MASSACHUSETTS INSTITUTE OF TECHNOLOGY.

THIRTEENTH

ANNUAL CATALOGUE

OF THE

OFFICERS AND STUDENTS,

WITH A

STATEMENT OF THE COURSES OF INSTRUCTION.

1877-1878.

BOSTON:
PRESS OF A. A. KINGMAN.
1877.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY.

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1877.

CONTENTS.

Extracts from Acts of the General Court of Massachusetts, in relation to the Massachusetts Institute of Technology.

Act of Incorporation. "William B. Rogers [and others named], their associates and successors, are hereby made a body corporate, by the name of 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 sciences in connection with arts, agriculture, manufactures, and commerce."

Chapter 183, *Acts and Resolves of* 1861.

Grant of Public Lands. "When the Massachusetts Institute of Technology shall have been duly organized, located, and established, ... there shall be appropriated and paid to its treasurer, each year, on the warrant of the Governor, for its endowment, support, and maintenance, one third part of the annual interest or income which may be received from the fund created under and by virtue of the 130th chapter of the Acts of the 37th Congress, at the second session thereof, approved July 2, 1862 [giving Public Lands to the States in aid of instruction in Agriculture, the Mechanic Arts, and Military Science and Tactics]. . . . . Said Institute of Technology, in addition to the objects set forth in its Act of Incorporation [as above quoted], shall provide for instruction in military tactics."

Chapter 186, *Acts and Resolves of* 1863.

Power to confer Degrees. "The Massachusetts Institute of Technology is hereby authorized and empowered to award and confer degrees appropriate to the several courses of study pursued in said Institution, on such conditions as are usually prescribed in universities and colleges in the United States, and according to such tests of proficiency as shall best promote the interests of sound education in this Commonwealth."

Chapter 247, *Acts and Resolves of* 1868.

CORPORATION

OF THE

MASS. INSTITUTE OF TECHNOLOGY.

FOR THE YEAR 1877-78.

President,

JOHN D. RUNKLE.

Secretary.

SAMUEL KNEELAND,

Treasurer,

JOHN CUMMINGS.

Committee on the School of Industrial Science,

JOHN AMORY LOWELL, *Chairman*,
EDWARD ATKINSON,
THOMAS T. BOUVÉ,
J. ELLIOT CABOT,
GEORGE B. EMERSON,
EDWARD S. PHILBRICK,
JOHN D. PHILBRICK,
WILLIAM B. ROGERS,
J. BAXTER UPHAM.

Treasurer, *ex-officio*.

Committee on Finance,

WILLIAM ENDICOTT, JR.,
JOHN M. FORBES,
HENRY P. KIDDER,
JAMES L. LITTLE,
SAMUEL D. WARREN.

Treasurer, *ex-officio*.

Committee on the Museum,

CHARLES H. DALTON,
JOSEPH S. FAY,
AUGUSTUS LOWELL,
HORACE McMURTRIE,
E. R. MUDGE,
OTIS NORCROSS,
M. D. ROSS,
STEPHEN P. RUGGLES,
NATHANIEL THAYER.

Committee on the Society of Arts,

MARSHALL P. WILDER, *Chairman*,
PHILLIPS BROOKS,
CHARLES L. FLINT,
JAMES B. FRANCIS,
J. C. HOADLEY,
FRED. W. LINCOLN,
SAMUEL K. LOTHROP,
ALEXANDER H. RICE,
HENRY B. ROGERS.

On the Part of the Commonwealth,

HIS EXCELLENCY, GOVERNOR ALEXANDER H. RICE.

HON. HORACE GRAY, *Chief Justice of the Supreme Court.*

HON. JOHN W. DICKINSON, *Secretary of the Board of Education.*

OFFICERS OF INSTRUCTION.

President.

JOHN D. RUNKLE, PH.D., LL.D.

JOHN D. RUNKLE, PH.D., LL.D.,
Walker Professor of Higher Mathematics.

JOHN B. HENCK, A.M.,
Hayward Professor of Civil and Topographical Engineering.

WILLIAM R. WARE, S.B.,
Professor of Architecture.

WILLIAM P. ATKINSON, A.M.,
Professor of English and History.

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

SAMUEL KNEELAND, A.M., M.D.,
Professor of Zoölogy and Physiology.

JOHN M. ORDWAY, A.M., †
Professor of Metallurgy and Industrial Chemistry.

JAMES M. CRAFTS, S.B.,
Professor of Organic Chemistry.

ROBERT H. RICHARDS, S.B.,
Professor of Mining Engineering, and Director of the Mining and Metallurgical Laboratories.

THOMAS STERRY HUNT, LL.D.,
Professor of Geology.

GEORGE H. HOWISON, A.M.,
Professor of Logic and the Philosophy of Science.

WM. RIPLEY NICHOLS, S.B.,
Professor of General Chemistry.

CHARLES P. OTIS, PH.D.
Professor of Modern Languages.

CHARLES H. WING, S.B.,
Professor of Analytical Chemistry.

ALPHEUS HYATT, S.B., Custodian of the Boston Society of Natural History,
Professor of Palæontology.

WILLIAM H. NILES, PH.B., A.M.,
Professor of Physical Geology and Geography.

* The instruction in Descriptive Geometry and Stereotomy is at present given by Prof. Osborne.

The instruction in Botany is given by Prof. Ordway.

CHANNING WHITAKER, S.B.,
Professor of Mechanical Engineering.

CHARLES R. CROSS, S.B.,
Professor of Physics and Descriptive Astronomy.

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

LIEUT. HENRY W. HUBBELL, JR., U. S. ART'Y,
Professor of Military Science and Tactics.

EUGENE LETANG,
Assistant in Architecture.

JULES LUQUIENS, PH.D.,
Instructor in Modern Languages.

CHARLES KASTNER,
Lowell Instructor in Practical Design.

WEBSTER WELLS, S.B.,
Instructor in Mathematics.

HENRY N. MUDGE,
Instructor in Mechanical and Free-hand Drawing.

WILLIAM O. CROSBY, S.B.,
Assistant in Palæontology.

SILAS W. HOLMAN, S.B.,*
Assistant in Physics.

JOHN B. HENCK, JR., S.B.,
Assistant in Physics.

EDWARD A. HANDY, S.B.,
Assistant in Civil Engineering.

HENRY M. WAITT, S.B.,
Assistant in Civil Engineering.

W. BUGBEE SMITH, A.B.,
Assistant in Mechanical Engineering.

CHARLES T. MAIN, S.B.,
Assistant in Mechanical Engineering.

FREDERICK A. EMMERTON, S.B.,
Assistant in the Mining and Metallurgical Laboratories.

JOHN ALDEN, S.B.,
Assistant in Quantitative Analysis.

ALBERT H. LOWE, S.B.,
Assistant in Quantitative Analysis.

JOHN E. HARDMAN, S.B.,
Assistant in General Chemistry and Qualitative Analysis.

HENRY K. BURRISON, S.B.,
Assistant in Mechanical and Free Hand Drawing.

GEORGE F. UNDERWOOD,
Assistant in Architecture.

* During the temporary absence of Mr. Holman, the duties are performed by Frank W. Very, S.B.

FACULTY.

JOHN D. RUNKLE, PH.D., LL.D., *President.*

JOHN B. HENCK, A.M.

WILLIAM R. WARE, S.B.

WILLIAM P. ATKINSON, A.M.

GEORGE A. OSBORNE, S.B.

SAMUEL KNEELAND, A.M., M.D., *Secretary.*

JOHN M. ORDWAY, A.M.

JAMES M. CRAFTS, S.B.

ROBERT H. RICHARDS, S.B.

THOMAS STERRY HUNT, LL.D.

GEORGE H. HOWISON, A.M.

WM. RIPLEY NICHOLS, S.B.

CHARLES P. OTIS, PH.D.

CHARLES H. WING, S.B.

CHANNING WHITAKER, S.B.

CHARLES R. CROSS, S.B.

GAETANO LANZA, S.B., C.E.

HENRY W. HUBBELL, JR., U. S. ART'Y.

STUDENTS.

I. Civ. Eng.; II. Mech. Eng.; III. Min. Eng.; IV. Arch.; V. Chem.; VI. Metal.; VII. Nat. Hist.; VIII. Phys.; IX. Sci. and Lit.; X. Phil.

GRADUATE STUDENTS.

NAME.	HOME.	RESIDENCE.
Bartol, George, *S.B.*, . V.	Lancaster	Charlestown.
Beeching, Wm. H., *S.B.*, V.	Boston	117 Princeton St.
Blodgett, Aaron D., *S.B.*, II, ...	W. Newton . . .	W. Newton.
Coffin, Chas. W., II, (*A.B.*, *Harvard College*) . . .	Jamaica Plain. . .	Jamaica Plain.
Clymer, Wm. B. S. . IV, (*A. B., Harvard Coll.*) .	Washington, D.C.	67 Charles St.
Kendall, William M., IV, (*A. B., Harvard College*)	Cambridge. . . .	Cambridge.
Longfellow, Alex. W., Jr., IV, (*A.B., Harvard Coll.*)	Portland, Me. . .	4 Spruce St.
Minot, Francis, . . IV, (*A.B., Harvard College*) .	W. Roxbury . . .	W. Roxbury.
Taylor, Eugene H., IV, (*B.S., Iowa College*) . .	Grinnell, Iowa . .	48 Chandler St

REGULAR STUDENTS.

FOURTH YEAR.

NAME.	COURSE.	HOME.	RESIDENCE.
Allbright, William B.	V.	Dorchester	Boston St.
Baker, Charles M.	IV.	Boston	22 Worcester St.
Dan, Takuma	III.	Fukuoka, Japan	2 Wyoming St.
Eaton, Charles S.	IV.	Lowell	Lowell.
Edwards, Charles F.	III.	Lowell	Lowell.
Higgins, Alfred S.	IV.	Boston	173 Warren Ave.
Kebler, Julian A.	I.	Cincinnati, O.	130 Highland St.
Morgan, Frank H.	V.	Portland, Me.	45 Poplar St.
Nichols, Everell J.	I.	Everett	Everett.
Norton, Charles H.	I.	Charlestown	Charlestown.
Prentiss, Frederick H.	II.	Boston	16 Bulfinch St.
Rich, Isaac	I.	Boston	706 Tremont St.
Ritchie, James	I.	Hyde Park	Hyde Park.
Rollins, James W., Jr.	I.	W. Roxbury	W. Roxbury.
Sawin, Charles D.	IX.	Charlestown	Charlestown.
Schwamb, Peter	II.	Arlington	Arlington.
Spalding, Frederic P.	I.	Lowell	Lowell.
Story, Isaac M.	I.	Somerville	Somerville.
Taney, Edmund	I.	Bangor, Me.	6 Sharon St.
Towne, Linwood O.	III.	Newtonville	Newtonville.
Williams, Emile F.	I.	Boston	21 Dover St.
Woolworth, James G.	V.	Westfield	46 Chandler St.

THIRD YEAR.

NAME.	COURSE.	HOME.	RESIDENCE.
Alden, Frank E.	IV.	W. Roxbury	W. Roxbury.
Allen, Walter S.	V.	New Bedford	65 Charles St.
Braley, Samuel T.	II.	Brockton	Brockton.
Cabot, John W.	III.	Boston	10 Pembroke St.
Campbell, Harry H.	III.	W. Roxbury	W. Roxbury.
Coffin, Charles W., II, (*A.B., Harvard College*)		Jamaica Plain	Jamaica Plain.
Coffin, Frederic S.	III.	Auburndale.	Auburndale.
Deane, Albert J.	II.	St. Paul, Minn.	536 Broadway.
Dunbar, William O.	II.	Canton	Canton.
Fabens, George W.	I.	Marblehead	Marblehead.

NAME.	COURSE.	HOME.	RESIDENCE.
Gooding, Charles S.	II.	Brookline	Brookline.
Grimes, Frederic W.	II.	Mansfield, O.	Arlington.
Harlow, Alfred B.	IV.	Middleboro'	14 Highland Av.
Hartwell, Ernest G.	IV.	Waltham.	Waltham.
Hosea, Raphael M.	I.	Cincinnati, O.	16 Wellington St.
Howe, Horace J.	I.	Boston	796 Tremont St.
Knapp, Frederick B.	I.	Plymouth	80 Pinckney St.
Lane, Frederic H.	II.	Boston	623 Tremont St.
Lodge, Richard W.	III.	Boston	1423 Washington St.
Loring, Frederic R.	VII.	Boston	8 Greenwich Park.
Macfarlane, William W.	V.	Montvale	Montvale.
Metcalf, Arthur H.	II.	Pawtucket, R. I.	550 Tremont St.
Miller, Edwin C.	II.	Boston	430 Columbus Ave.
Owen, Edward H., Jr.	II.	Waltham	Waltham.
Pickering, William H.	VIII.	Boston	84 Mt. Vernon St.
Riggs, George F.	I.	Cambridge	Cambridge.
Stantial, Frank G.	V.	Melrose	Melrose.
Stearns, William S.	I.	Cincinnati, O.	482 Columbus Av.
Waitt, Arthur M.	II.	Boston	22 Bedford St.

SECOND YEAR.

NAME.	COURSE.	HOME.	RESIDENCE.
Almy, William F.	V.	Fall River	355 Columbus Ave.
Barton, George H.	III.	N. Sudbury.	N. Sudbury.
Batchelder, J. Fred.	III.	Yokohama, Japan	12 Dartmouth St.
Blake, George	II.	Belmont	Belmont.
Brown, Arthur N.	II.	Springfield	Cambridge.
Brown, Charles H.	I.	Boston	341 Shawmut Ave.
Chase, Edwin E.	I.	Lowell	Lowell.
Clark, Fred W.	III.	Chicago, Ill.	44 Cortes St.
Crowell, Samuel	IV.	Dennis	2 Derne St.
Hamilton, George W.	I.	Wrentham	64 West Cedar St.
Millen, Loring R.	III.	Savannah, Ga.	Brookline.
Miller, William T.	VIII.	Boston	480 Columbus Ave.
Mills, Harvey P.	II.	Boston	154 Charles St.
Potter, Edward C.	III.	Chicago, Ill.	119 Pembroke St.
Ross, John H.	IX.	Jamaica Plain	Jamaica Plain.
Vining, Jared A.	II.	S. Abington	S. Abington.
Wellman, Arthur G.	II.	Brookline	Brookline.

FIRST YEAR.

NAME.	HOME.	RESIDENCE.
Abbott, Ira	Andover	Andover.
Allen, John H.	Walpole	Walpole.
Ayers, Charles H.	Maplewood	Maplewood.
Barnes, Howard	Waltham	Waltham.
Bissell, David S.	Pittsburgh, Pa.	482 Columbus Ave.
Brown, Edmund H.	Fisherville, N. H.	212 W. Canton St.
Came, Frank E.	Malden	Malden.
Chase, Frank D.	Dedham	Dedham.
Churchill, W. W., Jr.	Boston	54 Chester Square.
Clark, Arthur N.	Northampton	85 Dartmouth St.
Cole, Ernest C.	Mt. Pleasant, Ia.	12 Milford St.
Collins, Benjamin G.	Edgartown	20 Dartmouth Place.
Cutler, Harry H.	Boston	19 West Cedar St.
Duff, John, Jr.	Charlestown	Charlestown.
Emery, Francis F., Jr.	Boston	17 Union Park.
Foss, Harry A.	Jamaica Plain	Jamaica Plain.
Gerry, Lyman L.	Stoneham	Stoneham.
Goddard, David S.	Lowell	Lowell.
Hill, Solon P.	Concord, N. H.	212 W. Canton St.
Johnson, James W.	Eggleston Square	Eggleston Sq.
Kendall, Frederick P.	Woburn	482 Columbus Ave.
Koehler, Walter J.	Boston	Beech Glen Ave.
Lewis, Edwin J., Jr.	Dorchester	Adams St.
Lund, James	Charlestown	17 Seaver St.
Mansfield, Frank	Melrose	Melrose.
Maxcy, Edgar C.	Gardiner, Me.	Charlestown.
Mower, George A.	W. Newton	W. Newton.
Noble, Frank C.	Boston	106 Lexington St.
Norris, Webster	Charlestown	43 Soley St.
O'Grady, Thomas, Jr.	Boston	54 Conant St.
Parker, Theodore	Atlantic	Atlantic.
Preble, George H. R.	Boston	Commonw'th Hotel.
Reed, William A.	Westboro'	Westboro'.
Rindge, Samuel	E. Cambridge	E. Cambridge.
Rogers, Robert	Gloucester	9 Newbury St.
Rollins, Frank W.	Concord, N. H.	381 Columbus Ave.
Sargent, Allan C.	Graniteville	133 Pembroke St.
Saville, George G.	Quincy	Quincy.
Shed, Nathaniel W.	Boston	27 Fountain St.

NAME.	HOME.	RESIDENCE.
Smith, Joseph E.	Rockland	Rockland.
Snead, William R.	Louisville, Ky.	22 Ashburton Pl.
Stearns, Harold E.	Cincinnati, O.	482 Columbus Ave.
Van Duzee, Harry	West Newton	West Newton.
Walker, Joseph H.	Cambridge	Cambridge.
Warren, Edward R.	Waltham	Waltham.
Wilkes, Charles M.	S. Manchester, Conn.	201 W. Newton St.
Winslow, Arthur	Boston	94 Chestnut St.
Young, Herbert A.	Revere	Revere.
Zimmermann, William	Mequon River, P. Q.	12 Boylston St.

STUDENTS NOT CANDIDATES FOR A DEGREE.

[Students who are taking studies in different years are placed under the highest year, and the other years are indicated by the Arabic figures affixed. The Roman numerals show that a student is taking parts of the corresponding Regular Course.]

FOURTH YEAR.

NAME.	COURSE.	HOME.	RESIDENCE.
Adams, William W.	III.	Castine, Me.	Reading.
Fish, Charles C. R., 3	V.	Cambridgeport	Cambridgeport.
French, Alexis H., 2 3	I.	Brookline	Brookline.
Osgood, Joseph O., 2 3,	I.	Dorchester,	Dorchester.
Ramsdell, Sylvian M,	I.	Lynn	Lynn.

THIRD YEAR.

NAME.	COURSE.	HOME.	RESIDENCE.
Atwood, Frank S. 2	V.	Salem	Salem.
Avery, John H.	V.	Detroit, Mich.	366 Columbus Ave.
Betton, C. Grinnell 2	IX.	Boston	99 Mt. Vernon St.
Bryant, Henry	II.	Boston	61 Beacon St.
Fisher, William B.	III.	Brookline	Brookline.
French, Willard W. 1 2	V.	Three Rivers, Mich.	139 Roxbury St.
Gerhardt, Carl E., 1	II.	Newton	30 Buckingham St.
Hall, Henry G.	IX.	Boston	6 W. Cedar St.
Henshaw, John O.	I.	Cambridge	Cambridge.
Hosmer, Charles E. 4	V.	Boscawen, N. H.	611 Tremont St.
Johonnot, J. Oliver	V.	Newton	Newton.
Pope, Sidney T.	II.	Harrison Square	Harrison Square.
Sonrel, Louis A.	IV.	Winchester	Winchester.
Spicer, Vibe C.	II.	Winchester	Winchester.
Woodbridge, Sam'l H.	VIII.	Williamstown	95 Camden St.

SECOND YEAR.

NAME.	COURSE.	HOME.	RESIDENCE.
Benedict, William L.	IX.	Boston	129 Warren Ave.
Gardner, Joseph P.	IX.	Boston	152 Beacon St.
Howe, Louis P.	I.	Marlboro'	74 Chandler St.
Iasigi, Albert W.	VIII.	Boston	43 Mt. Vernon St.
Pattee, John F.[1]	V.	Manchester, N. H.	95 Appleton St.
Paxton, Blitz W.	III.	San Francisco, Cal.	60 Chandler St.
Sargent, Sullivan A.	IV.	Boston	7 W. Cedar St.
Small, N. Cogswell,	V.	Milwaukee, Wisc.	73 Montgomery St.
Whittier, Fred. W.[3]	I.	Lawrence	Lawrence.

FIRST YEAR.

NAME.	HOME.	RESIDENCE.
Ames, Frank A.	Canton	Canton.
Atkinson, James S.	Longwood	Longwood.
Briggs, Frank H.	Boston	124 Marlboro' St.
Crocker, Emmons	Fitchburg	24 Somerset St.
Darlington, Frank G.	Pittsburg, Pa.	381 Columbus Ave.
Dort, Frank G.	Keene, N. H.	Wakefield.
Everett, Herbert	Norwood	Norwood.
Gardiner, Edward G.	Boston	289 Marlboro' St.
Hastings, Thomas N.	Walpole, N. H.	Woburn.
Hussey, Charles M.	New Bedford	7 W. Cedar St.
Kenney, C. Harry	Philadelphia	16 Newbury St.
Munyan, Oscar	Thompson, Conn.	Thompson.
Paine, Robert T.	Boston	46 Mt. Vernon St.
Stebbins, Alfred, Jr.	Forest Hills	Forest Hills.
Wallace, George R.	Fitchburg	24 Somerset St.
Woods, Frank P.	Calais, Me.	58 Chandler St.

SPECIAL STUDENTS IN ARCHITECTURE.

NAME.	HOME.	RESIDENCE.
Aiken, Wm. M.	Charleston, S. C.	29 Greenwich Park.
Bancroft, James M.	Bradford	Bradford.
Brunner, Arnold W.	New York, N. Y.	18 Sharon St.
Clymer, Wm. B. S., (*A.B., Harvard College*)	Washington, D.C.	67 Charles St.
Ford, Frank H.	Bradford	Bradford.
Frost, Charles S.[2]	Lewiston, Me.	31 Warren Ave.

NAME.	HOME.	RESIDENCE.
Gracea, Joseph J.	Westfield	14 Boylston Pl.
Grover, George C.	Dedham	Dedham.
Kendall, William M. (*A.B., Harvard College*)	Cambridge	Cambridge.
Longfellow, Alexander W., Jr. (*A.B., Harvard College*)	Portland, Me.	4 Spruce St.
McCombs, Frank M.	St. Louis, Mo.	98 Pembroke St.
Minot, Francis, (*A.B., Harvard College*)	W. Roxbury	W. Roxbury.
Sargent, Sullivan A.	Boston	7 W. Cedar St.
Seabury, B. Hammett	Newport, R. I.,	20 Chester Park.
Storer, Frank Addison	Newport, R. I.,	Hotel Vendôme.
Swinburne, Henry H.	Newport, R.I.	51 Pinckney St.
Taylor, Eugene H. 1, (*B.S., Iowa College*)	Grinnell, Iowa	48 Charles St.
Taylor, James K.	St. Paul, Minn.	536 Broadway.
Warren, Herbert	Hillside	Roxbury.

SPECIAL STUDENTS IN CHEMISTRY.

NAME.	HOME.	RESIDENCE.
Armes, Jennie M.	E. Cambridge	E. Cambridge.
Bailey, Sarah L.	N. Andover	N. Andover.
Cole, Rhoda E.	Boston	4 Franklin Sq.
Doane, Caroline M.	Charlestown	8 Pearl St.
Hines, Mabel F.	Jamaica Plain	Jamaica Plain.
Melvin, Cynthia G.	Boston	7 Mt. Pleasant Pl.
Ordway, Louisa M.	Jamaica Plain	Jamaica Plain.
Palmer, Alice W.	Boston	Bellevue St.
Peabody, Lucia M.	Boston Highlands	St. James St.
Rider, Lucy J.	Jamaica Plain	Jamaica Plain.
Stone, Mary L.	E. Cambridge	E. Cambridge.
Walker, Hattie A.	Jamaica Plain	Jamaica Plain.
Walton, Evelyn M.	Saugus Centre.	Saugus.

STUDENTS IN PRACTICAL DESIGN.

NAME.	HOME.	RESIDENCE.
Breck, John L.	Newton	Newton.
Burnett, Arthur F.	Boston	66 Clarendon St.
Doolittle, Abraham L.	Boston	551 Eighth St.
Fisher, William C.	Boston	4 Buckingham Pl.
Lewis, Clarence H.	Watertown	Watertown.

NAME.	HOME.	RESIDENCE.
Luce, William B.	Boston	84 Pembroke St.
McMann, John	Roxbury	Roxbury.
Meierhardt, H. W.	Boston	1 Warrenton Pl.
Pierce, William H. C.	Charlestown	Waverley House.
Sawyer, Henry A.	Boston	18 Monument Ct.
Woods, Frank P.	Calais, Me.	58 Chandler St.
Young, J. Edson	Groton	Cambridge.
Baker, Maria T.	Newtonville	Newtonville.
Bean, Elizabeth C.	Boston	2 Glenwood Place.
Bradford, Marcia A.	Charlestown	Charlestown.
Brooks, Clara	Boston	622 Tremont St.
Close, Eva M.	Boston	38 Bremen St.
Corner, Charlotte A.	W. Medford	W. Medford.
De Huff, Mary E.	Roslindale	Roslindale.
Foster, Gertrude E.	Boston	2679 Washington St.
Kennedy, Mindora	Boston	Hotel Berkeley.
Smiley, Helen A.	W. Waterville, Me.	Melrose.
Starbuck, Florence M.	Jamaica Plain	Jamaica Plain.
Taylor, May B.	Boston.	99 Boylston St.
Winslow, Adelia I.	Boston	Hotel Eliot.

STUDENTS IN THE SCHOOL OF MECHANIC ARTS.

SECOND YEAR.

NAME.	HOME.	RESIDENCE.
Ayer, Winslow B.	Bangor, Me.	15 Joy St.
Bond, William C. N.	Boston	514 E. Broadway.
Chapman, George F.	Canton	Canton.
Devine, James V.	Boston	525 Fifth St.
Eldredge, Arthur S.	Boston	199 Beacon St.
Eldredge, Edward D.	Longwood	Longwood.
Gooding, Fred. M.	Waltham	Waltham.
Johnson, Charles B.	Concord	Concord.
Kendrick, George P.	Brookline	Brookline.
McMullan, Wm. P.	Salem	Salem.
Melcher, George S.	Brookline	Brookline.
Morejon, Gonzalo M.	Bolondron, Cuba	8 Union Park St.
Pratt, Charles R.	Jamaica Plain	Jamaica Plain.
Vinal, Charles W.	Somerville	Somerville.

FIRST YEAR.

NAME.	HOME.	RESIDENCE.
Carret, Charles R.	Trinidad, Cuba	Lincoln.
Cheong, Mon Cham	Hongkong, China	31 Hollis St.
Dennison, Charles S.	Boston	19 Worcester Sq.
Goding, William	Lowell	Cambridge.
Goss, W. F. M.	Barnstable	64 W. Cedar St.
Hall, Francis P.	Dorchester	Dorchester.
Hammett, William A.	Somerville	Somerville.
Hardy, Salem M.	N. Cambridge	N. Cambridge.
Harrington, Ephraim	Boston	118 Highland St.
Kimball, William N.	Bradford	Bradford.
Lawrence, James W.	Boston	1423 Washington St.
Libbie, Charles F., Jr.	Boston	190 Brooks St.
Little, David M.	Boston	2 Commonw'lth Ave.
Montgomery, Harry M.	Boston	44 E. Newton St.
Moore, James E.	Louisville, Ky.	185 W. Brookline St.
Page, Edward A.	Boston	82 Commonw'th Av.
Plimpton, George L.	W. Newton	W. Newton.
Quinby, George F.	Boston	75 Dennis St.
Richards, George A.	Boston	5 Sumner Pl.
Ring, James W.	Boston	1 Vinton St.
Rosing, William H.	Hyde Park, Ill.	381 Columbus Ave.
Ruggles, Elmer E.	Boston	25 Winthrop St.
Schmitt, William S.	Louisville, Ky.	185 W. Brookline St.
Sheridan, James J.	Boston	301 Fourth St.
Smith, George A.	Arlington	Arlington.
Smith, Lyman W.	Norwood	Norwood.
Strickland, Franklin V.	Bangor, Me.	15 Joy St.
Taft, Samuel H.	Lowell	Lowell.
Van Hovenberg, John	Charlestown	13 Adams St.
Whitney, George E.	Boston	Metropolitan Hotel.
Wood, John P.	Philadelphia, Pa.	Hyde Park.

SUMMARY.

Graduate Students	9
Regular Students, fourth year	22
" " third "	29
" " second "	17
" " first "	49
Students not candidates for a degree, fourth year	5
" " " " " third year	15
" " " " " second year	9
" " " " " first year	16
Special Students in Architecture,	19
Special Students in Chemistry	13
Students in Practical Design	25
Students in the School of Mechanic Arts	45
	273
Deduct names counted twice	6
Total	267

CALENDAR.

School-year began	Monday, Sept. 24, 1877.
School-year ends	Saturday, June 1, 1878.
The next School-year will begin	Monday, Sept. 30, 1878.
First Entrance Examinations	Monday, June 3, 1878, and Tuesday, June 4, 1878.
Second Entrance Examinations	Wednesday, Sept. 25, 1878, and Thursday, Sept. 26, 1878.
Examinations for Advanced Standing	Wednesday, June 5, 1878, and Friday, Sept. 27, 1878.

COURSES OF INSTRUCTION.

The Massachusetts Institute of Technology provides a series of scientific and literary studies and practical exercises, embracing pure and applied mathematics, the physical and natural sciences with their applications, drawing, the English language, mental and political science, French, and German. These studies and exercises are so arranged as to offer a liberal and practical education in preparation for active pursuits, as well as a thorough training for most of the scientific professions. Ten Regular Courses have been established, each extending through four years.

I. A Course in Civil and Topographical Engineering.
II. " " " Mechanical Engineering.
III. " " " Geology and Mining Engineering.
IV. " " " Building and Architecture.
V. " " " Chemistry.
VI. " " " Metallurgy.
VII. " " " Natural History.
VIII. " " " Physics.
IX. " " " Science and Literature.
X. " " " Philosophy.

These courses are identical during the first year; but for the three remaining years the studies in each course are arranged with reference to the end in view.

In these courses non-professional studies generally end at the middle of the fourth year; the second half of that year being mainly devoted to professional studies, including the preparation of a graduating Thesis.

The courses in Natural History, Physics, Science and Literature, and Philosophy, differ from the others in having a less

distinctly professional character. The course in Natural History affords an appropriate general training for those whose ulterior object is the special pursuit of Geology, Mineralogy, Botany, Zoölogy, Medicine, Pharmacy or Rural Economy. The course in Physics is based on the mathematical and physical sciences, the course in Philosophy on the mathematical and philosophical sciences, and the course in Science and Literature on the sciences and modern literature, and each course offers a sound education as well as suitable preparation for any of the departments of active life.

In all the courses it is intended to secure to every student a liberal mental development and general culture, as well as the more strictly technical education which may be his chief object.

For proficiency in any one of these courses the degree of S.B., Bachelor of Science, is conferred.

Advanced courses of study may be pursued, and the degree of Doctor of Science has been authorized by a vote of the Corporation.

At the request of the Woman's Education Association of Boston, and with their generous coöperation, new laboratories have been provided for the special instruction of women. The design is to afford every facility for the study of Chemical Analysis, of Industrial Chemistry, of Mineralogy, and of Chemistry as related to Vegetable and Animal Physiology. These courses are intended for such as may be able to devote their whole time to the work, as well as for those who, by reason of other engagements, can spend only a few hours a week in these exercises.

The laboratories, which are in the Annex to the main building, are open from 8.30 A.M. till 5.30 P.M.

Students in these laboratories will pay the same fees as other students of the Institute.

The Institute also provides annually several courses of instruction, scientific and literary, open to both sexes. At present these courses are free, being supported by the Trustee of the Lowell Institute. Fuller details are given on page 58.

REGULAR COURSES.

ALL COURSES. — FIRST YEAR.

		No. of Exercises.	Hrs. per week.
Algebra finished	1st half	45	3
Plane and Solid Geometry reviewed	2d half	15	3
Plane and Spherical Trigonometry	2d half	30	3
General Chemistry	1st half	60	6
General Chemistry	2d half	30	2
Qualitative Analysis	2d half	30	4
Rhetoric and Composition	1st half	30	2
Analysis of Terms and Sentences	2d half	30	2
French		120	4
Mechanical Drawing and Elements of Descriptive Geometry and Perspective		90	6
Free Hand Drawing		90	3
Physiology and Hygiene	2d half	30	2
Military Tactics		90	3

I. CIVIL ENGINEERING.

SECOND YEAR.

		No. of Exercises.	Hrs. per week.
Analytic Geometry	1st half	45	3
Calculus	2d half	45	3
Descriptive Geometry	1st half	30	2
Stereotomy	2d half	15	1
Surveying and Railroad Curves		35	2
Field Practice		25	6
Topographical and Plan Drawing		75	6
Physics (Lectures)		90	3
French finished, German begun		90	3
Descriptive Astronomy	1st quar.	18	3
Physical Geography	2d quar.	27	3
English Literature	2d half	45	3
Military Science		24	1

THIRD YEAR.

Engineering Geodesy		25	6
Construction of Roads		15	6
Hydraulics, Water supply, Drainage, etc.		25	6
Field Practice		25	9
Structural and other Drawing		90	6
Applied Mechanics		90	3
German		90	3
Physical Laboratory		60	2
General Geology	1st quar.	21	3
Outlines of Zoology	2d quar.	21	3
Constitutional History	3d quar.	21	3
Formal Logic	4th quar.	21	3

FOURTH YEAR.

Stability of Structures	1st half	20	3
Strength of Materials	1st half	25	3
Structures of Stone, Wood, Iron, and Steel		45	6
Hydrography		6	6
Geodesy and Practical Astronomy		12	6
Graphical Statics		27	6
Metallurgy of Iron	1st half	30	2
Designing Engineering Works		45	6
Motors	2d half	15	3
Dynamics	2d half	30	3
Building Materials	2d half	10	3
Applied Physics	1st half	15	2
German	1st half	45	3
Philosophy of Science	1st half	45	3

In addition to the prescribed studies, optional studies, selected from other courses may be taken, with the consent of the Faculty.

II. MECHANICAL ENGINEERING.

SECOND YEAR.

		No. of Exercises.	Hrs. per week.
Analytic Geometry	1st half	45	3
Calculus	2d half	45	3
Descriptive Geometry	1st half	30	2
Mechanical Drawing	1st half		4
Principles of Mechanism	1st half	30	2
Principles of Mechanism	2d half	60	4
Machine Drawing	2d half		4
Mechanical Laboratory or Shop Work			
Physics (Lectures)		90	3
French finished, German begun		90	3
Descriptive Astronomy	1st quar.	18	3
Physical Geography	2d quar.	27	3
English Literature	2d half	45	3
Military Science		24	1

THIRD YEAR.

Machinery and Millwork	$\frac{2}{3}$ year	80	6
Strength of Materials	$\frac{1}{3}$ year	40	6
Mechanical Laboratory or Shop Work			4
Machine Drawing			
Applied Mechanics		90	3
German		90	3
Physical Laboratory		60	2
General Geology	1st quar.	21	3
Outlines of Zoölogy	2d quar.	21	3
Constitutional History	3d quar.	21	3
Formal Logic	4th quar.	21	3

FOURTH YEAR.

Principles of Thermodynamics	1st half	90	6
Mechanism of the Steam Engine	2d half	50	8
Water power and Water wheels	2d half	70	8
Machine Drawing			6
Mechanical Laboratory or Shop Work			
Building Materials	2d half	10	3
Thesis Work			
Metallurgy of Iron	1st half	30	3
German	1st half	45	3
Philosophy of Science	1st half	45	3

In addition to the prescribed studies, optional studies, selected from other courses, may be taken, with the consent of the Faculty.

III. MINING ENGINEERING.

SECOND YEAR.

		No. of Exercises.	Hrs. per week.
Analytic Geometry	1st half	45	3
Calculus	2d half	45	3
Qualitative Analysis	1st half	45	6
Surveying and Drawing	1st half		4
Mineralogy	2d half	45	6
Botany	2d half	30	2
Quantitative Analysis	2d half		4
Physics (Lectures)		90	3
French finished, German begun		90	3
Descriptive Astronomy	1st quar.	18	3
Physical Geography	2d quar.	27	3
English Literature	2d half	45	3
Military Science		24	1

THIRD YEAR.

Chemical Laboratory			10
General Quantitative Analysis (Lectures)	1st half	30	2
Mining Engineering		90	3
Structural Palæontology	2d half	15	2
Applied Mechanics		90	3
German		90	3
Physical Laboratory		60	2
General Geology	1st quar.	21	3
Outlines of Zoölogy	2d quar.	21	3
Constitutional History	3d quar.	21	3
Formal Logic	4th quar.	21	3

FOURTH YEAR.

Metallurgy	1st half	45	3
Ore dressing	3d quar.	15	3
Drawing	1st half		2
Mining and Metallurgical Laboratory	2d half		12
Chemical Laboratory			10
Assaying	2d half	13	
Thesis Work			
American Geology	1st half	45	3
Coal and Ore Deposits	2d half	15	3
Building Materials	2d half	10	3
Chemical Geology	2d half	15	3
German	1st half	45	3
Philosophy of Science	1st half	45	3

In addition to the prescribed studies, optional studies, selected from other courses, may be taken, with the consent of the Faculty.

IV. ARCHITECTURE.

SECOND YEAR.

		No. of Exercises.	Hrs. per week.
Analytic Geometry	1st half	45	6
Calculus	2d half	45	3
Descriptive Geometry	1st half	30	2
Stereotomy	2d half	15	1
Mechanical Drawing	1st half		4
Drawing	2d half		10
Elements of Architecture	1st quar.	30	4
Greek and Roman Arch. History	2d quar.	30	4
Mediæval (or Modern) Architectural History	2d half	60	4
Physics (Lectures)		90	3
French finished, German begun		90	3
Descriptive Astronomy	1st quar.	18	3
Physical Geography	2d quar.	30	2
English Literature	2d half	45	3
Military Science		24	1

THIRD YEAR.

Applied Mechanics		90	3
Theory of Architecture, Ornamentation, etc.	1st half	45	3
Specifications and Working Drawings		30	1
Mediæval (or Modern) Architectural History	2d half	60	4
Drawing and Design			14
German		90	3
Physical Laboratory		60	2
General Geology	1st quar.	21	3
Outlines of Zoology	2d quar.	21	3
Constitutional History	3d quar.	21	3
Formal Logic	4th quar.	21	3

FOURTH YEAR.

Strength of Materials	1st half	90	6
Scientific Construction	2d half	90	6
Building Materials	2d half	10	3
Theory of Architecture, Ornamentation, etc.	1st half	45	3
Specifications and Working Drawings		30	1
Mediæval (or Modern) Architectural History	2d half	60	4
Architectural Drawing and Design			10
Architectural Research	2d half		14
Thesis Work			
Applied Physics	1st half	15	2
German	1st half	45	3
Philosophy of Science	1st half	45	3

In addition to the prescribed studies, optional studies, selected from other courses, may be taken, with the consent of the Faculty.

V. CHEMISTRY.

SECOND YEAR.

		No. of Exercises.	Hrs. pe week.
Qualitative Analysis	1st half		6
Mineralogy	2d half	45	6
Chemical Philosophy	1st half	45	3
Botany	2d half	30	2
Quantitative Analysis	2d half		6
Technical French and German	2d half	15	1
Physics (Lectures)		90	3
French finished, German begun		90	3
Descriptive Astronomy	1st quar.	18	3
Physical Geography	2d quar.	27	3
English Literature	2d half	45	3
Military Science		24	1

THIRD YEAR.

Chemical Laboratory			14
General Quantitative Analysis (Lectures)	1st half	30	2
Quantitative Analysis, Special Methods	2d half	30	2
Industrial Chemistry	2d half	45	3
Chemical Physiology	1st half	30	2
German		90	3
Physical Laboratory		60	2
General Geology	1st quar.	21	3
Outlines of Zoology	2d quar.	21	3
Constitutional History	3d quar.	21	3
Formal Logic	4th quar.	21	3

FOURTH YEAR.

Chemical Laboratory			15
Organic Chemistry (Lectures)		60	2
Metallurgy	1st half	45	3
Drawing	1st half		2
American Geology	1st half	45	3
Chemical Geology	2d half	15	3
Coal and Ore Deposits	2d half	15	3
Building Materials	2d half	10	3
Assaying	2d half	13	
Thesis Work			
Applied Physics	1st half	15	2
German	1st half	45	3
Philosophy of Science	1st half	45	3

In addition to the prescribed studies, optional studies, selected from other courses, may be taken, with the consent of the Faculty.

VI. METALLURGY.

SECOND YEAR.

		No. of Exercises.	Hrs. per week.
Qualitative Analysis	1st half		6
Mineralogy	2d half	45	6
Chemical Philosophy	1st half	45	3
Botany	2d half	30	2
Quantitative Analysis	2d half		6
Technical French and German	2d half	15	1
Physics (Lectures)		90	3
French finished, German begun		90	3
Descriptive Astronomy	1st quar.	18	3
Physical Geography	2d quar.	27	3
English Literature	2d half	45	3
Military Science		24	1

THIRD YEAR.

Chemical Laboratory			14
General Quantitative Analysis (Lectures)	1st half	30	2
Quantitative Analysis, Special Methods	2d half	30	2
Industrial Chemistry	2d half	45	3
Chemical Physiology	1st half	30	2
German		90	3
Physical Laboratory		60	2
General Geology	1st quar.	21	3
Outlines of Zoology	2d quar.	21	3
Constitutional History	3d quar.	21	3
Formal Logic	4th quar.	21	3

FOURTH YEAR.

Metallurgy	1st half	45	3
Ore-dressing	3d quar.	15	3
Drawing	1st half		2
Mining and Metallurgical Laboratory	2d half		10
Chemical Laboratory			10
Assaying	2d half	13	
Thesis Work			
American Geology	1st half	45	3
Coal and Ore Deposits	2d half	15	3
Building Materials	2d half	10	3
Chemical Geology	2d half	15	3
German	1st half	45	3
Philosophy of Science	1st half	45	3

In addition to the prescribed studies, optional studies, selected from other courses, may be taken, with the consent of the Faculty.

VII. NATURAL HISTORY.

SECOND YEAR.

		No. of Exercises.	Hrs. per week.
Chemical Philosophy	1st half	45	3
Botany	2d half	30	2
Qualitative Analysis	1st half		6
Mineralogy	2d half	45	6
Physics (Lectures)		90	3
French finished, German begun		90	3
Descriptive Astronomy	1st quar.	18	3
Physical Geography	2d quar.	27	3
English Literature	2d half	45	3
Military Science		24	1

THIRD YEAR.

General Quantitative Analysis (Lectures)	1st half	30	2
Comparative Zoölogy	2d half	45	3
Chemical Laboratory			10
Chemical Physiology	1st half	30	2
Structural Palæontology	2d half	15	2
German		90	3
Physical Laboratory		60	2
General Geology	1st quar.	21	3
Outlines of Zoölogy	2d quar.	21	3
Constitutional History	3d quar.	21	3
Formal Logic	4th quar.	21	3

FOURTH YEAR.

Special Zoölogy, Special Geology, Special Botany, or Special Stratigraphical Palæontology	Laboratory		12
Thesis Work			
American Geology	1st half	45	3
Coal and Ore Deposits	2d half	15	3
Building Materials	2d half	10	3
Chemical Geology	2d half	15	3
Applied Physics	1st half	15	2
German		90	3
Philosophy of Science	1st half	45	3
Political and Industrial Geography	2d half	30	2

In addition to the prescribed studies, optional studies, selected from other courses, may be taken, with the consent of the Faculty.

VIII. PHYSICS.

SECOND YEAR.

		No of Exercises.	Hrs. per week.
Analytic Geometry	1st half	45	3
Calculus	2d half	45	3
Descriptive Geometry	1st half	30	2
Qualitative Analysis	1st half		6
Physical Laboratory	2d half	45	6
Chemical Philosophy	1st half	45	3
Botany	2d half	30	2
Physics (Lectures)		90	3
French finished, German begun		90	3
Descriptive Astronomy	1st quar.	18	3
Physical Geography	2d quar.	27	3
English Literature	2d half	45	3
Military Science		24	1

THIRD YEAR.

Physical Laboratory	1st half		4
Physical Laboratory	2d half		10
General Physics		90	3
Advanced Physics	2d half	15	2
Applied Mechanics		90	3
General Quantitative Analysis (Lectures)	1st half	30	2
Chemical Physiology	1st half	30	2
Chemical Laboratory	1st half		6
German		90	3
General Geology	1st quar.	21	3
Outlines of Zoology	2d quar.	21	3
Constitutional History	3d quar.	21	3
Formal Logic	4th quar	21	3

FOURTH YEAR.

Physical Research			15
Advanced Physics		30	2
Photography	1st half	15	4
Lantern Projections	1st half	15	4
Thesis Work			
Chemical Laboratory	2d half	45	6
Practical Astronomy	1st half	30	3
Mechanical Engineering	1st half	15	3
Principles of Thermodynamics	1st half	60	4
American Geology	1st half	45	3
Chemical Geology	2d half	15	3
and Ore Deposits	2d half	15	3
Building Materials	2d half	10	3
German	1st half	45	3
Philosophy of Science	1st half	45	3
Political and Industrial Geography	2d half	30	2

In addition to the prescribed studies, optional studies, selected from other courses, may be taken, with the consent of the Faculty.

IX. SCIENCE AND LITERATURE.

SECOND YEAR.

		No. of Exercises.	Hrs. per week.
English History and Literature		90	3
English Composition		60	2
Elements of Philosophy	1st half	45	3
French finished, German begun.		90	3
Physics (Lectures)		90	3
Descriptive Astronomy.	1st quar.	18	3
Physical Geography.	2d quar.	27	3
Political and Industrial Geography	2d half	30	2
Descriptive Geometry	1st half	30	2
Elements of Architecture, or	2d quar.	30	4
Analytical Geometry	1st half	45	3
Mineralogy	2d half	45	6
Botany	2d half	30	2
Drawing			
Military Science		24	1

THIRD YEAR.

Political Economy	1st half	45	3
History (Constitutional)	2d half	45	3
English Literature (private reading)			
English Composition			2
Advanced French		90	3
German		90	3
Physical Laboratory		60	2
General Geology	1st quar.	21	3
Outlines of Zoölogy	2d quar.	21	3
Chemical Physiology	1st half	30	2
*Palæontology	2d half	30	2
*Industrial Chemistry	2d half	45	3
*Comparative Zoölogy	2d half	45	3
Formal Logic	4th quar.	21	3
Drawing (optional)			

FOURTH YEAR.

History (Commercial and Industrial)		90	3
English Literature (private reading)			
Philosophy of Science	1st half	45	3
Science of Language	2d half	45	3
German		90	3
Italian or Spanish		60	2
Applied Physics	1st half	15	2
Business Law	2d half	30	2
American Geology	1st half	45	3
Advanced Physical Research			
Geology	2d half	45	3
Thesis work.	2d half		

In addition to the prescribed studies, optional studies, selected from other courses, may be taken, with the consent of the Faculty.

* Two out of these three subjects will be required.

X. PHILOSOPHY.

SECOND YEAR.

		No. of Exercises.	Hrs. per week.
Elements of Philosophy, viz.,		90	3
Its Definition and General Problems; The Solutions proposed by the several Schools; Empirical Psychology			
French finished, German begun		90	3
Analytic Geometry	1st half	45	3
Calculus	2d half	45	3
Physics (Lectures)		90	3
Chemical Philosophy	1st half	45	3
Descriptive Astronomy	1st quar.	18	3
Physical Geography	2d quar.	27	3
English Literature	2d half	45	3
Military Science		24	1

THIRD YEAR.

Philosophy: Critical History of Modern Systems		150	5
Descartes, Spinoza, Leibnitz; Locke, Berkeley, Hume; Reid, the Transition to Kant			
Advanced French		90	3
German		90	3
History	1st half	30	2
Physical Laboratory		60	2
General Geology	1st quar.	21	3
Outlines of Zoology	2d quar.	21	3
Constitutional History	3d quar.	21	3
Formal Logic	4th quar.	21	3

FOURTH YEAR.

Philosophy: Critical History of Modern Systems		210	7
(*a*) Kant. (1st half. 75 lectures.)			
(*b*) Fichte. (1st half. 30 lectures.)			
(*c*) Transition from Kant to Hegel through Fichte. (2d half. 30 lectures.)			
(*d*) Hegel. (2d half. 75 lectures.)			
Thesis Work			
Philosophy of Science, viz.,	1st half	45	3
(*a*) Theory of Induction			
(*b*) Classification, Logical Connection, and Logical System of the Natural Sciences			
(*c*) Same treatment of the Mathematical Sciences			
(*d*) Logical Theory of the Calculus			
Science of Language	2d half	45	3
German		90	3
Earlier English Literature	1st half	45	3

In addition to the prescribed studies, optional studies, selected from other courses, may be taken, with the consent of the Faculty.

ADVANCED COURSES.

These courses are intended to afford to Bachelors of Science of this Institute, and others of equal attainments, facilities for continuing their studies. For proficiency in them the degree of S. D., or Doctor of Science, has been authorized.

The particular course of study which a student wishes to pursue must be submitted in writing, and must meet the approval of the Faculty. The methods of instruction, whether by lectures or recitations, or practice in the field or in the laboratories, will be those best adapted to each special case. Frequent examinations will be held to test the progress of the student; but in voluntary subjects no examination will be required.

The minimum term of residence of candidates for a degree will be two years; but occasional short absences, when the time is spent upon professional work by advice of the Faculty, will not be considered as interruptions of the student's residence.

A candidate will be required to present at least one printed thesis on some subject embraced in his course.

The usual final examinations for the degree will be held, and these, with all previous examinations and the thesis, will be the tests of the student's proficiency.

CONDITIONS OF ADMISSION.

Regular Courses. To be admitted as a regular student of the first year's class, applicants must have attained the age of sixteen years, and must pass a satisfactory examination in arithmetic (including the metric system of weights and measures); algebra, through equations of the second degree; plane and solid geometry, including spherical geometry; French grammar, through regular and irregular verbs,[1] and the first two books

[1] Part I. of Otto's French Grammar represents what is required.

of Voltaire's "Charles XII" (*i.e.*, about seventy pages), or the equivalent of the same; English grammar; English composition; rhetoric (so much as is included in the first four chapters of Hart's Rhetoric, or its equivalent); history of the United States; and geography.[1] In general, the training given in the best High Schools, Academies, and Classical Schools, will be a suitable preparation for this School.

To be admitted as a regular student of the second year's class, applicants must be at least seventeen years of age, and must pass a satisfactory examination in the first year's studies, besides passing the examination for admission to the first year's class; and a like rule applies to the case of applicants for admission into the classes of the succeeding years.

Graduates of Colleges will, in general, be presumed to have the requisite attainments for entering the third year as regular students, and may do so on satisfying the department which they purpose to enter that they are prepared to pursue the proposed studies to advantage. Such students, if deficient in any of the scientific studies of the first two years, will have opportunities for making them up without extra charge, and will be required to pass an examination in them before entering upon the studies of the fourth year. Should they be already proficient in any of the general studies of the third and fourth years, they will be excused, if they wish, from attendance on the exercises in these subjects.

A knowledge of the Latin language is not required for admission; but the study of Latin is strongly recommended to persons who purpose to enter this School, as this gives a better understanding of the various terms used in science. It also greatly facilitates the acquisition of the modern languages. Those who intend to take the course in Natural History will find it advantageous to acquire also the elements of Greek.

[1] For fuller details respecting the requirements for admission, and for specimens of the examination papers, see page 64.

Persons not candidates for a degree will be allowed to enter special divisions of either of the courses,—as, for example, the classes of mathematics, chemistry, physics, drawing, engineering, metallurgy, architecture, natural history, etc., — on giving satisfactory evidence to the Faculty that they are prepared to pursue with advantage the studies selected. They must be present for examination at the times stated below, and will be required to pass the entrance examination prescribed for regular students, in arithmetic, algebra through equations of the *first* degree, English grammar and rhetoric, and in such other subjects as may be deemed a necessary preparation for the profitable pursuit of the studies chosen.

Students may be admitted to the classes in Drawing and Architecture without examination.

There are also certain courses open to *advanced* students of either sex without examination. These courses will be advertised in September of each year.

An examination for admission to the first year's class will begin at 9 A.M., on the first Monday in June, and continue two days. A second examination will begin at 9 A.M., on the Wednesday preceding the last Monday in September, and continue two days. Attendance on both days of either examination is required. Applicants for advanced standing must present themselves at either the first or second entrance examination, as given above, and if they pass this examination, must present themselves for further examination at 9 A. M., on the Friday following either entrance examination. Applications for admission at other times than the above will be received only when sickness or some other equally good cause has prevented attendance on the days prescribed.

Advanced Courses. Bachelors of Science of the Institute may enter on these courses without examination. Bachelors of Arts, Science, or Philosophy, of any other Institution may enter, on giving satisfactory evidence, by examination or otherwise, that they are qualified to pursue the course selected. Any person may enter who, by examination, is found qualified to take the degree of Bachelor of Science in the Institute.

METHODS AND APPARATUS OF INSTRUCTION.

Ordinary Exercises. Instruction is given by lectures and recitations, and by practical exercises in the field, the laboratories, and the drawing rooms. The progress of each student is tested by frequent oral examinations. Text-books are used in many, but not in all departments. A high value is set upon the educational effect of laboratory practice, drawing, and field-work.

Written Examinations. Besides the oral examinations in connection with the ordinary exercises, written examinations are held from time to time, particularly in those departments in which the oral examination of the students is necessarily too infrequent to be exclusively relied upon.

Near the close of the months of January and May, general examinations are held, — that of January embracing the subjects studied during the first half-year, that of May covering the studies of the whole year. Each examination in a distinct subject is marked on a scale of 100, and the marks of each student are reported to his parent or guardian. These returns are intended to enable the parent or guardian to judge of the proficiency of his son or ward in each department of instruction. The examinations of January and May form the basis of admonition or advice from the Faculty in the case of students who are not profiting by their connection with the school. A student who fails to pass the May examination in any subject will not be permitted to enter upon the studies of the following year without passing a new examination. Such students must appear for re-examination at 9 A.M., on the Friday preceding the first Monday in October.

The Instruction in Chemistry. In the laboratories provision is made for teaching General Chemistry, Qualitative Analysis, Quantitative Analysis, Organic Chemistry, Assaying, Determinative Mineralogy, Metallurgy, and Industrial Chemistry; the

use of the blow-pipe, as well as the use of the microscope, spectroscope, and other optical apparatus.

During the first term of the first year, instruction is given in General Chemistry by recitations and lectures, and by practical exercises in the laboratory, where every student is provided with a desk and the necessary apparatus, and is required to perform, under the supervision of the professors, a large number of experiments selected to illustrate the laws of chemical action and the properties of all the more important chemical elements. In the second term, a systematic course of instruction in Qualitative Analysis is given, by laboratory practice and by oral and written examinations.

During the first term of the second year, further instruction is afforded in Qualitative Analysis as well as instruction in Chemical Philosophy. In the second term of the second year, and in the third and fourth years, the principal subjects of study are Volumetric and Gravimetric Analysis, Organic Chemistry, Gas Analysis, the Preparation of Chemical Products, Assaying, Mineralogy, the Use of the Blowpipe, Metallurgy, and Industrial Chemistry. A large portion of the time is allotted to work in the laboratories. In the third year, lectures are given on Quantitative Analysis and on Physiological and Industrial Chemistry. In the fourth year, the lecture room exercises are devoted to Organic Chemistry and Metallurgy. During the last two years the student is required to make reference to standard works and original memoirs in English, French, and German. Both regular and special students are encouraged to undertake experimental researches, and are assisted in bringing them to useful results.

Special provision has been made for giving women ample opportunities for laboratory work in Chemistry, Mineralogy, and Biology. Each study may be pursued by itself, or in connection with studies in other departments of the Institute.

The Instruction in Physics. During the second year the whole subject is discussed in a series of lectures, which are

attended by all the regular students. The various branches are treated both mathematically and experimentally. In all cases the theoretical discussion of a question is followed by a full account of its practical application.

The Institute possesses an extensive and constantly increasing collection of physical apparatus. The lectures are also illustrated by a large number of photographs on glass, which are projected upon a screen by means of a lime light.

In the third year the students enter the *Rogers Laboratory of Physics* and learn to use the different instruments, and to prove many of the fundamental laws of nature. Some of the experiments, as for instance those with the microscope and spectroscope, and the determination of specific gravities, have a direct value; others are intended to establish certain principles in the mind; others again serve to cultivate manual skill in handling minute or delicate objects; and still others exercise his reasoning faculties, and show him how to apply his mathematics to concrete problems. This course, therefore, has a value beyond the direct value of the experiments, in the direction of general culture, teaching the student to derive conclusions from observed facts, and showing him the various methods of experimental research.

In the fourth year a portion of the students carry on work of a more technical nature, or more closely connected with their professional studies. In this course original investigation is stimulated as far as possible, and the result has been a considerable number of published memoirs.

Besides the above, the students in the department of Physics pursue the following practical courses: —

Microscopy.— Theory of microscope; application to study of various objects; test-objects; modes of illumination; applications of polarized light; use of micro-spectroscope; measurement with different forms of micrometer; focal length and angular aperture of objectives; preparation of objects.

Photography.— Methods of photography and its connection with lithography and printing; preparation of baths; taking

glass negatives, lantern slides, paper positives; photographs of microscopic objects, of spectra, etc.

Lantern Projections. — Sunlight, lime, magnesium, and electric lights; lanterns, condensers, and projecting lenses; projection of views, of real objects; tanks, chemical and electric decompositions; projection of spectra.

Mechanical Engineering. — Tests of engines and boilers; evaporation per pound of coal; measurement of power; transmission and absorption-dynamometers; coating of steam pipes; friction of belts and pulleys; strength of materials.

Meteorology.—Atmospheric temperature, pressure, and moisture; velocity of the wind; magnetic elements; electricity of the air.

Astronomy.— Sextant, and its adjustment; determination of latitude, time, longitude and meridian; transit, its adjustment and corrections; measurement of time; transit in prime vertical; transit circle; zenith telescope; altitude and azimuth instrument; equatorial telescope; position and spider-line micrometer; principal objects, the sun, moon, planets, double stars, clusters, and nebulæ.

General Physics. — In addition to the laboratory work, students in this department receive instruction in General Physics throughout the 3d and 4th years, in order that as broad a foundation as possible may be laid for future work. They thus gain a familiarity with the standard works upon various branches of the subject both in their own and in foreign languages.

Advanced Physics. — As most of the students taking the course in Physics intend to make teaching their profession, a special course is prepared with this object in view, in which each student in turn prepares a particular subject, giving the result of his own or others' researches, and presents it in the form of a lecture, illustrated, as far as possible, by experiments.

Teachers of physics, and others properly qualified, may enter the laboratory, and take the whole or any part of the above courses.

The Instruction in English and History. In this department lessons are given, in the first half of the first year, in the history and constitution of the English language, and in that part of Rhetoric which relates to written composition; and in connection with this series of lessons, weekly written exercises are required of all regular students. During one half of the second year a course of lessons in literature and criticism is given, and during one fourth of the third year a course of lessons in political and constitutional history, accompanied, in each case, by the reading of some suitable text-book. Attendance on these three courses in the department of English and History is required of all regular students.

Department of Science and Literature. In addition to the exercises and lessons enumerated above as required of regular students of all departments, a wider course of study, both in History and Literature, is required of all candidates for a degree in the department of Science and Literature. This corresponds to the technical scientific instruction required in other departments. The wider course in History has for its object the acquirement of a fuller and more accurate knowledge of recent and contemporary history and, more particularly, of the present social and industrial condition of the leading nations of the civilized world. The wider course in Literature consists of a more extended course of critical reading of standard English writers.

The Instruction in Logic and Philosophy. The work done under these heads consists, first, of that required of all regular students; and, second, of that which constitutes the main work in the special Department of Philosophy.

I. The subjects required of all regular students are the Rudiments of Logic and the Philosophy of Science. In these, the aim of the instruction is to familiarize all with the logical principles underlying the sciences which form the subjects of their other studies, and warranting the methods of investigation which

are taught in each. The final object is, to acquaint each student with the Laws of Belief, so far as they have been reduced to system.

In the teaching of Logic, especial attention is paid during the first year to the structure and analysis of sentences, and to the classification and analysis of terms. In the third year, the forms of Deductive Inference are taught.

The instruction in the Philosophy of Science includes, as requirements for *all* regular students, (1) the Theory of Induction — its Nature, Limits, and Canons, and (2) the Classification, Logical Connection, and Logical Structure of the Natural Sciences. It will add, as requisites for the students in Engineering, Architecture, Physics, and Philosophy, (3) the Classification and Logical Structure of the Mathematical Sciences, and (4) the Logical Theory of the Calculus.

II. The requirements for regular students in the special department of Philosophy are embraced in a somewhat detailed study of the history and criticism of that subject. In this, the ground chosen is that of Modern Philosophy. Such references to ancient systems as may be necessary merely to explain the modern are of course made ; and the central works of the leaders of the modern systems are the text upon which the instruction is founded.

For details of the course see page 31.

The Instruction in Modern Languages. The object of the instruction in French and German is to enable the student to avail himself of the literature in these languages relating to his particular department of professional study, since many important sources of information, such as periodicals and works for consultation and reference, are only accessible in one or the other of these languages. But although the object is the practical one of learning in the shortest time to read with readiness a foreign scientific work, it is believed that this can be satisfactorily accomplished only by a thorough and systematic training in the forms, laws and usages of the language ; since it is only in this way that the essentials of *accuracy* and *strength*

can be attained, and the acquisition be a permanent one. It is not understood by this, however, that these forms, laws, and usages are to be learned by themselves as detached facts; on the contrary they are to be constantly studied and practised as parts of an actual organism, the language, and on this depends the value and interest of the work. Reading, talking and composition exercises are arranged in accordance with these views.

French is continued at the rate of four exercises a week through the first year and until a period of two years' study, including the time of preparation, has been devoted to the same. German is commenced at the beginning of the second year (or after the French is finished), and continued at the same rate as the French, and for a like period. To this extent these languages are studied by all regular students.

In the courses of Science and Literature and Philosophy, French and German are continued after they are finished in the professional courses. More difficult authors in both languages are studied, with more especial reference to the literature of the same. The special object of these courses being to afford a general education, it is intended that the languages should be taught here accordingly, and in a more disciplinary and extended manner than where the main object is to learn to read in the shortest time.

The elements of Italian and Spanish are taught in optional classes in the third and fourth years, for the benefit of those who may have special reasons for making a beginning in those languages. It is, however, recommended to students to go farther in French and German rather than to take up a new language.

Opportunity is offered in the "Advanced courses" for the study of the older forms of the Modern Languages, and of the subject of linguistic science.

The Instruction in Descriptive Geometry and Drawing. The exercises are of two kinds. In the lecture room, instruction, with models and diagrams, is combined with testing the stu-

dent's knowledge as gained from a text book. In the drawing room, the student aims to construct such problems, each week, from the lessons for that week, as shall, during the course, give him practice in all the usual operations belonging to the subject.

The Instruction in Stereotomy is given by means of lectures and drawing exercises, illustrating a variety of problems in Stone Cutting, on plane, double-curved, and warped surfaces. The application of Descriptive Geometry is extended to the construction of the oblique arch and winding staircases of various forms, so as to include a large number of useful and practical problems.

The Instruction in Civil Engineering is given by means of lectures and recitations, and by practice in the field and in the drawing rooms. The use of the various instruments for measuring lines and angles, and of the level, is taught mainly by actual work in the field; first, in ordinary surveying and levelling; then in laying out curves, both circular and parabolic; and afterwards in the survey of a railway line, and in staking it out ready for construction. These surveys are plotted and represented on finished plans. The necessary computations of areas, earth-work, etc., are also made.

In most of the remaining subjects peculiar to this department, as set down in the Course of Instruction, Rankine's Civil Engineering is used as a text-book; and the aim is to enable the student, by means of suitable explanations, illustrations and examples, to acquire a thorough working knowledge in these branches. Considerable time is given to drawing from actual structures, such as abutments, bridges, water-works, etc. Original designs on the same subjects, accompanied with working drawings, are made. Instruction in Graphical Statics is given in the fourth year.

The instruction in topography is mainly given in the field by means of the plane-table, as perfected and used in the United

States Coast Survey; that in hydrography by exercises in making marine surveys for engineering purposes. In both cases maps are made, showing the results of the survey.

An observatory, erected upon the Institute building, from which a large number of Coast Survey stations are visible, is used in the instruction in geodesy. Observations are also made for the determination of the meridian, and of latitude and longitude.

The Instruction in Mechanical Engineering. Subjects, not text-books, form the basis of this course of instruction: but the best text-books and engineering publications are freely consulted and carefully studied. The department has a valuable Technical Library for the use of the students.

Two classes of lectures are carried on simultaneously. In one class the Mathematical, and in the other class the Practical aspects of the subject are considered.

Frequent excursions are made, through the courtesy of the managers, to establishments where machinery is manufactured, or where it is in operation. The gentlemen in charge often explain to the students the interesting operations which they are directing. Sometimes they loan working drawings, and allow detail measurements of machines to be made. Thus the students observe how the subject is practically treated. They make written and graphical reports of their excursions.

At the middle of their second year the students cease to draw for mere practice, but use their graphical skill in various ways. They work out problems in machine construction. They plot the results of laboratory experiments and of calculations. They record the information which they gain, from time to time, by the careful examination of machinery and of working drawings. Their drawings are frequently pencil sketches, not drawn to scale, but giving dimensions. Or each student makes one or more detail drawings to scale, in pencil or ink, on Manila or Whatman's paper, from his own measurements, of a

motor or machine. The students interchange and trace these drawings. Thus each one becomes possessed in his own right of a full set of details without an excessive expenditure of time.

The Mechanical Engineering Laboratory is fitted with Steam Boilers, Superheaters, Engine, Calorimeter, Indicators, Pressure Gauges, Thermometers, and all the usual apparatus for producing and using steam, and for testing its nature and action. A substantial and accurately constructed mercury column has been erected in this laboratory. It is convenient for use, and is accompanied by delicate and manageable apparatus, by the aid of which, instruments indicating pressure or temperature can be tested with rare precision. The laboratory is also supplied with Transmission and Absorption Dynamometers. The students become practised in the use of the laboratory apparatus.

This course has been supplemented by the erection and equipment of instruction shops or laboratories for giving a practical knowledge of the nature of metals and woods and skill in arts of the metal and wood worker.

The Instruction in Mineralogy. Determinative Mineralogy is taught by the study of crystalline forms and the physical properties of minerals, the use of the blowpipe, and by the handling of specimens.

The collections of minerals in use for instruction is placed in the study room of the Mining department, and is thus ready for reference at any time.

The Instruction in Geology and certain related subjects is given as follows: —

In the third year is given a course of twenty-one lectures on Descriptive and Theoretical Geology, embracing the Classification of the Sciences; Scope of Geological Studies; Nature of Rocks, or Lithology; Stratigraphy; Succession of Formations; Zoological History; Geological Dynamics; Chemical and Physical Forces; Aqueous and Igneous Agencies; Currents; Sedi-

mentation; Elevation and Subsidence; Geographical Distribution of Formations; Nature and Origin of Mountains; Volcanic Action.

In the fourth year are given: — a course of forty-five lectures on American Geology, comprising Geological History; Geology of North America, considered lithologically, stratigraphically, and palæontologically; Comparative Geognosy: — a course of ten lectures on Practical Lithology, comprising the mineralogical composition of Rocks; Building-stones, their cohesion, porosity, etc.; Granites, Marbles, Limestones, Sandstones, Slates; Limes, Cements, and Mortars; Ornamental Stones and Gems: — and a course of fifteen lectures on Chemical Geology, or the chemical history of the globe; comprising the Origin of Rocks, both stratified and unstratified, the History of Vein-stones and Ore-deposits; the Formation of Coal and Petroleum; the Chemistry of Salt-deposits and Mineral Waters; the seat and Origin of Volcanic and Earthquake phenomena;—and a course of fifteen lectures on Economic Geology, mainly devoted to a detailed description of the coal and ore-deposits of North America, especially such as are most extensively worked.

The Instruction in Palæontology is given to students of the third year.

Palæontology, including the history of ancient animal life, and the study of the distinctive and characteristic fossils of the different formations, is taught as a necessary foundation for the further study of Geology. The aim of the course is to give the student a practical acquaintance with the structure of the characteristic families and orders of living and extinct animals, and by a judicious selection of examples to familiarize him to some extent with the genera which characterize various formations.

The handling and drawing of specimens by the students is an essential feature of the method of instruction. The lectures of the instructor are devoted largely to explanatory demonstrations of the specimens which the students are at the same time drawing.

The Instruction in Mining is given to students of the third year by a course of eighty lectures on the general character of the various deposits of the useful minerals, in the theory and practice of mining operations, such as prospecting, boring, sinking of shafts, driving of levels, different methods of working, hoisting, pumping, ventilation, etc. These lectures are illustrated by drawings, and by a set of models from Freiberg, Saxony, which show in detail the methods of working underground by underhand and overhand stoping, the timbering and walling of shafts and levels, the arrangements of pumps, man engines, ladder ways, hoisting ways, the sinking of shafts, etc.

In the fourth year, ore-dressing and metallurgy are taken up in a course of sixty lectures. This is followed by a series of continuous practical exercises in the concentration and smelting of ores in the Mining and Metallurgical laboratories.

The Professors in this department hope to give each student of Mining and Metallurgy at least one chance during his course of study, to join a party organized for visiting some of the more interesting mining regions.

The valuable scientific library and the large geological collection of the late Prof. Henry D. Rogers of the University of Glasgow, presented to the Institute by Mrs. Rogers, are accessible to the students in Geology and Mining. This collection is made up chiefly of fossils and rock specimens from American localities, and is especially rich in coal-plant fossils.

The Mining and Metallurgical Laboratories. These laboratories furnish to the student in Mining and Metallurgy the means for studying experimentally the various processes of ore-dressing and smelting. Ores of different kinds may be here subjected, on a small scale, to the same modes of treatment as have been adopted at the best mining and metallurgical establishments.

The mining laboratory is supplied with two suites of milling apparatus; —

I. A five-stamp battery, a set of amalgamating plates, a

mercury saver, buddles for concentrating tailings, an Atwood's amalgamator, and an amalgamating pan.

II. A Blake crusher, crushing rolls with automatic screens, a Spitzkasten, two automatic machine jigs, an elevator, two end percussion tables (the Freiberg stossherd), a side percussion table (Rittinger's stossherd), a settling tank, and a centrifugal pump, which throws the water from the settling tank back to the feed tank. The same water is thus used over and over again to avoid loss in slimes.

This laboratory also contains the following auxiliary apparatus: — a steam engine and boiler, a Whelpley and Storer pulverizer, an edge-stone mill, and a Sturtevant blower. The metallurgical laboratory contains a blast furnace, a reverberatory smelting furnace, a roasting furnace, a furnace for cupellation, furnaces for fusion, crucible and muffle assay furnaces, a blacksmith's forge, and a melting kettle.

The experimental work of the laboratory is carried on by the students under the immediate supervision 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, and determines its character and value by analysis and assays, and makes such other preliminary examinations as serve to indicate the proper method of treatment. He then treats the given quantity, makes a careful examination of the products at each step of the process, ascertains the amount of power, water, chemicals, fuel, and labor expended, wherever practicable, and thus learns approximately the effectiveness and economy of the method adopted. Each student is assisted in working his ore by his classmates, who have an opportunity in this way to run the boiler, engine, machines, and furnaces.

The Institute is from time to time receiving ores of gold, silver, lead, copper, antimony, zinc, iron, etc., from various localities on this continent. These ores are worked, and reports sent to those who contributed them; and it is hoped that by such coöperation the laboratory will continue to receive the necessary amount and variety of ores.

Models, etc., relating to the Engineering Courses. The collections under this head consist of models in wood, in metal, and in plaster, besides lithographs, photographs, and drawings collected in the United States and in Europe.

They illustrate the following subjects :—General Descriptive Geometry, Linear Perspective, Shades, Shadows and Reflections, Masonry and Stone Cutting, Joints, Girders and Trusses for Wood and Iron Structures, Furnaces and Boilers, Steam and Water Motors, Machines and their details.

The Instruction in Architecture. It is the object of this department to give to its students the instruction and discipline that cannot be obtained in architects' offices. The course is, however, practical as well as theoretical, and, besides the scientific study of construction and materials, it comprises the study of building processes, and of professional practice and procedure, as well as that of composition and design, and of the history of the art. It is calculated to meet the wants not only of young men who propose to pursue a comprehensive course of architectural study, but of those who are looking only for such an elementary training as shall qualify them for positions as draughtsmen.

The degree of Bachelor of Science is given in Architecture to all students who, at the conclusion of their fourth year, have passed the prescribed examinations and have executed in a satisfactory manner the drawings and designs required.

The more strictly professional work begins in the second year, the first half of which is given to the study of the Five Orders and their applications, and to Greek and Roman Architectural history. At the same time the students of the third and fourth years attend a series of lectures upon ornament and composition, or upon the theory of architecture. In the same way the study of specifications and working drawings is pursued by the two classes together, carpentry and its related subjects occupying one year, and masonry and stone-work the next. In the last half of the year the historical studies are

continued, the second and third year classes attending the same exercises. The mediæval period, from the fall of the Roman Empire to the fall of Constantinople, and the modern period, including that of the Renaissance, are taken up in alternate years, so that each class is carried over the whole ground.

During the third and fourth years the students are constantly practiced in original design, the character of the problems given out and the time allowed for their completion varying according to the advancement of the class and the kind of drawings required. Each set of drawings is examined and criticised before the class.

Special exercises are also had in shades, shadows, perspective, and the perspective of shadows, and in tracing and sketching, and drawing upon the blackboard. Opportunity is also afforded to sketch, measure, and draw out buildings already erected.

Special students in Architecture are received into a special course, occupying two years, and embracing all the subjects mentioned in the three preceding paragraphs. If not proficient in free-hand drawing and in practical geometry they will be required to make themselves so during the first half of the year, in addition to their other exercises. Such students, upon passing the entrance examination, will be permitted to pursue any other studies taught in the school, which they are prepared to pursue to advantage. The fee for this special course is the same as for the regular courses.

The Boston Society of Architects have established two prizes of the value of fifty dollars each, for students in this department who at the end of the year, exhibit the best year's work. The prizes are given in books. Those for the last year were awarded to Mr. Daniel W. Willard, of Jamaica Plain, a graduate of the Institute in 1870, in the department of Mechanical Engineering, who this year returned to the Institute as a special student in this department, and to Mr. William E. Chamberlin, of Cambridgeport, a member of the graduating class. The prizes for the previous year, which were not then

awarded, have been given to Mr. Frank H. Bacon, of Biddeford, Me., and Mr. Robert D. Andrews, of Hartford, Conn.

The Architectural Museum. Several thousand photographs, prints, drawings, and casts, have been collected for this Department, by means of a special fund raised for the purpose.

The collection of casts comprises architectural details and specimens of carving and sculpture illustrating various periods of art. It includes a valuable collection of sculptures from Lincoln Cathedral, and a large number of casts of Moorish ornamental details, recently presented by the Spanish Government, through the Spanish Commissioner at Philadelphia.

To these collections the following additions have been made, mostly by gift: —

A considerable collection of photographs, lithographs and drawings, presented to the Institute by French, English and American architects, taken from their own works, including sets of actual working drawings, with details and specifications.

A complete series of drawings, mostly presented by the late Ernst Benzon, Esq., of London, formerly a merchant of Boston, illustrating the course of Architectural instruction in the *Ecole des Beaux-Arts* in Paris: — *Esquisses-Esquisses*, *Projets Rendus*, *Projets d'ordre*, *Projets de Construction*, *Grand Prix de Rome*, *Envoi de Rome*.

Specimens of modern English and American stained glass and tile-work, partly purchased, and partly presented by the makers, with cartoons and drawings illustrating the process of manufacture.

The publications of the Royal Institute of British Architects, and of the *Société Centrale des Architectes*, in Paris, have been presented by the authorities of these institutions. The library already contains nearly four hundred volumes.

The Instruction in Natural History. This will be given with the aid of the collection and library of the Boston Society of Natural History, which, by an agreement between the Society and the Institute, are freely open to the students. These collections rank among the first in the country for extent and

value, and in many departments are unsurpassed; the library is rich in works on Natural Science, many of them finely illustrated, and embraces the leading American and European journals and periodicals on Natural History. It is believed that the facilities thus afforded to the students of the Institute are ample for the most thorough instruction in Zoölogy, Palæontology, and other branches of Natural Science. This instruction is given by the Professors of the Institute, and partly in the lecture room and Palæontological laboratory of the Natural History Society, whose building is upon the same square.

Botany is more generally required than heretofore, as affording the proper and natural introduction to the study of Zoölogy, Palæontology, and Biological Chemistry; and as being the science best calculated to train the mind for close observation, accurate description, and systematic classification. The instruction is given by lectures, recitations, and practical exercises in the examination of living plants and tissues. The numerous conservatories in Boston and vicinity furnish the means of studying hand specimens in many of the natural orders, and the wild flowers of early spring are usually obtained before the end of the school year.

The Biological laboratory has been furnished with a variety of microscopes and accessory apparatus, and affords facilities for both preparatory and advanced study. The working library of the professor in charge, which contains many valuable monographs as well as the more comprehensive works, is at the service of the students.

The Instruction in Physical Geology and Geography. This department of instruction has been organized for the purpose of giving the student a knowledge of geography in its more advanced and scientific relations.

The instruction given in the first half of the second year, is analytical; beginning with the earth as a whole, then resolving it into its more extensive divisions, and continuing on to those which are more limited. The features of the different regions

and their geological origin are thus presented in their natural relations.

The course in Political and Industrial Geography given during the second half of the fourth year is synthetic in character. The influence of geographical features, climates, etc., upon the distribution of plants and animals, also their direct and indirect influence upon the life, industries, and advancement of man are taught, with the hope of contributing to the completeness, unity, and utility of the entire course of study.

The Instruction in Military Science and Tactics. In conformity with the requirements of the Act of Congress of July 2, 1862, and of the Act of the General Court of Massachusetts in furtherance thereof, the Institute provides instruction in military science and tactics. An officer of the U. S. Army is detailed by the U. S. Government as Professor of Military Science and Tactics. During the first year all students are required to attend three times a week an exercise in tactics, unless specially excused. For these exercises they are organized as a battalion of two companies, and are required to provide themselves with a uniform consisting of dark blue pantaloons, cap with silver ornament, and double-breasted sack-coat with black gutta-percha buttons. These uniforms are manufactured from measures and by contract, to secure uniformity of material and manufacture, as well as cheapness. The whole cost will not exceed twenty-five dollars. The uniform must be worn at drill, and being inconspicuous, may be worn at other times if the student chooses. Arms and equipments are lent to the School by the United States. During the second year all regular students, and all special students who take one or more studies, in addition to the special ones, are required to attend one lecture a week, for twenty-four weeks, upon military science, pertaining chiefly to the duties of officers in disciplining, feeding, clothing, camping, marching troops, and the general sanitary measures necessary to maintain them in health. Whilst this instruction would be of service to the country in the emergency of a war, it will also be useful to the graduates of the

Institute, when, as Engineers, they are called upon to take charge of large bodies of laborers. The matter of attendance at drill is under the control of the Professor; but excuses of general application can be granted by the Faculty only. Applications to be excused from drill will be granted when based on the following grounds, viz.: —

1st, being an Alien; 2d, being a College Graduate; 3d, being over twenty-one; 4th, having a surgeon's certificate of disability; 5th, being able to pass an examination satisfactory to the Department.

Only the first and second classes mentioned, can, however, be exempt from the instruction of the second year.

The large drill-hall includes a well equipped gymnasium, used by all classes in the Institute.

Excursions. In aid of the practical studies of the school, and as a means of familiarizing students with the actual details of work, they are required, in term time, to make visits of inspection to machine-shops, engines, mills, furnaces, and chemical works, and to important buildings and engineering constructions within convenient reach.

In the vacations more extended excursions are made for the survey of mines, and for the study of metallurgical works and noted specimens of engineering. During the past summer the Mining students, with two of the Professors, spent two weeks in visiting the copper mine and furnaces at Ely, Vt., the iron mines and furnaces at Port Henry, Mineville, and Wadham's Mill, N. Y., the paint works at Brandon, and the marble quarries at Rutland, Vt.

THE SOCIETY OF ARTS.

One of the primary objects of the founders of the Institute of Technology, as shown by the extract from the charter given on page 4, was the establishment of a Society of Arts. This Society was organized in 1861, and now numbers about 220 mem-

bers. It holds regular meetings at its rooms in the Institute Building, on the second and fourth Thursdays of each month from November to May inclusive. At these meetings are presented communications on various subjects of applied science, with the exhibition of machines and apparatus illustrating important inventions in the mechanic and useful arts. Students of the school may be present at these meetings, by permission of the Secretary of the Institute.

THE BOSTON PUBLIC LIBRARY.

The professors and students of the Institute are allowed the full use of this extensive library. Copies of the complete catalogues of the Library are kept at the Institute for convenience of reference, and the Library Building is near at hand. The Library now contains over 300,000 volumes; and its reading-room is supplied with all the best scientific and technical periodical publications. New books of value are promptly bought, on proper application to the authorities of the Library. No college or school in the country has better facilities in these respects than those which the Trustees of the Boston Public Library have put at the disposal of the officers and students of the Institute of Technology.

THE THOMAS SHERWIN SCHOLARSHIP.

This scholarship for regular students has been founded by the English High School Association, in memory of the late Thomas Sherwin, who, for more than thirty years, was the distinguished master of the English High School of the City of Boston. Mr. Sherwin was also an active and influential member of the Corporation of the Institute. The pupil to receive the benefit of this Scholarship "is to be a graduate of the English High School in the city of Boston."

ADVANCED SCHOLARSHIPS.

Five advanced scholarships, of $200 each, have been established, and will be awarded to such applicants as are recommended by the Faculty.

DIPLOMAS AND CERTIFICATES.

The diploma or certificate is intended to be not only a reward to the student for his diligence and attainments, but an assurance to the public of his knowledge and skill in the particular department to which it relates.

The degrees or diplomas corresponding to the ten Regular Courses of the School are as follows: —

I. A Degree in Civil and Topographical Engineering.
II. " " " Mechanical Engineering.
III. " " " Geology and Mining Engineering.
IV. " " " Building and Architecture.
V. " " " Chemistry.
VI. " " " Metallurgy.
VII. " " " Natural History.
VIII. " " " Physics.
IX. " " " Science and Literature.
X. " " " Philosophy.

To be entitled to either of these degrees, the student must have passed satisfactory examinations in all the prescribed studies and exercises of the four years; and in addition, a final, or degree examination, embracing all the subjects which particularly relate to his course. He must, moreover, prepare a dissertation on some subject included in his course of study, or an account of some research made by himself, or an original report upon some machine, work of engineering, industrial works, mine, or mineral survey, or an original architectural design accompanied by an explanatory memoir. This thesis or design must be approved by the Faculty.

The examinations for these degrees are held in the month of May, and are partly oral and partly in writing.

The title of the degree in these courses is S. B., or Bachelor of Science, in the department of ————————.

The degree of S. D., or Doctor of Science, is awarded for proficiency in Advanced Courses of study.

Besides the degrees or diplomas of the Regular Courses and of the Advanced Courses, certificates of attainment in special subjects are given to such students as on examination are found to have the required proficiency in them.

REGULATIONS OF THE SCHOOL.

School-year. The school-year begins on the last Monday in September, and ends on the Saturday preceding the first Monday in June. On legal holidays the exercises of the school are suspended. There is a recess of one week ending at 9 A.M., on the first Tuesday in February.

Bond or Deposit. Every student is required, on entering the school, either to give a bond for two hundred dollars to pay all charges accruing under the regulations of the school; or to deposit, if he prefer so to do, the sum of two hundred dollars with the Secretary of the Institute, to be accounted for at the end of the school-year, or whenever the depositor leaves the school, in case he leaves it before the end of the year. This deposit must be renewed at the beginning of each year. The bond must be executed by two bondsmen, satisfactory to the Secretary of the Institute, one of them being a citizen of Massachusetts; and it must be filed within ten days after the date at which the student joins the school.

Fees. The fee for regular students is $200 per year, payable by students who have given bonds, $125 at the beginning, and $75 at the middle (first Tuesday in February) of the school-year. For one-half, or any less fraction of the school-year, the fee is $125. Payment is also required of the cost of apparatus

broken or used up in the laboratories. Students not candidates for a degree pay, in general, the full fee; but when a few branches only are pursued, and the time required for instruction is limited, some deduction may be made. The fee for students in the advanced courses is the same as that for regular students.

Attendance. Regular students are expected to attend all the exercises of their several courses. Students not candidates for a degree are expected to attend all the exercises in the subjects they have selected. A monthly return of absences and tardinesses is made by the Secretary of the Faculty to the parent or guardian of every student not of age. Tardiness consists in entering a lecture room, drawing room, or laboratory, more than five minutes after the hour designated for the beginning of the exercise. 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. (4 1-2 P. M., in winter), except during the interval for dinner. There are no exercises on Saturday afternoon, and the building is closed.

Discipline. While within the limits of the Institute, students are expected to behave with decorum, to obey the regulations of the school, and to pay a due respect to its officers. They are required to avoid all running, loud talking, whistling, or other noise in the halls and passages of the building. Every student will be held responsible for the furniture which he uses and the cost of repairing any damage thereto will be charged to him. In case of injury to the building, or to any of the furniture, apparatus, or other property of the Institute, the damage will be charged to the student or students known to be immediately concerned; but if the persons who caused the damage are unknown, the cost of repairing the same will be assessed equally upon all the students of the school. Conduct inconsistent with the general good order of the school, if repeated after admonition, will be followed by suspension or dismissal. 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, and the attempt of any student to present as his own the work of another, or to pass any examination by improper means, is regarded as a most serious offense, and renders the offender liable to immediate expulsion.

Residence and Expenses. As the exercises of the school begin at nine o'clock in the morning, and end at half past four or five o'clock in the afternoon, students may conveniently live in any of the neighboring 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 from six to eight dollars a week. The cost of board at the Institute restaurant is three dollars and fifty cents per week, and conveniently located rooms may be found at a cost of two dollars and upwards additional per week.

The cost of books, drawing instruments, paper, etc., exclusive of chemical breakage, is from twenty-five to thirty-five dollars a year.

FREE COURSES OF INSTRUCTION.

The Trustee of the Lowell Institute has established, under the supervision of the Institute of Technology, courses of instruction, generally in the evening, open to students of either sex, free of charge.

These courses are more or less varied from year to year by the omission or interchange of particular subjects, but include in their entire scope instruction in mathematics, physics, drawing, chemistry, geology, natural history, physiology, English, French, German, history, navigation and nautical astronomy, architecture, and engineering.

The subjects, and the extent of the several courses, will be made known in October of each year.

As it is the object of this branch of the school to provide substantial teaching, rather than merely popular illustration of the subjects, it is expected that all persons attending these courses will come with a serious purpose of improvement, and that they will cheerfully comply with such rules as may be prescribed in regard to attendance and to order in the class or lecture-room.

The conditions of attendance on these gratuitous courses are as follows : —

1. Candidates must have attained the age of eighteen years.
2. Their applications must be made in writing, addressed to the Secretary of the Faculty, specifying the course or courses they desire to attend ; mentioning their present or prospective occupations ; and, where the course is of a nature demanding preparation, stating the extent of their preliminary training.
3. The number of students in each class is necessarily limited. The selection will be made under the direction of the Faculty.

The courses for 1877–78 are on the following subjects : —

I. *The Undulatory Theory of Light.* Ten lectures by Prof. Cross, on Tuesday and Thursday evenings, at 7½ o'clock, beginning Dec. 11.

II. *The Logic Underlying Grammar.* Ten lectures by Prof. Howison, on Saturdays, at 2½ P. M., beginning Nov. 10.

III. *On the Life of the Primeval World.* Ten lectures by Prof. Kneeland, on Tuesday and Friday evenings, at 7½ o'clock, beginning Nov. 13.

IV. *Elementary Treatment of Strength of Materials.* Ten lectures by Prof. Lanza, on Monday and Wednesday evenings, at 7½ o'clock, beginning Nov. 12.

V. *Elementary Lessons in French.* Twelve lessons by Instructor Luquiens, on Monday and Wednesday evenings, at 7½ o'clock, beginning Nov. 12.

VI. *Elementary Lessons in German.* Twelve lessons by Prof. Otis, on Tuesday and Friday evenings, at 7½ o'clock, beginning Jan. 4.

VII. *Determinative Mineralogy and Blowpipe Analysis.* Ten laboratory exercises by Prof. Richards, on Saturdays, at 2¼ P. M., beginning Nov. 24.

VIII. *Office Work and Specifications for Architectural Draughtsmen.* Ten lessons by Prof. Ware, on Monday evenings, at 7½ o'clock, beginning Nov. 12.

IX. *Heat and Steam and their Applications.* Ten lectures by Prof. Whitaker, on Tuesday and Thursday evenings, at 7½ o'clock, beginning Nov. 13.

The Trustee of the Lowell Institute has also made provision for a course of free instruction in Practical Design for Manufactures, open to pupils of both sexes. Students are received at the beginning of the school year in September, to whom is taught the art of making patterns for Prints, Delaines, Silks, Paper-Hangings, Carpets, Oil-Cloths, etc.

The Course embraces: — 1. Original Design, or Composition of Patterns; 2. Secondary Design, or Variation of Patterns; 3. The Making of Working Drawings; 4. Technical Manipulations.

This school is provided with pattern looms for illustrating the practical applications of designs for woven goods.

Instruction is given personally to each student over his work, with occasional general exercises. Students supply their own instruments and materials.

The class is under the personal direction of Mr. Charles Kastner, for fourteen years designer at the Pacific Mills, formerly Director of the Atelier Lebert in Paris, and nephew and pupil of M. Jean Baptiste Lebert, *Dessinateur*, of Mulhouse in Alsace.

Applicants for admission to the above Course are required to bring specimens of their work, exhibiting an acquaintance with Free-hand Drawing, and some familiarity with the use of drawing instruments.

SCHOOL OF MECHANIC ARTS.

A School of Mechanic Arts, in which special prominence is given to *manual* instruction, has been established for those who wish to enter upon industrial pursuits, rather than to become scientific engineers.

This school is designed to afford such students as have completed the ordinary grammar school course, an opportunity to continue the elementary scientific and literary studies, together with mechanical and free hand drawing, while receiving theoretical and practical instruction in the use of the typical hand and machine tools for working in iron and wood.

The shop work is unique, being based upon the art and not the trade, and conducted upon a plan designed at the Imperial Technical School of Moscow, Russia, and carried out there with most satisfactory results. It has, indeed, proved a most efficient substitute for the apprenticeship system, which is fast becoming obsolete; while, by its thoroughly progressive and systematic method, it has proved a valuable educational element.

The shop courses of the school, when complete, will be as follows: —

In wood: I, Carpentry and Joinery; II, Wood Turning; III, Pattern Making.

In iron: I, Vise Work; II, Forging; III, Foundry Work; IV, Machine Tool Work.

The full course includes two years of theoretical and practical studies combined, and students, who successfully complete it, will receive a certificate stating the amount and quality of work done. Students will be received for shorter times and for special portions of the course.

Applicants must be at least fifteen years of age, and must pass a satisfactory examination in: — Arithmetic, including the Metric System, Geography, Spelling, Punctuation, English Composition, and American History.

The entrance examinations will be held in June and September, beginning the first Monday in June, and the Wednesday

preceding the last Monday in September. Tuition $125 a year. An additional fee of ten dollars will be charged for each shop course, to cover the depreciation of tools and the cost of material used. This fee entitles the student to the product of his work. Special students, taking only shop courses, will be charged thirty dollars for each course, which will include the use of tools and materials. Students, while on the premises of the Institute, are expected to remain in the study room, except when at recitations or in the work shops. A monthly return of absences is made to the parent or guardian.

FIRST YEAR.

		No. of Exercises	Hrs. per week
Shop Instruction		120	12
Algebra	1st half	75	5
Plane Geometry	2d half	75	5
English Language		90	3
Mechanical Drawing		90	8

SECOND YEAR.

Shop Instruction		120	12
Algebra finished	1st half	45	3
Solid Geometry	2d half	45	3
Elementary Physics		60	2
English		90	3
Mechanical Drawing		90	8

The beginning and ending of the school year and the days of examinations are the same as in the School of Industrial Science. See p. 56.

SCHOLARSHIPS OF THE MASS. CHARITABLE MECHANICS ASSOCIATION.

The two scholarships, founded by this Association, are awarded on competitive examination to sons of present or past members of the Association.

Besides the above courses, the school provides instruction as follows; —

In textiles: I, Designing; II, Pattern Weaving; III, Dyeing.

The course in Designing is supported by the Trustee of the Lowell Institute, and the instruction is free. See page 60. For the remaining courses, pattern weaving and dyeing, the fee will be determined by the time employed and the materials used.

APPENDIX.

REQUIREMENTS FOR ADMISSION.

In order to afford to instructors and others a somewhat definite idea of the requirements for admission to the school, the following statements and suggestions are made.

Arithmetic. — The candidate will be expected to be familiar with the ordinary operations of arithmetic in both simple and compound numbers, with common and decimal fractions, with the computation of interest, etc. In the metric system a general knowledge will be required of the origin and advantages of the system, of the manner of designating the multiples and divisions of the units of length, capacity, etc., and especially of the relation existing between the measures of weight and those of length and capacity. Ability to perform ordinary arithmetical problems in the metric system will be required, but no stress will be laid upon the conversion of the ordinary United States weights and measures into the corresponding values of the metric system; as, however, the metric weights and measures are constantly used immediately on the students' entering upon the work of the school, practical familiarity with them is very desirable.

Geography. — A good elementary knowledge of the motions of the earth, of the mathematical measurements and divisions of its surface, and of the outlines of physical and political geography is required. The candidate for admission should be able to correctly define any of the principal physical features of the earth's surface, such as peninsulas, gulfs, etc.; he should be able to locate and describe the chief natural and political divisions, and the most important mountain chains, river-systems, etc. A more complete knowledge of North America and Europe is expected than of the other continents, but minute details and statistics, such as the lengths of rivers and heights of mountains, are not required. Practice in free-hand map drawing

from memory is earnestly recommended, and proficiency in the art will receive the merit it so justly deserves.

English Grammar. — In English Grammar, candidates must be able to distinguish at sight between the several parts of speech, and to give the proper inflections of nouns, pronouns, adjectives, and verbs; especially the comparison of irregular adjectives, the principal parts of irregular verbs, and, in all verbs, the exact forms corresponding to the distinctions in mood and in tense. Particular attention should be paid, in preparing for the Institute, to distinguishing prepositions from conjunctions, and subordinate conjunctions from co-ordinate. The same is true in regard to demonstrative, indefinite, relative, and interrogative pronouns.

Candidates must also know how to classify terms (whether single words or phrases) into substantives and attributives, and must be familiar with the subdivisions of substantives into singulars, generals, and universals. They must have a good degree of skill in separating sentences into subject, copula, and predicate; and, in case these terms are complex, must know how to separate them into base and determinant, and how to tell whether the determinant *changes* the meaning of the base or merely *unfolds* it. In case the meaning is *changed*, they must be able to show whether the modifiers are objective, or signify some other relation, *e. g.*, time, place, cause, comparison or possession.

In regard to all the foregoing matters, teachers should aim to secure *practical skill in applying the distinctions to examples*, rather than a mere knowledge of their definitions. *In the examination for admission, this skill in practice will be made the vital point.*

[The less familiar of the foregoing distinctions may be defined as follows: —

A *singular* term is one that denotes absolutely but one object of a kind, whether that object be a solitary individual, or a solitary group of individuals. A singular may therefore be either a proper or a collective noun, or any phrase equivalent to either. For example, Julius Cæsar, London, this city, the committee, the cities of the plain.

A *general* term is one that denotes more than one object of a kind, but less than all the possible members of it. It may do this either (1) by naming any *one* of them *indeterminately* (as *man, a man, some man or other*), or (2) by naming several *distributively* (as *men, some men, five men*), or (3) by naming *all* within certain limits — all the *actual* cases as contrasted with all *possible* cases (as *men*, in the sense of *most men* or *all men* hitherto or *all men now living*). For example, cities, all the continents, the continents.

A *universal* term is one that denotes absolutely all the objects of a kind, *i. e.*, all

possible, future as well as present and past. For example, truth, the true, duty, the beautiful, space, time, causality, all triangles, every circle.

The *base* of a complex term is that word, or combination of words, in it that expresses the starting-point of the thought denoted by the whole term. For example, man, in the term "good man"; good man, in the term "every good man."

The *determinant* of a complex term is the word, or combination of words, added to the base, and characterizing it. For example, good, in the term "good man"; every, in "every good man"; of all times, in "the wise and good of all times."

All the other distinctions mentioned above, are to be taken according to the customary usage in treatises on grammar.]

English and American History. — The examination in this subject will be upon the period of the American Revolution beginning with the accession of George III. A better and more thorough knowledge of this portion of history will be expected, than can be obtained from the mere study of the names and dates of a school compendium.

Rhetoric. — In Rhetoric the examination will be confined to those parts of any school manual which give the rules for the construction of sentences, and treat of the qualities which characterize a good style. The object of this examination will be to test the candidate's ability to write good English, and as a preparation for it, *practice* in English composition is strongly recommended in preference to the study of the remaining portions of the Rhetorics.

French. The essential part of the *French requirement for admission* to the school is the grammar, or knowledge of the forms and structure of the language, and we would offer with this in view the following suggestions in regard to the preparatory study.

a. The *verb* should be made the main study, and the other parts of speech in proportion to the closeness of their relation to the same.

b. The *regular conjugations* should be mastered before taking up the study of the irregular ones, and so of the other regular forms and usages as compared with the exceptions and idioms.

c. Next to the verb in importance comes the pronoun, particularly the *personal pronoun*, the form and value of which depends mainly upon its relation to the verb, whether as subject, direct object, *dative*, or as connected by a preposition, a careful analysis alone eliciting the specific relation in each case; hence the importance of a thorough analytical training.

d. The amount of *reading matter* is not so much for the sake of the knowledge of words and its intrinsic value, as to afford a sufficiently wide field for exercise in analysis and the discrimination of forms, quality being more important than quantity, and accuracy essential.

e. In regard to pronunciation, it is more important that the student have an accurate conception of the nasal, e, é, è, and u sounds, the connection of words, and the division into syllables, than greater fluency with less accuracy.

English Literature. — The examination will be upon the literary history of the latter part of the Eighteenth, and the early part of the Nineteenth century. The candidate will be expected to be familiar with the names and general character of the leading writers of that period, and to show an acquaintance, from actual reading, with some portion of its literature.

Algebra. — Besides possessing ability to perform ordinary algebraic operations, the candidate must be able to solve simple and quadratic equations with two or more unknown quantities, and must understand theoretically and practically the involution of algebraic expressions, the extraction of square and cube roots, fractional and negative exponents and radicals.

Geometry. — In plane and solid (including spherical) geometry, the amount contained in the standard text-books on the subject will be required.

ENTRANCE EXAMINATIONS, SEPT. 1877.

ARITHMETIC.

1. Reduce 3£ 8s. 7d. 1far. to farthings.
   Reduce 237806 seconds to days, hours and minutes.
2. Find the prime factors of 15015.
3. Reduce $\frac{\frac{3}{8}-\frac{2}{3}+\frac{5}{6}}{\frac{3}{7} \text{ of } \frac{7}{4}}$ to its simplest form.
4. Divide 1265.35707 by 0.5487.
5. Divide 2 m. 5 fur. 8 rods 2 yds. 2 ft. 3 in. by 5.
6. Find the interest of $1723.18 for 1 yr. 3 mos. 5 days at 6 per cent.
7. Give the tables of weight and of capacity in the Metric System.
8. A meter being 39.37 inches, how many kilometers are there in 2 miles? (One mile = 63360 inches,)
9. A field is 35 meters long, and 23 meters wide; how many square dekameters does it contain?
10. What is the weight in grams of one deciliter of water?

ALGEBRA.

1. Square the expression $3x^2 - 4x - 5$.

2. Factor the expressions $36m^2 - 25n^4$ and $8x^3 + y^3$.

3. Find the Greatest Common Divisor of $8x^2y^3z^4$, $12x^3y^2z^3$ and $20x^4y^3z^2$.

4. Multiply together $\frac{a-b}{a^2+ab}$, $\frac{a^2-b^2}{a^2-ab}$, and $\frac{a^2}{a-b}$.

5. Given $\frac{ab+x}{b^2} - \frac{b^2-x}{a^2b} = \frac{x-b}{a^2} - \frac{ab-x}{b^2}$; find value of x.

6. A certain fraction becomes $\frac{1}{4}$ when 3 is taken from both its numerator and denominator; and it becomes $\frac{1}{2}$ when 5 is added to both its numerator and denominator. What is the fraction?

7. Given $6x^2 + x = 2$; find values of x.

8. Express with fractional exponents, $\sqrt[3]{a^4}$; express with positive exponents, $\frac{a^{-2}\,b^{-\frac{2}{3}}}{c^{-3}d^{-1}}$. Divide $a^{\frac{3}{8}}$ by $a^{-\frac{2}{3}}$.

9. Given $\sqrt{4+x} + \sqrt{x} = 3$; find value of x.

GEOMETRY.

1. If two triangles have the three sides of the one equal to the three sides of the other, each to each, the three angles will also be equal, each to each, and the triangles will also be equal.

2. Prove that if A : B : : C : D, then A + B : A : : C + D : C.

3. Parallelograms which have equal bases and equal altitudes are equivalent.

4. In any triangle, the square of the side opposite to an acute angle is equal to the sum of the squares of the base and of the other side minus twice the rectangle contained by the base and the distance from the acute angle to the foot of the perpendicular let fall from the opposite angle.

5. Define a trapezoid; a sector of a circle. The circumference of a circle is 25.1328; find its radius. ($\pi = 3.1416$.)

6. Any triangular pyramid is the third part of a triangular prism having the same base and altitude.

7. The sum of the sides of a spherical polygon is less than the circumference of a great circle.

8. Define the slant height of a regular pyramid; a spherical segment; a cone. Calculate the surface of a sphere whose radius is 4. ($\pi = 3.1416$.)

ENGLISH GRAMMAR.

1–8. Tell the part of speech of each numbered word in the following stanza: —

"And more[1] I tell thee, haughty peer,
E'en[2] in thy pitch of pride —
Here in thy hold[3], thy vassals near[4] —
I tell thee thou'rt defied!
And if[5] thou said'st I am not peer
To any[6] lord in Scotland here —
Lowland[7] or highland, far[8] or near —
Lord Angus, thou hast lied!"

9. There is an instance of the construction called *apposition* in the stanza: point it out.

10. Of how many distinct sentences does the stanza consist?

11. Divide "More I tell thee" into subject, copula, and predicate.

12–18. Tell whether the following terms taken from the stanza are substantive or attributive: —

12. Tell.
13. Peer.
14. Defied.
15. Not.
16. Here.
17. Any lord in Scotland.
18. In thy pitch of pride.

19–22. Tell whether the following are compound or complex:

19. Thy pitch of pride.
20. Lowland or highland.
21. Scotland, far or near.
22. Peer to any lord.

23–25. Decide whether the following are singular, general, or universal terms:

23. Any lord in Scotland here.
24. Scotland.
25. Thy vassals.

26. Divide the term "Any lord in Scotland" into base and determinant.

27. Does the determinant in this term *change* the meaning of the base, or only *unfold* that which the base itself implies?

28. Does it denote the quality, the quantity, the state, the subject, the object, the time, the place, or the cause of the base?

29. What does *in* [line 2 of stanza] connect, and what relation does it show between them?

30. Give the principal parts of *hast*, *tell*, and *said'st*, and classify each of these verbs as regular or irregular.

31. What are the voice, mode, tense, person and number of *hast lied*?

RHETORIC.

1. In the following description of what constitutes Propriety in Style, fill up the blanks: — "The style should be appropriate to ——. A writer offends against truth and justness on the one hand when in treating of ——— objects and occurrences, he adopts a ——— diction instead of a ——— one; on the other hand when he presents ——— subjects in such a manner as to awaken ——— associations."

2. Of two writers who write on the same subject with equal perspicuity, how may one be much more interesting than the other?

3. It has been said that a man's character may be read in his style: illustrate this by the example of any author you have read.

4. What rhetorical figures do the following examples illustrate?

a. "As a ship aground is battered by the waves, so man, imprisoned in mortal life, lies open to the mercy of coming events."

b. "He trampled on the laws."

c. "But behold wan Dawn before us, whispering a new day's birth."

d. "To Adam, Paradise was a home: to the good among his descendants, Home is a paradise."

5. Point out the faults in the following:

a. "They arrived at, but, for numerous reasons, could not proceed into the town."

b. —"to supply, on the summons of the king, a mounted and armed warrior, to attend at his own cost during 40 days in each year the king upon his military expeditions, wherever he went."

c. "The embers of the late war in that state would be regarded as having a tendency to a line of policy of which northern men do not at the present day heartily approve."

d. "After creeping round the edges of some snowbeds, the angle of the slope diminished."

6. What is an aphorism — a hyperbole? Give examples.

7. Give reasons for or against the adoption of the modern word *telegram*. What rules should govern the adoption of new words?

LITERATURE.

1. Give the period and subject of any one of Scott's novels you have read, and name the leading characters in it.

2. Who wrote the Elegy in a Country Churchyard? Write the first two verses and divide them into feet. (Substitute verses of any other poem if you do not remember these.)

3. Who wrote the Deserted Village -- Tam o'Shanter — the Sketch Book — Thanatopsis?

HISTORY.

1. Give briefly your notion of the character of George III.

2. Give some account of the early life of General Washington.

3. Describe the restrictions placed by the mother country upon the ocean commerce of the Colonies.

4. What military movements led to the battle of Long Island?

5. What was the strategic importance of Ticonderoga?

6. When was the so-called Battle of Bunker Hill fought? What was the object of the movement?

7. Name some of the public offices held by Benjamin Franklin: give some account of him as a writer: and as a student of science.

8. Name any English writers or statesmen who took the side of the Colonies: — any who opposed them.

9. Give some account of the military services of General Greene? — of General Schuyler.

GEOGRAPHY.

1. What is the prevailing direction of the mountain-system of Asia, and what are its principal component chains?

2. Give the location and general boundaries of the main river-basin of the United States, and name the chief river of the basin, with its principal tributaries.

3. What are the Tropics? and why are they called by that name?

4. What two motions has the Earth? What is the ecliptic? What is meant by *the obliquity of the ecliptic*, and what is its value?

5. Give the political divisions of Europe at the present day. To which of the three chief departments of Geography does this last question belong? To which belong questions 1 and 2? To which, questions 3 and 4?

FRENCH.

I. *Translate:* Ayant remarqué que le vent soufflait du Nord où il était au Sud où étaient campés les ennemis, il fit mettre le feu à quantité de paille mouillée, dont la fumée épaisse se répandant sur la rivière, dérobait aux Saxons la vue de ses troupes et de ce qu'il allait faire. A la faveur de ce nuage, il fit avancer des barques remplies de cette même paille fumante, de sorte que le nuage grossissant toujours et chassé par le vent dans

les yeux des ennemis, les mettait dans l'impossibilité de voir si le roi passait ou non.

1. Conjugate in full the present of *fit*, *répandant*, *grossissant*, and the preterit of *mettre*, *avancer*.

2. What is the compound of present of *se répandant* ?

3. What is the singular of *des ennemis*, *les yeux*; the masculine of *épaisse* and plural of *feu*?

4. By what tense do you render, respectively, 'the fire is spreading', 'it was remarked', 'the wood was smoking', 'did you see'?

5. What is the plural of *cette* (*paille*)? When is *celle* used?

Translate into French: 1. I have seen myself in great danger(1). 2. The enemy were advancing on us. 3. Did the wind drive the clouds? 4. He is putting on a thicker coat. 5. The king's troops have beaten(2) the Saxons.

1 danger. 2 battre.

II. Il ne pouvait dans sa jeunesse passer sur un pont sans frémir; il faisait fermer alors les volets de bois de son carrosse : le courage et le génie domptèrent en lui cette faiblesse machinale. Il fit construire un beau port près d'Azof, à l'embouchure du Tanais: il voulait y entretenir des galères ; et, dans la suite, croyant que ces vaisseaux longs, plats et légers devaient réussir dans la mer Baltique, il en a fait construire plus de trois cents dans sa ville favorite de Pétersbourg ; il a montré à ses sujets l'art de les bâtir avec du simple sapin, et celui de les conduire. Il avait appris jusqu'à la chirurgie ; on l'a vu dans un besoin faire la ponction à un hydropique. Il réussissait dans les mécaniques, et instruisait les artisans.

1. Parse (i. e. give the conjugation, tense, mood, person and particular form) the words *devait*, *réussir*, *avait appris*, giving moreover the first person singular of all the tenses of each.

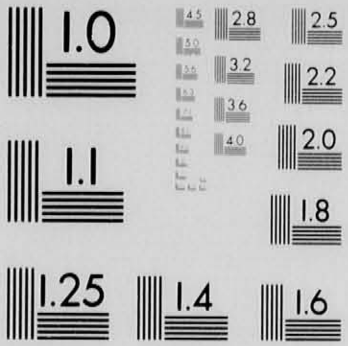
2. Tell all you know about the use of *y* (*entretenir*) and *en* (*a fait*).

3. Parse the pronouns *lui* (*en lui*), *l'* (*a vu*), *celui* (*de les conduire*) pointing out in each case the nouns they refer to, and giving the plural form.

4. Give the feminine and plural of *du* in *du simple sapin*; what does that word mean here?

5. Are personal pronouns ever placed after the verb and when?

Translate into French: 1. We showed him the way. 2. Take him to his room. 3. This ship is built of wood and iron. 4. I have seen her on the bridge.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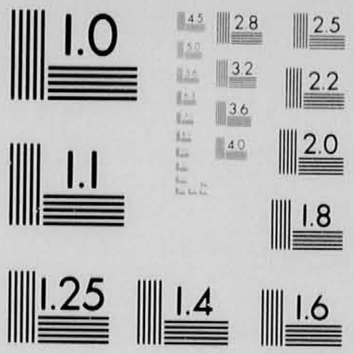
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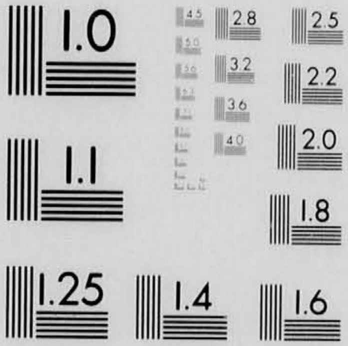
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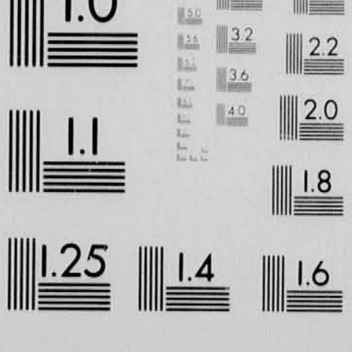
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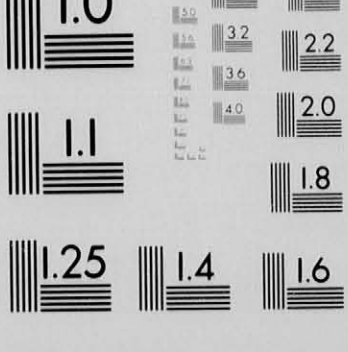
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