY.**

Professor Moore; Mr. Field, and assistant.

PREPARATION: 558; 590.

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., VIII., OPTIONS 1, 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.**

Professors Lewis, Sherrill.

PREPARATON: 30, and 31 or 32; 552; 771, which may be taken simultaneously.

In this course, which consists of forty-five exercises in the first term and thirty in the second, only the more important principles of Theoretical Chemistry are considered; but these are treated with great thoroughness, and are illustrated by applying them to a variety of problems, which the members of the class are required to solve. To the discussion of these problems a large part of the time is devoted, the aim being to develop power to deal with physico-chemical questions rather than merely to impart a knowledge of the phenomena. The principles are further illustrated by lecture experiments. The subjects considered most fully in the course are the pressure-volume relations of gases and solutions, the other properties from which molecular and atomic weights may be derived, the electrical properties of solutions, the ionic theory, the laws of the rate and equilibrium of chemical reactions, the first and second laws of energy in their application to chemical changes, and the production of heat and work by such changes.

[REQUIRED IN COURSES V., VII., (1st term), VIII., X., XII.]

613. ELECTRO-CHEMISTRY.

Professor Goodwin.

PREPARATION: 610.

This course of fifteen exercises given in the second term of the third year follows immediately after course 610, and treats of those parts of the subject not previously discussed in the latter course. The topics discussed are the production of electrical energy by chemical processes, the electro-motive force of voltaic cells, separate potential differences, decomposition potentials, electrolysis, and other related subjects. Le Blanc's Electro-chemistry is used as a text-book.

[REQUIRED IN COURSES V., OPTIONS 2, 3, X.]

618. THEORETICAL CHEMISTRY (Brief Course).

Professor Sherrill.

PREPARATION: 551; 770, which may be taken simultaneously.

In this course, consisting of thirty lectures and recitations, the subject of Theoretical Chemistry is presented in a much briefer form than in course 610. 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. The lectures are illustrated by experiments.

[REQUIRED IN COURSE III.]

619. THEORETICAL CHEMISTRY (Laboratory).

Professor Sherrill; Mr. Tolman and assistants.

PREPARATION: 610; 613, taken simultaneously.

This course consists of a series of laboratory exercises held throughout the year in connection with courses 610 and 613. It is intended to illustrate the methods of determining molecular weight, the important properties of solutions, the application of the principles relating to chemical reaction-velocity and equilibrium, and the fundamental conceptions of Thermo-chemistry and Electro-chemistry. Its primary purpose is to emphasize the principles of the subject, rather than to teach physico-chemical methods of measurement. (See course 610).

[REQUIRED IN COURSES V., X.]

620. ADVANCED THEORETICAL CHEMISTRY.

Professor Noyes.

PREPARATION: 610; 613.

This course is intended primarily 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 COURSES V., OPTION 1, VIII., OPTION 1. ELECTIVE FOR GRADUATE STUDENTS.]

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.]

624. ADVANCED ORGANIC CHEMISTRY.

Professor Moore.

PREPARATION: 592 or equivalent.

This course is designed for those wishing to pursue the study of special chapters in Organic Chemistry further than is practicable in connection with 592. The work will consist of weekly conferences and the subjects discussed will be selected to meet the needs of those taking the course. The course will be given only when elected by three or more students.

[ELECTIVE IN COURSES V., X., 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.

Text-book: Gill, Handbook of Oil Analysis.

[ELECTIVE.]

629. PROXIMATE TECHNICAL ANALYSIS.

Professor Gill and assistants.

PREPARATION: 221 or 231; 559; 580; 590 or 592.

A course of fifteen six-hour exercises of conference and laboratory work given in the first or second 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, 3.]

630. TEXTILE COLORING.

Professor Thorp and assistants.

PREPARATION: 590 or 592.

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 COURSE V., OPTION 2b.]

635. ANALYTICAL AND TECHNICAL CHEMISTRY.

Professors Gill, Moore and assistants.

PREPARATION: 551, except for Course XIII.A.

This course comprises thirty lectures during the first term, and six 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.]

638. GAS ANALYSIS.

Professor Gill and assistants.

PREPARATION: 558.

A course of five lectures and fifteen hours of laboratory work, embracing the qualitative and quantitative analysis of the various gases, the technical analysis of commonly occurring gaseous mixtures, such as illuminating and fuel gas, gases from acid chambers, and chimney gas, and the consideration of the losses due to waste gases. The text-book is Gill, Gas and Fuel Analysis for Engineers.

[REQUIRED IN COURSES V., VIII., OPTIONS 1a, 3.]

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. Given in connection with Engineering Laboratory, 397.

[REQUIRED IN COURSES II., VI., XIII.]

640. APPLIED CHEMISTRY.

Professor Gill.

PREPARATION: 551.

The course deals with the properties, testing, and applications of paints, oils, varnishes, lubricants and wood preservatives; with boiler scale and corrosion and bearing metals.

[REQUIRED IN COURSE XIII.]

645. HISTORY OF CHEMISTRY.

Professor Moore.

PREPARATION: 592; 610.

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 Talbot and members of the Instructing Staff.

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.]

648. THESIS REPORTS AND MEMOIRS.

Professor Walker, and members of the Instructing Staff.

A series of thirty exercises, a part of which are of the same nature as 647. In addition, each student is assigned several topics in applied chemistry upon which memoirs are prepared and presented for discussion before the class, and members of the Instructing Staff. In these papers the student is required to present the subjects as completely and critically as is practicable, and to supplement them by experiments, drawings, or tabulated statistics.

[REQUIRED IN COURSE X.]

649. ADVANCED FOOD ANALYSIS.

Professor 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.

[COURSE V., OPTION 3.]

SPECIAL LECTURES.

During the next year, in addition to the regular courses, it is planned to have special lectures given by the persons named below.

Mr. Arthur D. Little, consulting chemist, upon Cellulose, and the Manufacture of Paper; Mr. James W. Loveland, superintendent with B. T. Babbitt, upon the Manufacture of Soap and Glycerine; Mr. S. W. Wilder, Jr., General Manager of the Merrimac Chemical Company, upon Alumina and Alumina Compounds; and Mr. M. C. Whitaker, superintendent of the Welsbach Light Company, upon Factory Organization and Management.

RESEARCH LABORATORY OF PHYSICAL CHEMISTRY.

GILBERT N. LEWIS, PH.D.
Associate Professor of Physico-chemical Research; Acting Director of the Research Laboratory of Physical Chemistry.

ARTHUR A. NOYES, PH.D., LL.D.
Professor of Theoretical Chemistry.

Research Associates.

ARTHUR C. MELCHER, S.B.
ROY D. MAILEY, S.B.
WILLIAM C. BRAY, PH.D.
CHARLES A. KRAUS, PH.D.

Research Assistant.

ROGER D. GALE, S.B.

Most of the courses in physical-chemistry and related subjects are given in the Chemical and Physical Departments and will be found described under Nos. 610, 613, 618, 619, 620, 796, 799, 803, 829, and 830. 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. The following will be offered in 1908–1909.

THE RELATIONS BETWEEN PHYSICAL PROPERTIES AND CHEMICAL CONSTITUTION (Seminar).

Professor Noyes.

PREPARATION: 610.

This seminar, which will meet once a week throughout the second term, will deal with the correlation of the physical characteristics of substances with their chemical constitution. The experimental methods used in determining the various physical constants will also receive consideration. Familiarity with the applications of the principles to concrete cases will be secured by the solution of numerous problems.

THE PHASE RULE AND ITS APPLICATIONS (Seminar).

Dr. Bray.

PREPARATION: 610.

In this seminar, which will meet once a week during the first term, a number of typical examples of the application of the phase rule will be discussed. Findlay's text-book will be read, and other reading will be assigned to supplement it. Members will also be expected to solve problems in connection with the course.

ELEMENTARY THERMODYNAMICS (Seminar.)

Professor Lewis.

PREPARATION: 610.

In this seminar, which will meet once a week throughout the first term, the important equations of chemical thermodynamics will be systematically surveyed. The treatment will be elementary, but will be based upon certain new conceptions. Problems and reading will be assigned.

RESEARCH CONFERENCES.

Professors Noyes, Lewis.

Weekly conferences are held for the discussion of the researches in progress in the laboratory in order that each student may keep in close touch with all the work that is being carried on there.

PHYSICO-CHEMICAL COLLOQUIUM.

Professor Lewis.

An evening meeting will be held once a fortnight for a discussion of the problems of theoretical chemistry. Each meeting will be devoted to a single topic, and the discussion will be opened by one of the members of the colloquium in a general review of the subject.

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.

Dugald C. Jackson, C.E.
Professor of Electrical Engineering.

Harry E. Clifford, S.B.
Professor of Theoretical and Applied Electricity.

Frank A. Laws, S.B.
Associate Professor of Electrical Testing.

Ralph R. Lawrence, S.B.
Associate Professor of Electrical Engineering.

Harrison W. Smith, A.B., S.B.
Associate Professor of Electrical Engineering.

George C. Shaad, S.B., E.E.
Associate Professor of Electrical Engineering.

Instructors.

Charles H. Porter, A.B., S.B. Harold G. Crane, S.B.
Waldo V. Lyon, S.B.

Assistants.

Charles W. Green, B.S. Clarence C. Knipmeyer, B.S.
Ralph G. Hudson, S.B. George B. Thomas, E.E.
Evie J. Edwards, 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 throughout 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 affords opportunity for graduate students to carry out original investigations.

Journal meetings, in which abstracts of important engineering papers are presented by the students and then discussed, keep 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. **ALTERNATING CURRENT MACHINERY.**

Professor Clifford; Mr. Porter.

PREPARATION: 656.

This course of lectures and recitations, extending throughout the fourth year, is devoted to a careful discussion of the various types of alternating current machinery for the generation, transmission, and distribution of power. The special properties of each machine are considered, for the machine as a unit, and when it is used as a part of any electrical system. Some of the general considerations concerning long-distance power transmission are also included.

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

652. **ALTERNATING CURRENTS (Advanced).**

Professor Clifford.

The work of this graduate course, three hours per week during the year, is concerned chiefly with the transmission of power.

[ELECTIVE IN COURSE VI., GRADUATE YEAR.]

653. **ELEMENTS OF ELECTRICAL ENGINEERING.**

Professor Smith.

PREPARATION: 770.

A course of thirty lectures during the second term in which are considered the fundamental principles of the generation, distribution, and utilization of electrical energy.

[REQUIRED IN COURSES II., X.]

655. ELEMENTS OF ELECTRICAL ENGINEERING.

Professors Clifford and Smith; Messrs. Porter and Lyon.

PREPARATION: 30, 31, 770.

This course of sixty lectures and recitations given in the first term of the third year and fifteen given in the second term of the third year is devoted to the fundamental principles of Electrical Engineering. It includes a discussion of the laws and properties of electric and magnetic circuits, followed by an introduction to the study of variable currents and a treatment of the principles of direct current machinery. The solution of problems illustrating the engineering principles involved forms an important part of the instruction. The latter part of the course is devoted to the theory of direct current dynamos and the principles involved in their testing. The course is an introduction to the work in the dynamo electric laboratory.

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

656. ALTERNATING CURRENTS.

Professor Clifford; Messrs. Porter and Lyon.

PREPARATION: 655.

This course, of forty-five lectures and recitations, given in the second term of the third year, concerns itself with the general theory of alternating current circuits, and the application of the principles to various engineering problems. In connection with the work, considerable importance is attached to the solution of problems selected with reference to their engineering application.

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

657. ELECTRICAL ENGINEERING.

Professor Shaad.

PREPARATION: 655; 650, taken simultaneously.

A course of ninety lectures and recitations (seventy-five for Course VIII.), extending throughout the fourth year, devoted to a study of the principles involved and the methods used in the design of transmission and distribution systems, and the engineering features of the application of machinery and apparatus to light and power installations.

[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 or fourth 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 Courses I., III., VIII., Options 1, 2, X.]

662. DYNAMO ELECTRIC MACHINERY.

Professor Smith.

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. ELECTRIC LIGHT AND TRANSMISSION OF POWER.

Professor Jackson.

Preparation: 657, taken simultaneously.

Thirty lectures and quizzes per term during the fourth year, on the problems of electric lighting and the electric transmission of power.

[Required in Course VI.]

667. PRINCIPLES OF DYNAMO DESIGN.

Professor Derr.

Preparation: 650; 657.

A course of twenty exercises in the second 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 exercises in the first term forming a continuation of the preceding course and devoted to the design of electrical machinery, including the electrical and magnetic calculations.

[Elective in Course VI., Graduate Year.]

671. TELEPHONY.

Professor Cross.

Preparation: 656.

This course of ten 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. Omitted in 1908–1909.]

672. TELEPHONE ENGINEERING.

Professor Jackson.

Preparation: 671, taken simultaneously.

A course of fifteen lectures in the second term of the fourth year, discussing the design and construction of aërial and underground transmission lines, traffic problems, and something on the economics of telephone engineering.

[Required in Course VI. Omitted in 1908–1909.]

673. JOURNAL MEETINGS AND ENGINEERING EXCURSIONS.

During each term of the fourth year excursions are arranged to typical electrical installations, in Boston and vicinity, and formal reports on such inspection trips are required. These reports are criticised by both the English Department and the Department of Electrical Engineering.

Once each month a meeting of the students and the department instructors is held, for the purpose of considering the more important articles appearing in the current electrical journals. Abstracts of these articles are prepared and read by the students, and their reading is followed by a general discussion.

[Required in Course VI.]

679. DESIGN OF STATIONS AND DISTRIBUTION SYSTEMS.

Professor Shaad.

This course covers the design and estimates for a complete central station and distributing system.

[Elective in Course VI., Graduate Year.]

680. ELECTRICAL ENGINEERING.

Professor Shaad.

This course of fifteen lectures, given in the second term of the graduate year, deals with electrical installations, with special reference to navy yards and warships.

[REQUIRED IN COURSE XIII.A.]

683. ELEMENTS OF ELECTRICAL ENGINEERING.

Professors Laws, Smith.

PREPARATION: 653.

A course of thirty lectures and recitations in the first term of the fourth year, on technical electrical measurements and methods, followed by a discussion of electric installations.

[REQUIRED IN COURSE II. OMITTED IN 1908–1909.]

685. TECHNICAL ELECTRICAL MEASUREMENTS.

Professor Laws.

PREPARATION: 779; for Course VI. 686, taken simultaneously.

A course of thirty lectures and recitations in the second term of the third year, and for Course VI. ten in the first term of the fourth year. It is devoted to a detailed study of the various measuring instruments used in technical work, special attention being given to questions of accuracy and possible sources of error. In the latter part of the course the various alternating current instruments and methods which are of particular importance in station practice are considered.

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

686. STANDARDIZING LABORATORY.

Professor Laws and assistants.

PREPARATION: 656; for Course VI., 685, taken simultaneously.

In this laboratory course in the second term of the third year and the first term of the fourth year, particular attention is given to tests to determine the character and behavior of the materials of Electrical Engineering under various circumstances and 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 Alternating Currents.

[REQUIRED IN COURSES VI., VIII.]

687. ELECTRICAL TESTING (Advanced).

Professor Laws.

This is an advanced laboratory course of five to ten 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.]

688. ELEMENTARY TECHNICAL ELECTRICAL MEASUREMENTS.

Professor Laws.

A course of ten lectures and five laboratory exercises given in the first term of the graduate year. The course is designed to familiarize the student with the most important electrical instruments and methods of measurement.

[ELECTIVE IN COURSE III., GRADUATE YEAR.]

689. STANDARDIZING LABORATORY.

Professor Laws and assistants.

A course of twenty laboratory exercises in the senior year, 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.]

690. ELECTRICAL ENGINEERING LABORATORY.

Professor Laws and assistants.

PREPARATION: 653; 683, taken simultaneously.

A course of laboratory exercises in the second term of the third year, designed to familiarize the student with the elements of technical electrical measurements.

691. ELECTRICAL ENGINEERING LABORATORY.

Professor Smith and assistants.

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 conferences.

[REQUIRED IN COURSES VIII., OPTION 1b, X.]

692. ELECTRICAL ENGINEERING LABORATORY.

Professor Lawrence; Mr. Crane and assistants.

PREPARATION: 655, 778, 779 (except for Course VIII., Option 1b).

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. The preliminary reports submitted by students before performing any experiment in the laboratory are prepared in the class-room at times specially assigned for this work.

[REQUIRED IN COURSES VI., VIII., OPTIONS 1b, 3.]

693. ELECTRICAL ENGINEERING LABORATORY.

Professor Lawrence; Mr. Crane and assistants.

PREPARATION: 692; 650, 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 with conferences.

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

694. ELECTRICAL ENGINEERING LABORATORY.

Professors Clifford, Lawrence, and assistants.

The work in this course is arranged each year in accordance with the requirements of the individual student. It occupies seventy hours in the graduate year.

[REQUIRED IN COURSE XIII.A.]

696. ELECTRICAL ENGINEERING LABORATORY.

Professors Clifford, Lawrence, and assistants.

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.]

697. **ELECTRICAL ENGINEERING (Seminar).**

Professors Jackson and Clifford.

A series of conferences of all men pursuing graduate work in the branches relating to Electrical Engineering, for the purpose of studying the trend of contemporary advance in the art and its relations to historical development. Continued through the year.

[ELECTIVE IN COURSE VI., GRADUATE YEAR.]

698. **ORGANIZATION AND ADMINISTRATION OF PUBLIC SERVICE COMPANIES.**

Professor Jackson.

Three hours of lectures or conference per week through the year, accompanied by extensive assigned reading and examination of operating records. The course will treat of the relations of public service companies to the governments and to the people, the methods of organizing public service companies and the legitimate expenses entering into the cost of organization, their management viewed especially from the commercial aspect, and the legitimate functions of such companies. Certain aspects of the subject will be treated by the Department of Economics, particularly from the point of view of public interest.

[ELECTIVE IN COURSE VI., GRADUATE YEAR.]

699. **POWER AND ITS TRANSFORMATIONS.**

Professor Jackson.

Five lectures to second-year students, introductory to applied mechanics.

[REQUIRED IN COURSE VI.]

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.

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 Sanitary Biology.

EARLE B. PHELPS, S.B.
Research Assistant Professor of Chemical Biology.

Instructors.

ROBERT P. BIGELOW, 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 Vertebrate and

Comparative Anatomy gives practice in the dissection of the lower animals. More exact and more minute laboratory practice is obtained in the courses in Bacteriology and Protozoölogy in the third year, and in Industrial Biology and Comparative Physiology, etc., 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 advanced 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 more 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 Chemistry, Sanitary Engineering, and Geology.

[REQUIRED IN COURSE V., OPTIONS 2, 3, XI., XII.]

704. THEORETICAL BIOLOGY.

Professor Winslow, Dr. Woods.

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, taken simultaneously.

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 longer courses in Botany and Zoölogy, this shorter course is devoted to a practical study of the most important groups of organisms, the major types of plants and animals, especially such as occur in reservoirs or other portions of public water supplies. This work is a prerequisite for the fourth-year course in the Microscopical Analysis of Water and Sewage (711).

[REQUIRED IN COURSES V., OPTIONS 2, 3, XI.]

711. MICROSCOPICAL ANALYSIS OF WATER AND SEWAGE.

Professor Winslow.

PREPARATION: 700 or 701; 709 or 716, except for Course V.

This course of two exercises per week in the second term of the third and fourth years 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.

Professors Sedgwick and Winslow.

PREPARATION: 700 or 701.

A synoptic course of three hours per week in the second term, the time being divided about equally between lectures, 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 groups. Special stress is laid upon the economic aspects of the subject, and parasites, shell fish, and certain 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 Botany (735) be added—furnish a sound elementary knowledge of the principal classes of the living world.

[REQUIRED IN COURSES VII., XII.]

717. VERTEBRATE ANATOMY.

Dr. Bigelow.

PREPARATION: 716.

Six exercises a week in the second term of the third year. A course in Comparative Anatomy in which attention is concentrated upon the highest (vertebrated) animals, and especially upon Mammalian Anatomy. Intended partly as a preparation for General Physiology, and partly as an illustration of the anatomical evidence underlying the theory of organic evolution.

[REQUIRED IN COURSE VII.]

719. **COMPARATIVE ANATOMY.**

Dr. Bigelow.

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 all the principal groups of animals. 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 four laboratory hours a week in the first term of the third year.

[OPTIONAL IN COURSE VII.]

720. **ANTHROPOLOGY.**

Professor Winslow.

PREPARATION: 716.

This course consists of fifteen lectures in the second 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. Bigelow.

PREPARATION: 717, taken simultaneously.

A course of lectures and recitations, accompanied by laboratory practice, four hours a week during 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.]

723. EMBRYOLOGY.

Dr. Bigelow.

PREPARATION: 717.

Four hours a week of lectures and laboratory work in the second term, third year, in the elements of embryology, especially of vertebrates. The chick and the frog will be the forms principally considered.

[OPTIONAL IN COURSE VII.]

724. PROTOZOÖLOGY.

Dr. Bigelow.

PREPARATION: 744.

Two hours a week in the first term of the fourth year. A course of lectures and detailed laboratory work upon the lowest (unicellular) animals which of recent years have become highly important, especially in the sanitation of tropical countries. A complement to the courses in Bacteriology, which deal with some of the lowest forms of plant life.

[REQUIRED IN COURSE VII.]

725. GENERAL PHYSIOLOGY.

Dr. Stiles.

PREPARATION: 717.

Four hours weekly in the second term of the third year. Lectures and recitations upon the general principles of the physiology of protoplasms, with special emphasis upon cellular physiology. To be taken simultaneously with 728 (Physiological Laboratory).

[REQUIRED IN COURSE VII.]

726. PHYSIOLOGICAL LABORATORY (General).

Dr. Stiles.

PREPARATION: 717.

Three hours a week in the second term of the third year. An introduction to the whole subject, accompanying course 725.

[REQUIRED IN COURSE VII.]

727. COMPARATIVE PHYSIOLOGY.

Dr. Stiles.

PREPARATION: 726.

A course of five hours per week in the first term of 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., Option 1.]

728. PHYSIOLOGICAL LABORATORY.

Dr. Stiles.

Preparation: 717.

A course of thirty 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., Option 1.]

729. PERSONAL HYGIENE.

Dr. Stiles.

Preparation: 725.

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 an advanced discussion of such topics as the choice of foods, the effects of good and bad air upon the body, muscular activity, fatigue, sleep, est, recreation, the care of the eyes and other sense organs, bathing and baths, he dangers of the sedentary life, and similar subjects.

[Required in Coupse VII.]

734. EXPERIMENTAL ZOÖLOGY.

Dr. Bigelow.

Preparation: 723; 727.

Six hours a week in the second term, fourth year, of lectures, recitations, and laboratory work upon the most recent aspects of the subject as now pursued in Germany and America.

[Required in Course VII., Option 1.]

735. CRYPTOGAMIC BOTANY.

Professor Prescott.

Preparation: 700.

A course of two hours lectures and three 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.

Professor Sedgwick.

PREPARATION: 735.

A series of lectures and recitations, 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 Comparative 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 1.]

744. GENERAL BACTERIOLOGY.

Professor Prescott.

PREPARATION: 700 or 701.

A thorough course, four exercises a week (five for Course VII.) during one term in the third year, 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.]

745. BIOLOGY OF INFECTIOUS DISEASES.

Professor Sedgwick.

PREPARATION: 717; 722; 725.

Lectures and recitations, two hours a week, in the first term of the fourth year, on the biological characteristics of trichinosis, typhoid fever, tuberculosis, Asiatic cholera, and some other infectious diseases of special interest to the sanitarian.

[REQUIRED IN COURSE VII.]

746. **INDUSTRIAL BIOLOGY.**

Professor Prescott.

PREPARATION: 590 or 592; 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, taken simultaneously.

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 and theoretical problems in Chemistry, Biology and Hygiene.

[REQUIRED IN COURSE VII.]

748. **BACTERIOLOGY OF WATER AND SEWAGE.**

Professor Winslow.

PREPARATION: 744.

A course of two hours a week in the second term of the third year (for Course VII.) and in the first term of the fourth year (for Courses V., XI.), divided equally between lectures, recitations, and laboratory practice.

The course in General Bacteriology (744) is here supplemented and extended for those students of 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, XI.]

749. **CHEMICAL BIOLOGY.**

Professor Phelps.

PREPARATION: 610 (first term).

Lectures and recitations two hours a week in the second term of the fourth year. A discussion of the application of the principles of Physical Chemistry to biological phenomena, supplemented by a course of reading and reports by the student

[REQUIRED IN COURSE VII.]

750. RESEARCH SEMINAR (1).

Professor Sedgwick; Drs. Stiles, Bigelow.

PREPARATION: 727.

A meeting of the instructors and advanced students in the second term of the fourth year of the Course in Biology (Option 1) for the discussion of recent progress in Physiology and Zoölogy, and for the presentation of original and critical papers in these subjects.

751. RESEARCH SEMINAR (2).

Professors Sedgwick, Prescott, Winslow.

PREPARATION: 757.

A meeting of the instructors and advanced students in the second term of the fourth year of the Course in Biology (Option 2) for the discussion of recent progress in Sanitary Science and Public Health topics, and for the presentation of original and critical papers in these subjects.

752. INDUSTRIAL HYGIENE AND SANITATION.

Professor Winslow.

PREPARATION: 757.

Lectures and recitations twice a week in the second term of the fourth year. The course covers the effect of industries upon health and the principles involved in the safeguarding of employees, school children, and others in respect to hygiene and sanitation under the actual conditions of American factory and school life.

[ELECTIVE IN COURSE VII.]

753. MUNICIPAL SANITATION.

Professor 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 furnish unusual opportunities for research and demonstration in connection with this course.

[REQUIRED IN COURSES VII., OPTION 2, XI.]

754. PRINCIPLES OF SANITARY SCIENCE AND PUBLIC HEALTH.

Professor Sedgwick.

Fifteen general lectures (richly 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 qualify mature students to meet the increasing demand for trained assistants in the various State and municipal laboratories already established, or rapidly coming into existence in the United States, instruction is supplied in some of the more important methods employed in such laboratories. The course, given in the second term of the fourth 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, etc. Some time is also devoted to the theory of immunity and the results of serum-therapy and vaccination.

[REQUIRED IN COURSE VII., OPTION 2.]

756. SANITATION OF SHIPS.

Professor Sedgwick.

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.]

757. PUBLIC HEALTH PROBLEMS.

Professor Sedgwick.

PREPARATION: 755.

Thirty lectures, given once a week throughout the year to senior students of Sanitary Science. 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., OPTION 2.]

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.]

759. PUBLIC HEALTH LABORATORY PRACTICE.

Mr. Rickards.

PREPARATION: 744; 755.

Special instruction in the methods employed in Board of Health Laboratories, with constant laboratory practice. Designed for special students wishing to perfect themselves in public health laboratory technique.

[ELECTIVE.]

760. SANITATION OF HOUSES AND PUBLIC BUILDINGS.

Professor Sedgwick.

PREPARATION: 754; 757; 758.

One lecture weekly in the second term upon the application to actual practice of the principles of the hygiene of heating and ventilation (758) with special emphasis upon matters of administration and control and the criticism of current practice.

[ELECTIVE IN COURSES VII., XI., GRADUATE YEAR.]

761. HISTORY OF SCIENCE.

Professors Sedgwick, Tyler.

A course of forty-five lectures, one hour a week throughout the first term of the third year and two hours a week during the second term. The course will consist of a 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 be given of some of the greater workers—such as Pythagoras, Archimedes, Aristotle, Euclid, Roger Bacon, Leonardo, Copernicus, Galileo, Newton, Laplace, Lyell, Darwin and Pasteur—in connection with the discussion 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 consist of lectures and assigned reading and considerable illustrative material will be used.

[ELECTIVE.]

762. DAIRY BACTERIOLOGY.

Professor Prescott.

PREPARATION: 746; 747; 753; 755.

Six hours weekly in the first term consisting of lectures, laboratory work, conferences and field work upon one or more special problems of the milk industries and especially upon the milk supply of large cities. The student will be expected to make personal investigations and critical studies of different systems of supply, such for example as those of individuals, small companies and large contractors; of bacteriological and sanitary control and practice in different cities and different countries; of the pasteurization problem; the inspection problem, transportation, distribution, condensing, concentrating, refrigerating, etc.

[ELECTIVE IN COURSE VII., GRADUATE YEAR.]

763. BACTERIOLOGY OF THE FERMENTATION INDUSTRIES.

Professor Prescott.

PREPARATION: 746; 747.

Four hours weekly in the first term, consisting of lectures, laboratory work and conferences, applied to the investigation of selected problems in some branch of the fermentation industries, such for example as the development or improvement of methods employed in the manufacture of alcohol, lactic acid or other products of bacterial activity. Actual personal studies in the field will be expected, and upon these reports must be submitted for criticism and advice.

[ELECTIVE IN COURSE VII., GRADUATE YEAR.]

764. JOURNALS.

Professors Sedgwick, Prescott, Winslow, Phelps.

PREPARATION: 717; 744.

A weekly or semi-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.]

765. EPIDEMIOLOGY.

Professor Sedgwick.

PREPARATION: 725; 748; 753; 754; 757.

Two hours weekly in the first term, devoted to a detailed consideration of the natural history of epidemics, especially typhoid fever, diphtheria and scarlet fever, in relation to public water supplies, milk supplies, sewerage systems, sewer gas and similar ætiological factors of disease; the intention being to enable the student by a critical examination of the more celebrated and instructive examples to prepare himself for the interpretation of corresponding phenomena arising in actual sanitary practice.

[ELECTIVE IN COURSE VII., GRADUATE YEAR.]

766. PURIFICATION OF WATER AND SEWAGE.

Professors Winslow and Phelps.

PREPARATION: 748; 749; 753; 754.

Four hours weekly throughout the year, consisting of conferences and studies prescribed in connection therewith upon specific problems of water purification and sewage disposal, the object in view being to bring the student, by immediate contact with actual problems, into vital relations with the most recent state of the art. Reports submitted by students will be subjected to rigid criticism both as to substance and form, the design being first to inform the student as to current problems and their solution; second, to give him practice in dealing with similar cases; and third, to supply him with searching, friendly criticism as to his methods and results and as to the form which his reports should take.

During the year the student will be expected to make a detailed sanitary study of some one existing or proposed system of water or sewage purification and to report upon this *in extenso* precisely as he should do this if he were actually employed by a corporation, a city or a town. This report will then be critically considered in conference, more exacting requirements being applied to the later studies of the same sort.

[ELECTIVE IN COURSES I., VII., XI., GRADUATE YEAR.]

767. SEWAGE DISPOSAL PRACTICE.

Professors Winslow and Phelps.

PREPARATION: 748; 749; 753; 754; 766.

Three hours weekly in the second term. Present methods of sewage disposal, good and bad, in various parts of the world, will be examined and illustrated in lectures, and discussed in conference, the object being to trace in detail the evolution of the present practice in civilized countries and to facilitate a comparative examination so that the principles underlying the best practice of to-day may be emphasized and appreciated. A rich collection of lantern siides in the possession of the Biological Department furnishes unusual advantages for such a course, while experiments under way at the Sanitary Research Laboratory and Sewage Experiment Station on Albany Street, supply valuable examples of the latest thought and investigation.

[ELECTIVE IN COURSES VII., XI., GRADUATE YEAR.]

768. PUBLIC HEALTH LABORATORY PROBLEMS.

Mr. Rickards.

PREPARATION: 754; 755; 759.

Six hours weekly in the second term, devoted to actual investigation, under guidance, of the principal questions of current interest and importance in some one department of public health laboratory practice: such for example as the investigation of the purity of inland waters; the vitality of typhoid fever germs in shellfish; the behavior of bacteria in food subjected to cold storage; the fate of bacteria in sewage discharges, in harbors and estuaries, etc.

[ELECTIVE IN COURSE VII., GRADUATE YEAR.]

769. SANITATION OF WATER SUPPLIES.

Professor Sedgwick.

PREPARATION: 748; 754; 757.

Four hours weekly in the first term, consisting of lectures and conferences in which detailed consideration will be given to the protection of watersheds, the purification of water by storage and the efficiency of various systems of filtration. The conferences will include reports and discussions upon selected examples of water supplies in the immediate neighborhood, which the students will be expected to have examined for themselves from the sanitary standpoint and to be ready to criticise. The vicinity of greater Boston, the neighboring portions of Rhode Island, New Hampshire and Maine furnish interesting examples of actual practice, good and bad, so that material in abundance is at hand as a basis of work.

[ELECTIVE IN COURSES VII., XI., GRADUATE YEAR.]

769a. SANITARY STATISTICS.

Professors Sedgwick and Winslow.

Two lectures or conferences weekly for the investigation of the sanitary condition of particular states, cities or other communities as suggested by, and by means of, their vital statistics, and as affected by public works such as water supplies, sewerage systems, or by milk supplies or by climatological, racial, industrial, economic or other conditions. As an important branch of municipal research and as technically useful in studies bearing upon the prevention of disease, only those who are thoroughly qualified will be considered eligible, and original studies of high grade will alone be regarded as satisfying the requirements.

[Elective in Courses VII., XI., Graduate Year.]

DEPARTMENT OF PHYSICS.

CHARLES R. CROSS, S.B.
Thayer Professor of Physics and Director of the Rogers Laboratory.

HARRY M. GOODWIN, PH.D.
Professor of Physics and Electro-Chemistry.

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

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

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

MAURICE DEK. THOMPSON, PH.D.
Assistant Professor of Electro-Chemistry.

Instructors.

CLIFFORD M. SWAN, S.B.
EUGENE D. FORBES, S.B.
NEWELL C. PAGE, S.B.
DANIEL F. COMSTOCK, PH.D.
HERBERT T. KALMUS, PH.D.

Assistants.

EDMUND H. SQUIRE, S.B.
HAROLD C. FAXON, S.B.
JOHN H. LOCKE, S.B.
EDGAR P. SLACK, S.B.
HERBERT S. EAMES, S.B.
ARMEN H. TASHJIAN, A.B., S.M.

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 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, Drisko; Messrs. Swan, Page; Drs. Comstock, Kalmus.

PREPARATION: 21 or 22.

The course consists of three lectures accompanied by two recitations per week throughout the second year. The subjects considered are general mechanics, 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.

[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; Mr. Forbes.

PREPARATION: 30 or 32; 773, taken simultaneously.

A course of ten lectures and recitations, given in both terms 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. Elements of the Precision of Measurements and Graphical Methods by Professor Goodwin, is used as a basis for the course.

[REQUIRED IN COURSES II., III., V., VI., VII., VIII., XII., XIII., XIII.A.]

773. PHYSICAL LABORATORY (General Physical Measurements, Mechanics, Optics).

Professors Goodwin, Drisko; Messrs. Forbes, Swan; Dr. Kalmus, and assistants.

PREPARATION: 770, completed or taken simultaneously.

A series of fifteen two-hour exercises in the second or 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: Physical Laboratory Experiments, Part I., Mechanics, and Part II., Optics, prepared by Professor Goodwin.

[REQUIRED IN ALL COURSES EXCEPT IV.]

774. PHYSICAL LABORATORY (Heat).

Professors Goodwin, Drisko; Messrs. Forbes, Swan; Dr. Kalmus, 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: Physical Laboratory Experiments, Part III., Heat, prepared by Professor Goodwin.

[REQUIRED IN ALL COURSES EXCEPT IV.]

776. PHYSICAL LABORATORY (Advanced).

Professor Goodwin.

PREPARATION: 774.

A course in the second term of the third year, 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 collateral reading of references in French and German. The experiments assigned are in the nature of short researches devoted to the exact determination of various physical constants. An extensive collection of highest grade apparatus is provided for the work of this course.

[REQUIRED IN COURSE VIII., OPTION 1b.]

778. ELECTRICAL MEASURING INSTRUMENTS AND METHODS.

Professor Laws.

PREPARATION: 772; 779, 655 or 787, 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 attention 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. ELECTRICAL LABORATORY.

Professor Laws; Mr. Page and assistants.

PREPARATION: 772; 774; 778, taken simultaneously for Course VI.; 787 taken simultaneously by Course VIII., Options 1 and 2.

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.

[REQUIRED IN COURSES VI., VIII.]

781. HEAT MEASUREMENTS.

Professor Norton 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 temperature and heat measurements as are of technical importance,—for instance, the calorific efficiency of coal and the determination of the temperature of kilns and furnaces. The preparation and study of thermometers of the highest precision is required of students in Physics. The time devoted to the work varies in different Courses.

[REQUIRED IN COURSES III., OPTIONS 1, 2, V., VIII.]

782. ELECTRICAL MEASUREMENTS.

Professor Laws; 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.]

783. HEAT MEASUREMENTS.

Professor Norton.

PREPARATION: 781.

This course of forty-five hours lecture and laboratory in the second term is an extension of the undergraduate work in Heat Measurement, especially in the line of application to the study of the furnaces and other metallurgical apparatus where the maintenance of fixed high temperatures, the supplying of the necessary heat for reactions, and the minimizing of heat loss by radiation, etc., are of prime importance. A thermal study of a metallurgical furnace, or some similar investigation, will occupy a considerable part of the time in the laboratory.

[ELECTIVE IN COURSE III., GRADUATE YEAR.]

784. HEAT MEASUREMENTS.

Professor Norton and assistants.

PREPARATION: 774.

This course, given in the second term of the fourth year in connection with course 397, consists of about eight laboratory exercises in the measurement of high temperatures, the efficiency of fuels, and determinations of thermal properties of engineering materials. Especial attention is given to the study of such temperature and heat measurements as are of technical importance,—for instance, the calorific efficiency of coal and the determination of the temperature of kilns and furnaces.

[REQUIRED IN COURSES II., VI., X., XIII., AND XIII.A.]

787. ELECTRICITY.

Mr. Page.

PREPARATION: 31; 770; 779, taken simultaneously.

This course of thirty exercises in the second term of the third year is intermediate in character between the second year course in Electricity and the distinctly mathematical course on the Theory of Electricity given in the fourth year. It is planned to be taken concurrently with the laboratory course in Electrical Measurements and includes a discussion of such topics as Kirchhoff's laws, the magnetic circuit, capacity and inductance measurements and methods of determining the ohm, "v" and other fundamental electrical and magnetic constants.

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

790. THEORETICAL PHYSICS I.,—DYNAMICS.

Dr. Comstock.

PREPARATION: 31; 770; 42 or 36 taken simultaneously.

This course of three exercises per week throughout both terms of the third year is designed to give the student a thorough training in theoretical dynamics as a basis for his subsequent work in Theoretical Physics. Independent effort on the part of the student is considered essential to a proper understanding of so fundamental and important a subject and hence much time is devoted to solution of problems. The work begins with the elements of the subject, *i.e.*, with the motion of a point and the mathematical statement of Newton's Laws, and considers further the dynamics of a particle and the dynamics of rigid and deformable bodies. This includes a consideration of some of the general dynamical methods and principles, such as Lagrange's equations and Hamilton's principle.

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

791. THEORETICAL PHYSICS II.,—ELECTROSTATICS AND ELECTROKINETICS.

Dr. Comstock.

PREPARATION: 787; 790.

A course of three lectures per week throughout both terms of the fourth year, designed as an introduction to graduate work in the mathematical theory of electricity. The first part of the course is devoted to a consideration 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, Gauss, and Green. The modern theory of electrodynamics as developed by Maxwell and Lorentz is then taken up and applied to such problems as the dynamics of moving charges, radiation, etc. The purpose of this course is to give the student a general insight into the fundamental principles and methods of attack underlying the most recent investigations in theoretical electricity.

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

796. ELECTRO-CHEMISTRY.

Professor Goodwin.

PREPARATION: 610, 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 1, VIII.]

797. APPLIED ELECTRO-CHEMISTRY.

Professor 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 thirty-hour course (446).

[REQUIRED IN COURSE VIII., OPTION 3.]

798. APPLIED ELECTRO-CHEMISTRY (Special Problems).

Professor Thompson.

PREPARATION: 797; 800.

This is largely a problem course in which attention is directed to those factors which have to be considered in laying out plants for various electro-chemical processes. The student is given in a preliminary discussion data on the desired requirements of a given process, furnace or plant and is then expected to work out the details of the arrangement and choice of apparatus adapted to securing the desired end. The solution of problems is then criticised and discussed in class. A general knowledge of Electro-Chemistry and of electrical machinery is assumed as a basis of this course.

[ELECTIVE IN COURSE VIII., OPTION 3, GRADUATE YEAR.]

799. ELECTRO-CHEMICAL LABORATORY.

Professors Goodwin, 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 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 1, VIII., OPTION 3].

800. ELECTRO-CHEMICAL LABORATORY.

Professor Thompson.

PREPARATION: 797, taken simultaneously.

This course is given in the second term of the fourth year, in conjunction with course 797 on Applied 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, such as the production of carbides, carborundum, aluminum, and calcium, and the reduction of iron ores. For this work the laboratory is equipped with unusual facilities for both direct and alternating current work.

[REQUIRED IN COURSE VIII., OPTION 3.]

803. PHYSICO-CHEMICAL LABORATORY.

Professors Goodwin, Thompson.

PREPARATION: 610, completed or taken simultaneously.

This course, for which a special laboratory is provided, is designed to give practice in the more precise methods for the determination of physico-chemical constants. The equipment includes instruments of high grade for the measurement of optical, electro-chemical, and thermo-chemical constants, as well as equilibrium, reaction, and ionization constants. The student is given some latitude in the choice of the particular line of work he desires to pursue.

[REQUIRED IN COURSE VIII., OPTION 1a.]

806. MICROSCOPE THEORY AND PHOTOMICROGRAPHY.

Professor Derr.

PREPARATION: 31; 770.

A theoretical and experimental study of the principles of vision with the compound microscope, according to the diffraction theory of Abbé, with practice in photomicrography in black and white and natural colors, and in the use of the ultra-violet microscope. For this work there are provided a fine Zeiss compound microscope, with all the accessories required for a study of the theory of the instrument, an Abbé focometer and the Zeiss ultra-violet apparatus operated by a high-power induction coil. Four hours per week throughout the first or second term.

[ELECTIVE IN COURSE VIII., GRADUATE YEAR.]

807. OPTICAL LABORATORY.

Professor Goodwin.

PREPARATION: 773; 774; 808, taken simultaneously.

This course of four hours a week in the first term of the fourth year is devoted to advanced optical measurements. The work includes special methods in photometry, spectrophotometry, spectroscopy, including work with plane grating, concave grating and Littrow-Echelon spectroscopes, and measurements with the interferometer. For this work the laboratory is equipped with the best apparatus obtainable.

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

808. THEORETICAL PHYSICS III.,—OPTICS.

Dr. Comstock.

PREPARATION: 31; 790.

This course of three lectures and recitations per week during 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 theory and phenomena of physical Optics. Wood's Physical Optics is used as a text-book.

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

811. THE CONSTITUTION OF MATTER IN THE LIGHT OF RECENT DISCOVERY.

Dr. Comstock.

In this course of fifteen lectures during the second term an account is given of the present state of knowledge and hypothesis respecting the constitution of matter. The properties of the ether, the nature of negative electricity and the structure of the atom and molecule are considered as fully as time allows and where possible the problems pressing for solution are discussed so far as is necessary to indicate the probable direction of future investigation. This course is given in alternate years.

[ELECTIVE IN COURSE VIII., GRADUATE YEAR. OMITTED IN 1908–1909.]

812. WAVE-THEORY AND POLARIZATION.

Dr. Comstock.

PREPARATION: 770.

In this course of fifteen lectures during the first term, the theory of wave motion in isotropic and nonisotropic media is developed, first according to the general and then the electromagnetic theory. This involves a consideration of plane polarization, double refraction, circular, elliptical and rotary polarization as well as the more important phenomena of magneto-optics. Course 813 and the present one may be taken advantageously in connection with one another.

[ELECTIVE IN COURSE VIII., GRADUATE YEAR. OFFERED IN 1908–1909.]

813. POLARIZED LIGHT AND ITS APPLICATIONS.

Professor Cross.

PREPARATION: 770.

A course of fifteen experimental lectures given in the first term of alternate years, on polarized light and its applications. The phenomena of plane, circular and elliptical polarization, rotary polarization and the electromagnetic relations of light are discussed, and fully illustrated by experiments. The principles of different forms of polarimeter and saccharimeter are also considered.

[ELECTIVE. OMITTED IN 1908–1909.]

814. COLOR.

Professor Cross.

PREPARATION: 770.

A course of five lectures given alternate years in the first term to students of the third and fourth years. In these lectures are discussed the principles of color-sensation, color mixture, successive and simultaneous contrast, and their relations to phenomena in nature and art.

[REQUIRED IN COURSE IV., OPTION 1. GIVEN IN 1908–1909.]

815. PHOTOGRAPHY.

Professor Derr.

PREPARATION: 550; 770.

Fifteen lectures in the first term, 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. To avoid interference with other exercises, the lectures are given at 4 P.M. The text-book is Derr's Photography for Students of Physics and Chemistry.

[REQUIRED IN COURSE IV., OPTION 3; ELECTIVE IN OTHER COURSES FOR THE THIRD AND FOURTH YEARS.]

816. THE ELECTRICAL DISCHARGE IN GASES; RADIO-ACTIVITY.

Professor Cross.

This course consists of fifteen lectures in the second term, given in alternate years with course 817. 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. GIVEN IN 1908–1909.]

817. HERTZ WAVES; WIRELESS TELEGRAPHY.

Professor Cross.

In this course are discussed the phenomena of electrical oscillations and Hertz waves with their application to wireless telegraphy and allied subjects. The lectures are of the same general character as those in course 816, and will be given in alternate years with the latter.

[ELECTIVE. OMITTED IN 1908–1909.]

819. DESCRIPTIVE ASTRONOMY.

Professor Drisko.

PREPARATION: 21; 770.

A course of thirty lectures and recitations in the first term of the fourth year 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 Derr.

PREPARATION: 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.

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

824. ACOUSTICS.

Professor Cross.

PREPARATION: 770.

This course of five lectures given in the first term of alternate years to students of the third and fourth years is intended to furnish the student with a knowledge of such acoustic principles as are of importance in Architecture.

[REQUIRED IN COURSE IV., OPTION 1. GIVEN IN 1908–1909.]

829. THEORETICAL PHYSICS IV.,—ENERGETICS.

Professor Goodwin.

PREPARATION: 790; 610.

This course in conjunction with course 830 on the Kinetic Theory is devoted to the general mathematical theory of heat and concludes the undergraduate instruction in Theoretical Physics.

Course 829 consists of thirty exercises in the second term of the fourth year devoted to a general treatment of Thermodynamics with applications to gases, vapors, dilute solutions, and chemical equilibrium. The treatment is based on the properties of the entropy and thermodynamic potential functions and is intended to prepare students to take up as graduate work the study of such works as those of Duhem and Gibbs.

[REQUIRED IN COURSES V., OPTION 1, VIII., OPTIONS 1, 2.]

830. THEORETICAL PHYSICS IV.,—KINETIC THEORY OF GASES.

Professor Goodwin.

PREPARATION: 790; 829, taken simultaneously.

This course of fifteen exercises in the second term of the fourth year is given in conjunction with the preceding course on Energetics. The distinction between inductive and deductive methods of scientific investigation is contrasted in the development of the two courses. 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.]

831. PRINCIPLES AND METHODS OF PHYSICAL MEASUREMENTS.

Professor Goodwin.

PREPARATION: 31; 770; 772; 774.

This is a graduate course devoted to a consideration of the general principles underlying the planning out of scientific investigations and the best methods and apparatus to employ in specific cases. The course begins with a review of the principles of the Precision of Measurements which is then extended to include a discussion of the "best magnitudes" to choose for various component measurements or to assign to the dimensions of apparatus designed for a given purpose, so far as these are open to the choice of the investigator. Then follows a discussion of fundamental instruments and methods, special emphasis being directed to their particular advantages and disadvantages and to the precision attainable with each. The extensive collection of apparatus of the Department of Physics is available for illustrating this part of the work. The main portion of the course is devoted to the working out of a number of typical research problems selected from the various branches of Physics, Electro-Chemistry and Chemistry. This course is offered in alternate years.

[ELECTIVE IN GRADUATE YEAR. GIVEN IN 1908–1909.]

832. RADIATION.

Professor Goodwin.

This course of fifteen lectures is devoted to a discussion of the fundamental laws of radiant energy and its transformations. The course begins with a discussion of the laws of Kirchhoff, Stefan-Boltzmann, Wien, Planck and others on black body radiation and their experimental verification and application to high temperature measurements. The radiation of gases is then considered and includes a discussion of the effect of pressure, temperature, and magnetic field on spectra, the recent work on "series" and the application of spectroscopy to astrophysical phenomena. A brief discussion of the transformation of radiant into chemical energy is also included. The course is offered in alternate years.

[ELECTIVE IN GRADUATE YEAR. OMITTED IN 1908–1909.]

833. ADVANCED PHYSICS.

Professors Goodwin, Derr.

This option in the Course in Physics is intended to allow the student some latitude in the choice of the special work he desires to pursue in the last term of his Course. Advanced work in Spectroscopy, or Microscopy and Photomicrography 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. To avoid interference with other studies, the exercises are held at 4 P.M.

[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' 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.

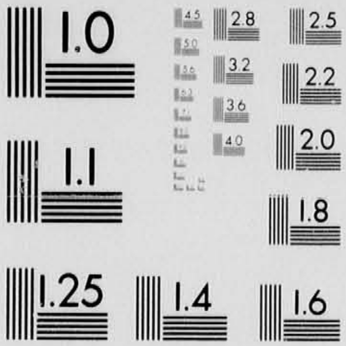
[REQUIRED IN COURSE VIII.]

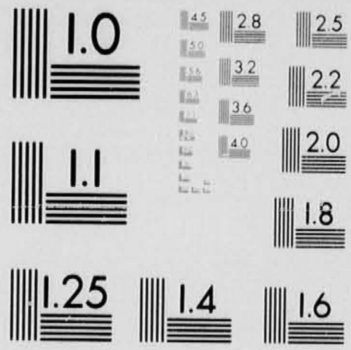
839. THE EVOLUTION OF WORLDS,—COSMIC PHYSICS.

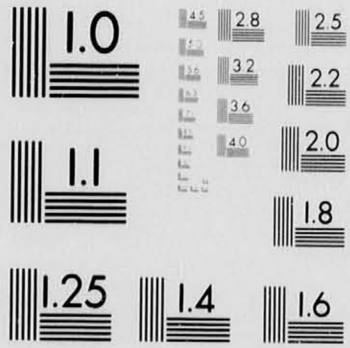
Professor Percival Lowell.

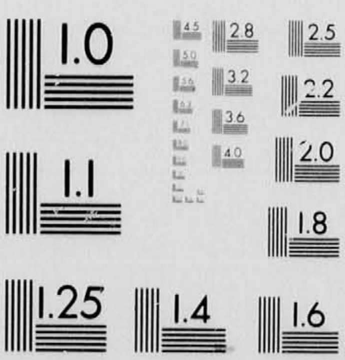
This course will consist of six lectures given once a week at the beginning of the second term. The main purpose of the course is to give a survey of the present knowledge regarding the physics of our solar system, and to awaken interest and arouse imagination and thought in the large problems which the subject involves. The more important topics to be considered in the lectures are: 1. *The Birth of the Solar System*—Dark bodies in space. Collisions with them, past and future. 2. *Evidence of the Initial Catastrophe*—Single and double star systems. Moments of momentum. Tidal action. Meteroites. The bearing upon this of Mr. Slipher's recent spectrograms. 3. *Formation of Planets*—Internal heat generated. How calculated. Its effect upon the planet's career. 4. *A Planet's Subsequent History*—Astronomy and Geology. An explanation of paleozoic times and of the course afterward pursued. 5. *Loss of Planet's Own Heat*—Heat received from the Sun. How evaluated. Glacial epochs. 6. *Death of a World*—*a.* Through accident—collision with other celestial bodies. *b.* Through paralysis—turning the same face always to the sun. *c.* Through old age—loss of water and of air.

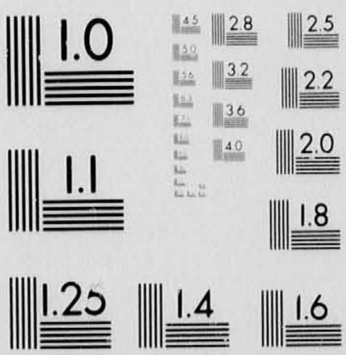
[ELECTIVE.]


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


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


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


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


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

M.I.T. ANNUAL CATALOGUES AND BULLETINS
1908/09

DEPARTMENT OF GEOLOGY.

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

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

WILLIAM O. CROSBY, S.B.
Professor of Geology; Retired under the Carnegie Foundation.

WALDEMAR LINDGREN, M.E.
Lecturer in Economic Geology for 1908–9. United States Geological Survey.

REGINALD A. DALY, PH.D.
Professor of Physical Geology.

CHARLES H. WARREN, PH.D.
Assistant Professor of Mineralogy.

HERVEY W. SHIMER, PH.D.
Assistant Professor of Paleontology.

Instructors.

GERALD F. LOUGHLIN, PH.D. CHARLES H. CLAPP, S.B.

Assistants.

JOHN A. ALLAN, B.A., M.SC.

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 1908–9.

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 include 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 Warren and assistant.

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.

[REQUIRED IN COURSES III., OPTIONS 1. 3, V., OPTIONS 2, 3, XII.]

841. MINERALOGY.

Professor Warren.

PREPARATION: 551.

This is a shorter course, given in the second year, and is similar in plan to course 840. The time devoted to the work varies in diffe[illegible] courses.

[REQUIRED IN COURSES III., OPTION 2, V., OPTION 1.]

842. ADVANCED MINERALOGY AND CRYSTALLOGRAPHY.

Professor Warren.

PREPARATION: 770; 840.

The course aims to take up somewhat fully the subjects of chemical and physical Crystallography and chemical Mineralogy. The work takes very largely the form of a seminar. In Crystallography Moses' "Characters of Crystals" is used as outline, while in chemical Mineralogy Braun's "Chemische Mineralogie" is followed. References on particular topics in other texts and in journals are given out to individual members of the class and their reports are discussed by all. The course is so arranged that the Crystallography can be taken independently of the chemical Mineralogy, although such an arrangement is not generally advisable. Arrangements can be made by a limited number of students to obtain some practice outside of the regular hours of the course in the measurement, calculation and drawing of crystals.

[ELECTIVE IN COURSE XII., OPTION 1. OPEN TO COURSES III. AND V., AND TO GRADUATE STUDENTS.]

843. PETROGRAPHY.

Professor Warren, Dr. Loughlin, and assistant.

PREPARATION: 770; 840; 858.

This course begins with the study of optical Crystallography and 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 for one 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.]

844. ADVANCED PETROGRAPHY.

Professor Warren.

PREPARATION: 843.

This course will aim to make a rather full study of the important types of the igneous and metamorphic rocks, and will also give the student a thorough training in the more refined methods of petrographical research, as well as an insight into the most recent developments of the science.

[ELECTIVE IN COURSE III., GRADUATE YEAR.]

850. CHEMICAL MINERALOGY AND PETROLOGY.

Professor Warren.

PREPARATION: 840; 618.

The work in this research course will take the form of a seminar (one hour), meeting once a week through the year. Its principal object will be to study the application of the principles of Physical Chemistry, so far as this is possible at the present time, to problems in Mineralogy and Petrology. The outside work may be expected to aggregate six hours per week.

[ELECTIVE IN COURSE III., GRADUATE YEAR.]

855. DYNAMICAL GEOLOGY.

Professor Jaggar.

PREPARATION: 551; 770.

This course of thirty hours in the first term of the third 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., VII., XI.]

856. GENERAL GEOLOGY.

Professor Daly.

Preparation: 551, 770, taken simultaneously.

Thirty hours in the first term of the second year. In this course, which is designed as a preparation for the more special courses in Geology, the emphasis is placed on the fundamental principles of the science. Special attention will be given to the chief processes by which the accessible rocks of the earth have been formed and evolved into their present condition. The history of the earth will thus be considered on its dynamic side, the geological work of the atmosphere, of the rivers, of the sea, and of the earth's interior heat forming the main subject-matter. The student will become familiar with many of the physical laws operating in the formation of mineral deposits, but the discussions will necessarily involve principles which have no immediate economic bearing.

[Required in Courses III., Options 1, 3, XII.]

857. STRUCTURAL AND FIELD GEOLOGY.

Mr. Clapp and assistant.

Preparation: 855, taken simultaneously.

Two hours a week, throughout the first term of the third year. This course consists of 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 field exercises in the study of the more common rocks and structures. The first seven exercises are spent in the field. The lectures are given in the remaining eight periods and are accompanied by laboratory work and problems. The work is especially adapted to the needs of civil engineers.

[Required in Courses I., XI.]

858. STRATIGRAPHIC GEOLOGY.

Professor Shimer.

Preparation: 840; 856.

This course of thirty hours in the second term of the second year aims to give a general view of the past history of the earth. The fifteen lectures are supplemented by assigned readings in geologic text-books. In the laboratory periods a working knowledge is obtained of the main groups of plants and animals found fossil. These fossils are studied through a comparison with their nearest living representatives, and in connection with their use in the determination of the earth's past history.

[Required in Courses III., Options 1, 3, XII.]

859. ECONOMIC GEOLOGY.

Dr. Loughlin.

Preparation: 840; 858; 870.

A course of thirty hours 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 minerals and coal. The structural features and theories as to origin of ore-deposits are reviewed, and the methods of classifying ore-deposits stated. 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).

Messrs. Lindgren and Clapp.

Preparation: 859.

A course of lectures, with conferences, laboratory and library work, dealing with iron, coal and the non-metallic earth products, their occurrence and economic production.

[Required in Courses III., Option 3, XII.]

861. ADVANCED ECONOMIC GEOLOGY.

Mr. Lindgren and Dr. Loughlin.

Preparation: 860; 889.

One hour a week consultation or seminar; five hours a week preparation. This course is designed to give the student experience in practical work along economic lines. Specific problems in field or laboratory are selected by each student and the progress checked by the weekly consultations. This course will lead to a thesis. Suitable topics for theses are the genesis or enrichment of ores, the geological structure and extent of ore-bodies in western mining districts, or questions concerning coal, water-supply or other products in the east. Abundant laboratory material for chemical or mineralogical topics may be furnished from the Crosby Collection, but a thesis drawn from the student's summer field work is preferable.

[Elective in Course III., Graduate Year.]

863. GLACIAL GEOLOGY.

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.

Professor Jaggar.

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 laboratory 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.

Dr. Loughlin and assistant.

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 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. STRUCTURAL AND FIELD GEOLOGY.

Dr. Loughlin and Mr. Clapp.

PREPARATION: 858, taken simultaneously.

This course consists 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. In the last eight weeks trips are made into the field to study actual examples of the principal kinds of rocks and rock-structures, both original and secondary. When the weather is unfavorable for field-work laboratory exercises are substituted.

[REQUIRED IN COURSES III., OPTIONS 1, 3, XII.]

871. GEOLOGICAL SURVEYING.

Professors Jaggar, Daly; Dr. Loughlin and assistants.

PREPARATION: 858; 870.

This comprehensive 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., OPTIONS 1, 3, XII.]

873. FIELD GEOLOGY (Advanced).

Professors Jaggar, Daly, Warren; Dr. Loughlin.

PREPARATION: 871.

This is a course of research demanding six hours work a week throughout a year of graduate study (or fourth year of Course XII.). The Boston field is peculiarly rich in bed-rock and glacial geology, and it is the plan of this course to take advantage of it. Structural, petrographic, stratigraphic or glacial problems are selected, frequently with geologic maps ready, prepared by a former class. The student investigates the topic selected in detail, and may publish his results. The area offers good unsolved problems in igneous contact, differentiation of sediments, shore erosion, and metamorphism.

[ELECTIVE IN COURSES III., GRADUATE YEAR, XII.]

874. TOPOGRAPHIC GEOLOGY.

Professor Daly.

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 lecture, laboratory and field studies on the relation of geologic processes and structures to topography. The student will find that the varied topographic forms of the earth's surface are best understood as the history of their development through geologic time becomes known. This fact is used as the basis for the discussion and systematic classification of land forms. The course will be fully illustrated with maps, and, where feasible, by excursions to instructive localities near Boston. A special aim of the course is to give the student practice in the use and interpretation of contour maps.

[REQUIRED IN COURSE XII. OMITTED IN 1908–1909.]

875. STRATIGRAPHIC GEOLOGY.

Professor Shimer.

PREPARATION: 855.

This course of fifteen hours in the second term of the third year is designed to give the student a general view of the past history of the earth as interpreted by the sedimentary rocks and their enclosed fossils.

[REQUIRED IN COURSES I. AND XI.]

877. GEOLOGY OF THE IGNEOUS ROCKS.

Professor Daly.

PREPARATION: 843; 856.

This course will occupy ninety hours in the second term. It will deal with the structures, relations and origins of igneous rock-bodies. Among the subjects specially discussed will be: the morphology and classification of intrusive masses, their methods of intrusion; the origin and differentiation of igneous magmas; the relation of igneous action to crustal deformation; contact metamorphism; the nature and origin of magmatic waters and gaseous emanations; the metamorphism of igneous rocks.

[ELECTIVE IN COURSE III., GRADUATE YEAR.]

878. INTRODUCTORY PALEONTOLOGY.

Professor Shimer.

PREPARATION: 858.

This course of forty-five hours in the first term of the third year is a preparation for Index Fossils, the main purpose being to make the student acquainted with the structure (anatomy) and relationships of the principal types of fossil invertebrates and plants. The instruction consists of laboratory work with specimens, supplemented by lectures.

[REQUIRED IN COURSE XII.]

880. INDEX FOSSILS.

Professor Shimer.

PREPARATION: 858.

A course of one lecture and three hours of laboratory work per week for one term. This is a continuation of the second part of course 858. It includes a study of those fossils which are most abundant and the most characteristic indices of the age of the different rocks, the identification of unknown material directly from the field, the working out of practical problems through the aid of fossils.

[REQUIRED IN COURSES III., OPTION 3, XII.]

883. PRINCIPLES OF PALEONTOLOGY.

Professor Shimer.

PREPARATION: 880, or 878.

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 the different forms of animal and plant life, the life history of the individual, and of the group to which it belongs, and the problems of faunas, including their rise, culmination and decadence, the relations of fossils to sediments and to shore, deep sea, and abyssal conditions, the cause of the varying stability and persistence of types, and their relative stratigraphic values.

[ELECTIVE.]

884. ADVANCED PALEONTOLOGY.

Professor Shimer.

PREPARATION: 880.

This is a seminar course of at least one hundred and twenty hours, arranged to meet the needs of the individual student. Topics for theses are: work on some stratigraphic area with making of exact correlations through identification of the fossils; correlation of an era or a portion of one throughout North America; migration of fossil or recent faunas; biological problems on the evolution of fossil or recent species. Abundant laboratory material for thesis work is stored in the collections of the Department.

[ELECTIVE IN COURSES III., XII., GRADUATE YEAR.]

889. ECONOMIC GEOLOGY (Metallic).

Messrs. Lindgren and Clapp.

PREPARATION: 859.

A course of lectures, with conferences, laboratory and library work, dealing with the metallic minerals, their occurrence and economic production.

[REQUIRED IN COURSES III., OPTION 3, XII.]

890. GEOLOGY OF NORTH AMERICA.

Professors Jaggar, Daly, Shimer.

PREPARATION: 859; 880.

Ninety hours in the second term of the fourth year. This course embraces the Stratigraphy, the general geologic structure, and the general Physiography 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. The third part is devoted to a discussion of the origin of the surface features of the country, and the representation of those features by contour maps.

[Required in Courses III., Option 3, XII.]

892. BUILDING STONES.

Dr. Loughlin.

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.]

893. BUILDING STONES (XII.).

Dr. Loughlin.

Preparation: 843.

In comparison with course 892 this longer course, 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 AND LITHOLOGY.

Dr. Loughlin.

Preparation: 857.

Thirty 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. The work consists of a systematic laboratory study of the common rocks alternating with illustrated lectures upon their application in engineering works. The quarrying, dressing, weathering, selection and testing of stones are considered.

[REQUIRED IN COURSES I., XI.]

896. **APPLIED GEOLOGY AND REPORTS.**

Professor Jaggar; Dr. Loughlin.

PREPARATION: 859.

Conferences and Reports, based on library and field work, whereby students are trained in the methods of reporting promptly and efficiently after examining a property in the field.

[REQUIRED IN COURSE XII.]

DEPARTMENT OF NAVAL ARCHITECTURE.

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

WILLIAM HOVGAARD.
Professor of Naval Design.

WALTER S. LELAND, S.B.
Assistant Professor of Naval Architecture.

Instructors.

HAROLD A. EVERETT, S.B.
HERMAN R. HUNT, S.B.

Assistants.

HAROLD S. WONSON, S.B.
ARTHUR H. JANSSON, 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 or who desire to enter allied industries. The special work of the regular Course is given in the form of lectures and recitations, and drawing and computation, during the 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 37 and 116 to 123.

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 104.

A circular of the Department of Naval Architecture will be sent on application to the Secretary of the Faculty.

900. SHIP CONSTRUCTION.

Professor Leland.

PREPARATION: 372.

This is a course of fifteen lectures in the second term of the second year, giving a description of general construction, methods of work, and the layout and equipment of the modern ship yard. The aim is to familiarize the student with ship yards and ship-yard methods before the work on construction details is begun. Students are supplied with lithograph plates and typewritten notes.

[REQUIRED IN COURSE XIII.]

901. NAVAL ARCHITECTURE.

Professor Peabody.

PREPARATION: 31; 65; 900, 71, 910, taken simultaneously.

A continuous series of lectures and recitations, forty-five in the second term, on the statics and dynamics 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 forty-five lectures, extending two hours a week through the first term, and one hour a week through the second, is a continuation of the course of the preceding year. 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. 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.

[REQUIRED IN COURSES XIII., XIII.A.]

904. SHIP CONSTRUCTION.

Professor Leland.

PREPARATION: 900; 910; 902, 911, taken simultaneously.

This is a course of twenty lectures in the second term of the third year, and is a continuation of course 900.

[REQUIRED IN COURSE XIII.]

905. SHIP CONSTRUCTION.

Professor Leland.

PREPARATION: 900; 910; 902, 911, taken simultaneously.

This is a course of fifteen lectures, given in the second term of the fourth year. It is a continuation of course 900, and deals entirely with details and fittings.

[REQUIRED IN COURSE XIII.]

910. SHIP DRAWING AND DESIGN.

Professor Leland.

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 seven hours per week in the first term and four hours per week in the second term.

[REQUIRED IN COURSE XIII.]

911. SHIP DESIGN.

Professor Leland.

PREPARATION: 901; 910; 902, taken simultaneously.

The drawing for naval architects is continued throughout the fourth year, with six hours per week the first term and seven 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. Everett.

PREPARATION: 385 or 386; 80, 401, 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.

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. The application of steam turbines to marine propulsion is discussed and students make the computations for the turbines and appropriate propellers for a given ship.

[REQUIRED IN COURSES XIII., XIII.A.]

914. VENTILATION AND DRAINAGE.

Professors Park, Leland.

A course of fifteen lectures, given in the first term of the fourth year. The course deals especially with the problems encountered in the ventilation and drainage of ships.

[REQUIRED IN COURSE XIII.]

915. THEORY OF WAR-SHIP DESIGN.

Professor Hovgaard.

PREPARATION: 901, taken simultaneously.

A series of sixty lectures, thirty in each term of the junior year. The work of the first term gives a historical account of the development of warships, 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.

The lectures during the second term are 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 complications, directly useful in naval design work.

[REQUIRED IN COURSE XIII.A.]

916. THEORY OF WAR-SHIP DESIGN.

Professor Hovgaard.

PREPARATION: 915; 902, taken simultaneously.

A course of sixty lectures extending throughout the senior year. The work of this year is a continuation of the lectures described under 915 and comprises 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.

The lectures during the second term comprise a discussion of drainage, ventilation and heating.

[REQUIRED IN COURSE XIII.A.]

917. THEORY OF WAR-SHIP DESIGN.

Professor Hovgaard.

PREPARATION: 915, 916; 903, taken simultaneously.

A course of sixty lectures extending throughout the graduate year, dealing with the design and installation of propelling machinery, so far as this question concerns the naval architect. A discussion is given of coal stowage and coaling, of the use of liquid fuel and of the marine steam turbine in warships, of the design of anchor gear, steering gear, etc. 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.

Professor Hovgaard, Mr. Hunt.

PREPARATION: 901; 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. The first term of the junior year is occupied by introductory work consisting of fairing of lines, tracing, and performing ship calculations. The object of this work is to provide exercises for the students in drawing and calculation, and to make them acquainted with various methods of calculation. In the second term of the junior year the students commence the design of a warship, 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 are 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, Mr. Hunt.

PREPARATION: 915; 920; 916, taken simultaneously.

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, Mr. Hunt.

PREPARATION: 915; 916; 921; 917, taken simultaneously.

This course is given throughout the graduate year and forms a continuation of course 921.

[REQUIRED IN COURSE XIII.A.]

925. MEMOIRS.

Professor Peabody.

[REQUIRED IN COURSE XIII.A.]

930. MODEL MAKING.

Mr. Everett.

PREPARATION: 900; 901.

Each student in Naval Architecture after having designed a set of lines for a ship is given twenty-five hours instruction in cutting a model to those lines, in order that a proper conception of the form of the ship may be had, and to determine whether the lines are fair.

To aid in shaping the model two sets of lines are transferred to the model. In the first place the lifts or boards from which the model is made, are sawed to the form of horizontal sections or water lines. These lifts are then glued together to form a block, which is profiled to the forms of transverse sections or stations, in a special machine. The student then proceeds to cut away redundant material and to fair and smooth up the model guided by the double system of lines which were transferred from his design. Should the model exhibit defects or unfairness the designed lines are redrawn, and the model altered to correspond. The model is afterward used for laying off shell plating. This course is given in the first term of the fourth year to Course XIII. and in June at the end of the second term to Course XIII. A.

[REQUIRED IN COURSES XIII., XIII.A.]

931. MOLD-LOFT WORK.

Professor Leland and assistant.

PREPARATION: 900; 901.

An optional course in Mold-loft Work is offered to students in Naval Architecture at the close of the spring term, and lasting about ten days. The method is one developed and used by some of the leading ship-yards in America and Great Britain. The Department has four glass topped tables, two 14 feet by 2½ feet, and two 3½ feet by 2½ feet. The glass is ground to a surface that takes pencil and ink lines satisfactorily, and can be readily cleaned.

The lines of a ship are drawn and faired to a large scale (an inch to the foot), and the difference or intervals between lines are measured and enlarged to full size. These full-sized differences are faired by the contracted system, care being taken that the sum of differences shall give the proper over-all dimention. By this method errors in excess of an eighth of an inch full size can be detected and eliminated. The body-plan is then laid down on the floor to the full size in the usual manner and faired and completed. Frames, floors, margin plates, and shell plating are located and bevel boards are cut as is customary in preparing to get out and bend the materials for framing the ship.

[ELECTIVE IN COURSES XIII. AND 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 beginning of the term in question, or who have passed an examination on the military course, or presented records for equivalent work at other colleges.

For these exercises they are required to provide themselves with uniforms, which are made from measure and by contract, in order to secure uniformity of material and manufacture, as well as cheapness. The whole cost to each student does not exceed sixteen dollars. A student presenting to the Faculty satisfactory evidence of physical disability may be excused from the prescribed drill exercises, and in lieu thereof will be required to attend a course of theoretical studies in Military

[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.

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.

[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.]

DEPARTMENT OF PHYSICAL TRAINING.

ALFRED E. BURTON, S.B.
Dean.

WINFIELD C. TOWNE, A.B.
Instructor in Physical Training.

HAROLD A. BRUCE.
Assistant in Physical Training.

A new gymnasium was erected on the Garrison Street property of the Institute in 1905. This building affords ample accommodation for the training of classes in gymnastics and indoor games.

The gymnasium is open to all students free of charge, and the instruction is especially arranged to fit individual needs. Bronze medals, known as the Cabot Medals for Improvement in Physical Training, are awarded to the five or six men showing the greatest physical improvement for the year. These medals are the gift of the late Samuel Cabot, for many years a member of the Corporation of the Institute.

An athletic field on the Institute's land in Brookline gives an opportunity for track-team contests and inter-class games. This athletic field is provided with a quarter-mile running track, straight-away tracks for 100-yard and 220-yard dashes, tennis courts, etc. It is under the direction of an Advisory Council on Athletics, composed of alumni and undergraduate students.

995. PHYSICAL TRAINING.

Mr. Towne and assistant.

Five lectures on the relation of exercise to health and on personal hygiene are given to the first-year class at the beginning of the school year, and all first-year men take a physical examination during the first month from which anthropometric charts are plotted. The class is then divided into four sections for gymnastic exercise, each section having two hours a week of work for twenty weeks under the direction of the instructor. All first-year students not specifically excused are required to take part in this work.

[REQUIRED IN ALL COURSES.]

Laboratories.

The most marked characteristic of the Institute from the material point of view consists of its numerous large and well-equipped laboratories.

Recognition of the value of laboratory instruction as a fundamental element in general education and of the proper function of such instruction are of comparatively recent origin, dating only from the latter half of the last century. Such instruction has formed a very important department of the work at the Institute from the beginning, the Institute having taken the initiative in the establishment of laboratory work along various lines.

In the first Annual Catalogue it was stated that "The Laboratory arrangements of the School are designed, when complete, to embrace the following departments: (1) Laboratory of Physics and Mechanics; (2) Laboratories for Chemical Analysis; (3) Laboratory for Metallurgy; and (4) Laboratory for Industrial Chemistry." "A high value is set upon the educational effect of laboratory practice, in the belief that such practice trains the senses to observe with accuracy, and the judgment to rely with confidence on the proof of actual experiment."

The system of laboratory instruction thus inaugurated has since been greatly extended, and now includes the following:

- The Engineering Laboratories, including the Laboratory of 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 Research Laboratory of Applied 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; the Research Laboratory of Physical Chemistry and the Sanitary Research Laboratory and Sewage Experiment Station in 1903; and the Research Laboratory of Applied Chemistry in 1908.

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 length 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.

A Westinghouse Parsons Steam turbine of 500 K.W. capacity has been installed and will be used for testing and experimental purposes.

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 twelve-inch centrifugal machine and a thirty-six inch hydroextractor; 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 is also an independently fired superheater capable of superheating 10,000 lbs. of steam per hour, 250° F., at a pressure of 250 lbs. It is connected so that superheated steam may be supplied to the laboratory for various experiments on and with superheated steam. The superheater is so connected to the boiler that efficiency tests can be made upon it.

There are available for purposes of experiment in connection with the work of these laboratories three 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 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 fifty 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, and a variety of other forms of apparatus. 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 flashpoint 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 two floors of the building Engineering C. It consists of ten small laboratories, most of which afford 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, pure-water distillation, the storage of chemicals and 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 equipment includes also a 120-volt storage battery. The laboratory has places for twenty research workers.

The Research Laboratory of Applied Chemistry.—This laboratory is located in a large room on the fifth floor of the Pierce Building, adjoining the Laboratory of Industrial Chemistry. It is fully equipped with everything which goes to make up a laboratory designed for research purposes, including a well-appointed machine shop. Its close proximity to the Laboratory of Industrial Chemistry renders available the large scale apparatus with which the latter is furnished. The laboratory will accommodate ten research workers.

The Augustus Lowell Laboratories of Electrical Engineering.—These laboratories embrace the Standardizing Laboratory, the High Voltage 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, single-phase, 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 of power-factor and frequency. Several oscillographs of different designs are provided for the examination of wave-forms. These are so arranged as to be readily portable, and are available for any tests carried on in the department. Included in the equipment of this laboratory is a complete set of portable potential and current transformers together with instruments, which make it possible to perform measurements in circuits of any voltage up to 13,000, and of current capacity up to 3,000 amperes. This equipment much facilitates the study of various problems of electrical engineering as they occur in practice. The laboratory is provided with sets of standard 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 High Voltage Laboratory is designed for the study of insulators and insulating materials as well as general high-voltage phenomena. For this purpose apparatus is provided for the determination of insulation resistances of both large samples of insulated wire and small specimens of insulating material under different conditions of temperature and electrical pressure. For determining dielectric strengths there are two fifteen kilowatt transformers, each capable of giving pressures up to 100,000 volts. These are provided with all necessary protective and controlling devices. The apparatus required for measuring high voltages and the ordinary electrical quantities is provided. Current for this laboratory is furnished by a dynamo which affords a wave form closely approximating to an exact sinusoid.

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 converter, having compounded field-widenings 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; a Lincoln variable speed motor and an Electro-Dynamic Company variable speed motor, each with 5-horse-power; 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, transformers, rotary converters, and reactors, 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. For the study of the phenomena of alternating current power transmission, an artificial transmission line is available, designed to give the constants of a 60-mile, three-phase system.

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. In connection with the photometric work there are various photometers of standard manufacture and a collection of primary and secondary light standards.

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 freezing and other microtomes, paraffin baths, microscopes, and reagents for work on the gross and microscopic anatomy of plants and animals. Students of Biology have also valuable privileges in connection with the Boston Society of Natural History, of which the museum and library are freely accessible.

For experimental work in Physiology there is a special laboratory equipped with continuous roll and drum kymographs, induction coils, and other electrical apparatus, moist chambers, tambours, plethysmographs, etc., for physiological measurements, 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 various branches of 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 experiments. 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 tanks," "sprinkling filters," 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 circuits 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.

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 capacity is also provided and wired directly to terminals on the switchboard 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, a Hartman and Braun resistance box, a 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. The laboratory is also provided with direct current mains capable of furnishing 100 amperes at 110 volts, and 300 amperes at 320 volts. 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 constructed at the Institute for electro-metallurgical work. A storage battery of large capacity has also been installed for processes requiring large currents at low constant voltage. Pyrometers for measuring very high temperatures and direct current and alternating current ammeters, voltmeters, and wattmeters complete the equipment for technical work.

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.

A photomicrographic camera and carefully selected apochromatic lenses supply the apparatus for photomicrographic work of high grade; and the equipment is supplemented by a Zeiss ultra-violet microscope operated by a high-power induction coil.

Provision is made for research in all the special laboratories.

The Geological and Mineralogical Laboratories.—These laboratories now occupy eight 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 Stratigraphic Geology and Paleontology contains in particular two extensive series of fossils, the one to illustrate their stratigraphic succession (Index Fossil set), the other their biologic relations. Besides these there is a reserve collection affording facilities for more extended work; and also a very good collection of modern shells for use in comparison with the fossil shells.

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 Petrographical Laboratory is equipped with eight polarizing microscopes and with excellent collections of rocks and rock thin sections.

The Laboratory of Mineralogy is equipped for work in both Descriptive and Determinative Mineralogy and Crystallography and contains collections of minerals arranged for class work in these subjects. The laboratory is also equipped with apparatus for the chemical and physical study of Mineralogy and Crystallography.

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-five wood-lathes, a large pattern-maker's lathe, and thirty-five 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 fifteen hand-lathes of approved patterns, a twenty-four-inch turret-lathe, three machine-drills, two centering-machines, four planers, a shaping-machine, two universal milling-machines furnished with spiral and gear-cutting attachments, a plain milling machine, two universal grinding-machines, a 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 recent years special courtesies have been shown by Mr. Lucius Tuttle, President of the Boston & Maine Railroad.

The Lowell Observatory.—Dr. Percival Lowell, the Director of this Observatory, is non-resident Professor of Astronomy in the Massachusetts Institute of Technology, and although there is no official connection between the two institutions, the Director is glad to extend to members of the Institute every facility for inspecting the work of the Observatory.

The Lowell Observatory is situated at Flagstaff, Arizona, 7,250 feet above the sea. It is furnished with a twenty-four-inch refractor built by Alvan Clark & Sons, a six-inch refractor made by the same firm and a large spectroscope by Brashear which is more powerful in the red end of the spectrum than any other in existence. Owing to the quality of the air at Flagstaff the conditions for astronomical observations are exceptionally favorable.

Equipment for Naval Architecture.—The Department of Naval Architecture possesses a valuable and constantly growing equipment. The departmental library contains a large collection of standard and recent works on Naval Architecture and Marine Engineering, including technical periodicals, and the students have also the advantage of the large libraries of Engineering, Physics, Chemistry, etc., belonging to the Institute.

There is in the drawing office of the department a collection of complete sets of drawings of ships and their machinery, both merchant ships and 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 courses on 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 above eighty thousand volumes and more than twenty thousand pamphlets, while over 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 eleven thousand volumes consisting of works 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, including a number of illustrated weekly papers in foreign languages. The Librarian of the Institute has his office adjoining. Near the office of the Librarian is the General Catalogue in which the location of any book belonging to the Institute may easily be ascertained. Each Departmental Library has also its special catalogue.

A collection of about four hundred volumes, chiefly on athletics, sports, and personal hygiene, given by the late Frank H. Cilley of the Class of 1889, to be placed in the Walker Memorial when that building is completed, are at present in the Technology Union. 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 extensive collections of the Boston Public Library, comprising about eight hundred 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, textbooks, 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 nineteen 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 may obtain permission to use it from the professor in charge.

The Library of History and Economics.—This library comprises twelve 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 seventeen 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 more popular of these are kept in the General Library.

The Engineering Library.—The libraries of the Departments of Civil, Mechanical, and Sanitary Engineering are united into a single library. This library contains about fourteen thousand volumes and five thousand pamphlets. It is especially rich in journals and transactions of societies dealing with the various branches of Engineering. Two hundred and forty 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 four thousand volumes, and receives annually eighty-four periodicals.

The Architectural Library.—The Architectural Library contains four thousand 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 sixteen thousand photographs and fifteen thousand 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 some eleven thousand volumes and two thousand 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 one hundred and twenty-two.

The Physical Library.—The library of the Department of Physics contains eight thousand volumes, and is very complete in recent works upon Physics, Electricity, and Electrochemistry. Eighty of the principal physical periodicals are received regularly, and all new publications of importance are procured.

The Library of Electrical Engineering.—This library contains about fifteen hundred volumes, including important sets of periodicals dealing with electrical and engineering subjects. For this Department the Institute takes regularly forty 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 four thousand 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 four thousand volumes and pamphlets. For this Department there are received regularly about seventy-five periodicals, including the biological publications of other colleges, 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 contains about fifteen hundred volumes and pamphlets on Naval Architecture, Ship-building, and Marine Engineering; and twenty-seven 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.

Scholarships and Fellowships.

Undergraduate Scholarships.—It is the policy of the Faculty to apply the available funds to the assistance of as many well qualified students as possible by assigning, in general, amounts less than the full tuition. Preference is given in making awards to regular students 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 whose record is not satisfactory. Awards will be made in August, 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 the State Board of Education may be advised as fully as possible in regard to the personal circumstances, as well as the scholastic standing of the applicants.

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.

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 they are to be awarded may be obtained by addressing the Secretary of the State Board of Education, State House, Boston. Applications for these scholarships must be filed on or before July 15 of each year.

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 English 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. This scholarship is restricted to students of Chemistry and preference will be given those 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 in aid of young men of American origin.

Dickinson Fund. By the will of Mrs. Ann White Dickinson the Institute has received about forty thousand dollars, the income of which is applied to the assistance of young men of American origin.

Austin Fund. From the estate of Edward Austin the Institute has received a bequest of three hundred and sixty thousand dollars to assist meritorious students and teachers in the pursuit of their studies. A part of the income from this fund is available for undergraduate scholarships.

Billings Student Fund. By the will of Robert C. Billings the Institute has received fifty thousand dollars. Any student receiving a benefit from this fund is expected to abstain from the use of alcohol and tobacco.

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.

William Barton Rogers Scholarship. In commemoration of the connection of President Rogers with William and Mary College of Virginia, the Executive Committee has established a scholarship of the value of three hundred dollars a year to be known as the William Barton Rogers Scholarship. This scholarship will be granted to a student nominated by the Faculty of William and Mary College.

Graduate Scholarships and Fellowships.—Applications for graduate scholarships or fellowships must be made upon blanks to be obtained from the Registrar and should, if possible, be presented to the Secretary of the Faculty 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 Fellowship. Founded by a bequest of Willard B. Perkins, of the Class of '72. The income, amounting to one 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. A portion of the income from this fund is devoted to undergraduate scholarships.

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 82, 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.

Lowell Institute.[1]

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 subjects included in the Courses are as follows:

First Year.—Mathematics; Elementary Physics, and Electricity; Elements of Mechanism, and Drawing.

Second-year Mechanical Course.—Elements of Thermodynamics, the Steam-engine and Boilers; Valve-gears; Mechanics; Elementary Hydraulics; Testing Laboratory; Steam and Hydraulic Laboratory; Mechanism Design, and Elementary Machine Design.

Second-year Electrical Course.—Elements of Thermodynamics, the Steam-engine and Boilers; Valve-gears; Steam Laboratory; Direct Current Machinery; Alternating Currents; Electric Distribution; Electrical Testing Laboratory; and Laboratory of Dynamo Electric Machinery.

It is the aim to adapt the courses to the men for whom the instruction is intended and to include the study of those principles with which they are not likely to become familiar in

[1] For general information in regard to the Lowell Institute, application should be made to Professor W. T. Sedgwick, Curator.

practice. The instruction embraces recitations, lectures, drawing-room practice, and laboratory exercises; and is given by members of the instructing staff of the Institute of Technology. Many of the lectures are fully illustrated by apparatus and experiments. Written tests are given from time to time, and problems are assigned for home work at nearly every exercise. Text-books are used in many of the subjects, but in some of the work, where the instruction differs widely from available books, printed notes are supplied to the students at cost. Students are expected to purchase such text-books, note-books, instruments, and other material as may be recommended throughout the course.

The scholarship of the students and their ability to continue the courses is determined in part by examinations, but considerable weight is given to the term's work. Those students who fail to keep well up with the work or to profit sufficiently by the instruction are informed that they are not qualified to pursue the course advantageously. Those who complete satisfactorily the required courses of the two years and pass the examinations are given certificates.

The School Year.—The next school year will begin October 4, 1909, and will close May 19, 1910. There will be a recess of one week at Christmas, and on legal holidays the exercises of the school will be suspended. Attendance from 7.30 to 9.30 for three or four evenings a week is required, in addition to outside study.

Requirements for Admission.—Application for admission should be made early and before June 1, if possible. To be admitted to the first-year Course the applicant must be at least eighteen years of age, and must pass satisfactorily entrance examinations in Arithmetic (including the Metric System), Elementary Alegebra, 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 Professor 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 1908 are:

President: WALTER B. SNOW, '82.

Vice-Presidents: EDWARD G. THOMAS, '87; ALBERT F. BEMIS, '93.

Secretary: WALTER HUMPHREYS, '97, Massachusetts Institute of Technology.

Executive Committee: THE PRESIDENT, VICE-PRESIDENTS, SECRETARY; ARTHUR G. ROBBINS, '86; LEONARD METCALF, '92; HOWARD L. COBURN, '98; and W. SPENCER HUTCHINSON, '92.

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 seven 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: JAMES FLACK NORRIS.
Vice-President: FRANK H. RAND.
Secretary: ROBERT S. WILLIAMS, '02.
Treasurer: AUGUSTUS H. GILL, '84.
Chairman of House Committee: HOWARD L. COBURN, '98.
Chairman of Membership Committee: FREDERICK S. WOODS.

The Executive Committee includes the above and the Secretary of the Faculty, *ex officio*.

NORTHWESTERN ALUMNI ASSOCIATION, MASSACHUSETTS INSTITUTE OF TECHNOLOGY.

This Association was founded in 1887, and at present numbers about five hundred members, the territory from which the membership is drawn including the whole country west of Buffalo and Pittsburgh. The headquarters of the Association is in Chicago, and a majority of the members are located in this city and the vicinity. Informal gatherings are held at various Clubs three or four times during the year, and the annual meeting and dinner occurs towards the end of February or early in March. The Association publishes a bulletin which announces meetings, speakers and other items of interest to the members. All former students of the Institute are welcomed to the Association, and may enjoy full privileges upon payment of dues, which are for non-resident members $1.00 and for resident members $2.00 per year.

President: JOHN L. SHORTALL, '88.
Vice-President: RICHARD E. SCHMIDT, '87.
Secretary-Treasurer: ERNEST WOODYATT, '97, 1615 Ashland Block, Chicago.
Executive Committee: THE PRESIDENT, VICE-PRESIDENT, SECRETARY, F. K. COPELAND, '76, SAMUEL D. FLOOD, '90, EDWARD M. HAGAR, '93, and MORTIMER FRANK, '97.

THE ROCKY MOUNTAIN TECHNOLOGY CLUB.

This Club was founded in 1889, and includes members from Colorado, Kansas, Wyoming, Montana, Utah and New Mexico. The meetings are held at the University Club, Denver, the annual meeting coming the Saturday before Christmas. The aim of the organization is to maintain as much Technology spirit as possible among the alumni in the far West.

President: FRANK E. SHEPARD, '87.

Vice-President: THEODORE E. SCHWARZ, '76.

Secretary: MAURICE B. BISCOE, '93, 25 East 18th Ave., Denver, Colo.

Treasurer: JOSEPH Y. PARCE, Jr., '93.

THE TECHNOLOGY CLUB OF NEW YORK CITY.

The Technology Club of New York was founded in 1895 and now has over three hundred members. All former students or instructors who have been connected with the Institute for at least one year, and who reside in the vicinity of New York City, are eligible for membership. Smokers and class reunions are held at the Club House, 36 East 28th Street, on the second and fourth Saturdays of each month. The annual meeting occurs on the first Saturday in February. Meals are served at the Club, and members of other Technology Associations may have the privileges of the Club House upon presentation of a card from their Secretary. The Club publishes an annual booklet containing reports, list of members, etc.

President: CHARLES R. RICHARDS, '85.

Secretary: WILLIAM H. KING, '94, 36 East 28th St.

Treasurer: JAMES E. BARLOW, '05.

Chairman of Membership Committee:

Board of Governors: THE PRESIDENT, SECRETARY, TREASURER, CHAIRMAN OF CLASS NIGHTS, and P. A. WARNER, '92.

Chairman of Smokers: WILL S. ALDRICH, '88.

Chairman of Class Nights:

THE TECHNOLOGY ASSOCIATION OF THE CONNECTICUT VALLEY.

This Club was formed in 1895. The region from which the membership is drawn comprises the entire territory in, and adjacent to, the Connecticut valley. One meeting is held during the year, usually in April, at Springfield or Hartford, and takes the form of a banquet at which there are several speakers. The Club has no permanent officers, but at each meeting a committee of arrangements for the next meeting is elected. All Technology men living within the territory named are considered members.

Executive Committee: Edmund P. Marsh, '89, *Chairman*, Springfield, Mass.; Clarence Whitney, '91; S. Ellsworth Horton, '90.

THE TECHNOLOGY CLUB OF PHILADELPHIA.

This Club was formed in 1896, and at present has sixty members. Conditions of membership are, that one must have been connected with the Institute, either as student or instructor, at least one year, and must have a residence within fifty miles of Philadelphia. Meetings are held about once a month, the time and place being determined by the Executive Committee. At these meetings papers on current topics are given by the members, and all Technology men are welcomed.

President: Jere R. Daniell, '97.

Vice-President: Frank H. Keisker, '97.

Secretary-Treasurer: Percy E. Tillson, '06, 419 Y. M. C. A. Bldg.

Executive Committee: Clayton W. Pike, '89; Harry P. Coddington, '95; Fred A. Hunnewell, '97; Edgar P. Trask, '99; Lewis A. Miller, '01; H. LeRoy Walker, '05.

THE PITTSBURGH ASSOCIATION, MASSACHUSETTS INSTITUTE OF TECHNOLOGY.

President: LUTHER K. YODER, '95.

Vice-President: SUMNER B. ELY, '92.

Secretary-Treasurer: WALDSO TURNER, '05, 1173 Frick Bldg. Annex.

Executive Committee: The PRESIDENT, VICE-PRESIDENT, SECRETARY-TREASURER, WARREN I. BICKFORD, '01, and C. SNELLING ROBINSON, '84.

THE TECHNOLOGY CLUB OF BUFFALO.

This Club was founded in 1898, and at present numbers forty-eight members. Any one who has been connected with the Institute for one year, and is now living within seventy-five miles of Buffalo, is eligible for membership. The meetings take the form of informal dinners, and are held four times during the year, the annual meeting coming on the second Saturday in September. Technical education is a subject of special interest at these gatherings, to which all Technology men are welcomed.

Secretary-Treasurer: HENRY A. BOYD, '79, 29 Erie Co. Bank Bldg., Buffalo, N.Y.

Executive Committee: THE SECRETARY-TREASURER, MAURICE B. PATCH, '72; N. LORING DANFORTH, '01; GEORGE A. RICKER, '86, and WARREN W. SANDERS, '00.

WASHINGTON SOCIETY OF THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY.

This society was established in 1899, and now numbers about one hundred and fifty members. The territory from which the membership is drawn includes Baltimore, the District of Columbia, Virginia and West Virginia. Informal dinners and smoke talks are held at the University Club, 930 16th Street, N.W., on the second Monday of each month, and at other times as announced. The annual meeting and dinner is held on the second Monday in December. All Technology men are invited to attend the informal meetings, and on notice to the Secretary are also welcomed to the annual dinner.

President: MARSHALL O. LEIGHTON, '96.

Vice-President: FREDERICK W. SWANTON,'90.

Secretary: ARTHUR C. WILLARD, '04, Geo. Washington Univ.

Treasurer: FRANCIS F. LONGLEY, '04.

Executive Committee: THE PRESIDENT, VICE-PRESIDENT, SECRETARY, TREASURER, and EDWIN F. ALLBRIGHT, '04.

M. I. T. CLUB OF CINCINNATI.

This Club was organized in 1901, and has a list of about eighty members. Any one is eligible to membership who has been connected with the Institute, either as student or instructor, for one year. Two regular yearly meetings are held, the time and place being decided by the Executive Committee. Members also meet regularly at luncheon every Tuesday from 12.30 to 1.30.

President: RUDOLPH TIETIG, '98.

Vice-President: STEPHEN H. WILDER, '74.

Treasurer: WILLIAM E. BROTHERTON, '73.

Secretary: H. C. SCHAEFER, '05, The Lunkenheimer Co.

Executive Committee: THE PRESIDENT, VICE-PRESIDENT, SECRETARY, TREASURER, MORTEN CARLISLE, '90; A. SENIOR PRINCE, '05; and STEWART MILLER, '06.

THE TECHNOLOGY CLUB OF THE MERRIMACK VALLEY.

This Club was organized in 1901, and now numbers about seventy-five members, who are located in the Merrimack Valley. The annual meeting occurs early in February, and numerous other gatherings called by the Executive Committee are held during the year, the times and places varying according to convenience.

President: RICHARD A. HALE, '77.

Vice-President: EDWARD B. CARNEY, '93.

Secretary: JOHN A. COLLINS, Jr., '97, 67 Thorndike St., Lawrence.

Treasurer: WILLIAM O. HILDRETH, '87.

Executive Committee: THE PRESIDENT, VICE-PRESIDENT, SECRETARY, TREASURER, and CHARLES H. EAMES, '97.

THE TECHNOLOGY CLUB OF RHODE ISLAND.

President: FREDERICK H. HOWLAND, '93.

Vice-President: KENNETH F. WOOD, '94.

Secretary-Treasurer: JOHN O. AMES, '93, Providence, 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.

This Club was established in 1904, and now numbers about twenty members. The annual meeting takes place on the first Thursday in November, and is followed shortly afterwards by the annual dinner. Other meetings are held from time to time at the homes of members on call of the Executive Committee.

President: EDGAR B. HAMMOND, '74.

Secretary-Treasurer: CHARLES F. WING, Jr., '98, 34 Purchase St.

Executive Committee: THE PRESIDENT, SECRETARY-TREASURER, and CHAUNCEY G. WHITON, '95.

VERMONT TECHNOLOGY ASSOCIATION.

The Vermont Technology Association was founded in 1905, and now has about twenty-five members. All Technology men residing in Vermont are eligible for membership, and alumni expecting to spend any time in the State are requested to send their names to the Secretary. The annual meeting and dinner is held in April or May, the place and date being determined by the Executive Committee. The inspection of plants and engineering works of interest is made a feature of the meeting.

President: CHARLES P. MOAT, '96.

Vice-President: ERNEST C. BRYANT, '93.

Secretary-Treasurer: ELBRIDGE C. JACOBS, '97, Burlington, Vt.

Executive Committee: THE PRESIDENT, VICE-PRESIDENT, SECRETARY-TREASURER and H. W. CLEMENT, '90.

THE TECHNOLOGY CLUB OF HARTFORD.

This Club was established in 1905, and has about forty members, most of whom reside in Hartford and its vicinity. Meetings are held once a month except in the summer, and the gatherings usually take place at Heublein's Hotel on the first Saturday in the month. Talks and discussions on subjects of general interest form a part of the programme of these meetings, and all Institute men not members of the Club are invited to attend. The annual meeting and dinner is held at the Hartford Club on the first Saturday in February.

President: CLARENCE E. WHITNEY, '91.

Vice-President: CHARLES R. NASON, '90.

Secretary-Treasurer: GEORGE W. BAKER, '92, 783 Main Street.

Board of Governors: THE PRESIDENT, VICE-PRESIDENT, SECRETARY-TREASURER, HOWARD H. BURDICK, '97, and EDMUND P. MARSH, '89.

THE TECHNOLOGY CLUB OF MINNESOTA.

President: HARRY W. JONES, '82.

Vice-President: HENRY YOERG, '95.

Secretary: JACOB STONE, JR., '99, 2436 Nicollet Avenue, Minneapolis.

Treasurer: JESSE SHUMAN, '97.

THE TECHNOLOGY CLUB OF NORTHERN OHIO.

This Club was formed in 1906, and has a membership of about fifty alumni of the Institute now residing in the northern part of Ohio. Meetings will be held occasionally during the winter. Annual dinner in February.

President: FRANKLIN B. RICHARDS, '84.

Vice-President: ROBERT B. WALLACE, '99.

Secretary: SIDNEY Y. BALL, '03, 1847 East 97th St., Cleveland, Ohio.

TECHNOLOGY ASSOCIATION OF NORTHERN CALIFORNIA.

This Association was organized in 1907, and its list of about seventy men is made up principally of Technology men residing in or near Northern California and Nevada. The purpose of the Association is to bring all Technology men in this region into the closest possible touch with each other. Dinners and other social gatherings are held at frequent intervals, and the annual meeting takes place on the first Saturday in May. Technology men visiting California are requested to notify the Executive Committee of their presence in order that small gatherings of special friends may be encouraged. A handbook of the Association will be issued.

President: CHARLES G. HYDE, '96, University of California, Berkeley.

Secretary-Treasurer: HOWARD C. BLAKE, '06.

Executive Committee: THE PRESIDENT, SECRETARY-TREASURER, WILLIAM E. LELAND, '91, OSCAR C. MERRILL, '05, ERNEST A. HERSAM, '91.

TECHNOLOGY CLUB OF THE SOUTH.

This Club was formed in 1907 and has now twenty-seven members. No constitution has been published, but it is the intention to hold quarterly meetings with the annual meeting May 1. Any Technology alumnus not a member is heartily welcomed to these gatherings.

President: ALLISON OWEN, '94.

Vice-President: WALTER G. ZIMMERMAN, '98.

Secretary-Treasurer: FRANK W. CROSBY, '92, 705 Morris Bldg., New Orleans, La.

THE M. I. T. CLUB OF CENTRAL NEW YORK.

This Club was founded in 1907 with a membership of twenty-five. Any one who has been connected with the Institute for one year, either as teacher or student, and who now resides in Central New York may become a member. Technology alumni from other places are invited to attend the meetings, and members of other Technology Alumni Societies are given full privileges.

No definite plan for meetings has, as yet, been adopted.

President: WALTER E. HOPTON, '91.

Secretary: IRVING S. MERRILL, '96, N. Franklin St., Syracuse, N.Y.

TECHNOLOGY CLUB OF SOUTHERN CALIFORNIA.

This Club was organized at Los Angeles, December 16, 1907, eighteen men being present. The object of the Club is to maintain the spirit of Technology and to promote interest in her welfare, as well as to make Institute men mutually helpful to each other. Any one who has been connected with the Institute one year is eligible for membership, and any Technology man who may be in the vicinity is welcomed to the meetings. Two regular meetings are held each year, one on the first Saturday in June and one on the first Saturday in December.

President: WILLIS T. KNOWLTON, '93.

Vice-President: JAMES W. JOHNSON, '82.

Secretary-Treasurer: ARTHUR B. WHITE, '00, 606 San Fernando Bldg., Los Angeles.

INLAND EMPIRE ASSOCIATION OF THE M. I. T.

Secretary: JAMES E. GRIFFIN, '06, 1711 10th Ave., Spokane.

Detailed information in regard to this Association has not yet been received

TECHNOLOGY CLUB OF CENTRAL PENNSYLVANIA.

Secretary: STEPHEN BADLAM, '00, Post-office Box 183, Steelton.

Detailed information in regard to this Association has not yet been received.

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 officio.* 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, City Hall, Boston.

Assistant Secretary, ISAAC W. LITCHFIELD, '85, 161 Devonshire St., Boston.

Class Secretaries, ROBERT H. RICHARDS, '68; HOWARD A. CARSON, '69; CHARLES R. CROSS, '70; EDWARD W. ROLLINS, '71; C. FRANK ALLEN, '72; SAMUEL E. TINKHAM, '73; CHARLES F. READ, '74; EDWARD A. W. HAMMATT, '75; JOHN R. FREEMAN, '76; RICHARD A. HALE, '77; LINWOOD O. TOWNE, '78; EDWIN C. MILLER, '79; GEORGE H. BARTON, '80; FRANK E. CAME, '81; WALTER B. SNOW, '82; HARVEY S. CHASE, '83; WILLIAM L. PUFFER, '84; ISAAC W. LITCHFIELD, '85; ARTHUR G. ROBBINS, '86; EDWARD G. THOMAS, '87; WILLIAM G. SNOW, '88; WILLIAM E. MOTT, '89; GEORGE L. GILMORE, '90; HOWARD C. FORBES, '91; WILLIAM A. JOHNSTON, '92; FREDERIC H. FAY, '93; SAMUEL C. PRESCOTT, '94; CHARLES H. PARKER, '95; CHARLES E. LOCKE, '96; JOHN A. COLLINS, Jr., '97; CHAS.-EDWARD A. WINSLOW, '98; HERVEY J. SKINNER, '99; HARRY E. OSGOOD, '00; ROBERT L. WILLIAMS, '01; FREDERICK H. HUNTER, '02; FREDERIC A. OLMSTED, '03; REGINALD A. WENTWORTH, '04; GROSVENOR DEW. MARCY, '05; GEORGE F. HOBSON, '06; A. MACOMBER, '07; JOHN T. TOBIN, '08; JAMES

H. CRITCHETT, '09; FRANK D. STEWART, '10; WILLIAM C. SALISBURY, '11; HENRY DONALD KEMP, '12.

Members, ex officio, ALFRED E. BURTON, Dean of the Faculty; ALLYNE L. MERRILL, '85, Secretary of the Faculty; WALTER B. SNOW, '82, President of the Alumni Association; WALTER HUMPHREYS, '97, Secretary of the Alumni Association; JAMES F. NORRIS, President of the Technology Club; ROBERT S. WILLIAMS, '02, Secretary of the Technology Club; JAMES H. CRITCHETT, President of the Institute Committee; ERNEST WOODYATT, '97, Secretary, North-western Association M. I. T.; MAURICE B. BISCOE, '93, Secretary, Rocky Mountain Technology Club; WILLIAM H. KING, '94, Secretary, Technology Club of New York; EDMUND P. MARSH, '89, Chairman, Executive Committee, Technology Club of the Connecticut Valley; PERCY E. TILLSON, '06, Secretary, Technology Club of Philadelphia; WALDSO TURNER, '05, Secretary, Pittsburg Technology Association; HENRY A. BOYD, '79, Secretary, Technology Club of Buffalo; ARTHUR C. WILLARD, '04, Secretary, Washington Society of the M. I. T.; H. C. SCHAEFER, '05, Secretary, The Cincinnati Club of the M. I. T.; JOHN A. COLLINS, Jr., '97, Secretary, The Technology Club of the Merrimack Valley; JOHN O. AMES, '93, Secretary, The Technology Club of Rhode Island; CHARLES F. WING, Jr., '99, Secretary, The Technology Club of New Bedford; CHARLES H. STRATTON, '00, Secretary, Annapolis Society of M. I. T.; ELBRIDGE C. JACOBS, '97, Secretary, Vermont Technology Association; GEORGE W. BAKER, '92, Secretary, Technology Club of Hartford; JACOB STONE, Jr., '99, Secretary, The Technology Club of Minnesota; SIDNEY Y. BALL, '03, Secretary, The Technology Club of Northern Ohio; HOWARD C. BLAKE, '06, Secretary, Technology Association of Northern California; FRANK W. CROSBY, '92, Secretary, Technology Club of the South; ARTHUR B. WHITE, '00, Secretary, Technology Club of Southern California; JAMES E. GRIFFIN, '06, Secretary, Inland Empire Association of the M. I. T.; STEPHEN BADLAM, '00, Secretary, Technology Club of Central Pennsylvania.

Committee on Publications, JAMES P. MUNROE, '82; WALTER B. SNOW, '82; ARTHUR A. NOYES, '86; WALTER HUMPHREYS, '97; I. W. LITCHFIELD, '85.

Statistics of the Graduates.

DOCTORS OF PHILOSOPHY.

The degree of Doctor of Philosophy was first conferred by the Institute in 1907 and of the six candidates upon whom it has been bestowed three have received their Bachelor's degree from the Institute and one has also received the Master's degree.

MASTERS OF SCIENCE.

The degree of Master of Science was first granted by the Institute in 1886 and since then the title has been conferred one hundred and eight times. Of the total number of recipients of the Master's degree seventy received their Bachelor's degree also from the Institute.

MASTERS OF SCIENCE BY YEARS.

1886	1	1897	4	1905	18
1887	1	1898	5	1906	9
1890	1	1899	3	1907	15
1893	1	1901	4	1908	12
1894	1	1902	8		
1895	3	1903	7	Total	108
1896	3	1904	12		

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 1908.

GRADUATES BY YEARS AND 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
1906	47	69	38	22	21	–	37	2	7	–	10	6	–	19	278
1907	37	52	22	21	10	–	32	–	5	–	14	3	2	10	208
1908	47	61	19	19	16	–	38	4	2	–	15	2	–	5	228
Totals	736	924	385	349	392	1	678	58	73	96*	183	62	14	160	4,106*

Names counted twice, students graduating in two different years . . .	20
Bachelors of Science	4,086*
Masters of Science, not included in the above	38
Doctors of Philosophy, not included in the above	1
Total . . .	4,127*

* Deducting names counted twice (students graduating in two courses).

GEOGRAPHICAL DISTRIBUTION OF GRADUATES.

UNITED STATES.

State	Number	State	Number
Alabama	11	Nebraska	8
Alaska	5	Nevada	18
Arizona	15	New Hampshire	33
Arkansas	2	New Jersey	78
California	89	New Mexico	5
Canal Zone	9	New York	634
Colorado	49	North Carolina	7
Connecticut	79	North Dakota	5
Delaware	14	Ohio	130
District of Columbia	101	Oklahoma	3
Florida	4	Oregon	10
Georgia	27	Pennsylvania	250
Hawaii	5	Philippine Islands	5
Idaho	9	Porto Rico	7
Illinois	180	Rhode Island	64
Indiana	35	South Carolina	4
Iowa	13	South Dakota	6
Kansas	11	Tennessee	13
Kentucky	14	Texas	29
Louisiana	14	Utah	19
Maine	49	Vermont	17
Maryland	27	Virginia	28
Massachusetts	1,187	Washington	27
Michigan	50	W. Virginia	9
Minnesota	30	Wisconsin	27
Mississippi	2	Wyoming	3
Missouri	44		
Montana	23		3,537

FOREIGN COUNTRIES.

Country	Number	Country	Number
Alberta	1	Nova Scotia	5
Argentina	1	Ontario	16
Australia	1	Persia	1
Belgium	1	Peru	1
Bolivia	1	Quebec	22
Brazil	5	Russia	1
British Columbia	6	Scotland	2
Cape Breton	1	Syria	1
Chile	1	Transvaal	2
China	2	Yukon	1
Costa Rica	1		
Cuba	7		149
England	7		
France	6		3,686
Germany	7	Unreported	24
India	1		
Italy	3		3,710
Japan	6	Deceased	177
Korea	2		
Mexico	36	Total	3,887
New Brunswick	1		

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.

1868–1907.

In Engineering Practice	134
With Railroad or Street Railway Companies	106
In United States Employ	44
In State Employ	26
In Municipal Employ	77
Steel and Iron Manufactures	12
Miscellaneous Manufactures	20
Engineering Business	29
Mining Business	4
Draughtsman	9
Contractors	13
With Construction Companies	49
With Gas and Insurance Companies	6
Teachers and Students	36
Other Professions and Business	55
Unassigned	25
	645
Deceased	43
	688

COURSE II., MECHANICAL ENGINEERING.

1868–1907.

Experts and Consulting Engineers	199
In Railroad Employ	27
Textile Industries	25
Ship and Marine Engine Works	11
Heating and Ventilation	13
Steel and Iron Works	37
Machine Construction	60
Special Machinery and Manufactures	86
Electrical Business	32
Engineering Business	136
In United States Employ	33
Teachers	56
Students	7
Lawyers	9
Manufacturing Chemists	6
Other Professions and Business	54
Unassigned	37
	828
Deceased	35
	863

COURSE III., MINING ENGINEERING AND METALLURGY.

1868–1907.

In Engineering Practice and Business	164
With Iron and Steel Works	35
Assayers and Chemists	29
In United States Employ	7
In State Employ	1
In Municipal Employ	2
Miscellaneous Manufactures	7
With Electric Companies	6
In Railroad Employ	3
Teachers	23
Students	1
Lawyers	2
Bankers and Brokers	4
Other Professions and Business	39
Unassigned	17
	340
Deceased	27
	367

COURSE IV., ARCHITECTURE.

1873–1907.

Architects	181
Landscape Architects	4
Architectural Engineers	31
Draughtsmen	22
Teachers	13
Students	6
In United States Employ	8
Miscellaneous Manufactures	3
Building	3
Brokers	1
Library Work	1
Other Professions and Business	18
Unassigned	24
	315
Deceased	15
	330

COURSE V., CHEMISTRY.

1869–1907.

Manufacture of Chemicals or Chemical Products	48
Metallurgists or Metallurgical Chemists	25
Analytical Chemists or Consulting Experts	48
Textile Industries	18
Soap, Lard, Glycerine, and Oil Industries	15
Public Health Laboratories	19
Miscellaneous Manufactures	14
Paper Industries	8
Rubber Industries	7
Sugar and Starch Industries	4
White Lead and Paint Industries	4
Gas Inspectors	6
Teachers	52
Research Work	14
Students	2
Insurance	2
Physicians	4
In United States Employ	12
Other Professions and Business	29
Unassigned	26
	357
Deceased	19
	376

COURSE VI., ELECTRICAL ENGINEERING.

1885–1907.

Electrical Engineers	235
Electrical Business	107
With Telegraph and Telephone Companies	71
With Street Railway Companies	17
Electro-chemists and Chemists	7
Engineers other than Electrical	24
General Business	58
In United States Employ	22
Teachers	32
Other Professions	20
Unassigned	28
	621
Deceased	19
	640

COURSE VII., BIOLOGY.

1876–1907.

Biologists	14
Physicians	12
In United States Employ	1
Library Work	2
Teachers	10
Students	1
Other Professions and Business	8
Unassigned	4
	52
Deceased	2
	54

COURSE VIII., PHYSICS.

1875–1907.

Astronomers	7
Teachers	21
Engaged in Private Research	1
In United States Employ	4
Other Professions and Business	27
Unassigned	7
	67
Deceased	4
	71

COURSE IX., GENERAL STUDIES.

1868–1907.

General Business	35
Bankers and Brokers	6
Lawyers	7
Journalists	2
In Engineering Practice	5
Teachers	13
Miscellaneous Manufactures	4
Insurance	3
In United States Employ	3
Other Professions	7
Unassigned	6
	91
Deceased	5
	96

COURSE X., CHEMICAL ENGINEERING.

1891–1907.

Manufacture of Chemicals or Chemical Products	41
Other Manufactures	31
Soap, Glycerine, or Oil Industries	7
Textile Industries	9
Insurance Inspection	6
Paper Manufacture	4
Rubber Manufacture	7
Sugar Industries	2
Water and Sewerage	1
In United States Employ	1
Consulting Engineers	7
Gas Manufacture	7
Electro-chemical or Electrical Industries	4
Teachers	13
Students	2
Lawyers	6
Publishers	1
Other Professions and Business	[illegible]
Unassigned	6
	165
Deceased	3
	168

COURSE XI., SANITARY ENGINEERING.

1892–1907.

In United States Employ	4
In State Employ on Sanitary Work	12
In Municipal Employ on Sanitary Work	17
In Private Employ on Sanitary Work	7
In Engineering Work other than Sanitary	7
Teachers	2
Bankers	1
Miscellaneous Manufactures	5
Unassigned	3
	58
Deceased	2
	60

COURSE XII., GEOLOGY.

1891–1907.

Geologists	3
Civil Engineers	2
Teachers	5
Business	1
Unassigned	2
	13
Deceased	1
	14

COURSE XIII., NAVAL ARCHITECTURE.

1895–1907.

Naval Architects	33
Marine Engineers	28
Civil and Mechanical Engineers	23
Electrical Engineers	9
Machine Construction	16
Steel Companies	4
Miscellaneous Manufactures	7
Business	9
Teachers and Students	14
Unassigned	10
	153
Deceased	2
	155

Titles of Theses

OF SUCCESSFUL CANDIDATES FOR GRADUATION,
JUNE, 1908.

Candidates for the Degree of Doctor of Philosophy.

GEORGE ALONZO ABBOTT, A.M. — Indianapolis, Ind.
A Physico-Chemical Study of Ortho and Pyro Phosphoric Acids and of their Sodium and Ammonium Salts.

CHARLES AUGUST KRAUS, B.S. — Newton Centre
Solutions of Metals in Non-Metallic Solvents.

EDWARD WIGHT WASHBURN, S.B. — Dorchester
Ionic Hydration and True Transference Numbers.

Candidates for the Degree of Master of Science.

ROWLAND BARNEY ANTHONY, A.B., B.S. — Kewanee, Ill.
A Study of the Phenomena Attending the Opening of Alternating Current Circuits in Air.

FREDERIC GALLUP COBURN, U.S.N. — Duluth, Minn.
Fuel Oil Tests on a Forge Furnace. (*With G. C. Westervelt.*)

WALDO PUTNAM DRULEY, U.S.N. — Belpre, Ohio
Test on Water Tight Deck. (*With A. H. Van Keuren.*)

PAUL HENRY FRETZ, U.S.N. — Washington, D.C.
Ventilation Test on U.S.S. *Salem*. (*With R. W. Ryden.*)

EDWIN GRAHAM KINTNER, U.S.N. — Davidson, Ind.
Friction Tests.

GEORGE MOIR JOHNSTONE MACKAY, M.A. — Dartmouth, N.S.
The Equilibria in Aqueous Solutions Containing Copper and Iodine.

EDWARD LEYBURN MORELAND, A.B. — McDonogh, Md.
A Study of the Phenomena Attending the Opening of Alternating Current Circuits in Air.

ROY WARREN RYDEN, U.S.N. — Brookline
Ventilation Test on U.S.S. *Salem*. (*With P. H. Fretz.*)

ARMEN HAIGOUNI TASHJIAN, A.B. Smyrna, Turkey
A Study of Some Properties of Concrete at High Temperature.

ALEXANDER HAMILTON VAN KEUREN, U.S.N. Howell, Mich.
Test on Water Tight Deck. (*With W. P. Druley.*)

GEORGE CONRAD WESTERVELT, U.S.N. Washington, D.C.
Fuel Oil Tests on a Forge Furnace. (*With F. G. Coburn.*)

FRANK WILLIAM WILLEY, B.S. Cincinnati, Ohio
The Effect of Frequency on the Disruptive Discharge.

Candidates for the Degree of Bachelor of Science.

I. Civil Engineering.	V. Chemistry.	X. Chemical Engineering.
II. Mechanical Engineering.	VI. Electrical Engineering.	XI. Sanitary Engineering.
III. Mining Engineering and Metallurgy.	VII. Biology.	XII. Geology.
IV. Architecture.	VIII. Physics.	XIII. Naval Architecture.

ROBERT CLIFFORD ALBRO (I) Springfield
Design for an Elevated Steel Water Tank.

HORACE ETHAN ALLEN (II) Toledo, Ohio
The Effect of Moisture in Air Brake Distributing Valves. (*With G. T. Glover.*)

LAWRENCE HOWE ALLEN (I) Quincy
The Elimination of Grade Crossing at Quincy. (*With C. O. Brown and A. C. Nichols.*)

MAURICE EVERETT ALLEN (I) Toledo, Ohio
An Investigation as to the Depth in a Vertical at which the Ratio of Observed to Mean Velocity is Least Variable. (*With W. I. Griffin.*)

MONROE AMES (I) West Medford
A Plan for Grade Crossing Elimination at Newton Lower Falls.

ROBERT CORSON ANGELL (II) South Fargo, N. Dak.
An Investigation of Running Balance at High Rotative Speeds on a Hydro-extractor. (*With J. M. Talbot.*)

ROBERT ALEXANDER ANGUS (II) Hartford, Conn.
Comparative Coal Tests using Forced and Natural Drafts. (*With H. R. Callaway.*)

ALFRED BENNETT BABCOCK (X) Boston
The Heat of Neutralization of Acids and Bases at 100° C.

MABEL KEYES BABCOCK, A.B. (IV) Wellesley Hills
Design for the Campus for the Northwestern University, Evanston, Illinois.

Carl Henry Bangs (II) South Braintree
Economy Tests of a 2000 K.W. Curtis Turbine at the Quincy Point Power Station of the Old Colony Street Railway Company. (*With S. F. Kedy.*)

Walter James Emmons Barcus (III) Albany, N.Y.
The Concentration of a Copper Ore from Virginia. (*With A. N. Penny.*)

John Stetson Barnes (II) Syracuse, N.Y.
A Test on Chrome-tan Belting and an Investigation of the Variation of the Sum of the Tensions. (*With J. H. Dennedy.*)

William Edward Barton (I) Somerville
Experiments to Determine Coefficient of Distribution of Certain Types of Sprinkler Filter Nozzles. (*With E. R. Smith.*)

Ralph Johnson Batchelder (IV) North Cambridge
Design for a Post Office and Custom House for a Large City.

Howard Edwin Batsford (X) Utica, N.Y.
Influence of the Temperature Employed on the Yield Obtained in the Destructive Distillation of Wood. (*With C. W. Clark.*)

Frank Kennedy Belcher (II) Medford
Carburation in Automobile Engines. (*With S. H. Daddow.*)

George Myron Belcher (I) Malden
Gauging of Steam Flow by Chemical Means. (*With C. S. Colson.*)

Harry Howe Bentley (IV) Oskaloosa, Iowa
Design for a Preparatory School.

Viggo Edward Bird (VI) Copenhagen, Denmark
A Design for a Hydro-electric Power Plant. (*With G. A. Murfey.*)

William Peet Bixby, S.B. (VI) Woburn
An Investigation of Flaming Arc Lights. (*With A. C. Sloss, Jr.*)

Henry Washington Blackburn (II) Lawrence
Tests on a Producer Gas Engine Plant. (*With C. A. Edmonds.*)

Francis Marvin Bond, A.B. (II) Baltimore, Md.
Determination of the Coefficient of the Trapezoidal Weir of Cippoletti. (*With P. R. Powell.*)

Ygnacio Safford Bonillas (III) Nogales, Mexico
Geology of Igneous Rocks Bordering the Narragansett Basin. (*With V. M. Frey.*)

Wilfred Edwin Bo[illegible] (VI) Waterville, Conn.
A Study of the Effect of Unbalancing on a 3-Wire Converter. (*With E. E. Kilburn.*)

KENNETH CAMM BOUSH (II) Brookline
Investigation of the Flow of Air through a Venturi Meter. (*With I. M. Guilford.*)

DONALD BOWMAN (VI) Marion, Ind.
A Comparison of Different Styles of Links in Enclosed Fuses. (*With L. B. Hedge.*)

CLIFFORD HALL BOYLSTON (I) Milton
Design for a Reinforced Concrete Arch.

ALEXANDER HENRY BRADFORD (III) Raynham
Pyritic Smelting of Nickel and Copper Bearing Pyrrhotite. (*With C. A. Gibbons, Jr.*)

ARTHUR EDMUND BREMER (I) Hoboken, N.J.
Design for Approaches and Concrete Arch over the Charles River in Newton. (*With F. A. Cole.*)

JOHN CUMMINGS BROOKS (II) Westfield
The Efficiency and Losses in a Hydro-electric Power Plant. (*With A. A. Longley.*)

CLAUDE OSGOOD BROWN (I) Haverhill
The Elimination of Grade Crossing at Quincy. (*With L. H. Allen and A. C. Nichols.*)

HARRY WHEELER BROWN, S.B. (VI) Allston
Comparative Tests of Storage Batteries. (*With F. M. Fuller.*)

PHILIP CARTER BROWN, A.B. (II) Dover, N.H.
A Study for Proper Formulas and Calculations for Reinforced Concrete Beams.

BENJAMIN BULLARD (VI) Garden City, Kans.
Operation of a Synchronous Motor near Unity Power Factor. (*With J. G. Gaylord.*)

JAMES MERRILL BURCH, JR. (II) Dubuque, Iowa
Investigation of the Starrett Air Lift Pump. (*With W. E. Caldwell.*)

HARRY LANCASTER BURGESS (VI) New York, N.Y.
An Investigation of the Westinghouse Automatic Synchronizer. (*With H. F. Richardson.*)

MORTIMER PERRY BURROUGHS (I) Boston
Design of a Reinforced Concrete Stand Pipe.

WALTER EVANS CALDWELL (II) Louisville, Ky.
Investigation of the Starrett Air Lift Pump. (*With J. M. Burch, Jr.*)

HENDLEY ROSS CALLAWAY (II) Westfield, N.J.
Comparative Coal Tests using Forced and Natural Drafts. (*With R. A. Angus.*)

HAROLD LESTON CARTER (II) Beachmont
Investigation of the Friction Losses in the Rubber Hose as used with the Vacuum Cleaner. (*With C. N. Cochrane.*)

BURTON WOLCOTT CARY (II) Lowell
Variation of Capacity with Different Heads and Speed of the Centrifugal Pump at the Metropolitan Sewerage Station, East Boston. (*With J. B. Sando.*)

LESLIE PHELPS CASSINO (II) Salem
Efficiency Test of a 500 K.W. Curtis Turbine at the United Shoe Machinery Company's Works, Beverly. (*With C. A. Hall.*)

HARRY STUART CHANDLER (X) Somerville
The Function of Nitrogen in Case-Hardening Iron.

KENNETH GORDON CHIPMAN (III) West Newton
The Geology of Cape Ann Granites. (*With J. W. Maxwell.*)

ARTHUR OLAF CHRISTENSEN (III) Beaufort, S.C.
Assay of Arsenical Ores for Gold and Silver.

CHALMERS STEVENS CLAPP (IV) Dorchester
Design for a City Club House.

CLARENCE WARNER CLARK (X) Roxbury
Influence of the Temperature Employed on the Yield Obtained in the Destructive Distillation of Wood. (*With H. E. Batsford.*)

DANA WRIGHT CLARK (II) Andover
Investigation of the Steam Economy of a Woolen Mill. (*With F. J. Friedman.*)

LAWRENCE ADDISON CLARK (II) Pontiac, Ill.
The Protection of Steam Heated Surfaces against Heat Loss. (*With C. H. Spiehler.*)

CLIFFORD NELSON COCHRANE (II) Melrose
Investigation of the Friction Losses in the Rubber Hose as used with the Vacuum Cleaner. (*With H. L. Carter.*)

LANGDON COFFIN (II) Newton
Investigation of the Stiffness of Steam Pipe Bends. (*With H. S. Eames.*)

ABRAHAM SAUL COHEN (II) Boston
Friction of the Chapman Double Ball Bearing.

FREDERICK ARTHUR COLE (I) Newton Highlands
Design for Approaches and Concrete Arch over the Charles River in Newton. (*With A. E. Bremer.*)

RICHARD CARTER COLLINS (II) Malden
A Turbine Plant Test at the Amoskeag Mills, Manchester, New Hampshire. (*With B. S. Leslie.*)

CHESTER SIMMONS COLSON (I) Beverly
Gauging of Steam Flow by Chemical Means. (*With G. M. Belcher.*)

JOHN STARR COYE, B.S. (V) Carson, Iowa
The Use of Diazotization and Development Methods in the Identification of Dyes.

RUSSELL GILBERT CRANE (IV) Taunton
Design for a Capitol for a Small State.

CHESNEY HARRISON CRISWELL, A.B. (X) Franklin, Pa.
A Study of the Soda Recovery and Causticizing Plant of a Paper Mill. (*With E. Myers.*)

HARDY CROSS, A.B., B.S. (I) Norfolk, Va.
Experimental Studies of the Lateral Thrust and Angle of Internal Friction of Soils. (*With H. V. Spurr and G. D. Whittle.*)

SAMUEL HARRIES DADDOW, A.B. (II) St. Clair, Pa.
Carburation in Automobile Engines. (*With F. K. Belcher.*)

HENRY HYMAN DAMON, A.B. (I) Boston
Design for a Reinforced Concrete Retaining Wall.

ALLSTON DANA, A.B. (I) Cambridge
A Review of Tests and a General Discussion of the Mechanical Bond of Steel Reinforcement for Concrete. (*With R. W. Ferris.*)

STEPHEN LOCK DAVIDSON (I) Wichita, Kans.
Design for a Reinforced Concrete Warehouse.

RAE WILLARD DAVIS, A.B. (VI) Watertown, S. Dak.
Some Experiences with a Fifty Kilowatt Rotary Converter. (*With J. G. Reid.*)

ARNOLD TRUMAN DEAN (I) Taunton
Design for a Sewage Disposal Plant at Taunton.

JAMES HOWARD DENNEDY (II) Detroit, Mich.
A Test on Chrome-tan Belting and an Investigation of the Variation of the Sum of the Tensions. (*With J. S. Barnes.*)

MAURICE EDWARD DENNY (XIII) Cardross, Scotland
Tank and Trial Results of the Twin-screw S.S. *Hythe.*

GREGORY MUMFORD DEXTER (I) Providence, R.I.
The Elimination of Grade Crossing at Greenwood Avenue, Rumford, Rhode Island.

LEON ARTHUR DICKINSON (III) Somerville
Constitution of Copper Nickel Sulphides.

WILLIAM FREDRIC DOLKE, JR. (IV) St. Paul, Minn.
Design for an Opera House.

RAYMOND EDWARD DRAKE (V) Brockton
The Identification of Azo-dyestuffs through Reduction with Hydrosulphites.

CLIFTON NATHAN DRAPER (V) Norwich, Conn.
A Partial Procedure for the Identification of the Azo-dyestuffs.

GUSTAVO ADOLFO DUBOIS (I) Matanzas, Cuba
Design for a Reinforced Concrete Arch.

HERBERT SETON EAMES (II) South Framingham
Investigation of the Stiffness of Steam Pipe Bends. (*With L. Coffin.*)

CHARLES ASHTON EDMONDS (II) Lawrence
Test on a Producer Gas Engine Plant. (*With H. W. Blackburn.*)

PAUL ALBERT ESTEN (V) Dorchester
A Method for the Determination of the Tensile Strength of Glue.

PAUL REVERE FANNING (III) Denver, Colo.
The Granites of Westerly, Rhode Island.

HAROLD CUSHING FAXON (II) Randolph
Efficiency Test on a Smoke Consumer. (*With E. R. Hall.*)

RAYMOND WEST FERRIS (I) Waban
A Review of Tests and a General Discussion of the Mechanical Bond of Steel Reinforcements for Concrete. (*With A. Dana.*)

HERBERT LAWRENCE FLETCHER (VI) Lawrence
An Investigation of the Resistance of Wire Joints.

BENJAMIN GREELY FOGG (I) Newburyport
A Design for a Suspension Bridge to Replace the Chain Bridge over the Merrimac River at Newburyport.

RUFUS COFFIN FOLSOM, A.B. (X) Dorchester
Tests on a Suction Gas Producer and Gas Engine.

WILLIAM CUMNER FOLSOM (XI) Melrose Highlands
Experiments to Determine the Lateral Distribution of Sewage in Percolating Filters. (*With D. H. Maxwell.*)

WINTHROP DREW FORD (II) Kingston
Efficiency Test on a Producer Plant. (*With M. Sampson.*)

JACOB ALGER FOTTLER (VI) Montello
Investigation of the Torque per Ampere of an Alternating Current Series Motor. (*With F. W. Lyle.*)

VICTOR MAX FREY, A.B. (III) York, Pa.
Geology of Igneous Rocks Bordering the Narragansett Basin. (*With Y. S. Bonillas.*)

FERDINAND JACOB FRIEDMAN (II) New York, N.Y.
Investigation of the Steam Economy of a Woolen Mill. (*With D. W. Clark.*)

FLOID MERRILL FULLER, S.B. (VI) Scranton, Pa.
Comparative Tests of Storage Batteries. (*With H. W. Brown.*)

JAMES THOMAS GALLAGHER (II) Leominster
Tests on Cutting Speed of Lathe Tools. (*With H. C. Lord.*)

ARTHUR LIVERMORE GARDNER (X) Wakefield
A Study of Some Preservative Coatings for Iron.

JOHN CLARENCE GAYLORD, B.S. (VI.) Pasadena, Cal.
Operation of a Synchronous Motor near Unity Power Factor. (*With B. Bullard.*)

ERNEST GEORGE GENOUD (V) Dorchester
The Colored Salts of Bases Formed by Condensing m-Aminodimethylaniline with Aromatic Aldehydes.

HERBERT THURSTON GERRISH (I) Melrose
A Study of the Removal of Ledge under Water.

JOHN GIANELLA, JR. (X) Brooklyn, N.Y.
Reduction of Formic Acid to Formaldehyde and Methyl Alcohol.

CHARLES ALPHONSUS GIBBONS, JR. (III) Taunton
Pyritic Smelting of Nickel and Copper Bearing Pyrrhotite. (*With A. H. Bradford.*)

BASIL LOVIBOND GIMSON (II) Leicester, England
Design of a Heating System for the Senate Office Building at Washington, District of Columbia.

GEORGE THUMMEL GLOVER (II) Grand Island, Nebr.
The Effect of Moisture in Air Brake Distributing Valves. (*With H. E. Allen.*)

LYNN SUMNER GOODMAN, PH.B. (VI) Loganton, Pa.
Tests on the Plant and Installation of the Gillette Safety Razor Company of Boston.

GARDNER SABIN GOULD (I) (As of the class of 1907.) Newton Upper Falls
The Abolition of the Grade Crossing at Quincy.

WHEATON IRA GRIFFIN (I) Utica, N.Y.
An Investigation as to the Depth in a Vertical at which the Ratio of Observed to Mean Velocity is Least Variable. (*With M. E. Allen.*)

HAROLD WILEY GRISWOLD (I) Hartford, Conn.
Water Waste in Cities and Means of Prevention.

Irving Morse Guilford (II) West Cheshire, Conn.
Investigation of the Flow of Air through a Venturi Meter. (*With K. C. Boush.*)

Harold Peaslee Gurney (X) East Boston
The Occurrence and Prevention of Pin-holes in Sheet Tin.

Lee Hagood, B.S., U.S.A. retired (VI) Columbia, S.C.
Power Supply for Searchlights in United States Coast Defences.

James Ellis Hale (II) Manchester, N.H.
Artificial Humidification and Tests on its Production in Textile Industries.

Joseph Woodwell Ledwidge Hale (VI) Newburyport
A Test of Bituminized Fibre. (*With R. E. Manning.*)

Philip Jewett Hale (I) Denver, Colo.
Design for a Reinforced Concrete Arch.

Carl Albe Hall (II) Concord, N.H.
Efficiency Test of a 500 K.W. Curtis Turbine at the United Shoe Machinery Company's Works, Beverly. (*With L. P. Cassino.*)

Edwin Rymes Hall (II) Somerville
Efficiency Test on a Smoke Consumer. (*With H. C. Faxon.*)

Lucius Felt Hallett (VI) Denver, Colo.
An Investigation of and Proposed Methods of Caring for the Probable Increase in Passenger Traffic due to Electrification of the Suburban Lines of the Boston and Albany Railroad. (*With W. D. Spengler.*)

Nelson Simpson Hammond (III) Butte, Mont.
Chemical Equilibrium of Lead Oxide with Reference to Carbon Monoxide and Carbon Dioxide. (*With T. K. Tse.*)

Carl Emil Hanson, A.B. (II) Marquette, Kans.
An Investigation of the Heating and Ventilating Plant of the Harvard University Medical School.

Julian Herbert Hunter Harwood (I) Rockport
Experimental Study of the Loss of Head in the Bends of Pipe. (*With H. B. Luther.*)

Samuel Frink Hatch (II) Greenland, N.H.
Determination of the Effects of a Waterproofing Compound on the Bond between Concrete and Steel. (*With G. C. Lees.*)

Matthew Cowden Hayes, B.S. (VI) Lewisburg, Pa.
On the Practicability of Electrifying the Hoosac Tunnel. (*With E. L. Warren.*)

Howard Spencer Hazen, Jr., B.S. (IV) La Salle, Ill.
Design for a State University.

EDMUND FRANCIS HEARD (XIII) Kingston, N.Y.
A Fuel Efficiency Test on an Internal Combustion Engine. (*With C. D. Steele.*)

LAFAYETTE BOYD HEDGE (VI) Citronelle, Ala.
A Comparison of Different Styles of Links in Enclosed Fuses. (*With D. Bowman.*)

WILLIAM ROY HEILMAN (II) Evansville, Ind.
Tests on Denatured Alcohol Fuel in a Two-cycle Engine.

PAUL HAROLD HEIMER (III) Mattapan
Cyanide Treatment of a Cripple Creek Telluride Ore.

ROBERT DAVID HENNEN (I) Morgantown, W. Va.
A Study of Solid Floors for Railroad Bridges.

ARTHUR THACHER HINCKLEY (V) Roslindale
An Attempt to Prepare Fusel Oil by a Process not Involving Fermentation.

BRADFORD BUTTRICK HOLMES (III) San Francisco, Cal.
Study of the Pulsator Jig and the Pulsator Classifier Working on a Missouri Lead Ore.

EUGENE CLARENCE HOWE, A.B. (VII) Brooklyn, N.Y.
Design and Construction of an Apparatus for the Determination of CO_2 in Air by a New Method; with a Review of our Knowledge of Air Analysis and of the Atmospheric Environment of Sedentary Persons.

CLARENCE LORING HUSSEY (II) Providence, R.I.
The Flow of Air in Pipes. (*With J. W. Wattles.*)

OLIVER SAUNDERS JENNINGS, A.B. (VI) Fall River
The Effect of Frequency on the Disruptive Discharge.

MAURICE TRIMBLE JONES, JR. (X) East Orange, N.J.
A Working Routine for the Three-color Carbon Process of Color Photography.

JAMES ALLEN KANE (IV) Long Green, Md.
Design for the Building of Honor of an Important University.

WARREN WINCHESTER KARNAN (V) Hyde Park
The Detection and Identification of Artificial Colors in Macaroni.

STILES FRASER KEDY (II) Dorchester
Economy Tests of a 2000 K.W. Curtis Turbine at the Quincy Point Power Station of the Old Colony Street Railway Company. (*With C. H. Bangs.*)

KARL RAYMOND KENNISON, A.B. (II) Waterville, Me.
The Design of a High Speed Braiding Machine.

RINKER KIBBEY (IV) Marshfield Hills
Design for a Hunt and Polo Club.

ERNEST EDWIN KILBURN (VI) Waterbury, Conn.
A Study of the Effect of Unbalancing on a 3-Wire Converter. (*With W. E. Booth.*)

CHARLES COLLINS KINSMAN (VI) Decatur, Ill.
Test of a 500 Kilowatt Turbo-Alternator.

ANDRÉ THEODOROVITCH KOLATSCHEVSKY (VI) Naples, Italy
A Brief Sketch of the Development of Alternating Current Machinery from 1891 to 1895 Inclusive.

HUGO FRANZ KUEHNE, C.E. (IV) Austin, Texas
Design for a Conservatory of Music.

JOHN ANGUS KYDD (V) Andover
Methods for the Separation of Dyestuffs in Mixtures and on Textile Fibres.

CLARENCE RONALD LAMONT (III) Malden
Structural and Petrographical Study of the Bear Hill Breccia.

GEORGE COOPER LEES (II) New Bedford
Determination of the Effects of a Waterproofing Compound on the Bond between Concrete and Steel. (*With S. F. Hatch.*)

BERNARD SHEPARD LESLIE (II) Milton
A Turbine Plant Test at the Amoskeag Mills, Manchester, New Hampshire. (*With R. C. Collins.*)

JOHN HAROLD LOCKE (VIII) Brookline
On the Preparation of Titanium Carbide and its Abrasive Properties. (*With R. E. Schirmer.*)

LEO LOEB, A.B. (II) Rich Hill, Mo.
Transverse Tests of Driving Spring Leaves.

ARTHUR ASHLEIGH LONGLEY (II) Kalamazoo, Mich.
The Efficiency and Losses in a Hydro-electric Power Plant. (*With J. C. Brooks.*)

HARRY CHESTER LORD (II) West Lynn
Tests on Cutting Speed of Lathe Tools. (*With J. T. Gallagher.*)

CHARLES LEWIS LUFKIN (V) Gloucester
A Study of Methods for the Determination of Sucrose and Lactose in Milk Chocolate.

HOWARD BOURNE LUTHER (I) Attleboro
Experimental Study of the Loss of Head in the Bends of Pipes. (*With J. H. H. Harwood.*)

EMERSON FLETCHER LYFORD (V) Milford
A Colorimetric Method for the Determination of Benzaldehyde in Almond Extract.

FREDERICK WILLIAM LYLE (VI) Waltham
Investigation of the Torque per Ampere of an Alternating Current Series Motor. (*With J. A. Fottler.*)

STEPHEN CHANDLER LYON (I) Woonsocket, R.I.
Comparison of Locke Level and Plane Table Methods of Taking Railroad Topography.

JAMES MCGOWAN, JR. (V) North Adams
Reactions and Absorption Spectra of the Sulphur Dyestuffs.

FRANCIS HARRINGTON MCGUIGAN, JR. (I) Montreal, Quebec
Design of a Reinforced Concrete Round-house for Large Terminal.

SCOTT MACNUTT, A.B. (VII) Richmond, Ind.
A Statistical Investigation of the Effects of Water Supply Purification upon Mortality in Certain Communities and especially upon Mortality from Diseases other than Typhoid Fever.

RALPH ERIC MANNING (VI) North Billerica
A Test of Bituminized Fibre. (*With J. W. L. Hale.*)

ROLANDO ARNOLDO MARTINEZ (I) Havana, Cuba
Design for a Two-hinged Steel Arch Highway Bridge.

DONALD HEBARD MAXWELL (XI) Newton
Experiments to Determine the Lateral Distribution of Sewage in Percolating Filters. (*With W. C. Folsom.*)

JESSE WORTH MAXWELL, B.S. (III) Austin, Texas
Geology of Cape Ann Granite. (*With K. G. Chipman.*)

WILLIAM DURANT MILNE (I) Lexington
Studies and Tests of Typical Massachusetts Sewage Disposal Plants.

FRANK EARL MOTT, PH.C. (V) Danielson, Conn.
Investigation of the Solubility of Silver Ferrocyanide in Dilute Solutions of the Alkali Halides.

GARDNER ARMSTRONG MURFEY (VI) Cleveland, Ohio
A Design for a Hydro-electric Power Plant. (*With V. E. Bird.*)

DESAIX BROWN MYERS, B.S. (III) Philadelphia, Pa.
A Report on the Sulphur Deposit of Mount Makushin, Unalaska. (*With H. P. Sweeny.*)

ELEAZAR MYERS (X) Chicago, Ill.
A Study of the Soda Recovery and Causticizing Plant of a Paper Mill. (*With C. H. Criswell.*)

EVERETT HILTZ NEWHALL (V) Lynn
Detection of Caramel in Vanilla Extract.

HENRY GEORGE NICHOLAS (X) Melbourne, Australia
Efficiency Test on an Electrolytic Oxy-Hydrogen Generator.

M.I.T. ANNUAL CATALOGUES AND BULLETINS
1908/09

UTAR JAMES NICHOLAS (VI) Melbourne, Australia
The Effect of Electric Currents upon Concrete and Steel.

ARCHER CORBIN NICHOLS (I) Boston
The Elimination of Grade Crossing at Quincy. (*With L. H. Allen and C. O. Brown.*)

PAUL WILLARD NORTON, B.A. (IV) Woburn
A Study of the Use of Reinforced Concrete in Architectural Construction, with some Reference to the most Economical Design of a Small Warehouse.

THOMAS WHITLEY ORR (I) Kansas City, Mo.
Design of a Reinforced Concrete Arch.

HAROLD SMITH OSBORNE (VI) Cambridge
The Synchronous Condenser for Power Factor Compensation.

HARRY CHAPMAN PATTEN (VI) Dorchester
Tests on a Direct-Current Railway Locomotive. (*With A. G. Place and E. A. Plumer.*)

ALEC NEWTON PENNY (III) Philadelphia, Pa.
The Concentration of a Copper Ore from Virginia. (*With W. J. E. Barcus.*)

WILLIAM JOSEPH PIERCE (II) Cambridge
Investigation of the Economy of an Air Compressor Plant. (*With A. T. Scannell.*)

ALFRED GRIFFIN PLACE (VI) Woburn
Tests on a Direct-Current Railway Locomotive. (*With H. C. Patten and E. A. Plumer.*)

EDWARD ASHBY PLUMER (VI) Newburyport
Tests on a Direct-Current Railway Locomotive. (*With H. C. Patten and A. G. Place.*)

WALTER EVERETT POOR (VI) Danvers
Current Rushes in Transformers.

JOSEPH POPE (XIII) Springfield
Speed and Power Tests of the Steam Vedette Boat *Beth*.

EUGENE VOORHEES POTTER (I) Somerville
Design for a Three-hinged Steel Arch Roof Truss.

PAUL RULISON POWELL (II) Baltimore, Md.
Determination of the Coefficient of the Trapezoidal Weir of Cippoletti. (*With F. M. Bond.*)

CLIFFORD HAMILTON PRESTON, A.B. (IV) Farmington, Me.
Design for a Church in a City Parish.

CHARLTON DASCOM PUTNAM (I) Reading
A Review of the Boylston Street Bridge over the Boston and Albany Railroad Tracks, Boston.

HARRY ANDREW RAPELYE (II) Hartford, Conn.
An Investigation of the Experiments to Determine the Shearing Strength of Rivet Metal—Double Shear.

JOSEPH GILMAN REID, A.B. (VI) Canton, Miss.
Some Experiences with a Fifty Kilowatt Rotary Converter. (*With R. W. Davis.*)

JOHN RANDOLPH REYBURN, A.B. (II) St. Louis, Mo.
Increase in Capacity of a Gasolene Automobile Engine without Regard to Efficiency.

FRANCISCO DAMASO REYES (X) Manila, P.I.
The Permeability of Cement Mortars.

HARRY FREDERIC RICHARDSON (VI) Taunton
An Investigation of the Westinghouse Automatic Synchronizer. (*With H. L. Burgess.*)

FRANK JOHN ROBINSON (IV) Boston
Design for a Municipal Group of Buildings for Recreations.

HENRY JASON RUGGLES (I) Cambridge
Design for a Three-hinged Arch.

MILES SAMPSON (II) South Hanson
Efficiency Test on a Producer Plant. (*With W. D. Ford.*)

JOSEPH BLAIR SANDO (II) Scranton, Pa.
Variation of Capacity with Different Heads and Speed of the Centrifugal Pump at the Metropolitan Sewerage Station, East Boston. (*With B. W. Cary.*)

EDWARD MICHAEL SAVAGE (I) Somerville
A Study of the Hydraulic Power at the Beaver Brook Mills, Collinsville.

ALBERT TERENCE SCANNELL (II) Lowell
Investigation of the Economy of an Air Compressor Plant. (*With W. J. Pierce.*)

RENS EDWARD SCHIRMER (VIII) West Roxbury
On the Preparation of Titanium Carbide and its Abrasive Properties. (*With J. H. Locke.*)

FREDERIC BECKER SCHMIDT (IV) Westfield
Design for the Building of Honor of an Important University.

GEORGE SCHOBINGER, A.B. (I) Morgan Park, Ill.
Design for a Section of a Subway for Boylston Street, Huntington Avenue, and Copley Square, Boston. (*With J. T. Tobin.*)

Charles Henry Shapleigh (I) — Lock Haven, Pa.
Plan for Elimination of Grade Crossing at Cherry Street, Vicksburg, Mississippi.

Edgar Percival Slack (VI) — North Abington
A Study of Circuit Breaker Operation. (*With G. E. Tolman.*)

Alexander Coffee Sloss, Jr. (VI) — St. Louis, Mo.
An Investigation of Flaming Arc Lights. (*With W. P. Bixby.*)

Edward Richard Smith (I) — Malden
Experiments to Determine Coefficient of Distribution of Certain Types of Sprinkler Filter Nozzles. (*With W. E. Barton.*)

Warren Daniel Spengler, B.L. (VI) — Cleveland, Ohio
An Investigation of and Proposed Methods of Caring for the Probable Increase in Passenger Traffic due to Electrification of the Boston and Albany Railroad. (*With L. F. Hallett.*)

Clarence Herbert Spiehler (II) — Rochester, N.Y.
The Protection of Steam Heated Surfaces against Heat Loss. (*With L. A. Clark.*)

Henry Vose Spurr (I) — Arlington
Experimental Studies of the Lateral Thrust and Angle of Internal Friction of Soils. (*With H. Cross and G. D. Whittle.*)

Carroll Dame Steele (XIII) — Dorchester
A Fuel Efficiency Test on an Internal Combustion Engine. (*With E. F. Heard.*)

Charles Mullen Steese (II) — Mount Holly Springs, Pa.
Investigation of the Stresses in Hooks and Open Links.

Loyd Hall Sutton (XIII) — Marlboro
The Comparative Corrosibility of Iron and Steel.

Harry Patterson Sweeny, B.A. (III) — Stroudsburg, Pa.
A Report on the Sulphur Deposit of Mount Makushin, Unalaska. (*With D. B. Myers.*)

John Rodney Tabor, B.S. (IV) — Houston, Texas
Design for a City Church.

James Martin Talbot, B.A. (II) — Newark, N.J.
An Investigation of Running Balance at High Rotative Speeds on a Hydro-extractor. (*With R. C. Angell.*)

William Chittenden Taylor (V) — Wiscasset, Me.
Estimation of Caffetannic Acid and Caffein in Coffee.

Leavitt Weare Thurlow (X) — Worcester
Production of Selenium and Tellurium from Refinery Waste.

John Theodore Tobin (I) Boston
Design for a Section of a Subway for Boylston Street, Huntington Avenue, and Copley Square, Boston. (*With G. Schobinger.*)

George Edward Tolman, A.B. (VI) Cumberland Mills, Me.
A Study of Circuit Breaker Operation. (*With E. P. Slack.*)

William Hervey Toppan (X) Newburyport
Effect of the Constituents of Glass on its Optical Properties.

Aram Torossian (IV) Norwich, Conn.
Design for an Armenian Church.

Freeman Eugene Towle (I) Waltham
Design for a Block Signal System.

Tsok Kai Tse (III) Kwangtung, China
Chemical Equilibrium of Lead Oxide with Reference to Carbon Monoxide and Carbon Dioxide. (*With N. S. Hammond.*)

Edward Joseph Tully (VII) Forest Hills
A Search for Bacterial Ferments of Cellulose.

Kurt Vonnegut (IV) Indianapolis, Ind.
Design for a Municipal Bath House.

Laurence Tidd Walker (VII) Stoneham
A Study of Certain Phenomena of Variation and Inheritance among Bacilli of the Paratyphoid Group.

Edmund Leon Warren, B.A. (VI) Grafton
On the Practicability of Electrifying the Hoosac Tunnel. (*With M. C. Hayes.*)

Ernest Joseph Hill Waters (I) Sydney, Australia
Design for a Three-hinged Steel Arch.

Joseph Warren Wattles, 3d (II) Canton
The Flow of Air in Pipes. (*With C. L. Hussey.*)

Rudolph Boynton Weiler (II) Brighton
An Experimental Investigation of the Strains in Steel Beams.

Leland Edward Wemple (V) Waverly, Ill.
Investigation of the Preparation of Fibrous Acetate of Cellulose.

Ching Yu Wen (III) Canton, China
The Heat Formation of Some Ferro-calcic Silicates.

Mason Tuxbury Whiting, A.B. (I) Brookline
Design for a Dam and Power Plant at Brattleboro, Vermont.

George Dilley Whittle, B.S. (I) Georgetown, Texas
Experimental Studies of the Lateral Thrust and Angle of Internal Friction of Soils. (*With H. Cross and H. V. Spurr.*)

Edgar Irving Williams (IV) Rutherford, N.J.

Design for a Large Establishment in the Country for the Celebration of Musical and Histrionic Festivals.

Rufus William George Wint, A.B. (V) Catasauqua, Pa.

A Microscopic Examination of Broken Steel Rails.

Masanao Yendo (II) Morioka, Japan

Flow of Steam through an Orifice under small Differences of Pressure.

Conrad Youngerman (IV) Des Moines, Iowa.

Design for a Country Club House.

Register of Students.

For residence addresses in suburban portions of Boston the following abbreviations are used.

A.	Allston.	N.	Neponset.
B.	Brighton.	N.D.	New Dorchester.
C.	Charlestown.	R.	Roxbury.
D.	Dorchester.	Ros.	Roslindale.
D.C.	Dorchester Centre.	S.B.	South Boston.
E.B.	East Boston.	U.C.	Uphams Corner.
J.P.	Jamaica Plain.	W.R.	West Roxbury.
M.	Mattapan.	F.	Faneuil.

FELLOWS.

NAME.	HOME.	RESIDENCE.
Clapp, Charles Horace S.B., Massachusetts Institute of Technology. Austin Fellow.	*So. Boston*	18 Atlantic Ave., S.B.
Howe, Eugene Clarence A.B., Cornell University. S.B., Massachusetts Institute of Technology. Savage Fellow.	*Brooklyn, N.Y.*	26 Ashford St., A.
Kendall, Burton Warren S.B., Massachusetts Institute of Technology. Swett Fellow.	*Gardner*	New York, N.Y.
Osborne, Harold Smith S.B., Massachusetts Institute of Technology. Saltonstall Fellow.	*Cambridge*	Cambridge.

CANDIDATES FOR THE DEGREE OF DOCTOR OF ENGINEERING.

NAME.	HOME.	RESIDENCE.
Osborne, Harold Smith, S.B.	*Cambridge*	Cambridge.

CANDIDATES FOR THE DEGREE OF DOCTOR OF PHILOSOPHY.

NAME.	HOME.	RESIDENCE.
Allan, John Andrew, B.A., M.Sc.	*Aubrey, Quebec* . .	572 Mass. Ave.
Clapp, Charles Horace, S.B. . .	*So. Boston*	18 Atlantic St., S.B.
Field, Charles, 3d, B.S., S.B. . .	*Chestnut Hill* . . .	Chestnut Hill.
Gale, Roger David, S.B. . . .	*Gloucester*	94 St. Botolph St.
Howe, Eugene Clarence, A.B., S.B.	*Brooklyn, N.Y.* . .	26 Ashford St., A.
Tolman, Richard Chace, S.B. .	*W. Newton*	W. Newton.

CANDIDATES FOR THE DEGREE OF MASTER OF SCIENCE.

NAME.	HOME.	RESIDENCE.
Babcock, Alfred Bennett, S.B. .	*Boston*.	719 Boylston St.
Babcock, Mabel Keyes, A.B., S.B.	*Wellesley Hills* . .	Wellesley Hills.
Baker, Cecil Franklin, A.B., S.B.	*Champaign, Ill.* .	Technology Chambers.
Batchelder, Ralph Johnson, S.B.	*No. Cambridge* . .	No. Cambridge.
Dolke, William Fredric, Jr., S.B.	*Boston*	285 Newbury St.
Farrington, Harold Phillips, S.B.	*W. Roxbury*	56 Bellevue St., W.R.
Finch, Stanley Phister, B.A. . .	*Austin, Texas*. . .	74 Batavia St.
Harrington, Charles Anthony, U.S.N.	*Fall River*	44 The Fenway.
Hinckley, Arthur Thacher, S.B. .	*Roslindale*	16 Sherwood St., Ros.
Howard, Herbert Seymour, U.S.N.	*Buffalo, N.Y.* . . .	44 The Fenway.
Kibbey, Rinker, S.B.	*Boston*	138 Newbury St.
Otterson, John Edward, U.S.N. .	*Newton*	Newton.
Reid, Joseph Gilman, A.B. . .	*Canton, Miss.* . . .	9 St. James Ave.
Rodman, Walter Sheldon, B.S., M.S.	*Kingston, R.I.* . .	12½ St. James Ave.
Sampson, Miles, S.B.	*So. Hanson*	So. Hanson.
Sutton, Herbert Hill, E.E. . . .	*Austin, Texas* . . .	45 St. Botolph St.
Tse, Tsok Kai, S.B.	*Kwangtung, China* .	96 Huntington Ave.
Wen, Ching Yu, S.B.	*Canton, China* . .	170 St. Botolph St.
Williams, Edgar Irving, S.B. . .	*Rutherford, N.J.* .	250 Newbury St.

GRADUATE STUDENTS.

(This list includes the names of all students, except non-resident 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.
Abell, Adelaide May B.S., Wellesley College.	*Allston*	19 Farrington Ave., A.
Adams, Percival Lysander B.S., Oregon Agricultural College.	*Hood River, Oregon*	172 W. Canton St.
Akerly, Harold Edward B.S., University of Rochester.	*Rochester, N.Y.*	139 Beacon St.
Alexander, Harry Silas A.B., Washington and Jefferson College.	*Washington, Pa.*	76 Huntington Ave.
Allan, John Andrew B.A., M.Sc., McGill University.	*Aubrey, Quebec*	572 Mass. Ave.
Almy, Charles, Jr. A.B., Harvard University.	*Cambridge*	Cambridge.
Anderson, Robert Emmet M.E., Notre Dame University.	*Cincinnati, Ohio*	257 W. Newton St.
Andrews, Albert Willard A.B., Wiliams College.	*Canandaigua, N.Y.*	73 Pinckney St.
Atherton, Thomas Henry, Jr. A.B., Princeton University.	*Wilkes-Barre, Pa.*	6 Louisburg Square.
Atkins, Lew Morton Graduate, U.S. Naval Academy.	*Hasting, Mich.*	32 Westland Ave.
Ayres, Richard Samuel A.B., Central University.	*Pineville, Ky.*	236 Newbury St.
Babcock, Alfred Bennett S.B., Massachusetts Institute of Technology.	*Boston*	719 Boylston St.
Babcock, Mabel Keyes A.B., Northwestern University. S.B., Massachusetts Institute of Technology.	*Wellesley Hills*	Wellesley Hills.
Bach, Joseph George A.B., Marquette University.	*Milwaukee, Wis.*	263 Newbury St.
Baker, Cecil Franklin A.B., University of Illinois. S.B., Massachusetts Institute of Technology.	*Champaign, Ill.*	Technology Chambers.
Bakewell, Donald Campbell B.A., Yale University.	*Pittsburgh, Pa.*	100 Mt. Vernon St.
Baldwin, John Robinson A.B., Emory College. B.S., Georgia School of Technology.	*Rome, Ga.*	49 Hemenway St.
Barnes, Albert Johnson B.Sc., Dalhousie University.	*Halifax, N.S.*	15 Conway St., Ros.
Batchelder, Ralph Johnson S.B., Massachusetts Institute of Technology.	*No. Cambridge*	No. Cambridge.
Baxter, Lewis L. B.E., Vanderbilt University.	*Nashville, Tenn.*	25 St. Botolph St.
Beall, Van Zandt B.S., Agricultural and Mechanical College of Texas.	*Fort Worth, Texas*	78 Huntington Ave.
Biedler, William Thomas B.S., Virginia Military Institute.	*Baltimore, Md.*	60 Batavia St.

GRADUATE STUDENTS (*continued*).

NAME.	HOME.	RESIDENCE.
Bierer, John Michael B.S., Washington and Lee University.	*Front Royal, Va.*	Garrison Hall.
Blanchard, Cecil King B.S., Amherst College.	*Quincy*	Quincy.
Blankenbuehler, Rae Edmunds A.B., Washington and Jefferson College.	*Elizabeth, Pa.*	1084 Boylston St.
Blodget, William Power A.B., Harvard University.	*Chestnut Hill*	Chestnut Hill.
Bollenbacher, John Carlisle A.B., Indiana University.	*Bloomington, Ind.*	Brookline.
Borden, Lee Scott Graduate, U.S. Naval Academy.	*Webster, Iowa*	2 Westland Ave.
Bragg, Caleb Smith B.A., Yale University.	*Cincinnati, Ohio*	Hemenway Chambers.
Brooks, John Nixon, A.B., Princeton University	*Trenton, N.J.*	Technology Chambers.
Burgher, Ballard Young B.A., University of Texas.	*Dallas, Texas*	41 St. Botolph St.
Burke, Thomas Joseph A.B., College of the Holy Cross.	*Clinton*	232 W. Newton St.
Burton, Felix Arnold A.B., Bowdoin College.	*Faneuil*	17 Newcastle Road, F
Busey, Charles Bowen A.B., University of Illinois.	*Urbana, Ill.*	47 St. Botolph St.
Byron, Walter Harwood B.S., Maryland Agricultural College.	*Williamsport, Md.*	Technology Chambers.
Cabot, Samuel, Jr. A.B., Harvard University.	*Boston*	109 Commonwealth Ave.
Camsell, Charles A.B., Manitoba University.	*Ottawa, Ontario*	Brookline.
Carey, Charles Donald A.B., Princeton University.	*Stroudsburg, Pa.*	16 Rutland Square.
Carter, Clifton Carroll, U.S.A. Graduate, U.S. Military Academy.	*Washington, D.C.*	112 Newbury St.
Cary, Richard Lucius A.B., A.M., Haverford College.	*Baltimore, Md.*	42 Rutland Square.
Chandler, Henry Daland A.B., Harvard University.	*Boston*	195 Marlborough St.
Chantry, Allan J., Jr. Graduate, U.S. Naval Academy.	*Malvern, Iowa*	32 Westland Ave.
Chase, Orliff van Heik A.B., Wesleyan University.	*Catskill, N.Y.*	Technology Chambers.
Chase, Philip Hartley A.B., Dartmouth College.	*Hanover, N.H.*	Technology Chambers.
Clapp, Charles Horace S.B., Massachusetts Institute of Technology.	*So. Boston*	18 Atlantic St., S.B.
Clapper, Leland B.C.E., Iowa State College.	*Ames, Iowa*	5 Barstow St., A.
Clough, Harry Linwood B.S., Amherst College.	*Brockton*	218 W. Springfield St.
Congdon, Howard Wilbur A.B., A.M., Brown University.	*Providence, R.I.*	46 Rutland Square.
Coppinger, Conor Walter Blaine A.B., Georgetown University.	*Washington, D.C.*	The Brunswick.
Court, Alva Breaker Graduate, U.S. Naval Academy.	*Houston, Texas*	2 Westland Ave.

GRADUATE STUDENTS (*continued*).

NAME.	HOME.	RESIDENCE.
Crawford, Chauncey Howard B.S., Earlham College.	*Huntington, W. Va.*	198 St. Botolph St.
Cummings, Harold Neff A.B., Bates College.	*Auburn, Me.*	11 Carlisle St., R.
de Landa, Carlos B.S., Santa Clara College.	*Mexico City, Mexico*	19 St. Botolph St.
Desmond, Thomas Charles A.B., Harvard University.	*Philadelphia, Pa.*	112 Pembroke St.
Dewey, Bradley A.B., Harvard University.	*Cambridge*	Cambridge.
Diehl, John Christopher B.S., Pennsylvania College.	*New Oxford, Pa.*	108 Chandler St.
Doane, Robert Edward B.S., Princeton University.	*Elmira, N.Y.*	Technology Chambers.
Doherty, Frederick John Aloysious A.B., Harvard University.	*Dorchester*	36 Mayfield St., D.
Dolke, William Fredric, Jr. S.B., Massachusetts Institute of Technology.	*Boston*	285 Newbury St.
Dornberger, Herbert Schumann A.B., Pennsylvania College.	*Pittsburgh, Pa.*	108 Chandler St.
Drake, Whitford Graduate, U.S. Naval Academy.	*Waltham*	Garrison Hall.
Dray, Walter Remy B.A., Yale University.	*Chicago, Ill.*	The Brunswick.
DuBois, Warren Livingston B.S., Rutgers College.	*Freehold, N.J.*	82 Huntington Ave.
Dunbar, Arthur Richards B.A., Amherst College.	*E. Bridgewater*	E. Bridgewater.
Dunlap, Joseph Howard A.B., Washington and Jefferson College.	*Washington, Pa.*	76 Huntington Ave.
Dunnington, Francis Howison B.A., University of Virginia.	*Charlottesville, Va.*	22 Peterborough St.
Dyer, Brainerd B.A., Amherst College.	*Pittsburg, Pa.*	218 W. Springfield St.
Fabens, Andrew Lawrie A.B., Harvard University.	*Williamstown*	122 Newbury St.
Farrington, Harold Phillips S.B., Massachusetts Institute of Technology.	*W. Roxbury*	56 Bellevue St., W.R.
Faulkner, Frederick Richardson A.B., Acadia College.	*Summerland, Br. Col.*	20 Bickerstaff St.
Fay, Thornwell, Jr. B.S., University of Louisiana.	*Houston, Texas*	Technology Chambers.
Fenger, Frederick Abildgaard M.E., Cornell University.	*Winnetka, Ill.*	263 Newbury St.
Ferris, Livingston Polk A.B., University of Colorado.	*Lamourie, La.*	45 St. Botolph St.
Field, Charles, 3d B.S., University of Pennsylvania. S.B., Massachusetts Institute of Technology.	*Chestnut Hill*	Chestnut Hill.
Finch, Stanley Phister B.A., C.E., University of Texas.	*Austin, Texas*	74 Batavia St.
Fitch, Edwin Oberlin, Jr. Graduate, U.S. Naval Academy.	*Beach Bluff*	Beach Bluff.
Fowler, Herbert Ernest B.S., University of Rochester.	*Rochester, N.Y.*	139 Beacon St.

GRADUATE STUDENTS (*continued*).

NAME.	HOME.	RESIDENCE.
Gadsby, George Madill B.Ph., Marietta College.	*Marietta, Ohio*	103 Mt. Vernon St.
Gale, Roger David S.B., Massachusetts Institute of Technology.	*Gloucester*	94 St. Botolph St.
Gallagher, John Patrick A.B., Boston College.	*Watertown*	Watertown.
Gasche, Karl Wise Ph.B., University of Wooster.	*Dresden, Ohio*	178 Huntington Ave.
Gawne, James Orville Graduate, U.S. Naval Academy.	*Fredonia, N.Y.*	2 Westland Ave.
George, Ralph Moore B.S., Princeton University.	*Bradford, Pa.*	25 St. James Ave.
Giesey, Earle McAdams A.B., Allegheny College.	*Wheeling, W. Va.*	39 St. Botolph St.
Gillis, Ridgway Mills A.B., Whitman College.	*Walla Walla, Wash.*	112 Pembroke St.
Godley, Frederick Augustus B.A., Yale University.	*New York, N.Y.*	112 Pinckney St.
Gordon, William Stuart, Jr. C.E., Princeton University.	*New York, N.Y.*	215 Newbury St.
Gravely, Julian Stuart B.A., Washington and Lee University.	*Wytheville, Va.*	Garrison Hall.
Greenau, James Owen A.B., Boston University.	*Taunton*	76 Huntington Ave.
Greenwood, Lester Clyde A.B., Dartmouth College.	*Farmington, Me.*	355A Columbus Ave.
Gross, Cora Burt Pharm.D., Massachusetts College of Pharmacy.	*Cambridge*	Cambridge.
Gurney, Harold Peaslee S.B., Massachusetts Institute of Technology.	*E. Boston*	196 Trenton St., E.B.
Hadji Savva, Achilles A.B., Anatolia College.	*Baffra, Turkey*	558 Tremont St.
Haley, Ralph Jandt A.B., Princeton University.	*Sioux City, Iowa*	Cambridge.
Harrington, Charles Anthony Graduate, U.S. Naval Academy.	*Fall River*	44 The Fenway.
Hawes, Henry Gordon, Jr. A.B., Harvard University.	*Santa Barbara, Cal.*	Technology Chambers.
Haynes, Herman Wallace B.S., Worcester Polytechnic Institute.	*Townsend*	4 Rockdale St., R.
Hersey, Mayo Dyer A.B., Colorado College.	*W. Hartford, Conn.*	424 Mass. Ave.
Hickerson, Thomas Felix Ph.B., A.M., University of North Carolina.	*Ronda, N.C.*	160 Newbury St.
Hill, Roger Frank B.S., Dartmouth College.	*Tilton, N.H.*	So. Weymouth.
Hilliard, Robert Bell Graduate, U.S. Naval Academy.	*Newton Centre*	Newton Centre.
Hilscher, Ralph B.S., Beloit College.	*Watseka, Ill.*	269 St. Botolph St.
Hinckley, Arthur Thacher S.B., Massachusetts Institute of Technology.	*Roslindale*	16 Sherwood St., Ros.
Hirschfeld, Benjamin Shuman B.S., University of California.	*San Francisco, Cal.*	7 Concord Square.
Hosmer, Helen Ross S.B., Massachusetts Institute of Technology.	*Billerica*	Billerica.

GRADUATE STUDENTS (*continued*).

NAME.	HOME.	RESIDENCE.
Howard, Herbert Seymour . . . Graduate, U.S. Naval Academy.	*Buffalo, N.Y.*	44 The Fenway.
Howe, Eugene Clarence . . . . A.B., Cornell University. S.B., Massachusetts Institute of Technology.	*Brooklyn, N.Y.* . . .	26 Ashford St., A.
Hufsmith, Clifford Lytton . . . B.S., Austin College.	*Palestine, Texas* . .	262 Newbury St.
Humphrey, George Selden . . . Ph.B., Marietta College.	*Belleville, W. Va.* .	103 Mt. Vernon St.
Hynes, John Joseph, Jr. . . . . A.B., Canisius College.	*Buffalo, N.Y.*	16 St. James Ave.
Jacoby, Louis . . . . A.B., University of Texas.	*Dallas, Texas* . . .	12 Newbury St.
James, Gorton . . . . A.B., Harvard University.	*Brookline*	Brookline.
Jenkins, Hubert Oliver . . . . A.B., Leland Stanford Junior University.	*Stanford University, Cal.*	7 Follen St.
Johnson, Reginald Davis . . . A.B., Williams College.	*Pasadena, Cal.* . .	71 Mt. Vernon St.
Kane, Irving Patterson . . . . B.S., Saint Johns College.	*Long Green, Md.*	Technology Chambers.
Kerr, Robert Clark . . . . . . A.B., Johns Hopkins University.	*Baltimore, Md.* .	9 Oak View Terrace, J.P.
Kibbey, Rinker . . . . S.B., Massachusetts Institute of Technology.	*Boston*	138 Newbury St.
Kilborn, Karl Bray . . . . . . A.B., Bowdoin College.	*Portland, Me.* . . .	180 Huntington Ave.
Knipp, Arthur Russell . . . . A.B., Johns Hopkins University.	*Baltimore, Md.* . .	10 St. James Ave.
Knox, Harry Gard . . . . . . Graduate, U.S. Naval Academy.	*Annapolis, Md.* . .	32 Westland Ave.
Lasnier, Gilberto . . . . A.B., University of Montevideo.	*Montevideo, Uruguay*	44 St. Botolph St.
Latimer, Robert Cathcart . . . B.A., Yale University.	*York, Pa.*	85 Newbury St.
Laurson, Philip Gustave . . . . B.S., Dakota Wesleyan University.	*Mitchell, S. Dak.* .	413 Columbus Ave.
Locke, John Harold . . . . . S.B., Massachusetts Institute of Technology.	*Brookline*	Brookline.
Lodge, John . . . . A.B., Harvard University.	*Media, Pa.*	Technology Chambers.
Lord, George Ransom . . . . A.B., Marietta College.	*Marietta, Ohio* . .	103 Mt. Vernon St.
Loud, Francis Martin . . . . . A.B., Colorado College.	*Colorado Springs, Colo.*	128 Berkeley St.
Lovewell, Frank Sherman . . . A.B., University of Chicago.	*Chicago, Ill.* . . .	122 St. Botolph St.
Lyons, Franklin Benton . . . . B.S., Adrian College.	*Steubenville, Ohio* .	3 Walnut St.
McClintock, Frank Stockton . . B.A., Yale University.	*Pittsburgh, Pa.* . .	85 Newbury St.
Machen, Thomas Gresham . . A.B., Johns Hopkins University.	*Baltimore, Md.* . .	85 Newbury St.
McKnight, William Frank . . . A.B., College of the Holy Cross.	*Taunton*	36 Union Park.

GRADUATE STUDENTS (*continued*).

NAME.	HOME.	RESIDENCE.
Maglott, George Frederick . . . B.S., Ohio Northern University.	*Ada, Ohio*	61 St. Botolph St.
Main, Charles Reed . . . . . B.S., Dartmouth College.	*Winchester*	Winchester.
Mason, Austin Blake . . . . . A.B., Harvard University.	*Boston*	347 Commonwealth Ave.
Mayer, Paul Hirschl . . . . . B.S., Princeton University.	*Mt. Vernon, N.Y.* . .	Cambridge.
Menke, Alvin Frederick . . . . A.B., Indiana University.	*Evansville, Ind.* . .	Brookline.
Merrill, Edward Dearborn . . . Ph.B., Iowa College (Grinnell).	*Des Moines, Iowa* .	Brookline.
Metcalf, Lester George . . . . B.S., Pomona College.	*Claremont, Cal.* . .	Cambridge.
Meulendyke, Charles Edmund . B.S., University of Rochester.	*Rochester, N.Y.* . .	Technology Chambers.
Miller, Fred Robinson . . . . A.B., Boston University.	*Newton Highlands* .	Newton Highlands.
Mills, John . . . . A.B., University of Chicago. A.M., University of Nebraska.	*Brookline*	Brookline.
Moore, Francis Aldrich . . . . B.S., Austin College.	*Tyler, Texas* . . .	262 Newbury St.
Morrison, George Adelbert . . B.S., Michigan College of Mines.	*Morgan Park, Ill.* .	17 Batavia St.
Mylchreest, George Lewis . . . B.S., Wesleyan University.	*Middletown, Conn.* .	82 Huntington Ave.
Nichols, William Robert . . . . B.S., Virginia Military Institute.	*Petersburg, Va.* . .	60 Batavia St.
Northrop, Joseph Walter, Jr. . . A.B., Wesleyan University.	*Bridgeport, Conn.*	. 80 W. Rutland Square.
Norton, Arthur Edwin . . . . Ph.B., Brown University.	*Watertown*	Watertown.
O'Brien, James H. . . . . . . B.S., Carleton College.	*Northfield, Minn.* .	138 Chandler St.
O'Hearn, Thomas Benedict . . A.B., College of the Holy Cross.	*Lowell*	Lowell.
Ohnuki, Riojo . . . . Imperial Japanese Naval Engineering College.	*Katsukara, Japan* .	12 St. James Ave.
O'Neill, Haylett . . . . A.B., Whitman College.	*Spokane, Wash.* . .	112 Pembroke St.
Osborne, Harold Smith . . . . S.B., Massachusetts Institute of Technology.	*Cambridge*	Cambridge.
Otterson, John Edward . . . . Graduate, U.S. Naval Academy.	*Newton*	Newton.
Paine, Harold William . . . . Ph.B., Brown University.	*Warwick, Conn.* . .	103 Mt. Vernon St.
Palmer, George Truman . . . . B.S., University of Rochester.	*Palmyra, N.Y.* . .	7 Follen St.
Perrin, Lester William . . . . B.A., Yale University.	*New Haven, Conn.*	Technology Chambers.
Pettit, Bertholf Marsh . . . . . Ph.B., University of Chicago.	*Kenosha, Wis.* . . .	217 Newbury St.
Pritchett, Leonard Waller . . . A.B., Harvard University.	*New York, N.Y.* .	1 Acorn St.

GRADUATE STUDENTS (*continued*).

NAME.	HOME.	RESIDENCE.
Pugsley, Edwin B.A., Yale University.	*Buffalo, N.Y.*	112 Pinckney St.
Reckard, Rufus William A.B., Ohio Wesleyan University.	*Proctorville, Ohio*	Cambridge.
Reeds, Clarence A.B., University of Oklahoma	*Norman, Okla.*	3 Rutland Square.
Reid, Joseph Gilman A.B., Southwestern Presbyterian University.	*Canton, Miss.*	9 St. James Ave.
Reppert, George Henry B.S., Princeton University.	*Pittsburgh, Pa.*	Brookline.
Rew, Morse Woolley B.S. Iowa College.	*Grinnell, Iowa*	Brookline.
Rodman, Walter Sheldon B.S., M.S., Rhode Island College of Agriculture and Mechanic Arts.	*Kingston, R.I.*	12½ St. James Ave.
Rogers, James Calvin B.S., Mississippi Agricultural and Mechanical College.	*Starkville, Miss.*	9 St. James Ave.
Ryerson, Edward Larned, Jr. Ph.B., Sheffield Scientific School, Yale University.	*Chicago, Ill.*	6 Louisburg Square.
St. John, Burton Harold B.A., Fairmount College.	*Wichita, Kans.*	3 Rutland Square.
Sampson, Miles S.B., Massachusetts Institute of Technology.	*So. Hanson*	So. Hanson.
Scofield, Walter W., Jr. A.B., Williams College.	*Dalton*	23 Rockland Ave., R.
Scriven, Edward Osborne B.S., Beloit College.	*Beloit, Wis.*	Beacon Chambers.
Sheldon, George Ware B.S., Rhode Island College of Agriculture and Mechanic Arts.	*Wakefield, R.I.*	12½ St. James Ave.
Simmons, Frank Ronald B.A., Yale University.	*Providence, R.I.*	Technology Chambers.
Slade, Walter Clifton M.S., Brown University.	*Providence, R.I.*	46 Rutland Square.
Smead, Ralph Amsden B.S., Dartmouth College.	*Greenfield*	169 W. Newton St.
Smith, Charles McLean B.A., Yale University.	*Hartford, Conn.*	162 Huntington Ave.
Smith, Mabel Esther A.B., Mount Holyoke College.	*Haverhill*	Haverhill.
Smith, Phifer B.A., University of Virginia.	*Livingston, Ala.*	Technology Chambers.
Spooner, Thomas A.B., Bates College.	*Auburn, Me.*	519 Columbus Ave.
Stauffer, Isaac Hull A.B., Harvard University.	*New Orleans, La.*	186 Commonwealth Ave.
Steese, Charles Mullin S.B., Massachusetts Institute of Technology.	*Mt. Holly Springs, Pa.*	422 Newbury St.
Stewart, Dugald A.B., Middlebury College.	*Middlebury, Vt.*	Technology Chambers.
Stewart, Harold Osborn B.S., University of Rochester.	*Rochester, N.Y.*	7 Follen St.
Stoddart, David Ayars C.E., Cornell University.	*Wilkes-Barre, Pa.*	Brookline.
Straus, Aubrey Hamilton B.S., Richmond College.	*Richmond, Va.*	171 Newbury St.
Sutherland, Carroll Arthur B.S., University of Rochester.	*Boston*	8 Irvington St.

GRADUATE STUDENTS (*continued*).

NAME.	HOME.	RESIDENCE.
Sutherland, Clarence Hale . . . A.B., Harvard University.	*Brunswick, Me.* . .	Cambridge.
Sutton, Herbert Hill . . . . . E.E., University of Texas.	*Austin, Texas* . . .	45 St. Botolph St.
Suzuki, Ewazo . . . . B.S., Central College.	*Kobe, Japan* . . .	94 Pinckney St.
Sweeney, John Calvin, Jr. . . . Graduate, U.S. Naval Academy.	*Paris, Tenn.* . . .	2 Westland Ave.
Taylor, Horace Van Sands . . . B.A., Yale University.	*Hartford, Conn.* . .	245 W. Newton St.
Thomas, George Smith . . . . B.S., Coe College.	*Carroll, Iowa* . . .	321 Columbus Ave.
Thomson, Stuart . . . . A.B., Harvard University.	*Swampscott* . . .	Technology Chambers.
Tiernan, Martin F. . . . . . . A.B., University of Rochester.	*Charlotte, N.Y.* . .	7 Follen St.
Tillard, Thomas Atkinson . . . B.A., Trinity College, Cambridge University.	*Petersfield, England*	9 Charles St.
Tilton, Charles Elliott . . . . . A.B., Harvard University.	*Tilton, N.H.* . . .	198 Beacon St.
Tolman, Richard Chace . . . . S.B., Massachusetts Institute of Technology.	*W. Newton*	W. Newton.
Towne, Lockwood Jones . . . Ph.B., De Pauw University.	*Greencastle, Ind.* . .	30 Rutland Square.
Trevithick, Harry Phillips . . . Ph.B., Wesleyan University.	*Middletown, Conn.* .	82 Huntington Ave.
Trueblood, Howard Moffitt . . B.S., Haverford College.	*Earlham, Ind.* . . .	10 St. James Ave.
Trueman, Joseph Douglas . . . B.Sc., Kingston School of Mines.	*St. John, N.B* . .	474 Mass. Ave.
Tse, Tsok Kai . . . . S.B., Massachusetts Institute of Technology.	*Kwangtung, China* .	96 Huntington Ave.
Van Inwegen, Willard Bull . . A.B., Williams College.	*Port Jervis, N.Y.* .	71 Mt. Vernon St.
Waller, Robert Pettit . . . . . A.B., Williams College.	*Bloomsburg, Pa.* . .	59 Hemenway St.
Wen, Ching Yu . . . . S.B., Massachusetts Institute of Technology.	*Canton, China* . .	170 St. Botolph St.
Wengert, William Harry . . . . B.S., Albright College.	*Lebanon, Pa.* . . .	34 Isabella St.
Wheeler, William Russell . . . A.B., Middlebury College.	*W. Rutland, Vt.* .	Technology Chambers.
Whipple, Malon Patterson . . . A.B., Bowdoin College.	*Solon, Me.*	Cambridge.
Whitney, Stanley Nathan . . . B.A., Amherst College.	*Westminster*	Brookline.
Wiester, Aber Stowe . . . . . B.S., University of California.	*Roxbury*	15 Arklow St., R.
Williams, Edgar Irving . . . . S.B., Massachusetts Institute of Technology.	*Rutherford, N.J.* .	250 Newbury St.
Wilson, Claude Thomas . . . . B.A., Amherst College.	*Waterville, N.Y.* . .	254 W. Newton St.
Winterstein, Herbert Brown . . B.S., Iowa College.	*Belle Plaine, Iowa* .	Brookline.
Zahner, Robert Van Lier . . . A.B., Williams College.	*Adams*	165 W. Newton St.

REGULAR STUDENTS.

FOURTH YEAR.

NAME.	COURSE.	HOME.	RESIDENCE.
Adams, Elliot Quincy	X.	*Medford*	Medford.
Altamirano, Salvador	VI.	*Mexico City, Mex.*	17 Grovenor Road, J.P.
Applin, Frank Dexter	VI.	*Keene, N.H.*	146 St. Botolph St.
Atherton, Thomas H., Jr., A.B.	IV.	*Wilkes-Barre, Pa.*	6 Louisburg Square.
Ayres, Richard Samuel, A.B.	II.	*Pineville, Ky.*	236 Newbury St.
Babcock, Elizabeth Brewer	V.	*Roxbury*	102 Crawford St., R.
Ballard, Harold Foote	I.	*Millington*	169 W. Newton St.
Barnett, Louis	VI.	*Boston*	480 Tremont St.
Batchelder, Charles Leland	I.	*No. Reading*	No. Reading.
Beers, Louis Gilbert	X.	*Taunton*	282 Dartmouth St.
Belcher, Daniel	II.	*Easton*	192 Dartmouth St.
Belden, Charles Josiah	II.	*New York, N.Y.*	234 Newbury St.
Bender, Homer Charles	I.	*Reno, Nev.*	Brookline.
Besselievre, Arthur Cleborne	XIII.	*Boston*	47 Rutland Square.
Bettington, Egerton Mitford	VI.	*Johannesburg, Trans.*	44 The Fenway.
Black, Thomas Bass	III.	*Sioux City, Iowa*	Technology Chambers.
Blankenbuehler, Rea E., A.B.	X.	*Elizabeth, Pa.*	175 St. Botolph St.
Blood, Kenneth Thompson	XIII.	*Concord Junction*	Concord Junction.
Bollenbacher, J. Carlisle, A.B.	IV.	*Bloomington, Ind.*	Brookline.
Border, Lee Scott	XIII.A.	*Webster, Iowa*	2 Westland Ave.
Bounetheau, Harold duPré	IV.	*Jacksonville, Fla.*	Hotel Kempton.
Bowman, Bion Angelo	I.	*Boston*	263 W. Newton St.
Brooks, John Nixon, A.B.	I.	*Trenton, N.J.*	Technology Chambers.
Bullard, Maurice Lucian	II.	*Radford, Va.*	122 Huntington Ave.
Bullens, Denison Kingsley	III.	*Newton*	Newton.
Burgher, Ballard Y., B.A.	I.	*Dallas, Tex.*	41 St. Botolph St.
Burgher, Stephen Lawrence	VI.	*Winthrop*	Winthrop.
Burton, Felix Arnold, A.B.	IV.	*Faneuil*	17 Newcastle Road, F.
Byron, Walter Harwood, B.S.	X.	*Williamsport, Md.*	Technology Chambers.
Calder, Horace Walter	VI.	*Norwood*	Norwood.
Campbell, Charles Lincoln	X.	*Wollaston*	Wollaston.
Campbell, Kenneth James	I.	*Mt. Vernon, Ohio*	122 St. Botolph St.
Carter, Clifton Carroll, U.S.A.	VI.	*Washington, D.C.*	112 Newbury St.
Cary, Richard Lucius, A.M.	I.	*Baltimore, Md.*	42 Rutland Square.
Chantry, Allan J., Jr.	XIII.A.	*Malvern, Iowa*	32 Westland Ave.
Chapman, Edward Prichard	III.	*Pueblo, Colo.*	Technology Chambers.

Fourth Year (*continued*).

NAME.	COURSE.	HOME.	RESIDENCE.
Chapman, Thomas Garfield	III.	*Boston*	54 Falmouth St.
Chase, Philip Hartley, A.B.	VI.	*Hanover, N.H.*	Technology Chambers.
Christie, John Anderson	V.	*No. Adams*	60 W. Rutland Square.
Clark, Horace Little	I.	*Exeter, N.H.*	263 Newbury St.
Clifford, Walter Woodbridge	I.	*Hyde Park*	Hyde Park.
Cloudman, Herbert Cordwell	II.	*Westbrook, Me.*	192 Dartmouth St.
Cole, Marcus Johnson	II.	*Lowell*	234 Newbury St.
Congdon, Howard Wilbur, A.M.	I.	*Providence, R.I.*	46 Rutland Square.
Connolly, Eugene Leo	V.	*Caryville*	Caryville.
Court, Alva Breaker	XIII.A.	*Houston, Texas*	2 Westland Ave.
Crawford, Chauncey H., B.S.	I.	*Huntington, W. Va.*	198 St. Botolph St.
Critchett, James Hamilton	VIII.	*Watertown*	262 Newbury St.
Davis, John Francis	II.	*Cambridge*	Cambridge.
Davis, Myron Mathews	VI.	*Augusta, Me.*	258 Newbury St.
Dawes, Chester Laurens	VI.	*Arlington Heights*	Arlington Heights.
Desmond, Thomas Charles, A.B.	I.	*Philadelphia, Pa.*	112 Pembroke St.
Dewey, Bradley, A.B.	X.	*Cambridge*	Cambridge.
Doane, Robert Edward, B.S.	VI.	*Elmira, N.Y.*	Technology Chambers.
Dort, Joseph Cummings	I.	*New York, N.Y.*	20 Bickerstaff St.
Dow, Benjamin Warren	II.	*Dorchester*	7 Standish St., D.
Dunkel, Charles Alexander	II.	*Roslindale*	14 Cohasset St., Ros.
Dunnington, Francis H., B.A.	VI.	*Charlottesville, Va.*	22 Peterborough St.
Dyer, Brainerd, B.A.	V.	*Pittsburgh, Pa.*	218 W. Springfield St.
Ellis, Ridsdale	VIII.	*Leicester, England*	258 Newbury St.
Elton, Herbert Charles	I.	*Dorchester*	105 King St., D.
Everett, Wilbur	VI.	*Georgetown*	Georgetown.
Faulkner, Frederick R., A.B.	I.	*Summerland, B.C.*	20 Bickerstaff St.
Fay, Thornwell, Jr., B.S.	X.	*Houston, Texas*	Technology Chambers.
Fick, Wilhelm Georg	II.	*St. Louis, Mo.*	109 Warren Ave.
Finnie, James Irving	VI.	*Clinton*	14 Durham St.
Fisher, Howard Colburn	II.	*Westwood*	Westwood.
Fitch, Edwin Oberlin, Jr.	XIII.A.	*Beach Bluff*	Beach Bluff.
Forrest, Laurence Raymond	X.	*Lynn*	Lynn.
Freed, Charles	I.	*Cambridge*	Cambridge.
Fuller, Bernard Roy	I.	*New York, N.Y.*	146 St. Botolph St.
Gawne, James Orville	XIII.A.	*Fredonia, N.Y.*	2 Westland Ave.
Gibbs, Arthur Sherman	VI.	*No. Middleboro*	27 Cumberland St.
Gilbert, Royce Wheeler	XI.	*Boston*	78 Westland Ave.
Gilkison, Gordon Mercer	I.	*Oakville, Ontario*	158 St. Botolph St.
Glancy, Robert Clifford	VI.	*Waltham*	Waltham.
Glazier, Harold Metcalf	IV.	*Hudson*	55 Rutland Square.
Gordon, W. Stuart, Jr., C.E.	II.	*New York, N.Y.*	215 Newbury St.
Gray, George Harrison	VI.	*Arlington*	Arlington.
Green, Fred Mortimer	VI.	*Newtonville*	Newtonville.

Fourth Year (*continued*).

NAME.	COURSE.	HOME.	RESIDENCE.
Green, William Duncan . . .	I.	*Brooklyn, N.Y.* . .	146 St. Botolph St.
Gregory, Newman Ballard .	III.	*Joplin, Mo.*	262 Newbury St.
Grimes, William Francis, Jr.	VI.	*Belmont*	Belmont.
Harriman, Daniel Francis	XIII.	*W. Boxford*	116 Appleton St.
Harrub, Calvin Nelson . .	XI.	*Silver Lake*	192 Dartmouth St.
Hartwell, Arthur Edward .	II.	*Houston, Texas* . .	64 W. Rutland Square.
Hathaway, Joseph Wood . .	VI.	*Middleboro*	169 W. Newton St.
Havens, Harry Lucas . . .	XI.	*Kansas City, Mo.* .	237 Beacon St.
Heidelberg, Frederick Marten	II.	*Houston, Texas* . .	64 W. Rutland Square.
Hickerson, Thomas Felix, A.M.	I.	*Ronda, N.C.* . . .	160 Newbury St.
Hilliard, Robert Bell .	XIII.A.	*Newton Centre* . .	Newton Centre.
Howland, Harold Howard . .	I.	*Westdale*	Westdale.
Hubbard, Carleton Waterbury	II.	*Greenwich, Conn.* .	85 Newbury St.
Hunt, Franklin Livingston	VIII.	*Waltham*	Waltham.
Inglee, Robert	II.	*Westdale*	Westdale.
Jacoby, Louis, A.B.	VI.	*Dallas, Texas* . . .	12 Newbury St.
Jaeger, Frederick	III.	*So. Weymouth* . . .	4 Linden Ave., R.
Johnson, Lewis Howes . .	VI.	*Rockland, Me.* . . .	128 Berkeley St.
Johnston, Cyrus Thurston .	VI.	*St. Paul, Minn.* . .	258 Newbury St.
Jones, Barry Hayes	VI.	*Poughkeepsie, N.Y.*	116 Appleton St.
Jones, Reginald Lamont . .	VI.	*W. Somerville* . . .	W. Somerville.
Jones, William Henry . . .	II.	*Ashland*	Ashland.
Keables, Austin Dow . . .	II.	*Lowell*	35 St. Botolph St.
Kelley, Mark Elbridge . . .	I.	*Peabody*	Peabody.
Kellogg, Alfred Galpin . .	IV.	*Brookline*	Brookline.
Kerr, Robert Clark, A.B. .	VI.	*Baltimore, Md.* .	9 Oakview Terrace, J.P.
King, Lester Hazen	IV.	*Hartford, Conn.* . .	44 The Fenway.
Knipp, Arthur Russell, A.B.	VI.	*Baltimore, Md.* . .	10 St. James Ave.
Latimer, Robert Cathcart, B.A.	II.	*York, Pa.*	85 Newbury St.
Lawrence, George Leonard, Jr.	I.	*Melrose*	Melrose.
Lazenby, Paul Helme	I.	*Lynn*	Lynn.
Lenox, John Edward	I.	*Cambridge*	Cambridge.
Longyear, Helen McGraw .	IV.	*Brookline*	Brookline.
Loomis, Lynn Albert . . .	III.	*Springfield*	237 Beacon St.
Loud, Francis Martin, A.B.	VI.	*Colorado Sprs., Colo.*	128 Berkeley St.
Lovewell, Frank Sherman, A.B.	I.	*Chicago, Ill.* . . .	122 St. Botolph St.
Luscomb, Florence Hope .	IV.	*Allston*	14 Ashford St., A.
McAuliffe, William James . .	I.	*Boston*	4 Melrose St.
McCain, Samuel Norman . .	I.	*Allegheny, Pa.* . .	262 Newbury St.
McCarthy, John Francis . .	I.	*So. Boston*	130 Chandler St.
McClintock, Frank S., B.A. .	II.	*Pittsburgh, Pa.* . .	85 Newbury St.
Machen, Thomas Gresham, A.B.	IV.	*Baltimore, Md.* . .	85 Newbury St.
Madenigian, Kevork	I.	*Aghin, Armenia* . .	216 W. Canton St.
Malcom, Sydney Arnold . .	XI.	*Somerville*	Somerville.

Fourth Year (*continued*).

NAME.	COURSE.	HOME.	RESIDENCE.
Marshall, Henry Herbert	II.	*Elmwood*	9 Haviland St.
Matte, Joseph	I.	*No. Adams*	178 W. Canton St.
May, Kenneth Sargeant	VI.	*Newton Highlands*	Newton Highlands.
Mayo, Lincoln	II.	*Jamaica Plain*	11 Robeson St., J.P.
Menke, Alvin Frederick. A.B	IV.	*Evansville, Ind.*	Brookline.
Merrill, Edward Dearborn, Ph.B.	I.	*Des Moines, Iowa*	Brookline.
Merriman, Thurston Cables	III.	*Hartford, Conn.*	24 Rutland Square.
Miller, George	III.	*Lawrence*	7 Durham St.
Miller, Henry Franklin, 2d	II.	*Wakefield*	262 Newbury St.
Mills, John, A.B., A.M.	VI.	*Brookline*	Brookline.
Mitchell, Arthur Knox	XI.	*Springfield*	Brookline.
Morrill, Arthur Bradford	XI.	*Haverhill*	15 Berwick Park.
Muñoz, Ramón Fidencio	III.	*Saltillo, Mexico*	546 Newbury St.
Myers, Henry Earle	IV.	*Ashland, Ohio*	55 Rutland Square.
Nickerson, John Winslow	II.	*Roxbury*	33 Alpine St., R.
Nisbet, Lewis Dexter	I.	*Providence, R.I.*	221 Newbury St.
O'Neill, Haylett, A.B.	VI.	*Spokane, Wash.*	112 Pembroke St.
Paine, Harold William, Ph.B.	X.	*Warwich, R.I.*	103 Mt. Vernon St.
Palmer, George Truman, B.S.	VII.	*Palmyra, N.Y.*	7 Follen St.
Parker, Joseph Warren	I.	*Somerville*	Somerville.
Pearce, John Stewart	III.	*Glen Campbell, Pa.*	215 Newbury St.
Pepper, Benjamin Ward	I.	*Dorchester Center*	12 Granville St., D.C.
Petzold, Herbert Robert	VI.	*Lawrence*	Lawrence.
Poor, Arthur Kenneth	II.	*Danvers*	Danvers.
Poore, Lester Deane	VI.	*Georgetown*	128 Berkeley St.
Porosky, Matthew	VI.	*Roxbury*	10 Sunderland St., R.
Putnam, Henry Rice	III.	*Brookline*	Brookline.
Radford, Charles Weston	I.	*Oshkosh, Wis.*	12 Newbury St.
Reeds, Clarence, A.B.	II.	*Norman, Okla.*	3 Rutland Square.
Reilly, William Robison	III.	*Salt Lake City, Utah*	26 Newbury St.
Reppert, George Henry, B.S.	VI.	*Pittsburgh, Pa.*	Brookline.
Rew, Morse Woolley, B.S.	I.	*Grinnell, Iowa*	Brookline.
Richards, Joseph Lovering	X.	*Brookline*	Brookline.
Robinson, Burr Arthur	III.	*Buffalo, N.Y.*	262 Newbury St.
Robinson, Clark Shove	X.	*Malden*	Malden.
Robinson, Elmo Arnold	VII.	*Canandaigua, N.Y.*	26 Ashford St., A.
Rountree, Walter Jefferson	II.	*Quitman, Ga.*	Somerville.
Schakne, Jacob Herzl	VI.	*Pittsburgh, Pa.*	84 W. Rutland Square.
Scharff, Maurice Roos	XI.	*Natchez, Miss.*	236 Newbury St.
Sharman, Frank Weller	IV.	*Boston*	11 Irvington St.
Shaw, Arthur Lassell	I.	*Clinton*	234 Newbury St.
Shen, Heenan Tinching	XIII.	*Foochew, China*	215 Huntington Ave.
Smith, Phifer, B.A.	VI.	*Livingston, Ala.*	Technology Chambers.
Smith, Robert Lewis	II.	*Roslindale*	14 Cross St., Ros.

Fourth Year (*continued*).

NAME.	COURSE.	HOME.	RESIDENCE.
Smith, Xanthus Russell	XIII.	*Weldon, Pa.*	12½ St. James Ave.
Soderstrom, Francis Harold	III.	*Beachmont*	Beachmont.
Spencer, Henry Kendall	II.	*Dorchester*	29 Larchmont St., D.
Spooner, Thomas, A.B.	VI.	*Auburn, Me.*	519 Columbus Ave.
Stephenson, Joseph Newell	X.	*Great Barrington*	474 Mass. Ave.
Stiebel, Herbert Joseph	III.	*Brookline*	Brookline.
Stone, Leo Solomon	I.	*Roxbury*	59 Fort Ave., R.
Sweeney, John Calvin, Jr.	XIII.A.	*Paris, Tenn.*	2 Westland Ave.
Temple, Raymond Barrus	II.	*Reading*	10 Rutland Square.
Thompson, Rebecca Hall	IV.	*Honolulu, T.H.*	27 St. James Ave.
Thornley, Albert Edward	II.	*Pawtucket, R.I.*	10 Rutland Square.
Towne, Lockwood Jones, Ph.B.	I.	*Greencastle, Ind.*	30 Rutland Square.
Treuthardt, Ernest Leonard P.	V.	*Medford*	Medford.
Turner, Channing	IX.	*Geneva, Ill.*	6 Louisburg Square
Wallis, George Edward	II.	*Beverly*	Beverly.
Ware, Ernest Alonzo	XI.	*Somerville*	Somerville.
Washburn, George Ellery	VIII.	*Lexington*	Lexington.
Webb, Harry	III.	*Springfield, Ohio*	237 Beacon St.
Weeks, Allen Taber	II.	*Marion*	59 Chestnut St.
Weill, Melville Kaiser	II.	*San Francisco, Cal.*	282 Dartmouth St.
Wells, Edward Ernest	X.	*Toronto, Ontario*	Lowell.
Whipple, Malon Patterson, A.B.	V.	*Solon, Me.*	Cambridge.
Whitaker, Harry Emerson	VI.	*Newton*	Newton.
White, Clifton Hackett	III.	*Newton Centre*	Newton Centre.
Willard, John Artemas	II.	*Wrentham*	Wrentham.
Williams, Edward Thrasher	I.	*Tientsin, China*	Brookline.
Winchester, Laurence Somerby	VI.	*Reading*	Reading.
Wiswall, Paul McCord	V.	*Providence, R.I.*	1 Mt. Warren, R.
York, Waldo Cornell	I.	*New Bedford*	Brookline.
Young, Philip Endicott	II.	*Dedham*	215 Newbury St.
Zahner, Robert Van Lier, A.B.	II.	*Adams*	165 W. Newton St.

THIRD YEAR.

NAME.	COURSE.	HOME.	RESIDENCE.
Adler, Leon Meyer	II.	*Birmingham, Ala.*	10 Newbury St.
Allen, Abbott	I.	*Dorchester*	36 Milwood St., D.
Almy, Charles, Jr., A.B.	X.	*Cambridge*	Cambridge.
Andrews, Albert Willard, A.B.	I.	*Canandaigua, N.Y.*	73 Pinckney St.
Arkell, William Clark	I.	*New York, N.Y.*	85 Newbury St.
Armstrong, Kenneth Potter	I.	*Somerville*	Somerville.
Arnold, Harold Shelton	III.	*No. Abington*	12 Newbury St.
Atkins, Lew Morton	XIII.A.	*Hastings, Mich.*	32 Westland Ave.
Avery, John, Jr.	I.	*W. Newton*	W. Newton.
Babcock, John Brazer, 3d	I.	*Dorchester*	11 Downer Ave., D.
Bartlett, Ralph Lincoln	III.	*Newburyport*	Newburyport.
Batcheller, George Ellinwood	II.	*Mt. Vernon, N.Y.*	Technology Chambers.
Beach, Albert John	I.	*Somerville*	Somerville.
Bell, Frank Frederick	II.	*Bristol, Pa.*	263 Newbury St.
Benton, Carroll Roland	I.	*Manchester, N.H.*	122 Huntington Ave.
Biedler, William Thomas, B.S.	VI.	*Baltimore, Md.*	60 Batavia St.
Bien, Van Tuyl Hart	XIII.	*Washington, D.C.*	43 Concord Square.
Blanchard, Cecil King, B.S.	VII.	*Quincy*	Quincy.
Bowers, Ralph Henry	VI.	*Dorchester*	832 Columbia Road, D.
Breyer, Robert Samuel	III.	*Houston, Texas*	26 Newbury St.
Briggs, Chester Jackson	III.	*Newtonville*	Newtonville.
Briggs, Leroy Edmund	II.	*Providence, R.I*	83 St. Botolph St.
Brown, Dallas, Jr.	II.	*New Bedford*	16 Fountain St., R.
Brown, Harold Chester	II.	*Dorchester*	104 Geneva Ave., D.
Brown, Perley Kimball	XI.	*Manchester, N.H.*	523 Newbury St.
Brownell, Walter Keith	I.	*Brookline*	Brookline.
Brush, Reuben Warner	VI.	*Cambridge, Vt.*	15 Durham St.
Burleigh, William Stover	II.	*Natick*	Natick.
Burnham, Philip Weeks	IV.	*Waltham*	Waltham.
Cadenas, Manuel Antonio	I.	*Camagüey, Cuba*	72 Huntington Ave.
Carey, Charles Donald, A.B.	II.	*Stroudsburg, Pa.*	16 Rutland Square.
Castelhun, Frederic Karl	VI.	*Newburyport*	Newburyport.
Chapin, Maurice Scott	XIII.	*Springfield*	262 Newbury St.
Chapman, Lawrence Boylston	XIII.	*Norwich, Conn.*	179 St. Botolph St.
Cilley, Jay Wesley	VI.	*So. Newbury, N.H.*	Somerville.
Clapp, Dudley	X.	*Dorchester*	52 Hartford St., D.
Clark, Eldon Saunders	I.	*Dorchester*	11 Montague St., D.
Cleverdon, Herbert Squires	IV.	*New York, N.Y.*	234 Newbury St.
Clough, Harry Linwood, B.S.	V.	*Brockton*	218 W.Springfield St.
Cobb, Frank Lewis	VI.	*Dorchester*	56 Mt. Everett St.,D.
Cohen, Samson Kalmon	I.	*Roxbury*	3 Elbert St., R.
Cole, John Foster	VI.	*So. Boston*	456 Broadway, S.B.
Collingham, Howard	VI.	*Somerville*	Somerville.

Third Year (*continued*).

NAME.	COURSE.	HOME.	RESIDENCE.
Conner, George Cartnell	VI.	*Truro, Nova Scotia*	1 Cohasset St., Ros.
Coplan, Michael Abram	I.	*Roxbury*	97 Hampden St., R.
Creecy, Charles Eaton	I.	*Washington, D.C.*	44 The Fenway.
Crommett, Orrin James	II.	*Chelsea*	Chelsea.
Cumings, George Bradley	VI.	*Winchester*	Winchester.
Cummings, Harold Neff, A.B.	I.	*Auburn, Me.*	11 Carlisle St., R.
Curtis, Allen	I.	*Gloucester*	14 Park Square.
Cushing, Walter Burgess	X.	*Norwood*	4 St. Botolph St.
Davies, Arnold Chaplin	VIII.	*Georgetown*	Somerville.
Dennett, Kingsley Winsor	II.	*W. Roxbury*	W. Roxbury.
Diehl, John Christopher, B.S.	I.	*New Oxford, Pa.*	108 Chandler St.
Dillon, Robert Emmet	II.	*Belchertown*	163 Huntington Ave.
Dodge, Robert Lincoln	VI.	*Wenham*	Wenham.
Dornberger, Herbert S., A.B.	I.	*Pittsburgh, Pa.*	108 Chandler St.
Dow, Leander Allen	IV.	*Spokane, Wash.*	26 Newbury St.
Downs, Loren Noxen, Jr.	VI.	*Boston*	33 Clarendon St.
Drake, Whitford	XIII.A.	*Waltham*	Garrison Hall.
Drew, William Noel	X.	*Roxbury*	201 Magnolia St., R.
Dunbar, Arthur Richards, B.A.	V.	*E. Bridgewater*	E. Bridgewater.
Everett, William Dexter	III.	*Dorchester*	8 Allston St., D.
Fabens, Andrew Lawrie, A.B.	II.	*Williamstown*	122 Newbury St.
Fales, Helen Lillian	V.	*So. Framingham*	So. Framingham.
Fernandez, Richard Osborne	X.	*Somerville*	Somerville.
Fernstrom, Karl Dickson	XIII.	*Norfolk, Va.*	95 Newbury St.
Fitzwater, John Moxcey	I.	*Penn Yan, N.Y.*	254 W. Newton St.
Fletcher, Matthew	IX.	*Boston*	282 Dartmouth St.
Foote, Arthur John	I.	*Pittsfield*	122 St. Botolph St.
Fowler, Herbert Ernest, B.S.	IV.	*Rochester, N.Y.*	139 Beacon St.
Freethy, George Edwards	II.	*Brookline*	Brookline.
French, Louis Osborne	II.	*Milwaukee, Wis.*	234 Newbury St.
Gasche, Karl Wise, Ph.B.	X.	*Dresden, Ohio*	178 Huntington Ave.
Gegenheimer, Ralph Edwin	V.	*Lawrence*	31 Concord Square.
George, Ralph Moore, B.S.	VI.	*Bradford, Pa.*	25 St. James Ave.
Gillis, Ridgway Mills, A.B.	I.	*Walla Walla, Wash.*	112 Pembroke St.
Godfrey, Karl Davenport	VI.	*Roxbury*	46 St. James St., R.
Godley, Frederick A., B.A.	IV.	*New York, N.Y.*	112 Pinckney St.
Goodwin, Richard Frederic, Jr.	III.	*Boston*	26 Newbury St.
Gould, Allen Adams	VI.	*Newton Upper Falls*	Newton Upper Falls.
Green, Charles Edward	II.	*Dorchester*	42 Parkman St., D.
Greene, Elbert Daniel	VI.	*Pueblo, Colo.*	26 Newbury St.
Guthrie, Seymour Ashley	III.	*Riverside, Ill.*	426 Newbury St.
Hadji Savva, Achilles, A.B.	I.	*Baffra, Turkey*	558 Tremont St.
Hale, Henry Appleton, Jr.	II.	*Salem*	Salem.
Haley, Ralph Jandt, A.B.	II.	*Sioux City, Iowa*	Cambridge.

Third Year (*continued*).

NAME.	COURSE.	HOME.	RESIDENCE.
Harcourt, Guy Nichols . . .	I.	*Wappingers Falls, N.Y.*	282 Dartmouth St.
Harding, Arthur Leslie . .	VI.	*Medfield*	Medfield.
Hargraves, William Burton	III.	*Jamaica Plain* . .	7 Eliot Place, J.P.
Harris, Phillip Thomas . .	IV.	*Orange*	3 Arlington St.
Harrison, J. Kearsley Mitchell	II.	*Philadelphia, Pa.* .	3 Mountfort St.
Hart, Philip	II.	*Portland, Ore.* . . .	237 Beacon St.
Hartman, Ira Samuel . . .	VI.	*Nashville, Tenn.* .	116 Appleton St.
Hemmenway, Laurence Todd	VI.	*Uphams Corner* .	41 Monadnock St., U.C.
Henderson, Stuart Llewellyn	VI.	*Dorchester*	28 Jones Ave., D.
Hield, Clifford Chase . . .	II.	*Minneapolis, Minn.*	12 Newbury St.
Hodges, Frank Ernest . . .	VI.	*Hyde Park*	Hyde Park.
Holbrook, John Alder . . .	VI.	*Milton*	Milton.
Horne, Ralph Warren . . .	XI.	*Malden*	Malden.
Horton, William Henry, Jr.	VI.	*Delavan, Wis.* . . .	Newton.
Huckins, Albert Kimball .	VI.	*Dorchester*	6 Wilbur St., D.
Humphrey, Charles Farrar .	VI.	*Waltham*	Waltham.
Jacobs, Elmer	I.	*Needham*	Needham.
Jacoby, Raymond Weiss . .	X.	*Wilkes-Barre, Pa.* .	264 Newbury St.
James, Gorton, A.B.	I.	*Brookline*	Brookline.
Jenckes, Edwin Kenyon . .	V.	*Pawtucket, R.I.* . .	11 St. James Ave.
Jones, Bradley	II.	*Winthrop*	254 Mass. Ave.
Jones, Raymond Leston . .	III.	*Barnstable*	205 W. Newton St.
Joy, Charles Frederick, Jr. . .	I.	*Roxbury*	241 Walnut Ave., R.
Kiely, Edmund Bernard . .	VI.	*Lynn.*	Lynn.
King, Walter Wellington .	X.	*New Brighton, N.Y.*	237 Beacon St.
Knox, Harry Gard . .	XIII.A.	*Annapolis, Md.* . .	32 Westland Ave.
Laurson, Philip Gustave, B.S.	I.	*Mitchell, S. Dak.* .	413 Columbus Ave.
Lodge, John, A.B.	I.	*Media, Pa.* . . .	Technology Chambers.
Lombard, Robert Hamilton	VIII.	*Ashburnham* . . .	82 Montgomery St.
Loud, Roger Perkins . . .	VI.	*Weymouth*	Weymouth.
Lovejoy, Carl Howard . . .	I.	*Dorchester*	25 Parkman St., D.
Lufkin, Fred Richards . .	VI.	*Woodfords, Me.* . .	92 Gainsborough St.
Lunt, George Perkins . . .	X.	*Danvers*	Danvers.
McPhee, Harold Evan . .	VI.	*So. Framingham* .	128 Berkeley St.
McRae, George Wadsworth	VI.	*Malden*	Malden.
Magee, George Hugh . . .	II.	*So. Groveland* . . .	159 Warren Ave.
Maglott, Geo. Frederick, B.S.	XI.	*Ada, Ohio*	61 St. Botolph St.
Manson, Harold Crosby . .	II.	*Dorchester*	263 Newbury St.
Mason, Austin Blake, A.B. .	I.	*Boston*	347 Commonwealth Ave.
Maxfield, Joseph Pease .	VIII.	*Brookline*	Brookline.
Merrill, Edward Francis . .	II.	*New Rochelle, N.Y.*	Newton Centre.
Merry, Augustus Bradford . .	I.	*Vineyard Haven* . .	Melrose Highlands.
Meulendyke, Charles E., B.S..	X.	*Rochester, N.Y.* .	Technology Chambers.
Mills, Leonard Olcott . . .	VI.	*Holyoke*	85 St. Botolph St.

Third Year (*continued*).

NAME.	COURSE.	HOME.	RESIDENCE.
Mylchreest, George Lewis, B.S.	I.	*Middletown, Conn.*	82 Huntington Ave.
Myrick, John Botume	VI.	*W. Newton*	W. Newton.
Nichols, William Robert, B.S.	VI.	*Petersburg, Va.*	60 Batavia St.
O'Brien, James H., B.S.	X.	*Northfield, Minn.*	138 Chandler St.
O'Neill, John Henry	XI.	*Lowell*	230 Newbury St.
Orchard, William John	XI.	*Roslindale*	14 Fletcher St., Ros.
Parsons, Harold Frank	I.	*Gloucester*	86 St. Botolph St.
Peabody, Dean, Jr.	II.	*Somerville*	Somerville.
Perry, Harold Robert	III.	*Dorchester Center*	296 Norfolk St., D.C.
Phillips, Alfred Ingersoll, Jr.	II.	*Philadelphia, Pa.*	12½ St. James Ave.
Pilling, Earl Wellington	I.	*Danielson, Conn.*	22 Claremont Park.
Piper, Carleton French	III.	*Randolph*	Randolph.
Pitcher, Floyd Jacob	I.	*Somerville*	Somerville.
Potter, Erford Merton	VI.	*Taunton*	Taunton.
Preston, Ralph Albion Drury	II.	*Natick*	Natick.
Price, Malcolm Dana	II.	*Brookline*	Brookline.
Ragsdale, Earl James Wilson	XIII.	*St. Petersburg, Russia*	Brookline.
Randall, Chester Joseph	X.	*Waltham*	Waltham.
Ransohoff, Nathan	II.	*Cincinnati, Ohio*	Technology Chambers.
Redfield, Clifford Steele	X.	*Nashua, N.H.*	Cambridge.
Redman, Ernest Albert	II.	*W. Lynn*	W. Lynn.
Reynolds, Herbert Gardner	II.	*Malden*	Malden.
Rice, Lawrence Grout	XI.	*Natick*	Natick.
Rietschlin, Otto Rheinhard	I.	*Jamaica Plain*	190 Lamartine St., J.P.
Roper, Thomas Avery	III.	*Brookfield*	217 Newbury St.
Rosenstein, Ludwig	X.	*San Francisco, Cal.*	7 Concord Square.
Ruckman, John Hamilton	II.	*San Francisco, Cal.*	137 Newbury St.
Russell, Earl Simmons	II.	*W. Hanover*	W. Hanover.
Sargeant, French Philbrick	XIII.	*Manchester, N.H.*	484 Beacon St.
Saul, Tom Wynne	I.	*Boston*	263 Newbury St.
Sawyer, Luke Eugene	II.	*Brighton*	56 Chestnut Hill Ave., B.
Schellens, Christopher Avery	XIII.	*Groton, Conn.*	Cambridge.
Schleicher, Henry Matthias	III.	*Roxbury*	16 Williams St., R.
Schmidt, Hermann Charles	VI.	*Richmond, Va.*	60 Batavia St.
Schofield, William McNair	III.	*Newtonville*	Newtonville.
Scofield, Walter W., Jr., A.B.	V.	*Dalton*	23 Rockland Ave., R.
Scriven, Edward Osborne, B.S.	VI.	*Beloit, Wis.*	Beacon Chambers.
Seeley, Nathaniel Stevens	II.	*Flushing, N.Y.*	44 The Fenway.
Shaw, Carroll Harper	VI.	*No. Abington*	No. Abington.
Sherman, Max Christopher	II.	*W. Newton*	W. Sherman.
Silsbee, Francis Briggs	VI.	*Lawrence*	54 Rutland Square.
Sittinger, Carl Joseph	VI.	*Roxbury*	59 Delle Ave., R.
Smead, Ralph Amsden, B.S.	I.	*Greenfield*	169 W. Newton St.
Smith, Charles McLean, B.A.	VI.	*Hartford, Conn.*	162 Huntington Ave.

Third Year (*continued*).

NAME.	COURSE.	HOME.	RESIDENCE.
Smith, Otis Sanborn	I.	*Laconia, N.H.*	11 St. James Ave.
Spaans, Walter	X.	*Brookline*	Brookline.
Stauffer, Isaac Hull, A.B.	I.	*New Orleans, La.*	186 Commonwealth Ave.
Stellwagen, Karl Donald	II.	*Detroit, Mich.*	282 Dartmouth St.
Stover, Frederick Haskell	VII.	*Newburyport*	Newburyport.
Stump, Horace Eugene	X.	*Chicago, Ill.*	285 Newbury St.
Taylor, Horace Van Sands, B.A.	VI.	*Hartford, Conn.*	245 W. Newton St.
Taylor, Philip Weston	I.	*Arlington*	Arlington.
Taylor, Richard Raymond	X.	*Lunenburg, Vt.*	474 Mass. Ave.
Terry, Philip Dunbar	I.	*Waterville, N.Y.*	254 W. Newton St.
Thompson, Maurice R.	VIII.	*E. Lexington*	E. Lexington.
Tilden, Merrill William	II.	*Chicago, Ill.*	215 Newbury St.
Tolman, Edward Chace	VIII.	*W. Newton*	W. Newton.
Truette, Arthur Pierce	II.	*Brookline*	Brookline.
Wadsworth, Prescott Kingsley	III.	*Eastport, Me.*	215 Newbury St.
Waite, Horace Stokes	II.	*Boston*	Hotel Buckminster.
Waldo, William Ratcliffe	I.	*Winthrop*	Winthrop.
Waller, Robert Pettit, A.B.	I.	*Bloomsburg, Pa.*	59 Hemenway St.
Wallower, Charles William	VI.	*Harrisburg, Pa.*	262 Newbury St.
Warren, Van Court	III.	*Los Angeles, Cal.*	237 Beacon St.
Wasserboehr, Harvey Paul, Jr.	VI.	*Hyde Park*	Hyde Park.
Waters, Lewis William	V.	*Orange*	19 Concord Square.
Watson, Richard Parker	I.	*Roxbury*	47 Bainbridge St., R.
Wells, Russell Diemer	VI.	*Spring City, Pa.*	234 Newbury St.
Wengert, William Harry, B.S.	II.	*Lebanon, Pa.*	34 Isabella St.
Wentworth, John Prescott	XI.	*Malden*	Malden.
White, Cyrus Newell	XI.	*Wakefield*	Wakefield.
Whithed, Houghton Hamilton	VI.	*Grand Forks, N. Dak.*	546 Newbury St.
Whitney, James Theodore	IV.	*Wakefield*	Wakefield.
Whittemore, Theodore B.	XI.	*New York, N.Y.*	215 Newbury St.
Wiester, Aber Stowe, B.S.	V.	*Roxbury*	15 Arklow St., R.
Wilbur, Harold Raymond	VI.	*Kingston*	15 Concord Square.
Williamson, Donald Voorhis	II.	*Brookline*	Brookline.
Wilson, Chester Worcester	II.	*Newton*	Newton.
Wohlgemuth, Bert Samuel	III.	*Youngstown, Ohio*	7 Berwick Park.

SECOND YEAR.

NAME.	COURSE.	HOME.	RESIDENCE.
Aaron, Joseph Abraham	VI.	*Roxbury*	3 Normandy St., R.
Adams, Arthur King	II.	*Adams*	1069 Beacon St.
Adams, Frederic Hillyer	XIII.	*Brooklyn, N.Y.*	Cambridge.
Adams, Ralph Guy	II.	*Needham*	Needham.
Allen, David Pillsbury	II.	*Saxonville*	155 Worcester St.
Allen, Walter Defriez	XIII.	*Nantucket*	5 St. James Ave.
Allison, Harold Burbridge C.	X.	*Cambridge*	Cambridge.
Anderson, Cedric Samuel	VI.	*W. Roxbury*	24 Ruskin St., W.R.
Angell, Herbert A.	IV.	*Portland, Oregon*	47 Concord St.
Arms, John Taylor, Jr.	IV.	*Washington, D.C.*	3 Spruce St.
Babbitt, Harold Eaton	XI.	*Boston*	140 St. Botolph St.
Barker, Charles Morse	VI.	*Marlboro*	Somerville.
Barr, Kester	II.	*Buffalo, N.Y.*	234 Newbury St.
Barton, Royal Miner	VI.	*Elmwood, R.I.*	13 Berwick Park.
Bates, Stanley Edwards	I.	*Newton*	Newton.
Batty, Ernest James	II.	*Valley Falls, R.I.*	Valley Falls, R.I.
Bell, John Rice	X.	*Malden*	Malden.
Bishop, Frank Day	V.	*Springfield*	19 E. Concord St.
Bragg, Caleb Smith, B.A.	II.	*Cincinnati, Ohio*	Hemenway Chambers.
Brown, George Arthur	X.	*Haverhill*	159 Warren Ave.
Buckley, William Joseph	I.	*Lynn.*	Lynn.
Burnham, Paul Edwin	I.	*Lowell*	Lowell.
Caldwell, Philip Lord	I.	*Boston*	101 Gainsborough St.
Campbell, James Kenneth	I.	*Esmont, Va.*	264 Newbury St.
Carney, Arthur William	III.	*Lawrence*	Lawrence.
Catching, Harry Hardin	I.	*London, Ky.*	264 Newbury St.
Cheney, James Burleigh	II.	*Chicago, Ill.*	237 Beacon St.
Clark, Oberlin Shurtleff	II.	*Dorchester*	30 Sydney St., D.
Coburn, William Haskins	VI.	*Jefferson, Me.*	422 Newbury St.
Coffin, Mitchell	II.	*Brooklyn, N.Y.*	Technology Chambers.
Constable, John Pierrepont	XIII.	*Utica, N.Y.*	6 Louisburg Square.
Cooley, Lloyd Cartwright	X.	*Brookline*	Brookline
Copeland, Stuart Brown	II.	*Milwaukee, Wis*	234 Newbury St.
Cornell, Samuel Hoag	XIII.	*New York, N.Y.*	44 The Fenway.
Cowee, George Alvin	III.	*Gardner*	Brookline.
Curtis, Frank Henry	III.	*E. Weymouth*	E. Weymouth.
Cushman, Paul Allerton	VI.	*Boston*	136 Newbury St.
Davis, Harold Martin	I.	*Dorchester*	28 Auckland St., D.
Davis, Henry Clarence, Jr.	VI.	*Fort Andrews*	44 The Fenway.
Day, Sidney Logan	IV.	*Huntington, W. Va.*	103 Mt. Vernon St.
de Forest, Alfred Victor	XIII.	*New York, N.Y.*	Brookline.
Denison, Orville Boardman	VI.	*So. Framingham*	So. Framingham.
Dolliver, Henry Francis	XI.	*So. Framingham*	So. Framingham.

Second Year (*continued*).

NAME.	COURSE.	HOME.	RESIDENCE.
Dows, Chester Lawrence	VI.	*Lowell*	Lowell.
Duffett, Norman	X.	*Rochester, N.Y.*	78 Huntington Ave.
Duffy, James Francis	VI.	*Dorchester*	8 Mather St., D.
Dunlap, Joseph Howard, A.B.	II.	*Washington, Pa.*	76 Huntington Ave.
Dyer, Sterling Burton	II.	*Cape Elizabeth, Me.*	11 Irvington St.
Edwards, Charles, Jr	XIII.	*Paterson, N.J.*	237 Beacon St.
Eldred, Calvin Powell	VI.	*Lowell*	20 St. James Ave.
Emmel, Rudolph	III.	*Jamaica Plain*	47 Walk Hill St., J.P.
Estes, George Henry	II.	*Auburn, Me.*	31 Newbury St.
Faunce, Kenneth W.	VI.	*W. Roxbury*	119 Bellevue St., W.R.
Foster, William Dewey	IV.	*Springfield*	422 Newbury St.
Fryer, Herbert	VI.	*Stoneham*	Stoneham.
Fuller, Joseph Cheever	II.	*W. Newton*	215 Newbury St.
Gaillard, David Saint Pierre	VI.	*Culebra, Canal Zone*	137 Newbury St.
Gardner, Albert Lester	II.	*Kingston*	Kingston.
George, Gardner Clifford	I.	*So. Groveland*	159 Warren Ave.
Gershberg, Joseph	VI.	*Baku, Russia*	126 Chandler St.
Goodwin, Edwin Weeks	VI.	*So. Berwick, Me.*	16 Tremlett St., D.
Gould, Richard Hartshorn	XI.	*Newton Upper Falls*	Newton Upper Falls.
Greenleaf, Cuthbert Tibbetts	II.	*Woburn*	Woburn.
Grossmann, Marcus Aurelius	III.	*Youngstown, Ohio*	7 Berwick Park.
Haines, Thomas Henry	II.	*Dorchester Center*	Peabody Square, D.C.
Hall, Edward Russell	II.	*Wollaston*	Wollaston.
Harrigan, Louis Jeremiah	XI.	*Beverly*	Beverly.
Harrington, Charles Henry	I.	*Cambridge*	Cambridge.
Harrington, Joseph Francis	VI.	*Canton Junction*	Canton Junction.
Hartshorn, Stanford Harding	X.	*Gardner*	41 St. Botolph St.
Haslam, Robert Thomas	X.	*Taunton*	Taunton.
Hayward, Roy Loring	I.	*So. Easton*	192 Dartmouth St.
Herlihy, John Albert	II.	*Lynn*	Lynn.
Hicken, Guy Reynolds	I.	*Newburyport*	Newburyport.
Hill, Bancroft	I.	*Baltimore, Md.*	85 Newbury St.
Hobson, Charles Foster	X.	*Lowell*	234 Newbury St.
Hodgman, Willis Kennedy, Jr.	II.	*Taunton*	78 Huntington Ave.
Holbrook, Ralph Anthony	X.	*Dorchester*	63 Harbor View St., D.
Hopkins, Warren Bernard	VI.	*Topeka, Kans.*	48 St. Stephen St.
Hufsmith, Clifford L., B.S.	VI.	*Palestine, Texas*	262 Newbury St.
Hugelmann, John Robert	I.	*Cambridge*	Cambridge.
Hutchins, Otis	VIII.	*Keene, N.H.*	31 Newbury St.
Huxley, Roy Desmond	VI.	*Florence*	312 Columbus Ave.
Ireland, Howard Percival	XI.	*Newton Centre*	Newton Centre.
Jenkins, David John	II.	*Stockett, Mont.*	95 Gainsborough St.
Jenks, Harold Gould	VI.	*Melrose Highlands*	Melrose Highlands.
Jewett, Frederic Carr	VI.	*Andover*	282 Dartmouth St.

Second Year (*continued*).

NAME.	COURSE.	HOME.	RESIDENCE.
Johnson, Cleon Rupert	X.	*Leominster*	140 St. Botolph St.
Kaufman, Abraham Harold E.	X.	*Lawrence*	169 Howard Ave., R.
Kellogg, Paul	IX.	*Buffalo, N.Y.*	6 Pickering Ave., R.
Kennedy, Edward	III.	*Holyoke*	41 St. Botolph St.
Kenney, George Churchill	I.	*Brookline*	Brookline.
Kerr, Charles Phillips	II.	*Catonsville, Md.*	546 Newbury St.
Kilborn, Karl Bray, A.B.	II.	*Portland, Me.*	180 Huntington Ave.
Killion, Thomas Stephen	III.	*Malden*	Malden.
Kimball, Scott Prescott	VI.	*Salt Lake City, Utah*	26 Newbury St.
Klapacs, Victor Paul	VI.	*So. Boston*	881 Broadway, S.B.
Kushlan, Max	VI.	*Boston*	40 Grove St.
Lake, Harry Eleazer	I.	*Topsfield*	23 Dalton St.
Larrabee, Herbert Pelham	VI.	*Waverley*	Waverley.
Leão, Pedro de Souza	VI.	*Manáos, Brazil*	132 Train St., D.
Leary, Arthur Francis	XI.	*E. Boston*	82 Havre St., E.B.
Levy, Nathan	I.	*Roxbury*	1617 Tremont St., R.
Livingston, George Edward	VI.	*Gloucester*	258 Newbury St.
Long, John Saberton	X.	*Tampa, Fla.*	84 Huntington Ave.
Lord, Harold Stowell	II.	*Athol*	63 St. Botolph St.
Lord, Raymond Harold	VI.	*Dorchester*	27 Park St., D.
Lougee, Norman Arthur	VI.	*Salem*	Salem.
MacCreadie, William Thomas	II.	*Andover*	Andover.
MacKenzie, John David	III.	*Baddeck, C.B.*	15 St. James Ave.
McKnight, W. Frank, A.B.	X.	*Taunton*	36 Union Park.
McMurtrie, Douglas Crawford	VI.	*New York, N.Y.*	6 Louisburg Square.
MacPherson, Roy Gay	II.	*So. Framingham*	So. Framingham.
Manley, Harry Lester	I.	*Providence, R.I.*	85 Newbury St.
Marston, Nathaniel Sidney	VI.	*Portland, Me.*	112 Homestead St., R.
Mather, Robert Harrison	VI.	*Windsor Locks, Conn.*	33 St. Botolph St.
Metcalf, Lester George, B.S.	II.	*Claremont, Cal.*	Cambridge.
Metz, August Carl	III.	*Oshkosh, Wis.*	140 Chandler St.
Meyer, Theodore Frederic W.	II.	*Yonkers, N.Y.*	285 Newbury St.
Moore, Francis Aldrich, B.S.	VI.	*Tyler, Texas*	262 Newbury St.
Morey, Chester Totten	II.	*Cambridge*	Cambridge.
Morrison Ibrahim Follansbee	I.	*Braintree*	Brookline.
Morse, Robert Emery	VI.	*Brookline*	127 Newbury St.
Nash, Edward Ardery	I.	*St. Joseph, Mo.*	234 Newbury St.
Nath, Simon	V.	*Boston*	21 Parkman St.
Nicholson, Ernest	I.	*Schenectady, N.Y.*	556 Columbus Ave.
Ofenstein, Clarence Leo	I.	*Washington, D.C.*	150 W. Canton St.
Omansky, Morris	V.	*Boston*	34 Auburn St.
O'Neill, Francis Michael	I.	*Holyoke*	75 Appleton St.
Osborn, Franklin, 2d	III.	*Peabody*	Peabody.
Parker, Theodore Bissell	I.	*Marblehead*	546 Newbury St.

Second Year (*continued*).

NAME.	COURSE.	HOME.	RESIDENCE.
Pepper, Chester Lawrence	II.	*Chelsea*	Chelsea.
Perrin, Lester William, B.A.	II.	*New Haven, Conn.*	Technology Chambers.
Phillips, Walter Irving	VI.	*Taunton*	Taunton.
Polhemus, Theodorus	XI.	*Newton Centre*	Newton Centre.
Prentiss, Nathan Newberry	III.	*Arlington*	Arlington.
Pushee, Harold Baldwin	X.	*Woburn*	Woburn.
Putnam, Scott Bradstreet	XI.	*Beverly*	Brookline.
Ranger, Richard Howland	VI.	*Indianapolis, Ind.*	74 Huntington Ave.
Ratzkoff, Silas Miram	II.	*Roxbury*	15 Ingleside St., R.
Rhoades, William Geyer	VI.	*Berkeley, Cal.*	282 Dartmouth St.
Richmond, Carl Gee	I.	*Revere*	Revere.
Rideout, Percy Adams	I.	*Concord Junction*	Concord Junction.
Robinson, Harold Long	I.	*Winchester*	Winchester.
Robinson, Kenneth Caleb	II.	*Roslindale*	250 Belgrade Ave., Ros.
Rooney, Arthur Hugh	VI.	*Lawrence*	Lawrence.
Runels, Ralph Earle	I.	*Lowell*	142 Huntington Ave.
Rush, James Edwin	XI.	*So. Boston*	120 Dorchester St., S.B.
Russell, Frank	II.	*Pittsfield*	237 Beacon St.
Ryder, Frank Pittis	III.	*Cadiz, Ohio*	Technology Chambers.
Salisbury, William Conyne	II.	*Chicago, Ill.*	215 Newbury St.
Sargent, Hall	II.	*Grand Forks, N.Dak.*	17 St. James Ave.
Schmidt, Samuel Myer	VII.	*Boston*	6 Minot St.
Schwartz, Lewis	V.	*Boston*	177 Chambers St.
Scribner, Samuel Harold	I.	*Lowell*	142 Huntington Ave.
Seligman, Wellesley Joseph	III.	*Brookline*	Brookline.
Shaw, Harold Francis	II.	*Leominster*	140 St. Botolph St.
Shohan, Abraham	VI.	*Roxbury*	35 Devon St., R.
Simonds, Warren James	I.	*Marlboro*	455 Columbus Ave.
Smith, Frank Griswold	III.	*Torrington, Conn.*	24 Rutland Square.
Smith, Hubert Stacy	X.	*Bay City, Mich.*	215 Newbury St.
Snyder, Henry Rossiter	IV.	*Gilbertville*	27 St. Stephen St.
Stanley, Robert Remington	II.	*Plymouth, N.H.*	27 St. Stephen St.
Stevens, Donald Read	II.	*Brookline*	Brookline.
Stewart, Dugald, A.B.	I.	*Middlebury, Vt.*	Technology Chambers.
Stewart, Oswald Wellington	I.	*Hyde Park*	Hyde Park.
Stimpson, Edwin Francis	X.	*Providence, R.I.*	Technology Chambers.
Suzuki, Ewazo, B.S.	X.	*Kobe, Japan*	94 Pinckney St.
Symmes, Ernest Montgomery	V.	*Winchester*	Winchester.
Torrey, Ralph Martin	XIII.	*Brookline*	Brookline.
Tuck, Davis Henry	VI.	*Nashville, Tenn.*	87 St. Botolph St.
Underhill, Arthur William, Jr.	VI.	*Springfield*	262 Newbury St.
Urquhart, John Alexander	XI.	*Concord*	263 Newbury St.
Van Hovenberg, Henry W.	XI.	*Eau Claire, Wis.*	4 St. Botolph St.
Van Syckel, Wallace Acie	III.	*Boston*	11 Blackwood St.

Second Year (*continued*).

NAME.	COURSE.	HOME.	RESIDENCE.
Van Tassel, Edward D., Jr.	X.	*Newtonville*	Newtonville.
Vose, Edwin Crawford	XI.	*Newtonville*	Newtonville.
Waterfall, Harry William	II.	*Brighton*	53 Fairbanks St., B.
Weisberg, Edward Isador	VI.	*Somerville*	Somerville.
Wells, Philip Varnum	VII.	*Roslindale*	15 Fairview St., Ros.
Wheeler, William Russell, A.B.	II.	*W. Rutland, Vt.*	Technology Chambers.
Whitcomb, Emmons Joseph	X.	*Somerville*	Somerville.
Wilkes, Gordon Ball	II.	*Buffalo, N.Y.*	Technology Chambers.
Wilson, Albert Olof	I.	*Cambridge*	Cambridge.
Wilson, Irving White	VIII.	*Brookline*	Brookline.
Wilson, Walter Chisholm	X.	*Lawrence*	243 W. Newton St.
Wood, Frank Asahel	II.	*Dorchester*	215 Newbury St.
Woodward, Edgar Lucian	VI.	*So. Boston*	5 Pacific St., S.B.
Yereance, Alexander Woodward	I.	*So. Orange, N.J.*	258 Newbury St.
Young, Erving Mandeville	I.	*Haverhill*	101 Gainsborough St.

FIRST YEAR.

NAME.	HOME.	RESIDENCE.
Albee, Albert Clifton	*W. Medford*	W. Medford.
Albee, Charles Herbert	*E. Boston*	109 Trenton St., E.B.
Alden, Frederick Thornton	*Malden*	Malden.
Allen, Vincent Weaver	*Waterbury, Conn.*	7 Follen St.
Appelquest, Jerome Anthony	*Middletown, Conn.*	37 St. Botolph St.
Bakeman, George Wilbur	*Newton Upper Falls*	Newton Upper Falls.
Baker, David Franklin	*Haverford, Pa.*	W. Newton.
Baker, Eugene Berkeley	*Auburndale*	Auburndale.
Baker, Frederick	*Lynn*	31 Newbury St.
Baker, John Wigham	*Auburndale*	Auburndale.
Balke, Frank Charles	*Indianapolis, Ind.*	Technology Chambers.
Ballard, Volant Vashon	*Creston, Cal.*	140 St. Botolph St.
Barker, Frederick William, Jr.	*Syracuse, N.Y.*	215 Newbury St.
Barnard, Jack Merrow	*Weymouth*	Weymouth.
Barnes, William Ellsworth, Jr.	*Dorchester*	432 Columbia Road, D.
Barry, John Lincoln, 3d	*Newton Centre*	Newton Centre.
Bates, Ralph Dudley	*Cohasset*	Cohasset.
Baxter, William Henry	*Boston*	755 Boylston St.
Beale, James McArthur	*Brookline*	Brookline.
Beason, Lew Wyatt	*Ogden, Utah*	74 Huntington Ave.
Becker, John, Jr.	*Hyde Park*	Hyde Park.
Benbow, David Fry	*Reading, Pa.*	234 Newbury St.

First Year (*continued*).

NAME.	HOME.	RESIDENCE.
Bennett, Frederick Arthur	*Hartford, Conn.*	245 W. Newton St.
Bennis, Arthur Thomas	*Punxsutawney, Pa.*	16 St. James Ave.
Benson, Harvey Smith	*Syracuse, N.Y.*	262 Newbury St.
Bent, Donald Earl	*Denver, Colo.*	12 Newbury St.
Bermudez, Ruben, Jr.	*Honduras, C.A.*	119 Berkeley St.
Bickerdike, Charles Edgar Odin	*Bakersfield, Cal.*	177 Mass. Ave.
Bird, William Case	*Rockland, Me.*	154 Huntington Ave.
Bizzozero, Angelo Peter	*Quincy*	Quincy.
Blaisdell, Walter Osgood	*Boston*	67 St. Botolph St.
Bommer, Fred William	*Chelsea*	Chelsea.
Borovoy, Samuel	*Boston*	49 McLean St.
Boyer, Joseph Alexander	*Gloucester*	26 Newbury St.
Brackett, Harold Hasty	*So. Framingham*	So. Framingham.
Bray, John Leighton	*Boston*	355 Columbus Ave.
Briel, Karl Rudolph	*Dorchester*	395 Ashmont St., D.
Brown, Edmund Guilford	*Medford*	Medford.
Brown, Karl Hamlin	*Watertown*	Watertown.
Brown, Parker Joseph	*Revere*	Revere.
Busby, Frederick Henry	*Boston*	368 Shawmut Ave.
Busey, Charles Bowen, A.B.	*Urbana, Ill.*	47 St. Botolph St.
Cabeen, Charles Franklin	*Salem*	Salem.
Caldeira, Renato	*Santos, Brazil*	6 Concord Square.
Caldwell, Frank Walker	*Lookout Mt., Tenn.*	3 Arlington St.
Calvin, Herbert Howard	*Oakland, Cal.*	282 Dartmouth St.
Campbell, Arthur	*Somerville*	Somerville.
Cardinal, Adolphe Charles	*Paterson, N.J.*	284 Dartmouth St.
Carpenter, Charles Hamlin	*Newton*	Newton.
Cartwright, Kenneth	*Wakefield*	Wakefield.
Chambers, George James	*Buffalo, N.Y.*	16 St. James Ave.
Champagne, Joseph Leslie	*Cambridge*	Cambridge.
Chandler, Leroy Wilder	*Leominster*	189 Warren Ave.
Chandler, Robert Adams	*Boston*	24 Yarmouth St.
Chen, Sidney Ying	*Shanghai, China*	9 St. James Ave.
Cherry, Martin Charles	*Roslindale*	22 Seymour St., Ros.
Christie, Madison Walter	*Somerville*	Somerville.
Clark, Franklin Haven, Jr.	*Baltimore, Md.*	6 Louisburg Square.
Codding, Henry White	*Brockton*	Brockton.
Cohen, Joseph Horace	*Boston*	113 Leverett St.
Collins, William Leo	*Medway*	Medway.
Comstock, Rock Livingston	*Wellsville, N.Y.*	413 Mass. Ave.
Connolly, John William	*Cambridge*	Cambridge.
Cook, James Arthur	*Peabody*	Peabody.
Cooper, Lester William	*Malden*	Malden.
Coram, Roy Everett	*Lowell*	59 Pinckney St.

First Year (*continued*).

NAME.	HOME.	RESIDENCE.
Cornish, Donald Owen	*W. Newton*	W. Newton.
Cotton, Evan Bruce	*Baltimore, Md.*	244 W. Newton St.
Coulson, Herbert	*Cambridge*	Cambridge.
Cox, Robert Sayre	*Terre Haute, Ind.*	6 Louisburg Square.
Coy, Edward Brown	*Westerly, R.I.*	7 Follen St.
Cremer, Randall	*Washington, D.C.*	242 Newbury St.
Crost, William Sol	*Hartford, Conn.*	126 Berkeley St.
Cummings, Laurence Theodore	*Winchendon*	155 Worcester St.
Curtis, George Lancey	*Newtonville*	Newtonville.
Dalrymple, Philip White	*W. Medford*	W. Medford.
Danser, Harold Wesley	*Freehold, N.J.*	154 Huntington Ave.
Davis, Albion Richmond	*Dorchester*	9 Butler St., D.
Davis, Ernest Walter	*Everett*	Everett.
Davis, Harold Beukma	*Lancaster, N.Y.*	110 Newbury St.
Davis, Roger Wolcott	*Hartford, Conn.*	215 Newbury St.
Devine, Robert Lawrence	*Roxbury*	110 School St., R.
Dexter, Harris Edward	*So. Boston*	1794 Columbia Rd.,S.B.
Dodge, Charles Ernest	*Manchester*	19 Garrison St.
Downing, Lester Locke	*Cambridge*	Cambridge.
Dowst, Henry, 3d	*Manchester, N.H.*	195 St. Botolph St.
Duell, Garth Homer	*Somerville*	Somerville.
Dugan, William Edward, Jr.	*Rochester, N.Y.*	225 Newbury St.
Duke, Leslie Burton	*Roxbury*	147 Harrishof St., R.
Duyser, Cornelius Anthony	*Winsted, Conn.*	166 Huntington Ave.
Edgerton, Gordon Irving	*No. Cambridge*	No. Cambridge.
Eicher, Archibald	*Greensburg, Pa.*	Cambridge.
Eisenberg, Adolph Martin	*Boston*	80 Green St.
Eksergian, Rupen	*Somerville*	Somerville.
Ellis, James Hawes	*Covington, Ky.*	171 Newbury St.
Farwell, Joseph Willard, Jr.	*Ponkapog*	Ponkapog.
Ferry, Earl Emerson	*Pittsfield*	135 W. Newton St.
Ferry, Ralph Montague	*Pittsfield*	135 W. Newton St.
Finberg, Joseph Benjamin	*Boston*	37 Lowell St.
Fish, Joseph Pryor	*Brockton*	Brockton.
Fisher, Thomas Chatfield	*Cotuit*	Salem.
Foley, Henry Michael	*Monson*	10 Batavia St.
Follett, David, Jr.	*Adams*	26 Newbury St.
Font y Gimenez, Manuel	*Mayaguez, Porto Rico*	96 Gainsborough St.
Forrester, George Wylie	*Clinton*	14 Durham St.
Foster, Raymond Celden	*Everett*	Everett.
Fox, Harold Robert Leslie	*Jamaica, W.I.*	7 Follen St.
Fox, Rudolph Herzer	*Hartford, Conn.*	242 Newbury St.
Fraser, Paul Gillivray	*Roxbury*	19 Minden St., R.
Fredriksen, Norman	*Newburyport*	Newburyport.

First Year (*continued*).

NAME.	HOME.	RESIDENCE.
Freedman, Abram James	*Brockton*	38 Dundee St.
Fuller, Francis Renel	*Pawtucket, R.I.*	215 Newbury St.
Funk, Carl Augustus	*Brookline*	Brookline.
Gale, Albert Garland	*Gloucester*	26 Newbury St.
Glidden, William Roy	*W. Somerville*	W. Somerville.
Gonzalez, Luis Ramon	*Santurce, Porto Rico*	75 Gainsborough St.
Goodwin, Leslie Hall	*Allston*	3 Barstow St., A.
Greenleaf, Harold	*Savanna, Ill.*	234 Newbury St.
Gregory, Amelio Francis	*Roxbury*	5 Pickering Ave., R.
Griffin, Harold Hopkinson	*W. Newton*	W. Newton.
Guillou, Alfred Victor	*Pasadena, Cal.*	4 Kearsarge Ave., R.
Hakes, Jesse Franklin	*Westerly, R.I.*	39 Mt. Pleasant Ave., R.
Hall, Herbert William	*Winsted, Conn.*	569 East 8th St., S.B.
Hall, John	*Freehold, N.J.*	21 Chestnut St.
Hall, Norwood Appleton	*Revere*	Revere.
Hammond, Angus Rutland	*Revere*	Revere.
Hanson, Hugo Henry	*Boston*	1037 Tremont St.
Hargrave, John Morris	*Norwood, Ohio*	78 Huntington Ave.
Harlow, Hamilton	*Cambridge*	Cambridge.
Hartnett, James Thomas	*Salem*	Salem.
Harvey, Walter Francis	*Everett*	Everett.
Hechinger, Lloyd Arthur	*Roxbury*	31 Lambert St., R.
Herreshoff, Nathaniel Greene, Jr.	*Bristol, R.I.*	64 Commonwealth Ave.
Higgins, Clark Freeman	*Worcester*	Melrose Highlands.
Holbrook, Edwin Charles	*Montello*	Brookline.
Holley, Francis Thomas	*Lawrence*	19 Fenwood Road, R.
Homan, Edmund Lewis	*Marblehead*	Marblehead.
Hooper, Linzee Sewall	*Boston*	7 Marlborough St.
Horgan, Patrick Donald	*Neche, N. Dak.*	409 Columbus Ave.
Hornor, Aurelius Pointer	*Helena, Ark.*	Technology Chambers.
Howland, Julius Lester	*Hyannis*	295 Dudley St., R.
Huddell, Arthur Stanley	*Chelsea*	Chelsea.
Huggins, Leslie Mansfield	*Malden*	Malden.
Hyde, Ralph Edwin	*Stoneham*	Stoneham.
Johnson, Harold Ingalls	*Dana*	16 St. James Ave.
Johnson, Henry Adams	*Newburyport*	Newburyport.
Joyner, Arthur Edward	*Miami, Fla.*	79 Waltham St.
Kahn, Milton	*Boston*	7 Minot St.
Kalbfleisch, Theodore Frederick, Jr.	*Glens Falls, N.Y.*	Brookline.
Kebbon, Harold Eric	*Boston*	Hotel Oxford.
Keith, Gerald Marcy	*Brooklyn, N.Y.*	2 St. Botolph St.
Kemp, Henry Donald	*W. Roxbury*	W. Roxbury.
Kenrick, Alfred Franklin	*Brookline*	Brookline.
Kimball, Merrill Justin	*Lowell*	Lowell.

First Year (*continued*).

NAME.	HOME.	RESIDENCE.
Kingsbury, Francis Henry	*Medfield*	Medfield.
Knight, Thomas Chalkley	*Philadelphia, Pa.*	263 Newbury St.
Lang, Walter Warren	*Roslindale*	33 Fairview St., Ros.
Langer, Robert Roger	*Somerville*	Somerville.
Laurie, Archibald Walwyn	*Somerville*	Somerville.
Learoyd, Fred Kenneth	*Danvers*	Danvers.
Leavitt, George Edward, Jr.	*Newburyport*	Newburyport.
Lehmann, Hans Frank	*New York, N.Y.*	65 St. Botolph St.
Lenaerts, John Henry	*Waltham*	Waltham.
Lennon, Arthur James	*Dorchester*	87 Brook Ave., D.
Levine, Max	*Boston*	6 Morton St.
Lombard, Oliver Cromwell	*Dorchester*	21 Walton St., D.
Lombardi, Pasquale Fredrick	*Boston*	156 Salem St.
Lovell, Joseph Warren	*E. Weymouth*	E. Weymouth.
Lowe, Rodney M.	*Fitchburg*	1 Willow St.
Lynch, William Charles	*Roxbury*	75 Marcella St., R.
Mabbott, Harold Clarkson	*Waterbury, Conn.*	35 St. Botolph St.
McAvoy, Francis Thomas	*Jamaica Plain*	13 St. Joseph St., J.P.
McClelland, Corliss Blake	*Cleveland, Ohio*	Newton Highlands.
McDonald, Albert James	*Hingham*	Hingham.
MacDonald, Henry Douglas	*Ludlow, Vt.*	Somerville.
MacDonough, John Vincent	*Watertown*	Watertown.
McFaul, Gregory Bernard	*New York, N.Y.*	Lexington.
McGrath, David James	*W. Roxbury*	6 Henshaw Ter., W.R.
Mackellar, Strathy Ridout	*Toronto, Ontario*	263 Newbury St.
McKenney, Karl Cushing	*Wellesley Hills*	Wellesley Hills.
Maguire, William James	*Providence, R.I.*	Hemenway Chambers.
Mangan, Edward	*Pittsfield*	198 St. Botolph St.
Manning, Harold Grosvenor	*Newton*	Newton.
Marceau, Eugene Theodore	*Wollaston*	Wollaston.
Mason, Edward Mansfield	*Winchester*	Winchester.
Mason, Max Clark	*Keene, N.H.*	55 Waverly St., R.
Matamoros Loria, Juan	*San José, Costa Rica*	251 W. Newton St.
Matthews, Leroy Allen	*Malden*	Malden.
Mayers, Edward Charles	*New York, N.Y.*	Technology Chambers.
Means, Alan Hay	*Chicago, Ill.*	32 St. James Ave.
Merrill, Hamilton	*New Rochelle, N.Y.*	74 Huntington Ave.
Mitchell, Harold Dies	*Newtonville*	Newtonville.
Monge, Luis Ernest	*Ibarra, Ecuador*	7 Follen St.
Montgomery, Edward	*Omaha, Nebr.*	Brookline.
Moore, Edmund Burke	*Springfield, Vt.*	15 St. James Ave.
Morash, Bernard Hudson	*Lunenburg, N.S.*	Lynn.
Morgan, Alfred Powell	*Upper Montclair, N.J.*	38 Dwight St.
Morrill, Carl Henry	*Haverhill*	15 Berwick Park.

First Year (*continued*).

NAME.	HOME.	RESIDENCE.
Morse, Fred Thurlow	*Topeka, Kans.*	205 Huntington Ave.
Morse, Harrison Herbert	*Malden*	Malden.
Mowry, Fred Lawrence	*Brockton*	Brockton.
Murphy, William Henry	*Wakefield*	Wakefield.
Murray, Wallace Jennings	*Dorchester*	571 Washington St., D.
Neff, Sidney Carlisle	*Dedham*	Dedham.
Nelson, Albert Peter	*E. Braintree*	E. Braintree.
Noyes, Jonathan Alvan	*Waltham*	Waltham.
O'Brien, Walter Francis	*Cambridge*	Cambridge.
O'Connor, Charles Thomas	*Holyoke*	75 Appleton St.
Olsen, Walter Jacobs	*Cambridge*	Cambridge.
O'Neill, Michael Cornelius	*Allston*	119 Franklin St., A.
Oppenheim, Joseph	*Boston*	49 Revere St.
Pacheco Lara, Ricardo	*San José, Costa Rica*	251 W. Newton St.
Park, John Ronald	*Winchester*	Winchester.
Partridge, Henry Hinman	*Detroit, Mich.*	Technology Chambers.
Paullis, George Lee	*Houston, Texas*	33 Batavia St.
Payson, Horace Stanwood	*Dorchester*	26 Everett Ave., D.
Pedersen, Aksel Marius	*Beverly*	Beverly.
Perrine, Charles Oscar	*Riverside, Cal.*	35 Pinckney St.
Pettingell, John Mason	*Newburyport*	478 Columbus Ave.
Poor, Frederick Edwin	*Jamaica Plain*	2 Greenough Ave., J.P.
Pratt, Jabez Harden	*Bridgewater*	Bridgewater.
Priest, Henry Malcolm	*Littleton*	35 St. Botolph St.
Prouty, Theodore Rentrope	*Scituate*	Scituate.
Pruyn, Kenyon	*Glens Falls, N.Y.*	8 St. Botolph St.
Rabinovitz, Louis	*Chelsea*	Malden.
Radford, Donald Haff	*Oshkosh, Wis.*	12 Newbury St.
Raymond, John William, Jr.	*Beverly*	Beverly.
Redfern, Philip Theobald	*Winchester*	Winchester.
Reed, Stalker Elijah	*Hudson, N.H.*	699 Mass. Ave.
Reiman, Clarence K.	*Newburyport*	Newburyport.
Reynolds, Charles Vaughn	*Canton*	Canton.
Rhodes, George Harold	*Norwood*	Norwood.
Richard, René Alphonse Joseph	*Holyoke*	41 St. Botolph St.
Richards, George William	*Erving*	474 Mass. Ave.
Richardson, Lawrence Wilson	*Somerville*	Somerville.
Richardson, William Elmer	*Dorchester*	887 Adams St., D.
Ricker, Daniel	*Somersworth, N.H.*	140 St. Botolph St.
Riddell, Ralph Huber	*Somerville*	Somerville.
Rieser, Charles William	*Hamilton, Ohio*	171 Newbury St.
Robb, Gordon Howard	*Salem*	Salem.
Roberts, Wilbur Taylor	*Albany, N.Y.*	Brookline.
Robinson, Frederick Alfred, Jr.	*E. Boston*	184 Webster St., E.B.

First Year (*continued*).

NAME.	HOME.	RESIDENCE.
Robinson, George Albert	*Mattapan*	222 W. Selden St., M.
Robinson, Harold Atherton	*Brookline*	Brookline.
Romero, Antonio	*San Juan, P.R.*	32 Wellington St.
Root, Royal Pulsifer	*New York, N.Y.*	Cambridge.
Rosenberg, Julius Matthew	*Everett*	Everett.
Ross, Bradley Travis	*Rensselaer, Ind.*	215 Newbury St.
Rowley, Charles Bacon	*Jackson, Mich.*	136 Newbury St.
Ruby, Walter Morley	*Oneida, N.Y.*	74 Huntington Ave.
Ryon, Gordon Ames	*Waltham*	Waltham.
Salgado, Agapito	*Olancho, Honduras*	16 St. James Ave.
Sanburn, Justus Curtis	*Mittineague*	136 Newbury St.
Sargent, Stuart Cary	*Fitchburg*	169 St. Botolph St.
Saslaw, Jacob	*Boston*	102 Poplar St.
Sawyer, George Summers	*Brighton*	49 Oak Square Ave., B.
Scanlon, Richard Harriman	*Leominster*	Brookline.
Schell, Erwin Haskell	*Kalamazoo, Mich.*	124 St. Botolph St.
Schmitt, Walter Henry	*Pittsburgh, Pa.*	19 Upton St.
Schneider, Solomon	*Roxbury*	1410 Columbus Ave., R.
Seelye, Seth Heness	*Key West, Fla.*	262 Newbury St.
Seetoo, Fucheng	*Kwangtung, China*	169 St. Botolph St.
Selfridge, John Soley	*San Francisco, Cal.*	Technology Chambers.
Selfridge, Samuel Woodworth	*San Francisco, Cal.*	Technology Chambers.
Shepard, Frederick Johnson, Jr.	*E. Derry, N.H.*	12 Newbury St.
Shore, Jacob David	*Boston*	13 Blossom St.
Shuttleworth, Wright	*Amsterdam, N.Y.*	7 Follen St.
Silverman, Benjamin	*Chelsea*	Chelsea.
Sircar, Brahma Behary	*Calcutta, India*	91 Appleton St.
Sloan, Vernon Gregory	*Arlington Heights*	Arlington Heights.
Soulis, Hugh Emerson	*Everett*	Everett.
Springall, Cyrus Foss	*Malden*	Malden.
Staiger, Allen Brown	*Atlantic City, N.J.*	1 Rutland St.
Starr, Frank Elijah	*Fitchburg*	169 St. Botolph St.
Stevens, Bernard Woodbury	*Newton Centre*	Newton Centre.
Stevens, Herbert Howe	*Marlboro*	Technology Chambers.
Stevens, Samuel Sprague	*Brookline*	Brookline.
Stewart, Clarence Augustus	*Newtonville*	Newtonville.
Stickney, Richard Carlton	*Gloucester*	7 Concord Square.
Stone, Roger Barton	*Jamaica Plain*	26 Grovenor Road, J.P.
Sullivan, Edward Lynch	*So. Boston*	564 5th St., S.B.
Swift, Herbert Dyer	*Detroit, Mich.*	282 Dartmouth St.
Symonds, Ralph Frederick	*Swampscott*	Swampscott.
Tarr, Elliot Whitney	*Gloucester*	7 Concord Square.
Taylor, Joseph Ingraham	*Wiscasset, Me.*	272 Newbury St.
Tenney, John Bouve	*Haverford, Pa.*	137 Newbury St.

First Year (*continued*).

NAME.	HOME.	RESIDENCE.
Thomas, Philip Edwin	*Blackstone*	Blackstone.
Thompson, Alvin Goodell	*Lowell*	37 Rutland Square.
Tirrell, Henry Stanley	*Brockton*	Brockton.
Tolman, Edward Mayo	*Concord*	282 Dartmouth St.
Tong, Philip	*Springfield*	240 Newbury St.
Torrey, Bates, Jr.	*So. Weymouth*	So. Weymouth.
Towne, Benjamin Boardman	*Topsfield*	Topsfield.
Troland, Leonard Thompson	*Malden*	Malden.
Tuller, Charles Lawton	*Allston*	15 Farrington Ave., A.
Tyler, Paul McIntosh	*Hyde Park*	Hyde Park.
Uman, George Louis	*Lowell*	Cambridge.
Upham, Edwin Osgood	*Keene, N.H.*	146 St. Botolph St.
Van Syckel, Elijah Carhart	*Boston*	11 Blackwood St.
Vickers, Hayes Bowers	*Roseboom, N.Y.*	13 Hancock St.
Vose, Arthur Williams	*Milton*	Milton.
Walker, Lawrence Brewster	*Quincy*	Quincy.
Wallis, Richard Parker	*New York, N.Y.*	Technology Chambers.
Walsh, Louis Sebastian	*Roxbury*	12 Mayfair St., R.
Ward, James Haller	*Melrose*	Melrose.
Watkins, Harold George	*Wakefield*	Wakefield.
Webber, Charles Willis	*Melrose Highlands*	Melrose Highlands.
Wheeler, Rodney	*Concord*	33 St. Botolph St.
Whipple, Robert Everett	*Beverly*	Beverly.
White, John Holbrook	*Hartford, Conn.*	44 The Fenway.
White, Russell Milton	*Taunton*	Taunton.
Whittlesey, John Eddy	*W. Newton*	W. Newton.
Wiessner, Oscar Karl	*Huntington*	27 Clarkwood St., M.
Wildes, Kenneth Neil	*Melrose Highlands*	Melrose Highlands.
Williams, Henry Chester	*Topsfield*	Topsfield.
Williamson, Paul Revere	*Marshfield Centre*	Marshfield Centre.
Willis, Charles Main	*No. Cambridge*	No. Cambridge.
Wilson, Raymond Everett	*Allston*	15 Bayard St., A.
Wiseman, Robert Joseph	*Cambridge*	Cambridge.
Woehling, Herbert Louis	*E. Orange, N.J.*	434 Columbus Ave.
Woodcock, Charles Martin	*Lawrence*	Lawrence.
Woodward, Clarence Richardson	*Malden*	Malden.
Wyman, Dwight Mead	*Montclair, N.J.*	173 St. Botolph St.

SPECIAL STUDENTS.

NAME.	COURSE.	HOME.	RESIDENCE.
Abbe, Roy Hosford	II.	*Bethlehem, N.H.*	523 Newbury St.
Abell, Adelaide May, B.S.	VII.	*Allston*	19 Farrington Ave., A.
Adams, Percival Lysander, B.S.	VI.	*Hood River, Oregon*	172 W. Canton St.
Ahearn, William Howard		*W. Hanover*	W. Hanover.
Ahern, Vincent Leo	XI.	*Lawrence*	85 Fenwood Road, R.
Ahlers, Johannes	I.	*Brooklyn, N.Y.*	74 Huntington Ave.
Akerly, Harold Edward, B.S.	IV.	*Rochester, N.Y.*	139 Beacon St.
Alexander, Harry Silas, A.B.	II.	*Washington, Pa.*	76 Huntington Ave.
Allen, Raynor Huntington	II.	*Cincinnati, Ohio*	237 Beacon St.
Allen, Samuel Holliday	IV.	*St. Louis, Mo.*	Technology Chambers.
Almy, Edward Taber, Jr.	III.	*New Bedford*	264 Newbury St.
Alter, John Frank	IV.	*Lawrence*	100 Pembroke St.
Anderson, Maurice Phelps	XIII.	*Seattle, Wash.*	285 Newbury St.
Anderson, Robert E., M.E.	III.	*Cincinnati, Ohio*	257 W. Newton St.
Anderson, Sarah Randolph	VII.	*Boston*	235 Commonwealth Ave.
Arnold, Grant William	VI.	*Fremont, Nebr.*	23 Dalton St.
Atwood, Harry Nelson	II.	*Swampscott*	Swampscott.
Bach, Joseph George, A.B.	III.	*Milwaukee, Wis.*	263 Newbury St.
Baker, Frank Adams	II.	*Dorchester*	12 Rill St., D.
Baker, Harry James	VI.	*Norwich, Conn.*	100 Pembroke St.
Bakewell, Donald C., B.A.	II.	*Pittsburgh, Pa.*	100 Mt. Vernon St.
Baldwin, John Robinson, B.S.	VI.	*Rome, Ga.*	49 Hemenway St.
Ball, Edwin Chester	VI.	*W. Somerville*	W. Somerville.
Barnard, John Edwin	IV.	*Winchester*	Winchester.
Barnes, Albert Johnson, B.Sc.	VI.	*Halifax, N.S.*	15 Conway St., R.
Barnes, Carlton Sloan	VI.	*Everett*	Everett.
Bartlett, Charles Lawrence	II.	*Buffalo, N.Y.*	Needham.
Bartlett, David Elmore	VI.	*Lowell*	Lowell.
Bates, Stacy Collins	II.	*Cambridge*	26 Newbury St.
Batsner, Alexander Graydon	II.	*Cincinnati, Ohio*	546 Newbury St.
Baxter, Lewis L., M.E.	IV.	*Nashville, Tenn.*	25 St. Botolph St.
Beales, Ralph Linwood	III.	*Rockland*	Rockland.
Beall, Van Zandt, B.S.	I.	*Fort Worth, Texas*	78 Huntington Ave.
Beckmann, Rafael Adolph	III.	*Parral, Mexico*	88 St. Botolph St.
Behr, Hermann	VI.	*Boston*	126 St. Botolph St.
Berkowitz, Benjamin		*Boston*	9 Spring St.
Besse, Eldred Edward	II.	*Fairhaven*	39 Concord Square.
Bicknell, Richard Stuart	X.	*Dorchester Center*	91 Esmond St, D.C.
Bierer, John Michael, B.S.	X.	*Front Royal, Va.*	Garrison Hall.
Bigelow, Braxton	III.	*Boston*	44 Brimmer St.

SPECIAL STUDENTS (*continued*).

NAME.	COURSE.	HOME.	RESIDENCE.
Bigelow, John Arthur	IV.	*Marlboro*	264 Newbury St.
Billings, Harold Dexter	XI.	*Newtonville*	Newtonville.
Block, Paul Henry	I.	*So. Boston*	42 Rogers St., S.B.
Blodget, William Power, A.B.	IV.	*Chestnut Hill*	Chestnut Hill.
Boardman, Wallace Eugene	II.	*Wakefield*	Wakefield.
Bogdasarian, Suren	IV.	*Allston*	37 Hopedale St., A.
Boltz, Robert Joseph	I.	*Germantown, Pa.*	428 Newbury St.
Bombrini, Alberto Maria	VIII.	*Genoa, Italy*	Brookline.
Bond, Thomas Davis	VI.	*Reading*	Reading.
Bonebrake, Benjamin Snively	VI.	*Baltimore, Md.*	Technology Chambers.
Bonvouloir, Lionel	VI.	*Holyoke*	85 St. Botolph St.
Bowers, George Winthrop	I.	*Lowell*	35 St. Botolph St.
Boyden, Roger Talbot	I.	*Boston*	282 Dartmouth St.
Bramhall, Percy Maynard	VI.	*Lowell*	Lowell.
Bridgman, Grenville Temple	III.	*Brookline*	Brookline.
Brody, Louis Nathaniel	I.	*E. Boston*	188A Chelsea St, E.B.
Brooks, Austin Whitney	VI.	*Wellesley Hills*	Wellesley Hills.
Brooks, Gordon Glyndon	VIII.	*Atlanta, Ill.*	25 Aberdeen St.
Brown, Clarence Jay	IV.	*Minneapolis, Minn.*	91 Newbury St.
Brownlee, Malcolm Bruce	III.	*Spokane, Wash.*	6 Louisburg Square.
Brownlee, Robert Bruce	II.	*Youngstown, Ohio*	116 W. Newton St.
Burke, Thomas Joseph, A.B.	V.	*Clinton*	232 W. Newton St.
Burnett, Robert Field	III.	*Chelsea*	Chelsea.
Burr, Barbara		*Boston*	90 Marlborough St.
Burroughs, Stanley Mainville	II.	*Watertown.*	Watertown.
Burt, Angus Edward	III.	*Newburyport*	297 Columbus Ave.
Cabot, Samuel, Jr., A.B.	V.	*Boston*	109 Commonwealth Ave.
Canaday, William Atkinson		*Albany, N.Y.*	756 Tremont St.
Carpenter, Kenneth Earle	IV.	*Pawtucket, R.I.*	240 Newbury St.
Cartagena, Nicholas Manrique	II.	*Mayaguez, Porto Rico*	W. Somerville.
Castro Béeche, Ruben		*San José, Costa Rica*	251 W. Newton St.
Chamberlin, Olin Vivian	II.	*Washington, Pa.*	422 Newbury St.
Chandler, Henry Daland, A.B.	IV.	*Boston*	195 Marlborough St.
Chapman, Laurance Dana	VI.	*Wellesley Farms*	Wellesley Farms.
Chase, Orliff van Heik, A.B.	IV.	*Catskill, N.Y.*	Technology Chambers.
Chinchilla-Kirkpatrick, P.	I.	*Valparaiso, Chile*	88 St. Botolph St.
Chow, Chushen	X.	*Shanghai, China*	Cambridge.
Clapper, Leland, B.C.E.	I.	*Ames, Iowa*	5 Barstow St., A.
Clark, Charles Cameron	IV.	*Holyoke*	480 Columbus Ave.
Clark, Milton Stanley	III.	*Jamestown, N.Y.*	Brookline.
Clavell, Antonio Cepero	V.	*Ponce, Porto Rico*	Cambridge.
Colburn, George Harold	II.	*Waltham*	Waltham.
Colebrook, Maus Winegar	V.	*Rochester, N.Y.*	47 Hemenway St.
Coleman, Arthur Moxham	VI.	*Louisville, Ky.*	Brookline.

Special Students (*continued*).

NAME.	COURSE.	HOME.	RESIDENCE.
Colson, Henry Clifford, Jr.	IX.	*Abington*	Abington.
Comins, Albert Knowlton	V.	*Wakefield*	Wakefield.
Comstock, Marshall Ernest	VI.	*W. Medford*	W. Medford.
Cook, Hardy Merrill	VI.	*Roxbury*	189 Blue Hill Ave., R.
Cooke, Francis Gray	XIII.	*Whitman*	Whitman.
Coppinger, Conor W. B., A.B.	I.	*Washington, D.C.*	The Brunswick.
Courtney, Bernard Freeman	V.	*Hyde Park*	Hyde Park
Covill, Frederick William	II.	*W. Roxbury*	61 Montview St., W.R.
Cox, James Alexander	XI.	*Roslindale*	32 Hemlock St., Ros.
Creighton, Irving Clement	II.	*Lynn*	Lynn.
Crichton, Hiram Neil	III.	*Odebolt, Iowa*	163 Warren Ave.
Crossley, Frederick Turner	VI.	*Providence, R.I.*	Hyde Park.
Crowley, John Edward	VI.	*Bangor, Me.*	158 Worcester St.
Cummings, Herbert Stanley		*W. Medford*	W. Medford.
Curtis, Arthur Harrison	I.	*Revere*	Revere.
Curwen, George Barr	III.	*Salem*	Salem.
Daley, Mitchell Joseph	III.	*Marlboro*	141 Charles St.
Davis, Luther	V.	*Dorchester*	258 Westville St., D.
Davis, Walter Swindell	IV.	*Baltimore, Md.*	10 St. James Ave.
de Araujo, Alberico Bevilaqua	II.	*Manáos, Brazil*	6 Cambridge Ter., A.
d'Autremont, Louis Paul	III.	*Duluth, Minn.*	80 St. Botolph St.
de Florez, Louis	II.	*Oyster Bay, L.I.*	6 Louisburg Square.
DeForest, Norman	III.	*Sanford, Fla.*	44 The Fenway.
de Landa, Carlos	IV.	*Mexico City, Mex.*	19 St. Botolph St.
Dennett, Minot Savage	II.	*Boston*	27 St. Stephen St.
de Romana, Albert Lopez	VI.	*Arequipa, Peru*	479 Mass. Ave.
Devlin, John Joseph	III.	*Brighton*	35 Parsons St., B.
De Witt, Ernest William	II.	*Osterville*	80 W. Newton St.
Diaz, Waldemar R.	VI.	*Coronel Pringles City, A.R.*	12½ St. James Ave.
Dierks, Fredrick Henry		*Kansas City, Mo.*	26 Newbury St.
Dillon, Peter Lawrence	VI.	*Dorchester*	17 Thornley St., D.
Doble, Charles French	II.	*Quincy*	Quincy.
Doherty, Frederick J. A., A.B.	V.	*Dorchester*	36 Mayfield St., D.
Dolke, Frank Clinton	VI.	*Boston*	Garrison Hall.
Dray, Walter Remy, B.A.	II.	*Chicago, Ill.*	The Brunswick.
DuBois, Warren L., B.S.	VI.	*Freehold, N.J.*	82 Huntington Ave.
Duffield, William Howard	II.	*Hamilton, Ontario*	263 Newbury St.
Dun, Henry Walke, Jr.	I.	*Albany, N.Y.*	6 Louisburg Square.
Dunbar, Henry Cape		*Dorchester Center*	481 Talbot Ave., D.C.
Dunlap, Chester Dwight	V.	*Everett*	Everett.
Dwight, Carl Wood	I.	*Burlington, Iowa*	Chestnut Hill.
Eaton, Warren Moseley	II.	*Waltham*	Waltham.
Egan, Raymond Wesley	II.	*Cincinnati, Ohio*	Brookline.

SPECIAL STUDENTS (*continued*).

NAME.	COURSE.	HOME.	RESIDENCE.
Elbert, John Jacob	X.	*Des Moines, Iowa*	44 The Fenway.
Elder, Gordon Wyman	V.	*Malden*	Malden.
Emerson, George Irving	XI.	*Haverhill*	422 Newbury St.
Evans, Frederick James	XI.	*So. Boston*	278 Ninth St., S.B.
Fellows, Raymond Henry	I.	*Concord, N.H.*	6 Garrison St.
Fenger, Frederick A., M.E.	XIII.	*Winetka, Ill.*	263 Newbury St.
Ferguson, George Orme	I.	*Brookline*	Brookline.
Ferguson, William Craig	II.	*Adams*	26 Newbury St.
Fernald, Paul Edmunds	III.	*Wilmette, Ill.*	603 Columbus Ave.
Fernandez, Francisco	VI.	*Asuncion, Paraguay*	12½ St. James Ave.
Ferris, Livingston Polk, A.B.	VI.	*Lamourie, La.*	45 St. Botolph St.
Fisher, Richard Bradford	V.	*Gloucester*	12½ St. James Ave.
Fitzherbert, Leroy George	I.	*Somerville*	Somerville.
Flagg, Montague	IV.	*Hartford, Conn.*	6 Louisburg Square.
Fleming, Paul Reed	I.	*Natick*	262 Newbury St.
Fletcher, Charles Barrows	II.	*Boston*	282 Dartmouth St.
Flett, Louis Ernest		*Melrose*	Melrose.
Flickenger, Harrison William	II.	*Erie, Pa.*	546 Newbury St.
Follansbee, Everett Merrill	X.	*Newburyport*	Newburyport.
Ford, Chester Cook	IV.	*So. Boston*	255 Emerson St., S.B.
Forristall, George Bashford	II.	*Brookline*	Brookline.
Foster, Cornelia Chase	II.	*Waverley*	Waverley.
France, Willis R.	I.	*Van Wert, Ohio*	29 Marlborough St.
Francis, Russell Dean	VII.	*Boston*	186 Commonwealth Ave.
Francis, Stafford Allen	IV.	*Exeter, N.H.*	Brookline.
Frazier, Donald Nichols	II.	*Lynn*	Lynn.
French, Donald Adams	IV.	*Hyde Park*	Hyde Park.
Frost, Harwood Young	II.	*Waltham*	237 Beacon St.
Fulton, Margaret Alexina	IV.	*Santa Barbara, Cal.*	Brookline.
Gadsby, George Madill, B.Ph.	V.	*Marietta, Ohio*	103 Mt. Vernon St.
Gallagher, John Patrick, A.B.	XI.	*Watertown*	Watertown.
Gallagher, Robert Townsend		*Roxbury*	33 Crawford St., R.
Gammons, Clifford Warren	VI.	*W. Newton*	W. Newton.
Garza, John		*Monterey, Mexico*	225 Newbury St.
Gaynor, Keyes Christopher	I.	*Sioux City, Iowa*	234 Newbury St.
Geary, Leslie Edward	XIII.	*Seattle, Wash*	Technology Chambers.
Gerity, Heath Scott	IV.	*Denver, Colo.*	217 Newbury St.
Giesey, Earle McAdams, A.B.		*Wheeling, W. Va.*	39 St. Botolph St.
Giles, Donald McFarlan	III.	*Amsterdam, N.Y.*	Technology Chambers.
Gilpatrick, Clifton Gray	IV.	*Dorchester*	27 Paisley Park, D.
Given, James Arthur	I.	*Austin, Texas*	64 W. Rutland Square.
Givrigian, Srabion Vartan	VI.	*Sergeville, Armenia*	16 Highland Ave., R.
Glazier, Leslie Gordon	I.	*Brookline*	Brookline.
Goicoechea, Luciano	VI.	*Havana, Cuba*	103 Newbury St.

SPECIAL STUDENTS (*continued*).

NAME.	COURSE.	HOME.	RESIDENCE.
Golden, Louis Robert	VI.	*Dorchester*	11 Wolcott St., D.
Goodhue, William Winfield	I.	*Ipswich*	Ipswich.
Goodspeed, Geo. Edward, Jr.	III.	*Roslindale*	27 Conway St., Ros.
Gordon, Louis Simon	III.	*Dorchester*	27 Harvard St., D.
Gott, Herbert Sidney	VI.	*Seacombe, England*	Cambridge.
Gram, Carl William	X.	*Wollaston*	234 Newbury St.
Grant, John Seely		*Dorchester*	25 Glendale St., D.
Graupner, Marcellus Fernando		*Cambridge*	Cambridge.
Gravely, Julian Stuart, B.A.	V.	*Wytheville, Va.*	Garrison Hall.
Greeley, Harold Wheeler		*E. Foxboro*	103 Charles St.
Greely, Leslie William	I.	*Muncie, Ind.*	Brookline.
Greenau, James Owen, A.B.	III.	*Taunton*	76 Huntington Ave.
Greenleaf, Kenneth	VI.	*Savanna, Ill.*	234 Newbury St.
Greenwood, Lester Clyde, A.B.	II.	*Farmington, Me.*	335A Columbus Ave.
Gring, Ambrose Daniel, Jr.	X.	*Cambridge*	Cambridge.
Groff, James Stephen	VII.	*Newport, R.I.*	City Hospital.
Gross, Cora Burt, Pharm.D.	V.	*Cambridge*	Cambridge.
Grubnau, Victor Carl	III.	*Wyncote, Pa.*	26 Newbury St.
Grunsky, Eugene Lucius	I.	*New York, N.Y.*	12 St. James Ave.
Guilford, Edward Higley*		*Winchester*	Winchester.
Gurney, Harold Peaslee, S.B.	X.	*E. Boston*	196 Trenton St., E.B.
Hague, Alfred	II.	*New York, N.Y.*	422 Newbury St.
Hallett, Harold Maurice	VI.	*Dorchester*	62 Kenwood St., D.
Hamilton, Earl Russell	VIII.	*Roslindale*	925 South St., Ros.
Hammond, James Clement	III.	*Roslindale*	3 S. Fairview St., Ros.
Hanna, Elias Samman	I.	*Tanta, Egypt*	128 Chandler St.
Hannaford, Ralph Herman	IV.	*Roxbury*	15 Rockville Park, R.
Harrington, Frederick Charles	I.	*Brookline*	Brookline.
Harrison, Henry Norris	XI.	*Philadelphia, Pa.*	Brookline.
Hartshorn, Derick Sibley	II.	*Dorchester*	30 Howe St., D.
Hastings, Russell	VI.	*Walpole, N.H.*	12 Newbury St.
Haugaard, William Edward	IV.	*Richmond Hill, L.I.*	138 Chandler St.
Hausman, Isaac	I.	*Marysville, Kans.*	186 Amory St., J.P.
Hawes, Henry G., Jr., A.B.	VI.	*Santa Barbara, Cal.*	Technology Chambers.
Hawkins, Eldred Birmingham	X.	*York, Pa.*	33 St. Botolph St.
Hayman, Milton Earnest	IV.	*Taunton*	78 Huntington Ave.
Haynes, Delos Garriott	VI.	*E. St. Louis, Ill.*	41 St. Botolph St.
Haynes, Herman Wallace, B.S.	V.	*Townsend*	4 Rockdale St., R.
Healy, Leon James Dyson	V.	*New Britain, Conn.*	Chelsea.
Hedden, Morris Wilbur	V.	*Brooklyn, N.Y.*	12 W. Cedar St.
Henderson, Austin Brown	I.	*Beverly*	Beverly.
Herreshoff, Alexander Griswold		*Bristol, R.I.*	64 Commonwealth Ave.
Herreshoff, A. Sidney DeW.	XIII.	*Bristol, R.I.*	64 Commonwealth Ave.
Hersey, Mayo Dyer, A.B.	II.	*W. Hartford, Conn.*	424 Mass. Ave.

SPECIAL STUDENTS (*continued*).

NAME.	COURSE.	HOME.	RESIDENCE.
Hidezi, Matsuo		*Gifuken, Japan*	Cambridge.
Higgins, John Joseph	III.	*Longford, Ireland*	159 Warren Ave.
Hildebrand, Walter Herbert	I.	*Chicago, Ill.*	31 Newbury St.
Hildreth, Arthur Griffin		*Westford*	Westford.
Hill, Roger Frank, B.S.	II.	*Tilton, N.H.*	So. Weymouth.
Hilscher, Ralph, B.S.	XI.	*Watseka, Ill.*	269 St. Botolph St.
Hirschfeld, Benjamin S., B.S.	IV.	*San Francisco, Cal.*	7 Concord Square.
Hodge, George Edward	V.	*E. Boston*	118 Princeton St., E.B.
Holbrook, Gordon Godshall	XIII.	*Minneapolis, Minn.*	Technology Chambers.
Hopkins, Merton White	I.	*Somerville*	Somerville.
Hopkins, Paul Stanley	III.	*Peking, China*	80 W. Rutland Square.
Hosmer, Helen Ross, S.B.	VII.	*Billerica*	Billerica.
Hoyt, Robert Nelson	VII.	*Wellesley Hills*	Wellesley Hills.
Huber, Berthold Convers	II.	*Taunton*	39 W. Newton St.
Hulsizer, Robert Inslee	VI.	*Bridgeport, Conn.*	124 St. Botolph St.
Humphreville, W. Edward	VI.	*Houston, Texas*	64 W. Rutland Square.
Humphrey, Geo. Selden, Ph.B.	VI.	*Belleville, W. Va.*	103 Mt. Vernon St.
Hurley, Frederick Aloysius	III.	*Dedham*	Dedham.
Hynes, John J., Jr., A.B.	I.	*Buffalo, N.Y.*	16 St. James Ave.
Ives, William Booth	VI.	*Denver, Colo.*	11 St. James Ave.
Jackson, Alexander Freeman	II.	*Milford*	Milford.
Jacobs, Carlton Dupee	II.	*Roxbury*	28 Maple St., R.
Jacobs, Richard Clark, Jr.	XI.	*Auburndale*	Auburndale.
James, Ivory Small	III.	*Boston*	146 Hemenway St.
James, Jesse Evans	I.	*Elverson, Pa.*	15 Concord Square.
Jarret, Raymond		*Woonsocket, R.I.*	Woonsocket, R.I.
Jenkins, Hubert Oliver, A.B.	VII.	*Stanford Univ., Cal.*	7 Follen St.
Jenkins, William Benjamin	II.	*Cleveland, Ohio*	Newtonville.
Johnson, Flora Augusta	IV.	*Newtonville*	Newtonville.
Johnson, Reginald D., A.B.	IV.	*Pasadena, Cal.*	71 Mt. Vernon St.
Johnston, Cecil Chestnut		*Fort Fairfield, Me.*	463 Mass. Ave.
Jones, Clarence Leslie	II.	*Barnstable*	205 W. Newton St.
Jones, Whitney Blake	V.	*Boston*	192 Marlborough St.
Joslin, Garnett Alfred	III.	*Los Angeles, Cal.*	26 Newbury St.
Kane, Irving Patterson, B.S.	XI.	*Long Green, Md.*	Technology Chambers.
Keefe, William Joseph	I.	*Roxbury*	132 Devon St., R.
Kelley, Edward Francis	II.	*Cambridge*	Cambridge.
Kelley, John Edmund	IV.	*Malden*	Malden.
Kelly, William James	V.	*Jamaica Plain*	61 Robinwood Ave., J.P.
Kenway, Edward	I.	*Newton*	Newton.
Kerr, William Caruthers	X.	*Catonsville, Md.*	546 Newbury St.
Kilman, Early C.		*Keller, Va.*	474 Mass. Ave.
Kimberley, Burton Russell	IV.	*Cleveland, Ohio*	258 Mass. Ave.
King, Frederick James	II.	*Abington*	Abington.

SPECIAL STUDENTS (*continued*).

NAME.	COURSE.	HOME.	RESIDENCE.
Kinney, Mark Curtis	IV.	*Mt. Vernon, Ohio*	138 Newbury St.
Knight, Joseph Carey	I.	*Cheyenne, Wyo.*	Cambridge.
Kostiuk, Samuel	V.	*New York, N.Y.*	34 Causeway St.
Kyle, Clinton Walker	II.	*Newtonville*	Newtonville.
Lang, Harold Locke	VII.	*Roslindale*	33 Fairview St., Ros.
Lange, Frank John	VI.	*Springfield*	14 Durham St.
Larkin, Thomas	I.	*Boston*	41 Thorndike St.
Lasier, Emery Liebschutz	I.	*Washington, D.C.*	Cambridge.
Lasnier, Gilberto, A.B.	VI.	*Montevideo, Uruguay*	45 St. Botolph St.
Lawrence, Beardsley	I.	*Dorchester Center*	103 Beaumont St., D.C.
Lawton, Stanley Herbert	V.	*Quincy*	Quincy.
Leddy, John Maurice		*New York, N.Y.*	95 Newbury St.
Lewis, Richard Wheatley	V.	*Fort Monroe, Va.*	237 Beacon St.
Little, James Bampton	III.	*Bath, Me.*	450 Mass. Ave.
Locke, Henrietta Willard	V.	*Lexington*	Lexington.
Locke, John Harold, S.B.	VIII.	*Brookline*	Brookline.
Lockett, Harold	II.	*Chicago, Ill.*	215 Newbury St.
Long, Thomas Alexander		*W. Newton*	W. Newton.
Lord, George Ransom, A.B.	V.	*Marietta, Ohio*	103 Mt. Vernon St.
Lord, Paul Burton	III.	*Dorchester*	18 S. Munroe Ter., D.
Loring, Ernest Moore	III.	*Spokane, Wash.*	26 Newbury St.
Lowenberg, Maurice Joseph	VI.	*Brookline*	Brookline.
Lusky, Leonard Maurice	VI.	*Nashville, Tenn.*	87 St. Botolph St.
Lyle, Arthur Lee		*Washington, Pa.*	12 Hemenway St.
Lyons, Franklin Benton, B.S.	VI.	*Steubenville, Ohio*	3 Walnut St.
Lyons, Manson Anslie	I.	*Parrsboro, N.S.*	W. Somerville.
McAllen, John Lavelle	III.	*Portland, Ore.*	258 Newbury St.
McCrady, Mac Harvey	XI.	*Lancaster, Wis.*	209 St. Botolph St.
McCune, William Rowe	II.	*New York, N.Y.*	Brookline.
McGinniss, Joseph	IV.	*Roxbury*	96 Blue Hill Ave., R.
Mackenzie, Morell	II.	*Taunton*	Taunton.
McLaughlin, Tho. Francis, Jr.	I.	*Roxbury*	51 Creighton St., R.
McManus, Charles Aloysius J.	I.	*Dorchester*	2 Winter St., D.
McMillan, Lee Richards	IV.	*New Orleans, La.*	112 Newbury St.
McNamara, John Daniel	III.	*Boston*	91 Oak St.
McNeil, Nicholas Tallon	I.	*Charlestown*	10 Putnam St., C.
McOsker, Paul Harold		*Lowell*	Lowell.
Maguire, Charles Augustine P.	I.	*Providence, R.I.*	Hemenway Chambers.
Mahoney, Dennis Francis	I.	*Brookline*	Brookline.
Main, Charles Reed, B.S.	II.	*Winchester*	Winchester.
Malone, John F., Jr.	XIII.	*Buffalo, N.Y.*	Technology Chambers.
March, William Henry	IV.	*Mobile, Ala.*	16 St. James Ave.
Martin, John Stephens		*Ross, Cal.*	234 Newbury St.
Martin, Thorndike DeVries	II.	*Brighton*	53 Chestnut Hill Ave., B.

SPECIAL STUDENTS (*continued*).

NAME.	COURSE.	HOME.	RESIDENCE.
Marvin, David Patterson.	XIII.	*Newtonville*	Newtonville.
Masjoan, Valerio	XIII.	*Mercedes, Arg. Rep.*	12½ St. James Ave.
Mathur, Bala Pershad	VI.	*Hyderabad, India*	91 Appleton St.
Matte, Andrew Lewis	VI.	*No. Adams*	178 W. Canton St.
Maxwell, Herbert Oulton		*Boston*	11 Holyoke St.
Mayer, Paul Hirschl, B.S.	III.	*Mt. Vernon, N.Y.*	Cambridge.
Maynard, Clarence Dickinson	I.	*Somerville*	Somerville.
Meanor, Wilbur Alpheus	IV.	*Turtle Creek, Pa.*	126 St. Botolph St.
Meisel, Otto Carl Francis	II.	*Dorchester*	10 Upland Ave., D.
Melendy, Ralph Peter		*Boston*	21 Cumberland St.
Mellish, Murray Holman	I.	*Malden*	Malden.
Merrill, Charles Hudson Sayre	I.	*Manchester*	W. Newton.
Merrill, Leonard Martin	V.	*Glendale, Ohio*	115 Gainsborough St.
Millard, Reginald William	II.	*Hamilton, Ontario*	158 St. Botolph St.
Miller, Fred Robinson A.B.	V.	*Newton Highlands*	Newton Highlands.
Miller, Waldo Benneville	XI.	*Cleveland, Ohio*	547 Columbus Ave.
Mohn, Joseph Theophile	IV.	*New York, N.Y.*	25 St. Botolph St.
Monto, Charles Philip	X.	*Rochester, N.Y.*	419 Mass. Ave.
Morrison, George A., B.S.	III.	*Morgan Park, Ill.*	17 Batavia St.
Moses, Alonzo Lemuel	VI.	*Boston*	244 Mass. Ave.
Müllhaupt, Alfred, Jr.	VI.	*St. Marys, Pa.*	Technology Chambers.
Muriel, Manuel	IV.	*San Luis Potosi, Mex.*	178 Huntington Ave.
Murray, Joseph Ignatious		*Everett*	Everett.
Murray, Michael William		*Newton Highlands*	Newton Highlands.
Myers, Aaron Leon	XI.	*Palestine, Texas*	16 Rutland Square.
Navarro, Manuel Adrian	I.	*Quito, Ecuador*	284 Dartmouth St.
Nelson, Norman		*Roxbury*	35 Intervale St., R.
Nichols, Russell Harrison	XI.	*S. Boston*	325 K St., S.B.
Nicol, Norman Carmichael	XI.	*Waterbury, Conn.*	13 Berwick Park.
Niles, Seymour Mansfield	V.	*E. Saugus*	E. Saugus.
Noble, James Bowen	IV.	*Eau Claire, Wis.*	9 Blackwood St.
Northrop, Joseph W., Jr., A.B.	IV.	*Bridgeport, Conn.*	80 W. Rutland Square.
Norton, Arthur Edwin, Ph.B.	II.	*Watertown*	Watertown.
Odell, Lawrence Gleason	VIII.	*Roxbury*	11 Wabeno St., R.
Oettinger, Mark Adolph		*Roxbury*	10 Woodville Park, R.
O'Hearn, Thomas Benedict, A.B.	I.	*Lowell*	Lowell.
O'Hearn, William John	XI.	*Brookline*	Brookline.
Ohnuki, Riojo	II.	*Katsukara, Japan*	12½ St. James Ave.
Orem, Archie Joshua	III.	*Salt Lake City, Utah*	177 Wachusett St., J.P.
Osborn, Frederick Warren	III.	*Edgartown*	336 Commonwealth Ave.
Packwood, Lahvesia Paxton C.	IV.	*Tampa, Fla.*	21 Gardner St., A.
Page, Atwood Collins	II.	*Danvers*	Technology Chambers.
Palmer, Herbert Hammond	VIII.	*Georgetown*	Georgetown.
Pardee, Harvey Sabin	VI.	*Minneapolis, Minn.*	7 Follen St.

SPECIAL STUDENTS (*continued*).

NAME.	COURSE.	HOME.	RESIDENCE.
Pead, William James, Jr.	VI.	*No. Adams*	60 W. Rutland Square.
Pearl, Holman Isaac	I.	*Boston*	9 Blackwood St.
Pearson, Paul Henry	II.	*Somerville*	Somerville.
Peet, Albert Stanton	II.	*Callao, Peru*	171 Hemenway St.
Perkins, Ralph Willis	VI.	*Wenham*	Wenham.
Perley, Henry Chaplin	II.	*Boxford*	Boxford.
Perry, Clyde Raymond	III.	*Stoneham*	Stoneham.
Perry, Frederick Gardiner	VI.	*Boston*	18 Huntington Ave.
Pettingell, William Moulton	X.	*Newburyport*	478 Columbus Ave.
Pettit, Bertholf Marsh, Ph.B.	IV.	*Kenosha, Wis.*	217 Newbury St.
Phelps, Dudley Winston	IV.	*Utica, N.Y.*	44 The Fenway.
Pierce, James Buchanan, Jr.	X.	*Sharpsville, Pa.*	225 Newbury St.
Pierson, Ruth Ogden	VII.	*Wellesley Hills*	Wellesley Hills.
Pope, Chester Henry	X.	*Winthrop*	Hotel Westminster.
Powell, Oliver Davis	XI.	*Haverhill*	15 Berwick Park.
Pratt, Chapin Smith	II.	*Buffalo, N.Y.*	215 Newbury St.
Pratt, Joshua Claude		*So. Framingham*	So. Framingham.
Pritchard, Charles Morse	X.	*Newburyport*	Newburyport.
Pritchett, Leonard Waller, A.B.	VI.	*New York, N.Y.*	1 Acorn St.
Proctor, John Albert		*Revere*	262 Newbury St.
Pugsley, Edwin, B.A.	VI.	*Buffalo, N.Y.*	112 Pinckney St.
Pulsifer, Revere Burnham	XIII.	*Manchester*	Manchester.
Purdom, Archibald Brantley	II.	*Blackshear, Ga.*	72 Robinwood Ave., J. P.
Quinn, Joseph Henry		*Jamaica Plain*	71 Peter Parley Road, J.P.
Read, William Carleton	VIII.	*Taunton*	Taunton.
Reckard, Rufus William, A.B.	V.	*Proctorville, Ohio*	Cambridge.
Reed, Ralph Omer	III.	*Melrose Highlands*	Melrose Highlands.
Remick, Frank Harley	XIII.	*Methuen*	Methuen.
Reynolds, Bergen	II.	*Somerville*	Somerville.
Rhodes, William Armitage		*Salt Lake City, Utah*	12½ St. James Ave.
Rice, Edward Thomson	III.	*Schenectady, N.Y.*	Technology Chambers.
Rice, Roger Cushing	I.	*Dorchester Center*	37 Mather St., D.C.
Richardson, Arthur Bancroft		*Washington, D.C.*	14 Pratt St., A.
Richardson, Wallace Dunster	XI.	*Cambridge*	Cambridge.
Ridstrom, Eric Herman	II.	*Waltham*	Waltham.
Riefkohl, Rudolf William	II.	*Maunabo, Porto Rico*	282 Dartmouth St.
Roads, George Mackay	III.	*Pottsville, Pa.*	44 The Fenway.
Robertson, Stewart Ross		*Dorchester*	11 Olney St., D.
Roche, Raymond Vincent	V.	*Uxbridge*	W. Lynn.
Rodriguez, Salvador, Jr.		*Port Chester, N.Y.*	262 Newbury St.
Rogers, James Calvin, B.S.	VI.	*Starkville, Miss.*	9 St. James Ave.
Rosenblatt, Arthur Morton	VI.	*Oskaloosa, Iowa*	Technology Chambers.
Rowe, Louis Griffin	I.	*Gloucester*	217 Newbury St.
Russell, Foster	II.	*Coeur d'Alene, Idaho*	24 Cumberland St.

SPECIAL STUDENTS (*continued*).

NAME.	COURSE.	HOME.	RESIDENCE.
Ryerson, Edward L., Jr., Ph.B.	I.	*Chicago, Ill.*	6 Louisburg Square.
Sage, Nathaniel McLean		*Vancouver, Wash.*	21 W. Cedar St.
St. John, Burton Harold, B.A.	V.	*Wichita, Kans.*	3 Rutland Square.
Savage, Edgar Channing	II.	*Dorchester*	117 Richmond St., D.
Saveny, Rufus Hathaway	VII.	*Marion*	4 Ashburton Place.
Scales, Freeman Montague	VII.	*E. Chatham, N.Y.*	44 Dwight St.
Scarff, John Henry	IV.	*Baltimore, Md.*	134 St. Botolph St.
Schaaf, John	I.	*Buffalo, N.Y.*	Brookline.
Schaffer, Harold	III.	*Rondebosch, Cape Town*	7 Follen St.
Schatz, Ruppert Ericson	I.	*Mt. Vernon, N.Y.*	25 St. Botolph St.
Scheuer, Jerome	III.	*New York, N.Y.*	Technology Chambers.
Schneider, Franz, Jr.	VII.	*Lawrence*	12 Newbury St.
Schreiber, Henry, Jr.	I.	*Jamaica Plain*	13 Bishop St., J.P.
Schriefer, Herman Carsten	III.	*Brooklyn, N.Y.*	422 Newbury St.
Schwarz, Edmund Arthur	IV.	*Sioux Falls, S. Dak.*	Technology Chambers.
Scoville, John Harris	IV.	*Hartford, Conn.*	Technology Chambers.
Seibert, Victor Elmer	IV.	*Walla Walla, Wash.*	74 Pinckney St.
Serra, Julius Herschel	I.	*Melrose Highlands*	Melrose Highlands.
Shaffer, Guy Fiske	IV.	*Seattle, Wash.*	207 Newbury St.
Sharkey, Arthur Edmund	VI.	*Cambridge*	Cambridge.
Sharp, Harold	I.	*Nantucket*	264 Newbury St.
Shaw, Joseph Henry	II.	*Plymouth*	285 Newbury St.
Shaw, Lawrence Copeland	V.	*Brockton*	67 Rutland Square.
Sheldon, George Ware, B.S.	VI.	*Wakefield, R.I.*	12½ St. James Ave.
Shenstone, Osborne Harris	I.	*Toronto, Ontario*	35 Intervale St., R.
Sherman, Henry Lancey	I.	*Brookline*	Brookline.
Sherman, Robert Parker		*Manila, P.I.*	51 Falmouth St.
Shippee, Allen Edward	X.	*E. Greenwich, R.I.*	478 Columbus Ave.
Simmons, Frank Ronald, B.A.	IV.	*Providence, R.I.*	Technology Chambers.
Simonds, Roland Scott	IV.	*Bradford*	28 Forest St., R.
Smith, Daniel Joseph	V.	*Allston*	40 N. Beacon St., A.
Smith, Harold Alfred	II.	*Lynn*	Lynn.
Smith, Mabel Esther, A.B.		*Haverhill*	Haverhill.
Smith, William Leo	IV.	*Concord Junction*	Concord Junction.
Sneddon, James Stuart	II.	*Elizabeth, N.J.*	12 Newbury St.
Snow, Sydney Ingalls	X.	*Rockland, Me.*	Brookline.
Soule, Lincoln Rockwell	X.	*Dorchester*	237 Beacon St.
Southgate, Donald Wright	IV.	*Nashville, Tenn.*	105 Appleton St.
Southgate, George Thompson	VI.	*Nashville, Tenn.*	105 Appleton St.
Southwick, Lewis Switzer	VI.	*Brooklyn, N.Y.*	237 Beacon St.
Spalding, Walter Talbot	IV.	*Seattle, Wash.*	Technology Chambers.
Stamper, Willson Young, Jr.	I.	*Fort Lawton, Wash.*	26 Newbury St.
Stark, Theodore Fiske	IV.	*Wakefield*	Wakefield.
Steese, Charles Mullin, S.B.	VI.	*Mt. Holly Sprs., Pa.*	422 Newbury St.

SPECIAL STUDENTS (*continued*).

NAME.	COURSE.	HOME.	RESIDENCE.
Stein, Arthur Leon	VI.	*Scranton, Pa.*	Technology Chambers.
Steinberg, Solomon		*Roxbury*	76 Waumbeck St. R.
Stevenson, Albert Fletcher	VII.	*E. Boston*	41 Princeton St., E.B.
Stewart, Frank Douglas	III.	*Helena, Mont.*	260 Newbury St.
Stewart, Harold Osborn, B.S.	VI.	*Rochester, N.Y.*	7 Follen St.
Stewart, Joseph Baird, Jr.	I.	*Newtonville*	Newtonville.
Stibbs, Franklyn Mosher	XI.	*Springfield*	113 St. Botolph St.
Stoddart, David Ayars, M.E.	VI.	*Wilkes-Barre, Pa.*	Brookline.
Straus, Aubrey Hamilton, B.S.	VII.	*Richmond, Va.*	171 Newbury St.
Stuart, Edward	XI.	*Boston*	264 Newbury St.
Sullivan, George Paul	X.	*Dorchester*	51 Charlotte St., D.
Sun, To-Tán	III.	*Shoachow, China*	183 Huntington Ave.
Sutherland, Carroll A., B.S.	VI.	*Boston*	8 Irvington St.
Sutherland, Clarence Hale, A.B.	I.	*Brunswick, Me.*	Cambridge.
Svarz, Louis	IV.	*Seattle, Wash.*	Technology Chambers.
Sweet, Myron Knight	V.	*Bridgewater*	26 Newbury St.
Swift, Lila Hathaway	IV.	*Wellesley Hills*	Wellesley Hills.
Taite, Frank Griffiths	I.	*Merion, Pa.*	237 Beacon St.
Thöde, Allan Fredrich	VI.	*Medford*	Medford.
Thomas, George Smith, B.S.	XIII.	*Carroll, Iowa*	321 Columbus Ave.
Thompson, Paul Ellis	X.	*Brookline*	Brookline.
Thomson, Stuart, A.B.	V.	*Swampscott*	Technology Chambers.
Tiernan, Martin F., A.B.	VII.	*Charlotte, N.Y.*	7 Follen St.
Tillard, Thomas Atkinson, B.A.	I.	*Petersfield, England*	9 Charles St.
Tilton, Charles Elliott, A.B.	III.	*Tilton, N.H.*	198 Beacon St.
Tod, Martin Stambaugh	I.	*Youngstown, Ohio*	Technology Chambers.
Tomonaga, Goro	II.	*Tokio, Japan*	12½ St. James Ave.
Towle, Franklin Thompson	II.	*Dorchester*	87 Sawyer Ave., D.
Trevithick, Harry P., Ph.B.	V.	*Middletown, Conn.*	82 Huntington Ave.
Tripp, James Gregory	I.	*New York, N.Y.*	264 Newbury St.
True, Guy Winford	I.	*Readville*	Readville.
True, Harold Edwin	V.	*Newburyport*	Newburyport.
Trueblood, Howard M., B.S.	VI.	*Earlham, Ind.*	10 St. James Ave.
Tsai, Yuan Tze	III.	*Hangchow, China*	Cambridge.
Turner, Arthur Hubesty	I.	*Philadelphia, Pa.*	242 Newbury St.
Tuttle, John Culliton	II.	*Salem*	Salem.
Van Alstine, Roy Daniel	I.	*Mitchell, S. Dak.*	413 Columbus Ave.
Van Inwegen, Willard B., A.B.	I.	*Port Jervis, N.Y.*	71 Mt. Vernon St.
Vining, Ralph Edward	III.	*So. Weymouth*	So. Weymouth.
Vogel, Andrew	IV.	*Schenectady, N.Y.*	Milton.
Wade, Norman Scranton	II.	*Salem, N.H.*	11 Irvington St.
Walcott, John Bigelow		*Boston*	17 Blagden St.
Waldstein, Julius	I.	*Boston*	54 Billerica St.
Walker, William Russell	IV.	*Providence, R.I.*	Technology Chambers.

SPECIAL STUDENTS (*continued*).

NAME.	COURSE.	HOME.	RESIDENCE.
Walsh, Raycroft		*E. Boston*	421 Meridian St., E.B.
Warner, William Weatherby	I.	*Titusville, Pa.*	264 Newbury St.
Watson, Earle Bradbury		*Dorchester*	162 Glenway St., D.
Watson, George Smythe	IV.	*Dallas, Texas*	41 St. Botolph St.
Watson, John Craig	X.	*Johannesburg, Trans.*	34 Reedsdale St., A.
Watts, Frank Edgar	I.	*Stewartstown, N.H.*	175 Warren Ave.
Webb, Curtis Christopher	III.	*Cambridge*	Cambridge.
Weeks, Kenneth		*Boston*	59 Chestnut St.
Welch, Walter Perkins	VI.	*Malden*	Malden.
Weltmer, Noyes	III.	*Santa Fe, N. Mex.*	146 Hemenway St.
Wentworth, Philip M.	VI.	*Danvers*	Danvers.
West, William Charles	II.	*Chicago, Ill.*	422 Newbury St.
Wetmore, Louis Leavitt	IV.	*Roslindale*	46 Fairview St., Ros.
Wheelwright, Barton	I.	*Minneapolis, Minn.*	Hemenway Chambers.
White, Joseph Henry	XI.	*Lawrence*	Lawrence.
White, Peter Desmond	II.	*New York, N.Y.*	258 Newbury St.
Whitney, Stanley Nathan, B.A.	IV.	*Westminster*	Brookline.
Whitney, William Orr		*No. Adams*	23 Pratt St., A.
Whorf, Allison Howes	III.	*Dorchester*	68 Charles St., D.
Williams, Charles Sumner, Jr.	V.	*Boston*	Navy Yard, C.
Williams, Howard David	XI.	*Springfield*	262 Newbury St.
Williams, Roy Pease		*Springfield*	262 Newbury St.
Willis, Sumner Chapin	I.	*Dorchester*	47 Wheatland Ave., D.
Wilson, Claude Thomas, B.A.	I.	*Waterville, N.Y.*	254 W. Newton St.
Winterstein, Herbert B., B.S.	VI.	*Belle Plaine, Iowa*	Brookline.
Witmer, George Stone	VI.	*Washington, D.C.*	44 The Fenway.
Wood, Frederick Brayton	III.	*Baltimore, Md.*	45 Hemenway St.
Wood, Robert Odione	VIII.	*Concord*	263 Newbury St.
Woods, Walter Samuel	VI.	*Philadelphia, Pa.*	426 Newbury St.
Woodward, Merle Gilbert		*Lynn*	234 Newbury St.
Yacoubyan, Vahan P.	I.	*Cairo, Egypt*	558 Tremont St.

SUMMARY.

NON-RESIDENT FELLOWS	1	GRADUATE STUDENTS	215
RESIDENT FELLOWS	3	REGULAR STUDENTS, 4th year	199
CANDIDATES FOR THE DEGREE OF DOCTOR OF ENGINEERING	1	" " 3d year	210
CANDIDATES FOR THE DEGREE OF DOCTOR OF PHILOSOPHY	6	" " 2d year	190
CANDIDATES FOR THE DEGREE OF MASTER OF SCIENCE	19	" " 1st year	323
		SPECIAL STUDENTS	510

Total	1,677
Deduct names counted twice	215
	1,462

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 14 to 28. For list of students see pages 395 to 438.

Aaron, J. A.	2
Abbe, R. H.	Sp.
Abell, Adelaide M.	Sp.
Adams, A. K.	2
Adams, C. L.	*Assoc. Prof.*
Adams, E. Q.	4
Adams, F. H.	2
Adams, P. L.	Sp.
Adams, R. G.	2
Adler, L. M.	3
Ahearn, W. H.	Sp.
Ahern, V. L.	Sp.
Ahlers, J.	Sp.
Akerly, H. E.	Sp.
Albee, A. C.	1
Albee, C. H.	1
Alden, F. T.	1
Alexander, H. S.	Sp.
Allan, J. A.	*Asst.*
Allen, A.	3
Allen, C. E.	*Asst.*
Allen, C. F.	*Prof.*
Allen, D. P.	2
Allen, R. H.	Sp.
Allen, S. H.	Sp.
Allen, V. W.	1
Allen, W. D.	2
Allison, H. B. C.	2
Almy, C., Jr.	3
Almy, E. T., Jr.	Sp.
Altamirano, S.	4
Alter, J. T.	Sp.
Alvord, H. B.	*Asst.*
Anderson, C. S.	2
Anderson, M. P.	Sp.
Anderson, R. E.	Sp.
Anderson, Sarah R.	Sp.
Andrews, A. W.	3
Angell, H. A.	2
Appelquest, J. A.	1
Applin, F. D.	4
Arkell, W. C.	3
Arms, J. T., Jr.	2
Armstrong, K. P.	3
Arnold, G. W.	Sp.
Arnold, H. S	3
Atherton, T. H., Jr.	4
Atkins, L. M.	3
Atwood, H. N.	Sp.
Avery, J., Jr.	3
Ayres, R. S.	4
Babbitt, H. E.	2
Babcock, A. B.	*Asst.*
Babcock, Elizabeth B.	4
Babcock, J. B., 3d	3
Babcock, Mabel K.	G.
Bach, J. G.	Sp.
Bailey, F. H.	*Prof.*
Bakeman, G. W.	1
Baker, C. F.	G.
Baker, D. F.	1
Baker, E. B.	1
Baker, F.	1
Baker, F. A.	Sp.
Baker, H. J.	Sp.
Baker, J. W.	1
Bakewell, D. C.	Sp.
Baldwin, J. R.	Sp.
Balke, F. C.	1
Ball, E. C.	Sp.
Ballard, H. F.	4
Ballard, V. V.	1
Bardwell, F. L.	*Asst. Prof.*
Barker, C. M.	2
Barker, F. W., Jr.	1
Barker, J. M.	*Asst.*
Barnard, J. E.	3
Barnard, J. M.	1
Barnes, A. J.	Sp.
Barnes, C. S.	Sp.
Barnes, W. E., Jr.	1
Barnett, L.	4
Barr, K.	2
Barry, J. L., 3d	1
Bartlett, C. L.	Sp.
Bartlett, D. E.	Sp.
Bartlett, D. P.	*Prof.*
Bartlett, R. L.	3
Barton, R. M.	2
Batchelder, C. L.	4
Batchelder, R. J.	G.
Batcheller, G. E.	3
Batchelor, C. C.	*Inst.*
Bates, A.	*Prof.*
Bates, R. D.	1
Bates, S. C.	Sp.
Bates, S. E.	2
Batsner, A. G.	Sp.
Batty, E. J.	2
Baxter, L. L.	Sp.
Baxter, W. H.	1
Beach, A. J.	3
Beale, J. M.	1
Beales, R. L.	Sp.
Beall, V. Z.	Sp.
Beason, L. W.	1
Becker, J., Jr.	1
Beckmann, R. A.	Sp.
Beers, L. G.	4
Behr, H.	Sp.
Belcher, D.	4
Belden, C. J.	4
Bell, F. F.	3
Bell, J. R.	2
Benbow, D. F.	1
Bender, H. C.	4
Bender, L. D. W.	*Asst.*
Bennett, F. A.	1
Bennis, A. T.	1
Benson, H. S.	1
Bent, D. E.	1
Benton, C. R.	3
Bekowitz, B.	Sp.
Bermudez, R., Jr.	1
Berry, C. W.	*Asst. Prof.*

Besse, E. E.	Sp.
Besselievre, A. C.	4
Bettington, E. M.	4
Bickerdike, C. E. O.	1
Bicknell, R. S.	Sp.
Biedler, W. T.	3
Bien, V. T. H.	3
Bierer, J. M.	Sp.
Bigelow, B.	Sp.
Bigelow, J., Jr.	*Prof.*
Bigelow, J. A.	Sp.
Bigelow, R. P.	*Inst.*
Billings, H. D.	Sp.
Bird, W. C.	1
Bishop, F. D.	2
Bizzozero, A. P.	1
Blachstein, J.	*Inst.*
Black, T. B.	1
Blaisdell, W. O.	4
Blanchard, A. A.	*Asst. Prof.*
Blanchard, C. K.	3
Blankenbuehler, R. E.	Sp.
Block, P. H.	Sp.
Blodget, W. P.	Sp.
Blood, K. T.	4
Boardman, W. E.	Sp.
Bogdasarian, S.	Sp.
Bollenbacher, J. C.	4
Boltz, R. J.	Sp.
Bombrini, A. M.	Sp.
Bommer, F. W.	1
Bond, T. D.	Sp.
Bonebrake, B. S.	Sp.
Bonvouloir, L.	Sp.
Border, L. S.	4
Borovoy, S.	1
Bounetheau, H. D. P.	4
Bowers, G. W.	Sp.
Bowers, R. H.	3
Bowman, B. A.	4
Boyden, R. T.	Sp.
Boyer, J. A.	1
Brackett, H. H.	1
Bradbury, R. D.	*Inst.*
Bradley, G. E.	*Asst.*
Bradley, H. C.	*Asst. Prof.*
Bragg, C. S.	2
Bramhall, P. M.	Sp.
Bray, J. L.	1
Bray, W. C.	*Res. Assoc.*
Breed, C. B.	*Asst. Prof.*
Breed, S. A.	*Inst.*
Breyer, R. S.	3
Bridgman, G. T.	Sp.
Briel, K. R.	1
Briggs, C. J.	3
Briggs, L. E.	3
Brody, L. M.	Sp.
Brooks, A. W.	Sp.
Brooks, G. G.	Sp.
Brooks, J. N.	4
Brown, C. J.	Sp.
Brown, D., Jr.	3
Brown, E. G.	1
Brown, F. A.	*Asst.*
Brown, G. A.	2
Brown, H. C.	3
Brown, K. H.	1
Brown, P. J.	1
Brown, P. K.	3
Brown, W. F.	*Inst.*
Brownell, W. K.	3
Brownlee, M. B., Jr.	Sp.
Brownlee, R. B.	Sp.
Bruce, H. A.	*Asst.*
Brush, R. W.	3
Buckley, W. J.	2
Bugbee, E. E.	*Asst. Prof.*
Bullard, M. L.	4
Bullens, D. K.	4
Burgher, B. Y.	4
Burgher, S. L.	4
Burke, T. J.	Sp.
Burleigh, W. S.	3
Burnett, R. F.	Sp.
Burnham, P. E.	2
Burnham, P. W.	3
Burnham, R. G.	*Inst.*
Burns, P. S.	*Inst.*
Burr, Barbara	Sp.
Burrison, H. K.	*Inst.*
Burroughs, S. M.	Sp.
Burt, A. E.	Sp.
Burton, A. E.	*Prof.*
Burton, F. A.	4
Busby, F. H.	1
Busey, C. B.	1
Byron, W. H.	4
Cabeen, C. F.	1
Cabot, S.	Sp.
Cadenas, M. A.	3
Caldeira, R.	1
Calder, H. W.	4
Caldwell, F. W.	1
Caldwell, P. L.	2
Calvin, H. H.	1
Campbell, A.	1
Campbell, C. L.	4
Campbell, J. K.	2
Campbell, K. J.	4
Camsell, C.	G.
Canaday, W. A.	Sp.
Cardinal, A. C.	1
Carey, C. D.	3
Carney, A. W.	2
Carpenter, C. H.	1
Carpenter, K. E.	Sp.
Carson, J. R.	4
Cartagena, N. M.	Sp.
Carter, B. E., Jr.	*Inst.*
Carter, C. C.	4
Cartwright, K.	1
Cary, R. L.	4
Castelhun, F. K.	3
Castro Beeche, R.	Sp.
Catching, H. H.	2
Chamberlin, O. V.	Sp.
Chambers, G. J.	1
Champagne, J. L.	1
Chandler, F. W.	*Prof.*
Chandler, H. D.	Sp.
Chandler, H. S.	*Asst.*
Chandler, L. W.	1
Chandler, R. A.	1
Chantry, A. J., Jr.	4
Chapin, M. S.	3
Chapman, E. P.	4
Chapman, L. B.	3
Chapman, L. D.	Sp.
Chapman, T. G.	4
Chase, O. van H.	Sp.
Chase, P. H.	4
Chen, S. Y.	1
Cheney, J. B.	2
Cherry, M. C.	1
Chinchilla-K., P.	Sp.
Chow, C. S.	Sp.
Christie, J. A.	4
Christie, M. W.	1
Cilley, J. W.	3
Clapp, C. H.	*Inst.*
Clapp, D.	3
Clapper, L.	Sp.
Clark, C. C.	Sp.
Clark, C. W.	*Asst.*
Clark, E. S.	3
Clark, F. H., Jr.	1
Clark, H. L.	4
Clark, M. S.	4
Clark, O. S.	2
Clavell, A. C.	Sp.
Cleverdon, H. S.	3
Clifford, H. E.	*Prof.*
Clifford, W. W.	4
Cloudman, H. C.	4
Clough, H. L.	3
Cobb, F. L.	3
Coburn, W. H.	2
Codding, H. W.	1
Coffin, M.	2
Cohen, J. H.	1
Cohen, S. K.	3
Colburn, G. H.	Sp.

Cole, J. F. 3
Cole, M. J. 4
Coleman, A. M. . . Sp.
Colebrook, M. W. . Sp.
Collester, C. H. . . *Inst.*
Collingham, H. . . . 3
Collins, W. L. 1
Colson, H. C., Jr. . Sp.
Comins, A. K. . . . Sp.
Comstock, D. F. . . *Inst.*
Comstock, M. E. . . Sp.
Comstock, R. L. . . . 1
Congdon, H. W. . . . 4
Conner, G. C. 3
Connolly, E. L. . . . 4
Connolly, J. W. . . . 1
Conron, R. F. . . . *Asst.*
Constable, J. P. . . . 2
Cook, H. M. . . . . Sp.
Cook, J. A. 1
Cooke, F. G. . . . Sp.
Cooley, L. C. 2
Cooper, L. W. 1
Copeland, S. B. . . . 2
Coplan, M. A. 3
Coppinger, C. W. B. Sp.
Coram, R. E. 1
Cornell, S. H. 2
Cornish, D. O. 1
Cotton, E. B. 1
Coulson, H. 1
Court, A. B. 4
Courtney, B. F. . . Sp.
Covill, F. W. . . . Sp.
Cowee, G. A. 2
Cowdrey, I. H. . . . *Asst.*
Cox, J. A. . . . . Sp.
Cox, R. S. 1
Coy, E. B. 1
Crane, H. G. . . . *Inst.*
Crawford, C. H. . . . 4
Creecy, C. E. 3
Creighton, I. C. . . Sp.
Cremer, R. 1
Crichton, H. N. . . Sp.
Criswell, C. H. . . . *Asst.*
Critchett, J. H. . . . 4
Crommett, O. J. . . . 3
Cross, C. R. . . . . *Prof.*
Crossley, F. T. . . Sp.
Crost, W. S. 1
Crowley, J. E. . . . Sp.
Cullimore, A. R. . . *Asst.*
Cumings, G. B. . . . 3
Cummings, H. N. . . 3
Cummings, H. S. . Sp.
Cummings, L. T. . . 1
Curley, E. . . . . . . *Asst.*
Currier, C. F. A. . . *Prof.*
Curtis, A. 3
Curtis, A. H. . . . Sp.
Curtis, F. H. 2
Curtis, G. L. 1
Curwen, G. B. . . . Sp.
Cushing, W. B. . . . 3
Cushman, P. A. . . . 2

Daley, M. J. . . . . . Sp.
Dalrymple, P. W. . . 1
Daly, R. A. . . . . *Prof.*
Danser, H. W. . . . 1
Davies, A. C. 3
Davis, A. R. 1
Davis, E. W. 1
Davis, H. B. 1
Davis, H. C., Jr. . . . 2
Davis, H. M. 2
Davis, J. F. 4
Davis, L. . . . . . Sp.
Davis, M. M. 4
Davis, R. W. 1
Davis, W. S. . . . Sp.
Dawes, C. L. 4
Day, S. L. 2
de Araujo, A. B. . . Sp.
d'Autremont, L. P. Sp.
de Florez, L. . . . Sp.
de Forest, A. V. . . . 2
De Forest, N. . . Sp.
de Lande, C. . . . Sp.
Denison, O. B. . . . 2
Dennett, K. W. . . . 3
Dennett, M. S. . . Sp.
de Romana, A. L. . Sp.
Derr, L. . . *Assoc. Prof.*
Desmond, T. C. . . . 4
Despradelle, D. . . *Prof.*
Devine, R. L. 1
Devlin, J. J. . . . Sp.
Dewey, B. 4
Dewey, D. R. . . . *Prof.*
DeWitt, E. W. . . Sp.
Dexter, H. E. 1
Diaz, W. R. . . . . Sp.
Dickinson, L. A. . . *Asst.*
Diehl, J. C. 3
Dierks, F. H. . . . Sp.
Dike, F. . . . . . *Inst.*
Dillon, P. L. . . . Sp.
Dillon, R. E. 3
Doane, R. E. 4
Doble, C. F. . . . . Sp.
Dodge, C. E. 1
Dodge, R. L. 3
Doherty, F. J. A. . Sp.
Dole, M. W. . . . . *Inst.*
Dolke, F. C. . . . . . Sp.
Dolke, W. F., Jr. . . G.
Dolliver, H. F. . . . 2
Dornberger, H. S. . . 3
Dort, J. C. 4
Doten, C. W. *Asst. Prof.*
Dow, B. W. 4
Dow, L. A. 3
Downing, L. L. . . . 1
Downs, L. N., Jr. . . 3
Dows, C. L. 2
Dowst, H., 3d 1
Drake, W. 3
Dray, W. R. . . . Sp.
Drew, W. N. 3
Drisko, W. J. *Asst. Prof.*
DuBois, W. L. . . Sp.
Duell, G. H. 1
Duffett, N. D. 2
Duffield, W. H. . . Sp.
Duffy, J. F. 2
Dugan, W. E., Jr. . . 1
Duke, L. B. 1
Dun, H. W., Jr. . . . 4
Dunbar, A. R. 3
Dunbar, H. C. . . . Sp.
Dunkel, C. A. 3
Dunlap, C. D. . . . Sp.
Dunlap, J. H. 2
Dunnington, F. H. . . 4
Duyser, C. A. 1
Dwight, C. W. . . . Sp.
Dyer, B. 4
Dyer, S. B. 2

Eames, H. S. . . . *Asst.*
Eaton, W. M. . . . Sp.
Edgerton, G. I. . . . 1
Edwards, C., Jr. . . . 2
Edwards, E. J. . . . *Asst.*
Egan, R. W. . . . Sp.
Eicher, A. 1
Eisenberg, A. M. . . . 1
Eksergian, R. 1
Elbert, J. J. . . . . Sp.
Elder, G. W. . . . Sp.
Eldred, C. P. 2
Ellis, J. H. 1
Ellis, R. 4
Elton, H. C. 4
Emerson, G. I. . . Sp.
Emmel, R. 2
Erhardt, J. . . . . *Inst.*
Estes, G. H. 2
Evans, F. J. . . . Sp.
Everett, H. A. . . . *Inst.*
Everett, W. 4
Everett, W. D. . . . 3

Fabens, A. L. 3
Fales, Helen L. . . . 3
Farrington, H. P. . . G.
Farwell, J. W., Jr. . . 1
Faulkner, F. R. . . . 4
Faunce, K. W. . . . 2
Faxon, H. C. . . . *Asst.*
Fay, H. . . . . . . *Prof.*
Fay, T., Jr. 4
Fellows, R. H. . . Sp.
Fenger, F. A. . . . Sp.
Ferguson, G. O. . . Sp.
Ferguson, W. C. . . Sp.
Fernandez, F. . . . Sp.
Fernandez, R. O. . . 3
Fernstrom, K. D. . . 3
Ferris, L. P. . . . Sp.
Ferry, E. E. 1
Ferry, R. M. 1
Fick, W. G. 4
Field, C., 3d . . . . *Inst.*
Finberg, J. B. 1
Finch, S. P. . . . . . G.
Finnie, J. I. 4
Fisk, J. P. 1
Fisher, H. C. 4
Fisher, R. B. . . . Sp.
Fisher, T. C. 1
Fiske, P. S. . . . . *Asst.*
Fitch, E. O., Jr. . . . 4
Fitzherbert, L. G. . Sp.
Fitzwater, J. M. . . . 3
Flagg, M. . . . . . Sp.
Fleming, P. R. . . Sp.
Fletcher, C. B. . . Sp.
Fletcher, M. 3
Flett, L. E. . . . . Sp.
Flickinger, H. W. . Sp.
Foley, H. M. 1
Follansbee, E. M. H. Sp.
Follett, D., Jr. . . . 1
Font y Gimenez, M. . 1
Foote, A. J. 3
Forbes, E. D. . . . *Inst.*
Ford, C. C. . . . . Sp.
Forrest, L. R. 4
Forrester, G. W. . . . 1
Forristall, G. B. . . Sp.
Foster, C. C. . . . Sp.
Foster, R. C. 1
Foster, W. D. 2
Fowler, H. E. 3
Fox, H. R. L. 1
Fox, R. H. 1
France, W. R. . . . Sp.
Francis, R. D. . . . Sp.
Francis, S. A. . . . Sp.
Fraser, P. G. 1

Frazier, D. N. . . . Sp.
Fredriksen, N. . . . 1
Freed, C. 4
Freedman, A. J. . . . 1
Freethy, G. E. . . . 3
French, D. A. . . . Sp.
French, L. O. 3
Frost, H. Y. . . . Sp.
Fryer, H. 2
Fuller, B. R. 4
Fuller, C. E. . . *Assoc. Prof.*
Fuller, F. R. 1
Fuller, J. C. 2
Fulton, Margaret O. Sp.
Funk, C. A. 1

Gadsby, G. M. . . . Sp.
Gaillard, D. S. P. . . 2
Gale, A. G. 1
Gale, R. D. . *Res Asst.* G.
Gallagher, J. P. . . Sp.
Gallagher, R. T. . . Sp.
Gammons, C. W. . Sp.
Gardner, A. L. . . . 2
Gardner, H. W. *Asst. Prof.*
Gardner, R. S. . . . *Asst.*
Garratt, J. E. . . . *Asst.*
Garza, J. . . . . . Sp.
Gasche, K. W. . . . 3
Gawne, J. O. 4
Gaynor, K. C. . . . Sp.
Geary, L. E. . . . Sp.
Gegenheimer, R. E. . 3
George, G. C. 2
George, N. R., Jr. *Asst. Prof.*
George, R. M. 3
Gerity, H. S. . . . Sp.
Gershberg, J. 2
Gibbons, C. A., Jr. . *Inst.*
Gibbs, A. S. 4
Gideon, S. E. . . . *Inst.*
Giesey, E. McA. . . Sp.
Gilbert, R. W. 4
Giles, D. McF. . . . Sp.
Gilkison, G. M. . . . 4
Gill, A. H. . *Assoc. Prof.*
Gillis, R. M. 3
Gilpatrick, C. G. . . Sp.
Given, J. A. . . . . Sp.
Givrigian, S. V. . . Sp.
Glancy, R. C. 4
Glazier, H. M. 4
Glazier, L. G. . . . Sp.
Glidden, W. R. . . . 1
Godfrey, K. D. . . . 3
Godley, F. A. 3
Goicoechea, L. . . Sp.

Golden, L. R. . . . Sp.
Gonzalez, L. R. . . . 1
Goodhue, W. W. . . Sp.
Goodrich, A. L. . . *Inst.*
Goodspeed, G. E., Jr. Sp.
Goodwin, E. W. . . . 2
Goodwin, H. M. . . *Prof.*
Goodwin, L. H. . . . 1
Goodwin, R. F., Jr. . 3
Gordon, L. S. . . . Sp.
Gordon, W. S., Jr. . . 4
Gott, H. S. . . . . Sp.
Gould, A. A. 3
Gould, R. H. 2
Gram, C. W. . . . Sp.
Grant, J. S. . . . . Sp.
Graupner, M. F. . . Sp.
Gravely, J. S. . . . Sp
Gray, G. H. 4
Greeley, H. W. . . Sp.
Greely, L. W. . . . Sp.
Green, C. E. 3
Green, C. W. . . . *Asst.*
Green, F. M. 4
Green, W. D. 4
Greenau, J. O. . . . Sp.
Greene, E. D. 3
Greenleaf, C. T. . . . 2
Greenleaf, H. 1
Greenleaf, K. . . . Sp.
Greenwood, L. C. . Sp.
Gregory, A. F. . . . 1
Gregory, N. B. . . . 4
Griffin, H. H. 1
Grimes, W. F., Jr. . . 3
Gring, A. D., Jr. . . Sp.
Groff, J. S. . . . . Sp.
Gross, Cora B. . . . Sp.
Grossmann, M. A. . . 2
Grubnau, V. C. . . Sp.
Grunsky, E. L. . . Sp.
Guilford, E. H. . . Sp.
Guillou, V. 1
Gunn, S. . . . . . *Inst.*
Gurney, H. P. . . . Sp.
Guthrie, S. A. 3

Hadji Savva, A. . . . 3
Hague, A. . . . . Sp.
Haines, T. H. 2
Hakes, J. F. 1
Hale, H. A., Jr. . . . 3
Haley, R. J. 3
Hall, E. R. 2
Hall, H. W. 1
Hall, J. 1
Hall, N. A. 1
Hall, W. T. . . . . *Inst.*

Hallett, H. M. . . . Sp.
Hamilton, E. R. . . Sp.
Hammond, A. R. . . 1
Hammond, J. C. . . Sp.
Hanna, E. S. . . . Sp.
Hannaford, R. H. . Sp.
Hanson, H. H. . . . 1
Harcourt, G. N. . . . 3
Harding, A. L. . . . 3
Hargrave, J. M. . . . 1
Hargraves, W. B. . . 3
Harlow, H. 1
Harrigan, L. J. . . . 2
Harriman, D. F. . . . 4
Harrington, C. A. . . G.
Harrington, C. H. . . 2
Harrington, F. C. . Sp.
Harrington, J. F. . . 2
Harris, P. T. 3
Harrison, H. N. . . Sp.
Harrison, J. K. M. . . 3
Harrub, C. N. 4
Hart, P. 3
Hartman, I. S. . . . 3
Hartnett, J. T. . . . 1
Hartshorn, D. S. . . Sp.
Hartshorn, S. H. . . 2
Hartwell, A. E. . . . 4
Harvey, W. F. . . . 1
Haslam, R. T. 2
Hastings, R. . . . Sp.
Hathaway, J. W. . . 4
Hatch, S. F. . . . . *Asst.*
Haugaard, W. E. . Sp.
Hausman, I. . . . Sp.
Haven, G. B. *Asst. Prof.*
Havens, H. L. 4
Hawes, H. G., Jr. . Sp.
Hawkins, E. B. . . Sp.
Hayman, M. E. . . Sp.
Haynes, D. G. . . . Sp.
Haynes, H. W. . . Sp.
Hayward, C. R. . . *Inst.*
Hayward, H. W. *Asst. Prof.*
Hayward, R. L. . . . 2
Healy, L. J. D. . . Sp.
Hechinger, L. A. . . . 1
Hedden, M. W. . . Sp.
Heidelberg, F. M. . . 4
Hemmenway, L. T. . 3
Henderson, A. B. . Sp.
Henderson, S. L. . . 3
Herlihy, J. A. 2
Herreshoff, A. G. . Sp.
Herreshoff, A. S. DeW. Sp.
Herreshoff, N. G., Jr. . 1
Hersey, M. D. . . . Sp.
Heuter, R. R. . . . *Inst.*

Hicken, G R. 2
Hickerson, T. F. . . . 4
Hidezi, M. . . . . Sp.
Hield, C. C. 3
Higgins, C. F. 1
Higgins, J. J. . . . Sp.
Hildebrand, W. H. . Sp.
Hildreth, A. G. . . Sp.
Hill, B. A. 2
Hill, R. F. . . . . Sp.
Hilliard, R. B. . . . 4
Hilscher, R. . . . . Sp.
Hinckley, A. T. . . *Asst.*
Hirschfeld, B. S. . . Sp.
Hobson, C. F. 2
Hodge, G. E. . . . Sp.
Hodges, F. E. 3
Hodgman, W. K. . . 2
Hofman, H. O. . . *Prof.*
Holbrook, E. C. . . . 1
Holbrook, G. G. . . Sp.
Holbrook, J. A. . . . 3
Holbrook, R. A. . . . 2
Holley, F. T. 1
Holmes, A. F. . . . *Inst.*
Homan, E. L. 1
Hooper, L. S. 1
Hopkins, M. W. . . Sp.
Hopkins, P. S. . . Sp.
Hopkins, W. B. . . . 2
Horgan, P. D. 1
Horne, R. W. 3
Hornor, A. P. 1
Horton, W. H., Jr. . . 3
Hosmer, G. L. *Asst. Prof.*
Hosmer, Helen R. . Sp.
Howard, H. S. . . . G.
Hovgaard, W. . . . *Prof.*
Howard, J. W. . . . *Inst.*
Howe, E. C. . . . . . G.
Howland, H. H. . . . 4
Howland, J. L. . . . 1
Hoyt, R. N. . . . . Sp.
Hubbard, C. W. . . . 4
Huber, B. C. . . . Sp.
Huckins, A. K. . . . 3
Huddell, A. S. 1
Hudson, R. G. . . . *Asst.*
Hufsmith, C. L. . . . 2
Hugelmann, J. R. . . 2
Huggins, L. M. . . . 1
Hulsizer, R. I. . . . Sp.
Humphreville, W. E., Jr. Sp.
Humphrey, C. F. . . 3
Humphrey, G. S. . Sp.
Humphreys, W. *Registrar*
Hunt, F. L. 4
Hunt, H. R. . . . . *Inst.*

Hunter, A. R. . . . *Asst.*
Hurley, F. A. . . . Sp.
Hutchins, O. 2
Huxley, R. D. 2
Hyde, R. E. 1
Hynes, J. J., Jr. . . Sp.

Inglee, R. 4
Ireland H. P. 2
Ives, W. B. . . . . Sp.

Jackson, A. F. . . . Sp.
Jackson, D. C. . . . *Prof.*
Jacobs, C. D. . . . Sp.
Jacobs, E. 3
Jacobs, R. C., Jr. . Sp.
Jacoby, L. 4
Jacoby, R. W. 3
Jaeger, F. 4
Jagger, T. A., Jr. . *Prof.*
James, G. 3
James, I. S. . . . . Sp.
James, J. E. . . . Sp.
James, W. H. . . . *Inst.*
Jansson, A. H. . . . *Asst.*
Jarret, R. . . . . . Sp.
Jenckes, E. K. . . . 3
Jenkins, D. J. 2
Jenkins, H. O. . . . Sp.
Jenkins, W. B. . . Sp.
Jenks, H. G. 2
Jewett, F. C. 2
Johnson, C. L. 2
Johnson, Flora A. . Sp.
Johnson, H. I. 1
Johnson, H. A. . . . 1
Johnson, L. H. . . . 4
Johnson, R. D. . . Sp.
Johnston, C. C. . . Sp.
Johnston, C. T. . . . 4
Johnston, W. A. *Assoc. Prof.*
Jones, B. 3
Jones, B. H. 4
Jones, C. L. . . . . Sp.
Jones, Raymond L. . 3
Jones, Reginald L. . . 4
Jones, W. B. . . . Sp.
Jones, W. H. 4
Joslin, G. A. . . . Sp.
Joy, C. F., Jr. 3
Joyner, A. E. 1

Kahn, M. 1
Kalbfleisch, T. F., Jr. 1
Kalmus, H. T. . . . *Inst.*
Kane, I. P. . . . . Sp.
Kaufman, A. 2
Keables, A. D. . . . 4

Kebbon, H. E. . . . 1
Keefe, W. J. . . . Sp.
Keith, G. M. 1
Kelley, E. F. . . . Sp.
Kelley, J. E. . . . Sp.
Kelley, M. E. 4
Kellogg, A. G. 4
Kellogg, P. 2
Kelly, W. J. . . . Sp.
Kemp, H. D. 1
Kenison, E. . *Asst. Prof.*
Kennedy, E. 2
Kenney, G. C. 2
Kenrick, A. F. . . . 1
Kenway, E. . . . . Sp.
Kerr, C. P. 2
Kerr, R. C. 4
Kerr, W. C. . . . . Sp.
Kibbey, R. . . . . . G.
Kiely, E. B. 3
Kilborn, K. B. . . . 2
Killion, T. S. 2
Kilman, E. C. . . . Sp.
Kimball, M. J. . . . 1
Kimball, S. P. 2
Kimberley, B. R. . . Sp.
King, F. J. . . . . Sp.
King, L. H. 4
King, W. W. 3
Kingsbury, F. H. . . 1
Kinney, M. C. . . . Sp.
Klopacs, V. P. . . . 2
Kneeland, F. R. . . *Inst.*
Knight, J. C. . . . Sp.
Knight, T. C. 1
Knipmeyer, C. C. . *Asst.*
Knipp, A. R. 4
Knox, H. G. 3
Kostiuk, S. . . . . Sp.
Kraus, C. A. *Res. Assoc.*
Kurrelmeyer, H. R. *Inst.*
Kushlan, M. 2
Kyle, C. W. . . . . Sp.

Lake, H. E. 2
Lang, H. L. . . . . Sp.
Lambirth, J. R. . . *Inst.*
Lang, W. W. 1
Lange, F. J. . . . . Sp.
Langer, R. R. 1
Larkin, T. . . . . Sp.
Lanza, G. . . . . . *Prof.*
Larrabee, H. P. . . . 2
Lasier, E. L. . . . Sp.
Lasnier, G. . . . . Sp.
Latimer, R. C. . . . 4
Laurie, A. W. 1
Laurson, P. G. . . . 3
Lawrence, B. . . . Sp.
Lawrence, G. L., Jr. . 4
Lawrence, R. R. *Assoc. Prof.*
Lawrence, W. H. *Assoc. Prof.*
Laws, F. A. . *Assoc. Prof.*
Lawton, S. H. . . . Sp.
Lazenby, P. H. . . . 4
Leão, P. de S. 2
Learoyd, F. K. . . . 1
Leary, A. F. 2
Leavitt, C. E. . . . *Asst.*
Leavitt, G. E., Jr. . . 1
Leddy, J. M. . . . Sp.
Lehmann, H. F. . . . 1
Leland, W. S. *Asst. Prof.*
Lenaerts, J. H. . . . 1
Lennon, A. J. 1
Lenox, J. E. 4
Levine, M. 1
Levy, N. 2
Lewis, G. N. . *Asst. Prof.*
Lewis, R. W. . . . Sp.
Lewis, W. K. . . . *Asst.*
Lipke, J. . . . . . . *Inst.*
Little, J. B. . . . . Sp.
Littlefield, C. E. . . *Inst.*
Livingston, G. E. . . 2
Locke, C. E. *Asst. Prof.*
Locke, Henrietta W. Sp.
Locke, J. H. . . . . *Asst.*
Lockett, H. . . . . Sp.
Lodge, J. 3
Lombard, O. C. . . . 1
Lombard, R. H. . . . 3
Lombardi, P. F. . . . 1
Long, J. S. 2
Long, T. A. . . . . Sp.
Longyear, Helen McG. 4
Loomis, L. A. 4
Lord, G. R. . . . . Sp.
Lord, H. S. 2
Lord, P. B. . . . . Sp.
Lord, R. H. 2
Loring, E. M. . . . Sp.
Loud, F. M. 4
Loud, R. P. 3
Lougee, N. A. 2
Loughlin, G. F. . . *Inst.*
Lovejoy, C. H. . . . 3
Lovell, J. W. 1
Lovewell, F. S. . . . 4
Lowe, R. M. 1
Lowenberg, M. J. . Sp.
Lufkin, F. R. 3
Lunt, G. P. 3
Luscomb, Florence H. 4
Lusky, L. M. . . . Sp.
Luther, H. B. . . . *Asst.*
Lyle, A. L. . . . . Sp.
Lynch, W. C. 1
Lyon, W. V. . . . . *Inst.*
Lyons, F. B. . . . Sp.
Lyons, M. A. . . . Sp.

Mabbott, H. C. . . . 1
McAllen, J. L. . . . Sp.
McAuliffe, W. J. . . . 4
McAvoy, F. T. . . . 1
McCain, S. N. 4
McCarthy, J. F. . . . 4
McClelland, C. B. . . 1
McClintock, F. S. . . 4
McCrady, M. H. . . Sp.
MacCreadie, W. T. . . 2
McCune, W. R. . . Sp.
McDonald, A. J. . . . 1
MacDonald, H. D. . . 1
MacDonough, J. V. . 1
McFaul, G. B. 1
McGinniss, J. . . . Sp.
McGrath, D. J. . . . 1
Machen, T. G. 4
Mackellar, S. R. . . . 1
McKenney, K. C. . . 1
MacKenzie, J. D. . . 3
Mackenzie, M. . . . Sp.
Mackenzie, M. C. . *Inst.*
McKnight, W. F. . . 2
McLaughlin, T. F., Jr. Sp.
McManus, C. A. J. . Sp.
McMillan, L. R. . . Sp.
McMurtrie, D. C. . . 2
McNamara, J. D. . Sp.
McNeil, N. T. . . . Sp.
McOsker, P. H. . . Sp.
McPhee, H. E. . . . 3
MacPherson, R. G. . . 2
McRae, G. W. 3
Madenigian, K. . . . 4
Magee, G. H. 3
Maglott, G. F. 3
Maguire, C. A. P. . Sp.
Maguire, W. J. . . . 1
Mahoney, D. F. . . Sp.
Mailey, R. D. *Res. Assoc.*
Main, C. R. . . . . Sp.
Malcom, S. A. 4
Malone, J. F., Jr. . Sp.
Mangan, E. 1
Manley, H. L. 2
Manning, H. G. . . . 1
Manson, H. C. 3
Marceau, E. T. 1
March, W. H. . . . Sp.
Marshall, H. H. . . . 4
Marston, N. S. . . . 2

Martin, J. S. . . . Sp.
Martin, T. DeV. . . Sp.
Marvin, D. P. . . . Sp.
Masjoan, V. . . . . Sp.
Mason, A. B. 3
Mason, E. M. 1
Mason, M. C. 1
Matamoros, J. L. . . 1
Mather, R. H. 2
Mathur, B. P. . . . Sp.
Matte, A. L. . . . Sp.
Matte, J. 4
Matthews, L. A. . . . 1
Maxfield, J. P. . . . 3
Maxwell, H. O. . . Sp.
May, K. S. 4
Mayer, P. H. . . . Sp.
Mayers, E. C. 1
Maynard, C. D. . . Sp.
Mayo, L. 4
Meanor, W. A. . . Sp.
Means, A. H. 1
Meisel, O. C. F. . . Sp.
Meister, G. . . . . *Inst.*
Melcher, A. C. *Res. Assoc.*
Melendy, R. P. . . Sp.
Mellish, M. H. . . . Sp.
Menke, A. F. 4
Merrick, T. B. . . . *Inst.*
Merrill, A. L. . . . *Prof.*
Merrill, C. H. S. . . Sp.
Merrill, E. D. 4
Merrill, E. F. 3
Merrill, H. 1
Merrill, L. M. . . . Sp.
Merriman, T. C. . . . 4
Merry, A. B. 3
Metcalf, L. G. 2
Metz, A. C. 2
Meulendyke, C. E. . . 3
Meyer, T. F. W. . . . 2
Millard, R. W. . . Sp.
Miller, E. F. . . . . *Prof.*
Miller, F. R. . . . Sp.
Miller, G. 4
Miller, H. F., 2d . . . 4
Miller, W. B. . . . Sp.
Mills, J. . . . . . *Inst.*
Mills, L. O. 3
Mitchell, A. K. . . . 4
Mitchell, H. D. . . . 1
Mohn, J. T. . . . . Sp.
Moller, K. . . . . *Asst.*
Monge, L. E. 1
Montgomery, E. . . . 1
Monto, C. P. . . . Sp.
Moore, C. L. E. . . . *Inst.*
Moore, E. B. 1

Moore, F. A. 2
Moore, F. J. . . *Asst. Prof.*
Moore, L. E. . . *Asst. Prof.*
Morash, B. 1
Morey, C. T. 2
Morgan, A. P. 1
Morrill, A. B. 4
Morrill, C. H. 1
Morrison, G. A. . . Sp.
Morrison, I. F. . . . 2
Morse, F. T. 1
Morse, H. H. 1
Morse, R. E. 2
Moses, A. L. . . . Sp.
Mott, W. E. *Assoc. Prof.*
Moulton, A. L. . . . *Asst.*
Mowry, F. L. 1
Mullhaupt, A., Jr. . Sp.
Mulliken, S. P. *Asst. Prof.*
Munoz, R. F. 4
Muriel, M. . . . . Sp.
Murphy, W. H. . . . 1
Murray, J. I. . . . Sp.
Murray, M. W. . . Sp.
Murray, W. J. 1
Myers, A. L. . . . Sp.
Myers, H. E. 4
Mylchreest, G. L. . . 3
Myrick, J. B. 3

Nash, E. A. 2
Nath, S. 2
Navarro, M. A. . . Sp.
Neff, S. C. 1
Nelson, A. P. 1
Nelson, N. . . . . Sp.
Nichols, R. H. . . . Sp.
Nichols, W. R. . . . 3
Nicholson, E. 2
Nickerson, C. B. . . *Asst.*
Nickerson, J. W. . . . 4
Nicol, N. C. . . . . Sp.
Niles, S. M. . . . Sp.
Niles, W. H. . *Prof. Emer.*
Nisbet, L. D. 4
Noble, J. B. . . . . Sp.
Northrop, J. W., Jr. Sp.
Norton, A. E. . . . Sp.
Norton, C. L. *Assoc. Prof.*
Noyes, A. A. *Acting Pres.*
Noyes, J. A. 1

O'Brien, J. H. 3
O'Brien, W. F. . . . 1
O'Connor, C. T. . . . 1
Odell, L. G. . . . . Sp.
Oettinger, M. A. . . Sp.
Ofenstein, C. L. . . . 2

O'Hearn, T. B. . . Sp.
O'Hearn, W. J. . . Sp.
Ohnuki, R. . . . . Sp.
Olsen, W. J. 1
Omansky, M. 2
O'Neill, F. M. 2
O'Neill, H. 4
O'Neill, J. H. 3
O'Neill, M. C. 1
Oppenheim, J. 1
Orchard, W. J. . . . 3
Orem, A. J. . . . . Sp.
Osborn, F., 2d 2
Osborn, F. W. . . Sp.
Osborne, G. A. . . . *Prof.*
Osborne, H. S. . . . G.
Otterson, J. E. . . . G.

Pacheco Lara, R. . . 1
Packwood, Lahvesia P. Sp.
Page, A. C. . . . . Sp.
Page, N. C. . . . . *Inst.*
Paine, H. W. 4
Palmer, G. T. 4
Palmer, H. H. . . . Sp.
Pardee, H. S. . . . Sp.
Park, C. F. . *Assoc. Prof.*
Park, J. R. 1
Parker, J. W. 4
Parker, T. B. 2
Parsons, H. F. . . . 3
Partridge, H. H. . . . 1
Passano, L. M. *Asst. Prof.*
Paullis, G. L. 1
Payson, H. S. 1
Peabody, C. H. . . *Prof.*
Peabody, D., Jr. . . . 3
Peabody, O. L. . . . *Asst.*
Pead, W. J., Jr. . . Sp.
Pearce, J. S. 4
Pearl, H. I. . . . . Sp.
Pearson, H. G. *Assoc. Prof.*
Pearson, P. H. . . Sp.
Pedersen, A. M. . . . 1
Peet, A. S. . . . . Sp.
Pepper, B. W. 4
Pepper, C. L. 2
Perkins, R. W. . . Sp.
Perley, H. C. . . . Sp.
Perrin, L. W. 2
Perrine, C. O. 1
Perry, C. R. . . . . Sp.
Perry, F. G. . . . . Sp.
Perry, H. R. 3
Pettingell, J. M. . . . 1
Pettingell, W. M. . Sp.
Pettit, B. M. . . . Sp.
Petzold, H. R. . . . 4

Phelan, J. W. . . . *Inst.*
Phelps, D. W. . . . . Sp.
Phelps, E. B. *Asst. Prof.*
Phillips, A. L., Jr. . . . 3
Phillips, H. B. . . . *Inst.*
Phillips, W. I. 2
Pierce, J. B., Jr. . . Sp.
Pierson, Ruth O. . . Sp.
Pilling, E. W. 3
Piper, C. F. 3
Pitcher, F. J. 3
Polhemus, T. 2
Poor, A. K. . . . . Sp.
Poor, F. F. 1
Poore, L. D. 4
Pope, C. H. . . . . Sp.
Pope, T. E. . . . . *Prof.*
Porosky, M. 4
Porter, C. H. . . . *Inst.*
Porter, D. . . . . . *Prof.*
Potter, E. M. 3
Powell, O. D. . . . Sp.
Pratt, C. S. . . . . Sp.
Pratt, J. C. . . . . Sp.
Pratt, J. H. 1
Prentiss, N. N. . . . 2
Prescott, S. C. *Asst. Prof.*
Preston, R. A. D. . . 3
Price, M. D. 3
Priest, H. M. 1
Pritchard, C. M. . . Sp.
Pritchett, L. W. . . Sp.
Proctor, J. A . . . Sp.
Prouty, T. R. 1
Pruyn, K. 1
Pugsley, E. . . . . Sp.
Pulsifer, R. B. . . . Sp.
Purdom, A. B. . . Sp.
Pushee, H. B. 2
Putnam, H. R. . . . 4
Putnam, S. B. 2

Quinn, J. H. . . . Sp.

Rabinovitz, L. . . . 1
Radford, C. U. . . . 4
Radford, D. H. . . . 1
Ragsdale, E. J. W. . . 3
Rand, F. H. . . . *Bursar*
Randall, C. J. 3
Ranger, R. H. 2
Ransohoff, N. 3
Ratzkoff, S. M. . . . 2
Raymond, J. W., Jr. . 1
Read, W. C. . . . Sp.
Reckard, R. W. . . Sp.
Redfern, P. F. 1
Redfield, C. S. 3

Redman, E. A. . . . 3
Reed, R. C. . . . . *Inst.*
Reed, R. O. . . . . Sp.
Reed, S. E. 1
Reeds, C. 4
Reid, J. G. . . . . . G.
Reilly, W. R. 4
Reiman, C. K. 1
Remick, F. H. . . . Sp.
Reppert, G. H. . . . 4
Rew, M. W. 4
Reynolds, B. . . . Sp.
Reynolds, C. V. . . . 1
Reynolds, H. G. . . . 3
Rhoades, W. G. . . . 2
Rhodes, G. H. 1
Rhodes, W. A. . . Sp.
Rice, E. T. . . . . Sp.
Rice, L. G. 3
Rice, R. C. . . . . Sp.
Richards, Ellen H. . *Inst.*
Richards, R. H. . . *Prof.*
Richards, R. A. J. . . 1
Richards, G. W. . . . 1
Richards, J. L. . . . 4
Richardson, A. B. . Sp.
Richardson, L. W. . . 1
Richardson, W. D. . Sp.
Richardson, W. E. . . 1
Richmond, C. G. . . . 2
Ricker, D. 1
Riddell, R. H. 1
Rideout, P. A. . . . 2
Ridstrom, E. H. . . Sp.
Riefkohl, R. W. . . Sp.
Rieser, C. W. 1
Rietschlin, O. R. . . 3
Riley, J. C. . *Asst. Prof.*
Roads, G. M. . . . Sp.
Robb, G. H. 1
Robbins, A. G. *Assoc Prof.*
Roberts, W. T. . . . 1
Robertson, S. R. . . Sp.
Robinson, A. T. *Asst. Prof.*
Robinson, B. A. . . . 4
Robinson, C. S. . . . 4
Robinson, E. A. . . . 4
Robinson, F. A., Jr. . 1
Robinson, G. A. . . . 1
Robinson, H. A. . . . 1
Robinson, H. L. . . . 2
Robinson, K. C. . . . 2
Roche, R. V . . . Sp.
Rodman, W. S. . . . G.
Rodriguez, S., Jr. . Sp.
Rogers, J. C. . . . Sp.
Rolfe, G. W. . . . *Inst.*
Romero, A 1

Rooney, A. H. . . . 2
Root, R. P. 1
Roper, T. A. 3
Rosenberg, J. M. . . 1
Rosenblatt, A. M. . Sp.
Rosenstein, L. 3
Ross, B. T. 1
Rountree, W. J. . . . 4
Rowe, L. G. . . . . Sp.
Rowley, C. B. 1
Ruby, W. M. 1
Ruckman, J. H. . . . 3
Runels, R. E. 2
Rush, J. E. 2
Russell, E. S. 3
Russell, Foster . . Sp.
Russell, Frank . . . 2
Russell, G. E. *Asst. Prof.*
Ryder, F. P. 2
Ryerson, E. L., Jr. . Sp.
Ryon, G. A. 1

Sage, N. McL. . . . Sp.
St. John, B. H. . . Sp.
Salgado, A 1
Salisbury, W. C. . . . 2
Sampson, M. . . . . G.
Sanburn, J. C. 1
Sargeant, F. P. . . . 3
Sargent, H. 2
Sargent, S. C. 1
Saslaw, J. 1
Saul, T. W. 3
Savage, E. C. . . . Sp.
Saveny, R. H. . . . Sp.
Sawyer, G. S. 1
Sawyer, L. E. 3
Scales, F. M. . . . Sp.
Scanlon, R. H. . . . 1
Scarff, J. H. . . . . Sp.
Schaaf, J. . . . . . Sp.
Schaffer, H. . . . . Sp.
Schakne, J. H. . . . 4
Scharff, M. R. 4
Schatz, R. E. . . . Sp.
Schell, E. H. 1
Schellens, C. A. . . . 3
Scheuer, J. . . . . Sp.
Schleicher, H. M. . . 3
Schmidt, H. C. . . . 3
Schmidt, S. M. . . . 2
Schmitt, W. H. . . . 1
Schneider, F., Jr. . Sp.
Schneider, S. 1
Schofield, W. McN. . 3
Schreiber, H., Jr. . Sp.
Schriefer, H. C. . . Sp.
Schwamb, P. . . . *Prof.*

Schwartz, L. 2
Schwarz, E. A. . . Sp.
Scofield, W. W., Jr. . 3
Scoville, J. H. . . . Sp.
Scribner, S. H. . . . 2
Scriven, E. O. 3
Seaver, H. L. *Asst. Prof.*
Sedgwick, W. T. . . *Prof.*
Seeley, N. S. 3
Seelye, S. H. 1
Seetoo, F. 1
Seibert, V. E. . . . Sp.
Selfridge, J. S. 1
Selfridge, S. W. . . . 1
Seligman, W. J. . . . 2
Serra, J. H. . . . . Sp.
Shaad, G. C. . *Assoc. Prof.*
Shaffer, G. F. . . . Sp.
Sharkey, A. E. . . Sp.
Sharman, F. W. . . . 4
Sharp, H. . . . . . Sp.
Shaw, A. L. 4
Shaw, C. H. 3
Shaw, H. F. 2
Shaw, J. H. . . . . Sp.
Shaw, L. C. . . . . Sp.
Sheldon, G. W. . . Sp.
Shen, H. T. 4
Shenstone, O. H. . Sp.
Shepard, F. J. 1
Sherman, H. L. . . Sp.
Sherman, M. C. . . . 3
Sherman, R. P. . . Sp.
Sherrill, M. S. *Asst. Prof.*
Shimer, H. W. *Asst. Prof.*
Shippee, A. E. . . . Sp.
Shohan, A. 2
Shore, J. D. 1
Shuttleworth, W. . . 1
Silsbee, F. B. 3
Silverman, B. 1
Simmons, F. R. . . Sp.
Simonds, R. S. . . Sp.
Simonds, W. J. . . . 2
Sircar, B. B. 1
Sittinger, C. J. . . . 3
Slack, E. P. . . . . *Asst.*
Slade, W. C. . . . . G.
Sloan, V. G. 1
Smead, R. A. 3
Smith, C. McL. . . . 3
Smith, D. J. . . . Sp.
Smith, F. G. 2
Smith, H. A. . . . Sp.
Smith, H. S. 2
Smith, H. W. *Assoc. Prof.*
Smith, L. S. . . . . *Inst.*
Smith, Mabel E. . . Sp.

Smith, O. S. 3
Smith, P. 4
Smith, R. H. . . . *Inst.*
Smith, R. L. 4
Smith, W. L. . . . Sp.
Smith, X. R. 4
Sneddon, J. S. . . . Sp.
Snow, S. I. . . . . Sp.
Snyder, H. R. 2
Soderstrom, F. H. . . 4
Soule, L. R. . . . . Sp.
Soulis, H. E. 1
Southgate, D. W. . Sp.
Southgate, G. T. . . Sp.
Southwick, L. S. . . Sp.
Spaans, W. 3
Spalding, W. T. . Sp.
Spear, E. B. . . . . *Inst.*
Spencer, H. K. . . . 4
Spooner, T. 4
Springall, C. F. . . . 1
Squire, E. H. . . . *Asst.*
Staiger, A. B. 1
Stamper, W. Y., Jr. Sp.
Stanley, R. R. 2
Stark, T. F. . . . . Sp.
Starr, F. E. 1
Stauffer, I. H. 3
Steese, C. M. . . . Sp.
Stein, A. L. . . . . Sp.
Steinberg, S. . . . Sp.
Stellwagen, K. D. . . 3
Stephenson, J. N. . . 4
Stevens, B. W. . . . 1
Stevens, D. R. . . . 2
Stevens, H. H. . . . 1
Stevens, S. S. 1
Stevenson, A. F. . . Sp.
Stewart, C. A. 1
Stewart, D. 2
Stewart, F. D. . . . Sp.
Stewart, H. O. . . Sp.
Stewart, J. B., Jr. . Sp.
Stewart, O. W. . . . 2
Stibbs, F. M. . . . Sp.
Stickney, R. C. . . . 1
Stiebel, H. J. 4
Stiles, P. G. . . . . *Inst.*
Stimpson, E. F. . . . 2
Stoddart, D. A. . . Sp.
Stone, L. S. 4
Stone, R. B. 1
Stover, F. H. 3
Straus, A. H. . . . Sp.
Stuart, E. . . . . Sp.
Stump, H. E. 3
Sullivan, E. L. . . . 1
Sullway, G. P. . . . Sp.

Sumner, J. O. . . . *Prof.*
Sun, T. T. . . . . Sp.
Sutherland, C. A. . Sp.
Sutherland, C. H. . Sp.
Sutton, H. H. . . . . G.
Sutton, L. H. . . . *Asst.*
Suzuki, E. 2
Svarz, L. . . . . . Sp.
Swain, G. F. . . . . *Prof.*
Swan, C. M. . . . . *Inst.*
Sweeney, J. C., Jr. . . 4
Sweet, M. K. . . . Sp.
Swett, G. W. . . . *Inst.*
Swift, H. D. 1
Swift, Lila H. . . . Sp.
Symmes, E. M . . . 2
Symonds, R. F. . . . 1

Taft, T. H. . . . . *Inst.*
Taite, F. G. . . . . Sp.
Talbot, H. P. . . . *Prof.*
Tarr, E. W. 1
Tashjian, A. H. . . *Asst.*
Taylor, E. W. . . . *Asst.*
Taylor, H. V. S. . . . 3
Taylor, J. I. 1
Taylor, P. W. 3
Taylor, R. R. 3
Temple, R. B. 4
Tenney, J. B. 1
Terry, P. D. 3
Thayer, R. E. . . . *Asst.*
Thöde, A. F. . . . Sp.
Thomas, G. B. . . . *Asst.*
Thomas, G. S. . . . Sp.
Thomas, J. J. . . . *Asst.*
Thomas, P. E. 1
Thompson, A. G. . . 1
Thompson, M. deK. *Asst. Prof.*
Thompson, M. R. . . 3
Thompson, P. E. . Sp.
Thompson, Rebecca H. 4
Thomson, S. . . . Sp.
Thornley, A. E. . . . 4
Thorp, F. H. . *Asst. Prof.*
Tiernan, M. F. . . Sp.
Tilden, M. W. 3
Tillard, T. A. . . . Sp.
Tilton, C. E. . . . Sp.
Tirrell, H. S. 1
Tod, M. S. . . . . Sp.
Tolman, E. C. 3
Tolman, E. M. . . . 1
Tolman, R. C. . . . *Inst.*
Tomonaga, G. . . . Sp.
Tong, P. 1
Toppan, W. H. . . *Inst.*

Torrey, B., Jr. 1
Torrey, R. M. 2
Towle, F. T. Sp.
Towne, B. B. 1
Towne, L. J. 4
Towne, W. C. *Inst.*
Treuthardt, E. L. P. 4
Trevithick, H. P. Sp.
Tripp, J. G. Sp.
Troland, L. T. 1
True, G. W. Sp.
True, H. E. Sp.
Trueblood, H. M. Sp.
Trueman, J. D. G.
Truette, A. P. 3
Tsai, Y. T. Sp.
Tse, T. K. G.
Tuck, D. H. 2
Tuller, C. L. 1
Turner, A. H. Sp.
Turner, C. 4
Tuttle, J. C. Sp.
Tyler, H. W. *Prof.*
Tyler, P. McI. 1

Uman, G. L. 1
Underhill, A. W. 2
Upham, E. O. 1
Urquhart, J. A. 2

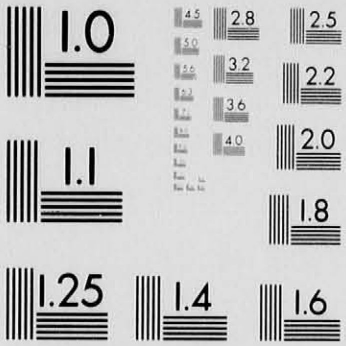
Van Alstine, R. D. Sp.
Van Hovenberg, H. W. 2
Van Inwegen, W. B. Sp.
Van Syckel, E. C. 1
Van Syckel, W. A. 2
Van Tassel, E. D. 2
Vickers, H. B. 1
Vining, R. E. Sp.
Vogel, A. Sp.
Vogel, F. *Prof.*
Vose, A. W. 1
Vose, E. C. 2

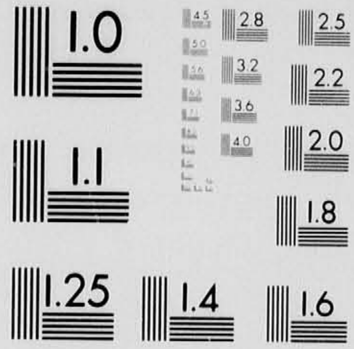
Wade, N. S. Sp.
Wadsworth, P. K. 3
Waite, H. S. 3
Walcott, J. B. Sp.
Waldo, W. R. 3
Waldstein, J. Sp.
Walker, L. B. 1
Walker, W. H. *Prof.*
Walker, W. R. Sp.
Waller, R. P. 3
Wallis, G. E. 4
Wallis, R. P. 1
Wallower, C. W. 3
Walsh, L. S. 1
Walsh, R. Sp.
Ward, J. H. 1
Ware, E. A. 4
Warner, W. W. Sp.
Warren, C. H. *Asst. Prof.*
Warren, V. C. 3
Washburn, G. E. 4
Wasserboehr, H. P., Jr. 3
Waterfall, H. W. 2
Waters, L. W. 3
Watkins, H. G. 1
Watson, E. B. Sp.
Watson, G. S. Sp.
Watson, J. C. Sp.
Watson, R. P. 3
Watts, F. E. Sp.
Webb, C. C. Sp.
Webb, H. 4
Webber, C. W. 1
Weeks, A. T. 4
Weeks, K. Sp.
Weiler, R. B. *Asst.*
Weill, M. K. 4
Weisberg, E. J. 2
Welch, W.-P. Sp.
Wells, E. E. 4
Wells, O. F. *Recorder*
Wells, P. V. 2
Wells, R. D. 3
Weltmer, N. Sp.
Wen, C. Y. G.
Wengert, W. H. 3
Wentworth, J. P. 3
Wentworth, P. M. Sp.
West, W. C. Sp.
Wetmore, L. L. Sp.
Wheeler, F. *Prof.*
Wheeler, R. 1
Wheeler, W. R. 2
Wheelwright, B. Sp.
Whipple, M. P. 4
Whipple, R. E. 1
Whitaker, H. E. 4
Whitcomb, E. J. 2
White, C. H. 4
White, C. N. 3
White, F. W. *Med. Adv.*
White, John H. 1
White, Joseph H. Sp.
White, P. D. Sp.
White, R. M. 1
Whithed, H. H. 3
Whiting, M. T. *Asst.*
Whitney, J. T. 3
Whitney, S. N. Sp.
Whitney, W. O. Sp.
Whittemore, T. B. 3
Whittlesey, J. E. 1
Whorf, A. H. Sp.
Wiessner, O. K. 1
Wiester, A. S. 3
Wilbur, H. R. 3
Wildes, R. N. 1
Wilkes, G. B. 2
Willard, J. A. 4
Williams, C. S., Jr. Sp.
Williams, E. I. G.
Williams, E. T. 4
Williams, H. C. 1
Williams, H. D. Sp.
Williams, R. P. Sp.
Williams, R. S. *Inst.*
Williamson, D. V. 3
Williamson, P. R. 1
Willis, C. M. 1
Willis, S. C. Sp.
Wilson, A. O. 2
Wilson, C. T. Sp.
Wilson, C. W. 3
Wilson, E. B. *Assoc. Prof.*
Wilson, I. W. 2
Wilson, R. E. 1
Wilson, W. C. 2
Winchester, L. S. 4
Winslow, C.-E. A. *Asst. Prof.*
Wint, R. W. G. *Asst.*
Winterstein, H. B. Sp.
Wiseman, R. J. 1
Wiswall, P. M. 4
Witmer, G. S. Sp.
Woehling, H. L. 1
Wohlgemuth, B. S. 3
Wonson, H. S. *Asst.*
Wood, F. A. 2
Wood, F. B. Sp.
Wood, R. O. Sp.
Woodbridge, S. H. *Assoc. Prof.*
Woodcock, C. M. 1
Woodman, A. G. *Asst. Prof.*
Woods, F. S. *Prof.*
Woods, W. S. Sp.
Woodward, C. R. 1
Woodward, E. L. 2
Woodward, M. G. Sp.
Wyman, D. M. 1

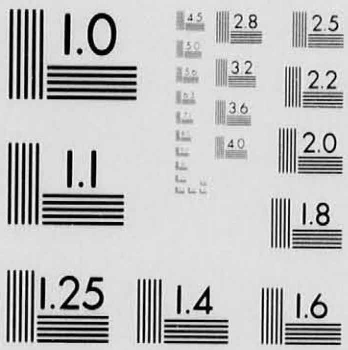
Yacoubyan, V. P. Sp.
Yereance, A. W. 2
York, W. C. 4
Young, E. M. 2
Young, P. E. 4

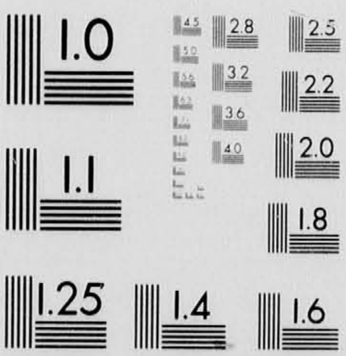
Zahner, V. L. R. 4

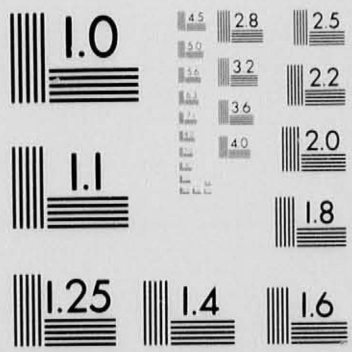
Alphabetical Index.


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


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


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


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


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