

M. I. T. ANNUAL CATALOGUES AND BULLETINS

1869/70

01 OF 01

FIFTH  
ANNUAL CATALOGUE

OF THE

OFFICERS AND STUDENTS

AND

PROGRAMME OF THE COURSE OF INSTRUCTION

TO THE

MASSACHUSETTS INSTITUTE OF TECHNOLOGY.

1869-70.

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BOSTON:  
PRESS OF A. A. KINGMAN.  
1870.

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BOSTON:  
PRESS OF A. A. KINGMAN,  
1870.

*Extract from an Act of the General Court of Massachusetts, approved April 10, 1861, to incorporate the Massachusetts Institute of Technology.*

“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 science in connection with arts, agriculture, manufactures, and commerce.”

*Chapter 183, Acts and Resolves of 1861.*

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The Institute shares the benefits of the Act of Congress of July 2d, 1862, giving Public Lands to the States in aid of instruction in Agriculture and the Mechanic Arts. Under an Act of the General Court of Massachusetts, approved April 27, 1863, the Institute receives from the State “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. . . . 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.*

GOVERNMENT  
OF THE  
MASSACHUSETTS INSTITUTE OF TECHNOLOGY  
FOR THE YEAR 1869-70.

President,  
WILLIAM B. ROGERS.

Vice-Presidents,

JOHN A. LOWELL,  
JACOB BIGELOW,

Secretary,  
SAMUEL KNEELAND.

Committee on Instruction,  
WILLIAM B. ROGERS,  
JOHN D. PHILBRICK,  
HENRY B. ROGERS,  
GEORGE W. TUXBURY,  
JAMES B. FRANCIS,  
EDWARD ATKINSON,  
SAMUEL K. LOTHROP,  
GEORGE T. BIGELOW,  
JOSEPH WHITE.

Committee on Publication,  
JOHN D. RUNKLE,  
CHARLES L. FLINT,  
GEORGE B. EMERSON,  
J. C. HOADLEY,  
ALEXANDER H. RICE.

MARSHALL P. WILDER,  
NATHANIEL THAYER.

Treasurer,  
WILLIAM ENDICOTT, JR.

Committee on Museum,  
ERASTUS B. BIGELGW,  
FREDERIC W. LINCOLN, JR.,  
STEPHEN P. RUGGLES,  
RICHARD C. GREENLEAF,  
JAMES L. LITTLE,  
JOSEPH S. FAY,  
M. DENMAN ROSS,  
CHARLES H. DALTON,  
JOHN CUMMINGS, JR.

Committee on Finance,  
JAMES M. BEEBE,  
EDWARD S. TOBEY,  
J. WILEY EDMANDS,  
J. INGERSOLL BOWDITCH,  
JOHN M. FORBES.

CYRUS M. WARREN, *Chairman of Committee on Chemical Products and Processes.*  
H. WELD FULLER, *Chairman of Committee on Household Economy.*

On the Part of the Commonwealth,

HIS EXCELLENCY, GOVERNOR WILLIAM CLAFLIN.

HON. REUBEN A. CHAPMAN, *Chief Justice of the Supreme Court.*

HON. JOSEPH WHITE, *Secretary of the Board of Education.*

During the temporary absence of the President the duties of the office are performed by Professor Runkle.

# OFFICERS OF INSTRUCTION.

---

## President,

WILLIAM B. ROGERS, LL.D.

- JOHN D. RUNKLE, A.M., PH.D. . . . . *President pro tempore, and Walker Professor of Mathematics and Mechanics.*  
WILLIAM B. ROGERS, LL.D. . . . . *Professor of Geology.*  
FRANK H. STORER, S.B. . . . . *Professor of General and Analytical Chemistry.*  
JOHN M. ORDWAY, A.M. . . . . *Professor of Metallurgy and Industrial Chemistry.*  
CYRUS M. WARREN, S.B. . . . . *Professor of Organic Chemistry.*  
WILLIAM P. ATKINSON, A.M. . . . . *Professor of the English Language and Literature.*  
FERDINAND BÔCHER . . . . . *Professor of Modern Languages.*  
JOHN B. HENCK, A.M. . . . . *Hayward Professor of Civil and Topographical Engineering.*  
WILLIAM WATSON, PH.D. . . . . *Professor of Descriptive Geometry and Mechanical Engineering.*  
WILLIAM R. WARE, S.B. . . . . *Professor of Architecture.*  
GEORGE A. OSBORNE, S.B. . . . . *Professor of Astronomy and Navigation.*  
ALFRED P. ROCKWELL, A.M. . . . . *Professor of Mining Engineering.*  
EDWARD C. PICKERING, S.B. . . . . *Thayer Professor of Physics.*  
SAMUEL KNEELAND, A.M., M.D. . . . . *Professor of Zoology and Physiology.*  
HENRY L. WHITING,  
U. S. Coast Survey . . . . . *Professor of Topography.*  
HENRY MITCHELL, A. M.,  
U. S. Coast Survey . . . . . *Professor of Physical Hydrography.*  
JOHN TROWBRIDGE, S.B. . . . . *Assistant Professor of Physics and Superintendent of Drawing.*  
JOHN A. WHIPPLE . . . . . *Instructor in Photography.*  
ERNEST SCHUBERT . . . . . *Instructor in Free-Hand and Machine Drawing.*  
ALBERT F. HALL, Grad. of the Institute . *Instructor in Mechanical and Plan Drawing.*  
ROBERT H. RICHARDS, Grad. of the Inst. *Instructor in Assaying and Qualitative Analysis.*  
WILLIAM R. NICHOLS, Grad. of the Inst. *Instructor in Determinative Mineralogy and General Chemistry.*  
FRANCIS W. CHANDLER . . . . . *Assistant in Architecture.*  
J. NÖROTH . . . . . *Assistant in German.*  
HOBART MOORE . . . . . *Instructor in Military Tactics.*

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GEORGE A. OSBORNE . . . . . *Secretary of the Faculty. (Address, Mass. Institute of Technology, Boston.)*

The instruction in History and Political Economy is at present given by Professor Atkinson.

# STUDENTS.

## FIRST YEAR.

[The numbers affixed to some of the names indicate that the students thus designated are taking special or partial courses in the years corresponding to the numbers.]

NAME.	RESIDENCE.	ROOM.
Abbott, Frank Pierce 1, 2	Boston . . . . .	6 Arlington St.
Almy, Walter . . . . .	New Bedford . . . . .	74 W. Cedar St.
Barker, George M. . . . .	Boston . . . . .	148 Chandler St.
Barker, Joseph H. . . . .	Cincinnati, O. . . . .	148 Chandler St.
Barnard, Charles I. . . . .	Boston . . . . .	106 Beacon St.
Barnes, William H. . . . .	W. Brookfield . . . . .	29 Charter St.
Barney, Edward E. 1 . . . . .	Dayton, O. . . . .	602 Tremont St.
Barnhill, Brunswick B. . . . .	St. John, N. B. . . . .	493 Tremont St.
Bee, Albert W. . . . .	San Francisco, Cal. . . . .	Dorchester.
Belden, Charles A. . . . .	San José, Cal. . . . .	11 Boylston Pl.
Blaisdell, Hiram W. . . . .	Concord . . . . .	Concord.
Blodgett, George W. . . . .	Lemington, Vt. . . . .	61 Chambers St.
Borden, Philip D., Jr. . . . .	Fall River . . . . .	51 Appleton St.
Brown, Frank N. . . . .	Newton Centre . . . . .	Newton Centre.
Carpenter, George O., Jr. 1	Boston . . . . .	10 Union Park.
Carruth, Charles T. . . . .	Boston . . . . .	1115 Washington St.
Clark, Jonas, Jr. . . . .	Waltham . . . . .	Waltham.
Cleveland, Ralph D. . . . .	Chicago, Ill. . . . .	91 E. Brookline St.
Cogswell, Henry P. . . . .	Salem . . . . .	Salem.
Crosby, Arthur M. . . . .	Jamaica Plain . . . . .	Jamaica Plain.
Dean, Ralph W. . . . .	Boston . . . . .	185 K St.
Dexter, Wallace D. . . . .	Newton Centre . . . . .	Newton Centre.
Duncklee, Horace L., Jr. . . . .	Cambridge . . . . .	Cambridge.
Fabens, Samuel A., Jr. . . . .	Marblehead . . . . .	Marblehead.
Field, James A. 1, 2 . . . . .	Beloit, Wis. . . . .	189 Warren Av.
Fisher, Frederick L. . . . .	Medway . . . . .	Medway.
Forbes, Arthur W. 1, 3 . . . . .	Bangor, Me. . . . .	98 W. Springfield St.



NAME.	RESIDENCE.	ROOM.
Fox, William L. F. . . . .	Philadelphia . . . . .	23 Beacon St.
Freeman, Frederick W. . . . .	Boston . . . . .	37 Union Park.
Greenleaf, Edward H. . . . .	Boston . . . . .	28 Chambers St.
Greenwood, Charles W. . . . .	Cincinnati, O. . . . .	150 Chandler St.
Guild, Frederick, Jr. . . . .	Boston . . . . .	666 Shawmut Av.
Haines, Walter S. . . . .	Chicago, Ill. . . . .	7 Concord Sq.
Hall, Herbert C. . . . .	Somerville . . . . .	Somerville.
Hammord, Edgar B. . . . .	New Bedford . . . . .	9 Merrimack St.
Harris, William D. 1 . . . . .	Truro, N. S. . . . .	493 Tremont St.
Henderson, John A. . . . .	Charlestown . . . . .	Charlestown.
Hill, Charles E. . . . .	Dover, N. H. . . . .	Dover, N. H.
Houghton, George W. W. 1 . . . . .	Cambridgeport . . . . .	Cambridgeport.
Humphrey, William . . . . .	Weymouth . . . . .	16 Edinboro' St.
Hunt, George P. 1 . . . . .	Charlestown . . . . .	Charlestown.
Hutchings, William R. . . . .	Boston . . . . .	10 Franklin Sq.
Jewett, William P. . . . .	Cape Elizabeth, Me. . . . .	Dorchester.
Johnston, Albert W. . . . .	Charlestown . . . . .	Charlestown.
Kimball, George H. . . . .	Maplewood . . . . .	Maplewood.
Kirby, Joseph B. . . . .	Catskill, N. Y. . . . .	189 Warren Av.
Kneeland, Samuel, Jr. 1 . . . . .	Boston . . . . .	United States Hotel.
Leman, William T. . . . .	Chelsea . . . . .	Chelsea.
Leuchars, Alexander . . . . .	Boston . . . . .	131 Appleton St.
Lodge, Henry E. 1, 3 . . . . .	Boston . . . . .	1227 Washington St.
Lucas, Silas T. . . . .	Portland, Me. . . . .	Somerville.
Maloy, George W. . . . .	Boston . . . . .	23 New St.
Mauran, Frederick L. . . . .	Providence, R. I. . . . .	Dedham.
May, William C. . . . .	Dorchester . . . . .	Dorchester.
Mead, Alpheus E. . . . .	North Cambridge . . . . .	North Cambridge.
Means, James 1 . . . . .	Dorchester . . . . .	Dorchester.
Minor, William A. 1 . . . . .	New Britain, Conn. . . . .	Charlestown.
Page, William B. 1 . . . . .	Newton . . . . .	Newton.
Parsons, Charles O. . . . .	Charlestown . . . . .	Charlestown.
Partridge, Henry S. . . . .	Medway . . . . .	Medway.†
Phillips, Henry A. . . . .	Chicago, Ill. . . . .	Jamaica Plain.
Pond, Frank H. . . . .	Woonsocket, R. I. . . . .	7 Asylum St.
Pratt, Nathan D. . . . .	Reading . . . . .	Reading.
Preston, Elliott W. 1 . . . . .	Boston . . . . .	116 Boylston St.
Quincy, Thomas D., Jr. . . . .	Dorchester . . . . .	Dorchester.
Ripley, Henry L. . . . .	Kingston . . . . .	Kingston.
Ross, Waldo O. 1, 3 . . . . .	Jamaica Plain . . . . .	Jamaica Plain.
Russ, Willis R. . . . .	Boston . . . . .	11 Franklin Pl.



NAME.	RESIDENCE.	ROOM.
Salisbury, Eugene F. 1	Lawrence . . . .	Lawrence.
Shailer, Robert A. . . .	Boston . . . . .	2051 Washington St.
Smith, Osgood P. 1 . . . .	Salem . . . . .	Salem.
Stafford, Charles E. . . .	Boston . . . . .	Grove Hall Av.
Steele, Egbert T. . . . .	Dayton, O. . . . .	Winthrop House.
Stone, James E. 1 . . . .	Charlestown . . . .	Charlestown.
Stratton, D. Wilbur 1, 2 . .	Hudson . . . . .	29 Charter St.
Straw, Frank L. . . . .	Hyde Park . . . . .	Hyde Park.
Thayer, Deming, J. 1, 2 . .	Boston . . . . .	47 E. Brookline St.
Tinkham, Samuel E. . . . .	Taunton . . . . .	Malden.
Tompson, George M. . . . .	Wakefield . . . . .	Wakefield.
Toppan, Charles B. 1 . . . .	Greenwood . . . . .	Greenwood.
Very, Frank W. . . . .	Salem . . . . .	Salem.
Wade, Edric A. 1 . . . . .	Lawrence . . . . .	Lawrence.
Warren, Albert C. . . . .	W. Newton . . . . .	W. Newton.
Whitman, Charles B. . . . .	Boston . . . . .	573 Broadway.
Wilder, Stephen H. . . . .	Cincinnati, O. . . . .	Jamaica Pl.
Williams, Francis H. . . . .	Boston . . . . .	15 Arlington St.
Wood, Louis F. . . . .	Newton . . . . .	Newton.
Woodbury, Charles J. H. . .	Lynn . . . . .	Lynn.
Woodbury, Edward F. . . .	Winchester . . . . .	Winchester.

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 S E C O N D Y E A R .

NAME.	RESIDENCE.	ROOM.
Adams, Joseph S. 1, 2 . . . .	Framingham . . . . .	Framingham.
Allen, Calvin F. . . . .	Boston . . . . .	66 Vernon St.
Bigelow, William B. . . . .	New York, N. Y. . . . .	86 Boylston St.
Brewster, Benjamin E. . . . .	Boston . . . . .	Mt. Warren Av.
Browne, Walter H. . . . .	Boston . . . . .	1680 Tremont St.
Carpenter, Charles S. . . . .	Cincinnati, O. . . . .	Waltham.
Carpenter, Edwin J. . . . .	Cincinnati, O. . . . .	Waltham.
Chapman, James R. . . . .	Beverly . . . . .	Beverly.
Crowell, Edwin D. . . . .	East Dennis . . . . .	45 Essex St.
Dodge, William B. 2 . . . .	Beverly . . . . .	Beverly.
Emmerton, Frederick A. . . .	Salem . . . . .	Salem.
Fallon, John H. 2 . . . . .	Lawrence . . . . .	Lawrence.
Farley, Arthur C. 2 . . . . .	Boston . . . . .	41 Allen St.
Foley, John B. . . . .	Boston . . . . .	Edgewood St.
Haley, James W. 2 . . . . .	Salmon Falls, N. H. . . . .	Chelsea.

NAME.	RESIDENCE.	ROOM.
Harkness, Frank 2 . . . .	Cincinnati, O. . . . .	Waltham.
Hodge, James M. . . . .	Plymouth . . . . .	Plymouth.
Howard, William L. 2 . . . .	Canton . . . . .	Canton.
Hunking, Arthur W. 2 . . . .	Haverhill . . . . .	Haverhill.
Knapp, J. Austin . . . . .	Hanover . . . . .	Hanover.
Lewis, David S. 2, 3 . . . . .	Rochester . . . . .	42 Oak St.
Locke, Bradford H. . . . .	Charlestown . . . . .	Charlestown.
Locke, Edward C. . . . .	Watertown . . . . .	Watertown.
Lothrop, Eben W., Jr. . . . .	Chelsea . . . . .	Chelsea.
Minot, Charles S. 1, 2 . . . . .	Jamaica Plain . . . . .	Jamaica Plain.
Morse, Frank B. . . . .	Boston . . . . .	13 Worcester Sq.
Patch, Maurice B. . . . .	Lowell . . . . .	Lowell.
Phillipps, George . . . . .	Marshfield . . . . .	1050 Washington St.
Porter, Theodore C. . . . .	Duxbury . . . . .	Lowell.
Putnam, Nathan B. 2 . . . . .	Salem . . . . .	Salem.
Sparrow, William E., Jr. . . . .	Mattapoisett . . . . .	42 Oak St.
Stafford, Frederick H. . . . .	Boston . . . . .	Grove Hall Av.
Stearns, William H. . . . .	Malden . . . . .	Malden.
Upton, Edgar W. . . . .	Peabody . . . . .	Peabody.
Ward, Clarence S. . . . .	Newtonville . . . . .	Newtonville.
Wheildon, Frederick W. . . . .	Concord . . . . .	Concord.
Wright, John E. . . . .	Prairie du Sac, Wis. . . . .	83 Carver St.

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### THIRD YEAR.

NAME.	RESIDENCE.	ROOM.
Allis, Edward P., Jr. 3 . . . .	Milwaukee, Wis. . . . .	62 Pinckney St.
Appleton, Francis H. 2, 3 (A.B., Harvard College) . . . . .	Boston . . . . .	26 Commonwealth Av
Avery, George A. 3 . . . . .	Boston . . . . .	42 Chester Park.
Badger, George F. 3 . . . . .	Boston . . . . .	2 Pemberton Sq.
Beal, Foster E. L. 3 . . . . } Assistant in Mathematics	Boston . . . . .	127 Emerson St.
Berry, Abraham Hun, 3 . . . . .	Lynn . . . . .	Lynn.
Carter, John R. 2, 3 . . . . .	North Woburn . . . . .	North Woburn.
Chadbourne, John W. 2, 3 . . . .	Chelsea . . . . .	Chelsea.
Clark, George A. 3 . . . . .	Chelsea . . . . .	Chelsea.
Connor, Addison 2, 3 (A.B., Tufts College) . . . . .	Boston . . . . .	165 W. Canton St.
Cutler, Henry M. . . . .	San José, Cal. . . . .	11 Boylston Pl.

NAME.	RESIDENCE.	ROOM.
Damon, C. Willis 1, 3 . . .	Haverhill . . . . .	93 Springfield St.
Danforth, Charles F. . . . .	Chelsea . . . . .	Chelsea.
Darling, Elmer A. 3 . . . . .	East Burke, Vt. . . . .	Auburndale.
Durham, Charles W. 2, 3 . . . . .		
(A.B., <i>Harvard College</i> ) . . . . .	Boston . . . . .	369 Columbus Av.
Faunce, Elmer . . . . .	Kingston . . . . .	Kingston.
Fay, Harrie F. . . . .	Chelsea . . . . .	Chelsea.
Foote, Edward H. . . . .	North Somerville . . . . .	North Somerville.
Herrick, J. Amory 3 . . . . .	Chelsea . . . . .	Chelsea.
Howe, Henry M. 2, 3 (A.B., <i>Harvard College</i> ) . . . . .	Boston . . . . .	32 Mt. Vernon St.
Howland, Albert H. 2, 3 . . . . .		
(A.M., <i>Amherst College</i> ) . . . . .	West Barnstable . . . . .	350 Columbus Av.
Judkins, Charles A. . . . .	Winchester . . . . .	Winchester.
Lee, Henry, Jr., 3 . . . . .	Brookline . . . . .	Brookline.
Levanseler, Frank E. 3 . . . . .	Boston . . . . .	11 Boylston Pl.
Lewis, William W. 3 . . . . .	Boston . . . . .	206 Warren Av.
Lincoln, George R. . . . .	Philadelphia, Pa. . . . .	Hingham.
Lothrop, William U. . . . .	East Boston . . . . .	163 Webster St.
Mason, John R. 2, 3 (A.B., <i>Harvard College</i> ) . . . . .	Bangor, Me. . . . .	Boston.
Meredith, Henry 3 . . . . .	Baltimore . . . . .	Roxbury.
Morse, Henry Hazen 3 . . . . .	Dorchester . . . . .	Dorchester.
Newell, Francis A. 3 . . . . .	Salem . . . . .	Salem.
Page, George W. 3 . . . . .	Boston . . . . .	45 Lawrence St.
Pike, William A. . . . .	Dorchester . . . . .	Dorchester.
Pond, Joseph A. 3 . . . . .	Allston . . . . .	Allston.
Pope, Thomas E. 2, 3 (A.B., <i>Harvard College</i> ) . . . . .	Brookline . . . . .	Brookline.
Pratt, George H. . . . .	Salem . . . . .	Salem.
Reed, John . . . . .	Boston . . . . .	1 Oak Pl.
Rich, Thomas P. 3 . . . . .	Boston . . . . .	92 E. Brookline St.
Richards, Henry 3 (A.B., <i>Harvard College</i> ) . . . . .	Boston . . . . .	85 Pinckney St.
Rollins, Edward W. . . . .	Concord, N. H. . . . .	150 Chandler St.
Scott, Joseph R. . . . .	Jamaica Plain . . . . .	Jamaica Plain.
Shaw, George R. 3 (A.B., <i>Harvard College</i> ) . . . . .	Cambridge . . . . .	Cambridge.
Silsbee, Joseph L. (A.B., <i>Harvard College</i> ) . . . . .	Salem . . . . .	Salem.
Smith, Edward N. 3 . . . . .	Boston . . . . .	141 Harrison Av.

NAME.	RESIDENCE.	ROOM.
Smith, Philip H. 2, 3 . . .	South Hadley Falls . . .	87 Myrtle St.
Smith, Walter W. 3 . . .	Dayton, O. . . . .	189 Warren Av.
Sparks, Wm. Eliot 3 (A.B., <i>Harvard College</i> ) . . .	Cambridge . . . . .	6 Allston St.
Spinning, Frank 3. . . . .	Dayton, O. . . . .	189 Warren Av.
Stearns, William C. 3 . . .	Lexington . . . . .	350 Columbus Av.
Stone, Charles F. . . . .	Waltham . . . . .	350 Columbus Av.
Tappan, Roger 1, 2, 3 . . .	Topsfield . . . . .	Topsfield.
Trowbridge, Almarin, Jr. . . .	Charlestown . . . . .	Charlestown.
Weeks, Isaiah S. P. . . . .	} West Barnstable . . .	7 Sheafe St.
<i>Assistant in Mathematics</i>		
Whitney, Eli, Jr. 1, 2, 3. . .	} New Haven, Conn. . .	8 Berkeley St.
(A.B., <i>Yale College</i> ) . . .		
Whittier, Randal . . . . .	Boston . . . . .	87 Waltham St.
Woodman, Frank 3 (A.B., <i>Harvard College</i> ) . . .	Cambridge . . . . .	Cambridge.

## FOURTH YEAR.

NAME.	RESIDENCE.	ROOM.
Brewster, William W. . . . .	Plymouth . . . . .	Plymouth.
Brooks, Frederick 3, 4 (A.B., <i>Harvard College</i> ) . . .	Boston . . . . .	130 Boylston St.
Cabot, Samuel, Jr. . . . .	Boston . . . . .	11 Park Sq.
Cary, S. Mathews 3, 4 . . .	Houlton, Me. . . . .	1282 Washington St.
Clark, Edward K. . . . .	Bangor, Me. . . . .	98 W. Springfield St.
Cross, Charles R. . . . .	} Newburyport . . . . .	60 Pleasant St.
<i>Assistant in German</i>		
Curtis, Russell H. . . . .	} Jamaica Plain . . . . .	Jamaica Plain.
<i>Assistant in Engineering</i>		
Footman, Frederick N. 4 . . .	Great Falls, N. H. . . .	42 Charles St.
Fuller, Frank L. . . . .	Grantville . . . . .	Grantville.
Hardy, George R. . . . .	Malden Centre . . . . .	Malden Centre.
Henry, William T. 3, 4 . . .	Fall River . . . . .	1282 Washington St.
Hinman, Charles W. . . . .	W. Concord, Vt. . . . .	41 Anderson St.
Lamb, Charles D. 4 (A.B., <i>Harvard College</i> ) . . .	Boston . . . . .	13 Somerset St.
Mason, Sampson D. . . . .	} Concord . . . . .	Concord.
<i>Assistant in Surveying</i>		

NAME.	RESIDENCE.	ROOM.		
Merrill, N. Fred. 3, 4 . . . <i>Assistant in Chemistry</i>	} Cambridgeport . . .	Cambridgeport.		
Pearson, Arthur H. 4 . . . <i>Assistant in Chemistry</i>			} Haverhill . . . . .	Haverhill.
Preble, Henry O, 4 . . . <i>Assistant in Chemistry</i>				
Tillinghast, Theodore F. . .	New Bedford . . . . .	135 Harrison Av.		
Turner, Edmund K. . . . .	Marblehead . . . . .	Marblehead.		
Whittlesey, Walter 3, 4 . . .	Chelsea . . . . .	Chelsea.		
Wilbur, Charles A. . . . .	West Newton . . . . .	West Newton.		
Willard, Daniel W. . . . .	Jamaica Plain . . . . .	Jamaica Plain.		
Woollett, William M. 4 . . .	Albany, N. Y. . . . .	Auburndale.		
Wrinkle, Laurence F. J. . . .	Lee . . . . .	Roxbury.		

S U M M A R Y .

Students of the first year, . . . . .	89
“ “ second year, . . . . .	37
“ “ third “ . . . . .	56
“ “ fourth “ . . . . .	24
Total, . . . . .	206

D A T E S .

School-year began . . . . .	Monday, Oct. 4, 1869.
School-year ends . . . . .	Saturday, June 4, 1870.
The next School-year will begin . . . . .	Monday, Oct. 3, 1870.
Examinations for admission to the first year's class, . . . . .	{ Monday, June 6, 1870. Thursday, Sept. 29, 1870.
Examinations for advanced standing, . . . . .	{ Tuesday, June 7, 1870. Friday, Sept. 30, 1870.

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## GRADUATES IN 1868.

NAME.	RESIDENCE.	IN THE DEPARTMENT OF
Albert F. Hall . . . .	Charlestown . . . .	Mechanical Engineering.
Frank R. Firth . . . .	Boston . . . . .	Civ. and Top. Engineering.
Charles E. Greene . . . .	Cambridge . . . .	" " "
William E. Hoyt . . . .	Portsmouth, N. H. . .	" " "
Walter H. Sears . . . .	Plymouth . . . . .	" " "
Charles A. Smith . . . .	Newburyport . . . .	" " "
Joseph Stone . . . . .	Charlestown . . . .	" " "
Ellery C. Appleton . . . .	Boston . . . . .	Geol. and Min. Engineering.
Nelson W. Conant . . . .	Louisville, Ky. . . .	" "
Charles C. Gilman . . . .	Chelsea . . . . .	" "
Robert H. Richards . . . .	Boston . . . . .	" "
Bryant P. Tilden . . . .	Boston . . . . .	" "
James P. Tolman . . . .	Boston . . . . .	" "
Eli Forbes . . . . .	Clinton . . . . .	Science and Literature.

## GRADUATES IN 1869.

NAME.	RESIDENCE.	IN THE DEPARTMENT OF
William R. Nichols . . . .	Boston . . . . .	Chemistry.
Channing Whitaker . . . .	Lowell . . . . .	Mechanical Engineering.
J. Rayner Edmands . . . .	Boston . . . . .	" "
Howard A. Carson . . . .	Boston . . . . .	Civ. and Top. Engineering.



SCHOOL  
OF THE  
INSTITUTE OF TECHNOLOGY.

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The Massachusetts Institute of Technology provides a four years' course 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. The course is so selected and arranged as to offer a liberal and practical education in preparation for active pursuits, as well as a thorough training for the professions of the Civil and Mechanical Engineer, Chemist, Metallurgist, Engineer of Mines, Architect, and Teacher of Science. All the studies and exercises of the first and second years are pursued by the whole school. At the beginning of the third year, each student selects one of the following special courses of study:—

1. A COURSE IN MECHANICAL ENGINEERING.
2. " " " CIVIL AND TOPOGRAPHICAL ENGINEERING.
3. " " " CHEMISTRY.
4. " " " GEOLOGY AND MINING ENGINEERING.
5. " " " BUILDING AND ARCHITECTURE.
6. " " " SCIENCE AND LITERATURE.

These courses differ widely, but certain general studies are common to them all. It is intended to secure to every student, whatever his special course of study, a liberal mental development and general culture, as well as the more strictly technical education which may be his chief object. The course in Sci-

ence and Literature differs from the others in not having so distinctly a professional character. It offers a sound education founded upon the sciences and modern literature, and furnishes, with its wide range of elective studies, a suitable preparation for any of the departments of active life or for teaching science.

The Institute also provides courses of evening instruction in the main branches of knowledge above referred to, for persons of either sex who, being unable to study during the day, desire to avail themselves of systematic evening lessons or lectures.

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### CONDITIONS OF ADMISSION.

To be admitted to the first year's class the student must have attained the age of sixteen years, and must pass a satisfactory examination in arithmetic, so much of algebra as precedes equations of the second degree, plane geometry, English grammar, and geography. In general, the training given at the best High Schools, Academies, and Classical Schools, will be a suitable preparation for the studies of this School.

In order to enter the second year's class, the student must be at least seventeen years of age, and must pass a satisfactory examination upon 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 students seeking admission into the classes of the succeeding years.

A knowledge of the Latin language is not required for admission; but the study of Latin is strongly recommended to young men who propose to enter this School.

Examinations for admission to the first year's class will be held on Monday, June 8, 1870, and on Thursday, Oct. 1, 1870, beginning at 9 A. M., precisely. The candidates will assemble at the Institute Building, Boylston Street, Boston. The exam-

inations for advanced standing will take place on Tuesday, June 9, 1870, and on Friday, Oct. 2, 1870, beginning at 9 A. M. Applicants for admission are earnestly advised to present themselves at the regular examinations; but under special circumstances, they may present themselves at other times.

To make the opportunities of instruction as widely accessible as possible, students will be allowed to enter special divisions of either of the courses,—as, for example, the classes of mathematics, of engineering, of chemistry, of physics, or of mining and metallurgy,—on giving satisfactory evidence that they are prepared to pursue such special studies with advantage.

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## COURSE OF INSTRUCTION.

### FIRST YEAR.

*Mathematics.* Algebra, beginning with quadratic equations and including logarithms. Solid Geometry. Mensuration. Plane Trigonometry. Applications of Trigonometry to Navigation.

*Physics.* Sound. Heat.

*Chemistry.* Experimental study of General Inorganic Chemistry.

*English.* Composition. History and Structure of the Language.

*German.* Grammar and Translation.

*Descriptive Geometry.* Problems of position relative to the Point, the Right Line, and the Plane.

*Mechanical Drawing.* Use of instruments, water-colors, and India-ink. Graphical construction of problems in Geometry, Trigonometry, and Descriptive Geometry.

*Free-hand Drawing.* With chalk and crayons. Machinery. Ornamentation.

*Errata.*—For dates of Examination, see “Dates,” p. 11.

## SECOND YEAR.

*Mathematics.* Spherical Trigonometry. Analytic Geometry of two and three dimensions. First Principles of the Differential and Integral Calculus.

*Descriptive Astronomy.* The Earth. The Sun. Time. Gravitation. The Moon. Planets. Comets. Nebulæ. Constellations.

*Surveying.* Field-work. Plotting surveys. Computing areas. Plans.

*Physics.* Light. Magnetism. Electricity.

*Chemistry.* Qualitative Analysis. Organic Chemistry.

*English.* Composition. Reading. History of the Language.

*French.* Grammar and Translation.

*German.*

*Descriptive Geometry.* Projections, Perspective, Shades and Shadows.

*Mechanical Drawing.* Geometric, Perspective, and Isometric Drawing.

*Free-hand Drawing.* Machinery. Ornamentation. Landscape.

## THIRD YEAR.

## I. COURSE IN MECHANICAL ENGINEERING.

*Mechanism.* The Principles of Machinery.

*Mathematics.* Differential and Integral Calculus. Analytic Mechanics.

*Applied Mechanics.* Strength of Materials. Friction and Rigidity. Cinematics. Dynamics of Solids. Hydrostatics and Hydrodynamics. Thermodynamics. Useful Effect of Machines.

*Descriptive Geometry.* Applications to Masonry, Carpentry, and Machinery.

*Drawing.* Machinery.

*Physics.* Laboratory Practice.

*Geology.* Physiographic Geology. Lithology. Outline of Geological History. Dynamical Geology.

*English.* Logic. Rhetoric. History of English Literature.

*Constitutional History.* England and the United States.

*French.* (Spanish may be substituted.)

*German.*

## II. COURSE IN CIVIL AND TOPOGRAPHICAL ENGINEERING.

*Engineering.* Survey, Location, and Construction of Roads, Railways, and Canals. Measurement and Computation of Earth-work and Masonry. Supply and Distribution of Water. Drainage. Hydrographical Surveying. River and Harbor Improvements. Field-Practice.

*Mathematics.* Differential and Integral Calculus. Analytic Mechanics.

*Applied Mechanics.* Stress. Stability, Strength, and Stiffness.

*Spherical Astronomy.* Higher Geodesy. Latitude and Longitude.

*Descriptive Geometry.* Applications to Masonry and Carpentry.

*Drawing.* Plans, Profiles, Elevations, Sections, etc.

*Physics.* Laboratory Practice.

*Geology.* Physiographic Geology. Lithology. Outline of Geological History. Dynamical Geology.

*English.* Logic. Rhetoric. History of English Literature.

*Constitutional History.* England and the United States.

*French.* (Spanish may be substituted.)

*German.*

## III. COURSE IN CHEMISTRY.

*Industrial Chemistry.* Study of Chemical Manufactures. Glass, Pottery, Soda-ash, Acids, Soap, Gas, etc. The Arts of Dyeing, Calico-Printing, Tanning, Brewing, Distilling, etc.

*Metallurgy.* Metallurgical Processes, Constructions, and Implements.

*Assaying.* Wet and Dry Ways.

*Descriptive and Determinative Mineralogy.* Use of the Blowpipe.

The foregoing studies are elective. Each student must select one or more of them. The following studies are required:—

*Quantitative Chemical Analysis.* Laboratory Practice.

*Drawing.* Chemical or Metallurgical Apparatus. Plans of Works.

*Physics.* Laboratory Practice.

*Geology.* Physiographic Geology. Lithology. Outline of Geological History. Dynamical Geology.

*English.* Logic. Rhetoric. History of English Literature.



*Constitutional History.* England and the United States.  
*French.* (Spanish may be substituted.)  
*German.*

#### IV. COURSE IN MINING ENGINEERING.

*Engineering.* Survey and Construction of Roads and Railways.  
 Measurement of Earth-work and Masonry. Hydraulics. Drainage. Field-practice.  
*Descriptive and Determinative Mineralogy.* Use of the Blowpipe.  
*Assaying.* Wet and Dry Ways.  
*Quantitative Chemical Analysis.* Laboratory Practice.  
*Metallurgy.* Metallurgical Processes, Constructions, and Implements.  
 Furnaces, Crucibles, Blowing Machines, Fuels, and Fluxes.  
*Mathematics.* Differential and Integral Calculus. Analytic Mechanics.  
*Applied Mechanics.* Stress. Stability, Strength, and Stiffness.  
*Drawing.* Sections and Maps. Mines. Metallurgical Apparatus.  
*Physics.* Laboratory Practice.  
*Geology.* Physiographic Geology. Lithology. Outline of Geological History. Dynamical Geology.  
*English.* Logic. Rhetoric. History of English Literature.  
*Constitutional History.* England and the United States.  
*French.* (Spanish may be substituted.)  
*German.*

#### V. COURSE IN BUILDING AND ARCHITECTURE.

*Architectural Design.* The Elements of Design. The Principles of Composition. Exercises. The Study of Executed Works.  
*Construction.* Building Materials and Processes. The Study of Works in Progress.  
*Drawing.* Plans, Elevations, Sections, and Details. Ornament. Sketching from Buildings.  
*Mathematics.* Differential and Integral Calculus. Analytic Mechanics.  
*Applied Mechanics.* Stress. Stability, Strength, and Stiffness.  
*Descriptive Geometry.* Applications to Masonry and Carpentry.  
*Geology.* Physiographic Geology. Lithology. Outline of Geological History.



*English.* Logic. Rhetoric. History of English Literature.

*Constitutional History.* England and the United States.

*French.* (Spanish may be substituted.)

*German.*

#### VI. COURSE IN SCIENCE AND LITERATURE.

*Mathematics.* Differential and Integral Calculus. Analytic Mechanics.

*Chemistry.* Quantitative Analysis. Pure and Applied Chemistry.

*Physics.* Physical Research.

*Architectural Design.* The Elements of Design. The Principles of Composition. Exercises. The Study of Executed Works.

The foregoing studies are elective. Each student must select one or more of them. He may in addition choose any of the special subjects of the other Professional Courses, such as Descriptive Geometry, Engineering, Spherical Astronomy, Metallurgy, or Mineralogy. The following studies are required :—

*History.* Guizot—Histoire Générale de la Civilisation en Europe.

*Drawing.* Subjects determined by each student's choice of studies.

*Physics.* Laboratory Practice.

*Geology.* Physiographic Geology. Lithology. Outline of Geological History. Dynamical Geology.

*English.* Logic. Rhetoric. History of English Literature.

*Constitutional History.* England and the United States.

*French.* (Spanish may be substituted.)

*German.*

### FOURTH YEAR.

#### I. COURSE IN MECHANICAL ENGINEERING.

*Machines.* Strength and Proportions of the Parts of a Machine. Hand Machinery,—Cranes, Derricks, Pumps, Turn-tables, etc.

*Motors.* Hydraulic Motors. Water-wheels. Water-Pressure Engines. Power and Strength of Boilers. Steam Engines,—Stationary, Locomotive, Marine. Air and Gas Engines.

*Building Materials.* Stones, Bricks, Mortars, and Cements.

*Descriptive Geometry.* Applications to Masonry, Carpentry, and Machinery. Modelling.

*Drawing.* Machines. Working Plans and Projects of Machinery, Mills, etc.

*Political Economy.*

*Natural History.* Zoölogy, Physiology.

*French.* (Italian may be substituted.)

*German.*

## II. COURSE IN CIVIL AND TOPOGRAPHICAL ENGINEERING.

*Engineering.* Structures of Wood,—Framing, Trusses, Girders, Arches, Roofs, Bridges. Structures of Stone,—Foundations, Retaining Walls, Arches, Bridges. Structures of Iron,—Foundations, Beams, Girders, Columns, Roofs, Bridges. Field-practice.

*Machinery and Motors.* Hand Machinery. Water-wheels. Boilers. Steam-engines.

*Building Materials.* Stones, Bricks, Mortars, and Cements.

*Descriptive Geometry.* Applications to Masonry and Carpentry.

*Drawing.* Plans, Profiles, Elevations, Sections, etc.

*Political Economy.*

*Natural History.* Zoölogy and Physiology.

*French.* (Italian may be substituted.)

*German.*

## III. COURSE IN CHEMISTRY.

*Chemistry.* Pure and Applied. Quantitative Analysis. Preparation of Chemical Products. Special Researches.

*Building Materials.* Stones, Bricks, Mortars, and Cements.

*Drawing.* Apparatus. Machinery and Plans of Works.

*Political Economy.*

*Natural History.* Zoölogy and Physiology.

*French.* (Italian may be substituted.)

*German.*

## IV. COURSE IN MINING ENGINEERING.

- Mining.* The Useful Minerals. Modes of occurrence. Prospecting. Boring. Blasting. Sinking Shafts,—Timbering, Walling, and Tubbing. Driving Levels. Methods of Mining. Ventilation. Lighting. Winding Machinery. Ladders and Man-Engines. Underground Transportation. Pumps. Dressing and Concentration of Ores,—Crushers, Stamps, Washers, Amalgamators, etc. Details of American Mining.
- Machinery and Motors.* Hand Machinery. Water-wheels. Boilers. Steam-engines.
- Engineering.* Structures of Wood, Stone, and Iron. Foundations, Walls, Arches, Domes, Beams, Trusses, Girders, Roofs.
- Chemistry.* Quantitative Analysis. Laboratory Practice.
- Geology.* Historical Geology. Palæontology. Detailed study of American Geology.
- Building Materials.* Stones, Bricks, Mortars, and Cements.
- Drawing.* Geological Maps and Sections. Plans and Sections of Mines, Quarries and other open Workings. Mining Machinery and Implements.
- Political Economy.*
- Natural History.* Zoölogy and Physiology.
- French.* (Italian may be substituted.)
- German.*

## V. COURSE IN BUILDING AND ARCHITECTURE.

- Architectural Design.* Exercises in Composition. History of Architecture. The other Arts of Design.
- Professional Practice.* Specifications. Contracts. Estimating and Measuring. Superintendence.
- Drawing.* Architecture, Landscape, and the Human Figure. Lithography and Etching. Modelling. Drawing from Memory.
- Engineering.* Structures of Wood, Stone, and Iron. Foundations, Walls, Arches, Domes, Beams, Trusses, Girders, Roofs.
- Descriptive Geometry.* Applications to Masonry and Carpentry.
- Warming, Lighting, Ventilating, Acoustics.* Lectures.
- Building Materials.* Stones, Bricks, Mortars, and Cements.

*Political Economy.*

*Natural History.* Zoölogy and Physiology.

*French.* (Italian may be substituted.)

*German.*

VI. COURSE IN SCIENCE AND LITERATURE.

*The Higher Mathematics.*

*Chemistry.* Special Researches.

*Physics.* Special Researches.

*Architectural Design.* Exercises in Composition. History of Architecture. The other Arts of Design.

The foregoing studies are elective. Each student must select one or more of them. He may in addition choose any of the special subjects of the other Professional Courses, such as Machinery and Motors, Descriptive Geometry, Engineering, Mining, or Geology. The following studies are required:—

*Mental Science.*

*Building Materials.* Stones, Bricks, Mortars, and Cements.

*Drawing.* Subjects determined by each student's choice of studies.

*Political Economy.*

*Natural History.* Zoölogy and Physiology.

*French.* (Italian may be substituted.)

*German.*

## MILITARY INSTRUCTION.

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 tactics. During the first two years all students are required to attend a weekly exercise in military tactics, unless specially excused. For these exercises they are organized as a battalion of two companies. Arms and equipments are lent to the School by the State. The matter of attendance at drill is under the control of the Secretary of the Faculty; but excuses of general application can only be granted by the Faculty.

## RESIDENCE OF STUDENTS.

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; so that students may conveniently live in either of the adjoining cities or in the neighboring country, if they prefer to do so.

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## 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 on 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 his son's or ward's proficiency 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.

*The Instruction in Chemistry.* In the chemical laboratories provision is made for teaching General Chemistry, Qualitative Analysis, Quantitative Analysis, Assaying, Determinative Mineralogy, the Use of the Blowpipe, Metallurgy, and Industrial Chemistry. The department occupies five ample laboratories, a chemical lecture-room, and a recitation-room, besides rooms for apparatus, balances, and storage.

In the first year, instruction is given in General Chemistry by exercises which combine a recitation and an illustrated lecture, and by weekly lessons 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 important chemical elements. In the second year, a systematic course of instruction in Qualitative Analysis is given, by laboratory



practice and by oral and written examinations. Every student works in the laboratory twice a week during the greater part of the year. Towards the close of the year instruction is given in the elements of Organic Chemistry. Manuals, specially prepared for the purpose, are used in aid of the laboratory instruction given to the classes of the first and second years.

In the third and fourth years the principal subjects of study are Quantitative Analysis, Assaying, Mineralogy, the Use of the Blowpipe, Metallurgy, and Industrial Chemistry. Competent students are encouraged to undertake special researches, and are assisted in bringing them to useful results. A separate laboratory has been fitted for the special use of advanced students.

*The Instruction in Physics.* The course of instruction in Physics, required of all students, extends through two years and a half. The various branches of the subject are treated both mathematically and experimentally.

Through the liberality of friends of the Institute, an extensive collection of acoustic, optical, and electrical apparatus has been obtained, including a Seebeck's siren, a spectroscope of the largest size and most approved form of construction, made by Mr. Alvan Clark, and complete apparatus for exhibiting the electric light, including a polariscope and solar microscope. A large part of the physical apparatus of the Lowell Institute, particularly those portions relating to pneumatics and electricity, has also been lent to the School.

*The Physical Laboratory.* During the third year the instruction is mainly given by laboratory work, each student being required to perform a large number of experiments in the various branches of the subject. To avoid duplication, and so far as possible to prevent breakage by the transfer of apparatus, the same experiment is always performed at the same table, the students occupying the different tables in succession, until the series in hand is completed. By furnishing more places than there are students in the laboratory at any one time, all delay

and confusion are avoided. Each table is supplied with written directions to guide the student in making the experiment.

During this year students are taught the use of the microscope, spectroscope, and various meteorological instruments, and are required to determine the density, specific heat, and other physical constants of various substances. The instruction in *Practical Photography* is given as part of the work in this laboratory. Students in the department of Science and Literature, who choose physics as one of the elective studies of their fourth year, continue their laboratory work in an advanced series of more elaborate experiments, and such original investigations as the taste or capacity of each may determine.

Persons who desire to devote themselves particularly to physical studies may enter this Laboratory as Special Students. It is also open to those who wish to acquire technical skill in the use of special instruments, such as the microscope or spectroscope, or to learn the use of physical apparatus for purposes of instruction.

*The Instruction in Mechanical Drawing.* The use of mathematical instruments and of water-colors and India-ink, is taught during the first two years in connection with the study of Geometry, Trigonometry, Descriptive Geometry and Perspective. During the third and fourth years instruction is given under the supervision of the several professors in the making of the sketches and drawings used in their respective departments.

Every student has a separate drawing table assigned to him, which he may occupy either for drawing or study when not engaged in other exercises. The instruction in drawing is given at stated hours.

Besides an abundant collection of engraved and lithographed copies, the students have the use of an excellent series of manuscript drawings, mostly French, and of models of machinery, carpentry, and engineering works.

*The Instruction in Free-Hand Drawing.* During the first two years, drawing upon the blackboard and with the pencil and crayons is taught according to the system of Mr. Hendrickx, in use in the public schools of Belgium, and lately adopted in the French normal schools. This method, which in Europe is applied chiefly to ornamentation, has been successfully extended in this School to working drawings of machinery and engineering works, as well as of architectural ornament and details. These exercises are thus made auxiliary to those in mechanical and architectural drawing. The style of work is simple, and the treatment of form somewhat conventional; but it enables the student to acquire, even in the short time devoted to it, a method of delineating objects which is of great efficiency and practical value, and which forms an excellent introduction to more artistic study. The application of this method to isometric and perspective drawing, concludes this part of the course.

During the last two years, the students have further practice of the same sort in connection with the special projects upon which they are engaged, including drawing from models and making diagrams.

*The Instruction in Descriptive Geometry.* The course in Descriptive Geometry for the first two years embraces the subjects of orthographical, isometric, and spherical projections, perspective, and shades and shadows. During the third and fourth years it comprehends the practical problems which occur in the construction of stonework, carpentry, and machinery, such as the making of zinc and pasteboard patterns for arches, domes, and staircases, for the articulations of timber, and for the parts of machines.

Problems are given from time to time, and when the subjects admit, the graphical solutions are applied to solids in wood or in plaster, prepared expressly for this purpose.

The students have exercises in modelling in plaster during the latter part of the course.

The instruction is illustrated by more than three hundred models in relief, carefully selected from the best collections in Europe, and in many cases made expressly for the School. Use is also made of the stereoscope and of the stereographs of Saint-Loup.

*The Instruction in Mechanical Engineering.* Besides the ordinary lectures and recitations, there are in this department two distinct kinds of instruction; the first is that given in the drawing rooms in making sketches and finished drawings of machinery from models; the second is the practical instruction by projects. These projects, given in connection with the lectures and complementary to them, are of three kinds. The projects of the first kind comprise those in applied Cinematics, having for their object to determine from the graphical representation of the motion, the form adapted to each piece of mechanism. They include the construction of cams, eccentrics, link work, and all kinds of gearing. Projects of the second kind are exercises in the construction of parts of machines, such as axles, cranks, valves, pistons, and finally of complete machines, from numerical data.

Projects of the third kind are not given until the students have been made acquainted with the doctrine of the strength of materials, so as to be able to find the dimensions of pieces to resist flexure, shearing, torsion, etc. They consist of original designs for machines, involving the determination of the strength, dimensions, and proper proportions of the several parts by calculation. Much value is attached to these last exercises, and the whole of the previous work is made tributary to them.

*Museum of Descriptive Geometry and Mechanics.* The collections of this museum consist of models in wood, in metal, and in plaster, besides lithographs, photographs, and manuscript drawings, arranged for convenience in the following groups. Some of these groups contain one or two hundred models, others only a few typical ones; it is, however, proposed to add from time to time such as may be required for the purposes of instruction.

**Descriptive Geometry.** This group includes models in relief, illustrating the problems of position of the point, the right line and the plane; polyhedrons, single curved, double curved, and warped surfaces, with their sections and intersections; shades, shadows, and reflections.

**Stone Cutting.** Models representing groined and cloistered arches, domes, staircases, etc., with detached voussoirs.

**Carpentry.** Models of joints, frames, roofs, centres for bridges, etc.

**Applied Mechanics.** Plaster models, exhibiting the strongest forms of beams to resist extension, compression, and flexure; casts of Saint-Venant's models, showing the changes of form which prismatic bodies undergo when subjected to flexure, and to torsion; also a full size model of the liquid vein observed and measured by Poncelet and Lesbros in their hydraulic experiments.

**Cinematics.** Models of the contrivances for transmitting, transforming, and modifying motions in machines; such as wheel work, link work, wrapping connectors, cams, etc.

**Machinery.** Models and other illustrations of gas-engines, steam-engines, boilers, fire-grates, etc.

Through the liberality of Hon. Erastus B. Bigelow, the museum has been supplied with a number of highly finished models, made by Schröder of Darmstadt, representing the parts of machines, such as axles, cranks, eccentrics, cross-heads, etc., lifting machines, such as crab-engines, cranes, pumps, presses, etc., and hydraulic motors, such as water-wheels and turbines, and a water-pressure engine.

**Manuscript Drawings.** These include *Projets de Concours* of the *Ecole des Ponts et Chaussées* in Paris; also those relating to *Descriptive Geometry* and the *Construction of Machines*, given at the Polytechnic School at Carlsruhe. The collections also comprise about twelve hundred lithographs, including models for linear design and perspective, and for shading and tinting in India ink and water colors.

**Portfolio of the *Corps des Ponts et Chaussées*.** This rare



collection, made by order of the French Government, and engraved under the supervision of the professors of the *Ecole des Ponts et Chaussées*, contains the working plans with minute details in the various departments of civil and mechanical construction, such as roads, railways and bridges, works of inland navigation, tidal and coast works, lighthouses, railway stations and markets; as well as engines, boilers and machine tools. The plates pertaining to each subject are accompanied by a descriptive text.

This museum is accessible, not only to the students of the school, but to the public.

*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 leveling; 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 courses of the third and fourth years, 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. The department has a good stock of excellent field instruments. An *Observatory*, erected upon the Institute building, from which a large number of coast survey stations are visible, is used in the instruction in triangulation and geodesy.

*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. The maps are completed in the drawing rooms, where instruction is given in the conventional modes of shading and topographical illustration.



*The Instruction in Physical Hydrography* is begun by practice in water surveys. After the student has become familiar with the data and the means of obtaining them, applications are made to the construction of breakwaters, docks, wharves, and other harbor improvements, as well as to the dyking and reclaiming of lands, to the location and construction of canals, and to the rectification of rivers.

*The Instruction in Geology and Mining.* The examination of ores, veinstones, rocks, and fossils, the drawing of geological sections, mining machinery, and plans of mines, and the practical study of the various processes of mining and the details of geology, particularly of American geology, make up the characteristic work of this department. The general aim of the instruction is to give the student an exact knowledge of the subjects discussed, and to develop his judgment and powers of observation. Dana's *Geology* is used as a text-book. Those subjects for which no suitable manuals are accessible are discussed in lectures. During the vacations, students are expected to visit mines, and report upon them with drawings and explanatory memoirs.

The very valuable scientific library and the large and well-selected geological collection of the late Prof. Henry D. Rogers of the University of Glasgow, which have been presented to the Institute by Mrs. Rogers, are of special benefit to the students in Geology and Mining. This collection is made up chiefly of fossils and rock specimens from American localities. Accompanying this collection are a large number of diagrams and maps of great value for the lecture room.

A typical set of models of mining machinery, chiefly from Freiberg, Saxony, will be used in the course of instruction. They are designed mainly to illustrate the principles of the various processes of mining and ore dressing, but combine also the latest improvements in machines. It is proposed, as opportunity offers, to add to this collection other similar models. The collection of ores and vein stones is constantly receiving additions from the various mining regions.

*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, rather than to cover the whole ground of architectural study. The course is, however, practical as well as theoretical, and, besides the scientific study of construction and materials, pursued in connection with the Department of Civil Engineering, 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.

In addition to the exercises which directly accompany and illustrate this instruction, a series of independent exercises in original design, consisting of problems in architecture and ornament, are given out from time to time to any students who have time to give to them, and are sufficiently advanced in their studies to take part in them with profit. It is the object of these problems, by affording a large amount and variety of practice in architectural composition, to enable students to acquire practical skill in design. No student can become a candidate for the Diploma in Architecture, unless he has presented a proper number of such original designs of a suitable degree of merit.

It is clear that the prescribed studies in the third and fourth years leave but little time to the student for acquiring this skill and preparing these works. It is accordingly necessary for most students either to take time for them after their other studies are finished, or to extend their studies over a longer period, and to devote their chief attention, throughout, to the exercises in original composition, to which, indeed, all the rest of their labor is properly subservient.

In the same way practising draughtsmen or assistants in architects' offices are able, by entering this Department as special students, to take up different subjects one by one, and finally to become candidates for the Diploma.

The Boston Society of Architects "wishing to do its part in the work of professional education," have established by con-

sent of the Government of the Institute, two prizes, of the value of fifty dollars each, for students in the first year of their professional studies. These prizes are awarded by a committee acting in behalf of the Society, and are given, one for the best work in the class of design, and one for the best work in the class of construction, during the current year.

*The Architectural Museum.* A large number of photographs, prints, drawings, and casts, have been collected for this Department, by means of a special fund raised for the purpose. This collection includes a number of English and French water-colors, mostly of architectural subjects, several lithographic publications issued by architectural students in England and on the continent, and photographs from the competition drawings for the Foreign Offices, the Law Courts, and the National Gallery in London, and others from French competitions for public buildings, and from the *Concours* of the *Ecole des Beaux-Arts*.

The collection of casts comprises both architectural details and specimens of carving and sculpture illustrating almost every period of art. It includes a large and valuable collection of sculptures from the choir of Lincoln Cathedral, and contains also several models of temples and other buildings lent to the School by the Boston Athenæum.

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

A considerable collection of photographs and lithographs of great interest presented to the Institute by French and English architects, taken from their own works and from their drawings, including photographs of the details of the New Opera House in Paris, presented by Mr. Charles Garnier.

A complete series of drawings, mostly presented by Ernst Bazon, 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, Projet d'ordre, Projet de Construction, Grand Prix de Rome, Envoi de Rome.*

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

Besides the publications of the Royal Institute of British Architects, and of the Architectural Institute of Scotland, and the miscellaneous papers of the Architectural Publication Society, presented by the authorities of these institutions, the following valuable works have been added to these collections by the French Minister of Public Instruction.

Monographie de la Cathédrale de Chartres.

Statistique Monumentale de Paris.

Monographie de l'Eglise Notre Dame de Noyon.

Iconographie Chrétienne.

Comptes de dépenses de la construction du château de Gaillon.

Histoire de l'architecture monastique.

*The Boston Public Library.* The professors and students of the Institute are allowed the full use of this noble 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 150,000 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.

*Excursions for the Inspection and Study of Machines, Processes of Manufacture, Buildings, Works of Engineering, Geological Sections, Quarries, and Mines.* 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 to make visits of inspection to machine-shops, engines, mills, mines, furnaces, and chemical works, and to important buildings and engineering constructions which are within convenient reach.

With a like view they are expected to spend parts of their vacations in excursions for observation and practice.

Visits have recently been made to the Boston Gas Works, Storey's coal-tar works, Downer's Petroleum works, Drake's benzole gas works, Hooper & Co.'s Brass Foundry, and the Eagle Sugar Works in Boston; to the East Boston Sugar Refinery; to Alger's Iron Works, the Bay Side Chemical Works, the Bay State Rolling Mill, and to Whelpley and Storer's machine works at South Boston; to the Middlesex Bleachery; to the Flax Mills, Woolen Mills and Dye Houses at Webster; to the Tanning and Currying works, the Vulcanized Rubber works, and Cochrane's Chemical Works at Malden; to the N. E. Glass Co.'s works at Cambridge; to the Merrimack Chemical Works at Wilmington; to Talbot's Chemical Works at North Billerica; to the Pacific Mills at Lawrence; to the Lowell Machine Shop, the Card Clothing Manufactory and the Carpet Mills at Lowell; to Joslyn's Screw Manufactory in Roxbury, and to the Whiting Mill, Tannery, and Ammonia and Coal Tar Works at Chelsea; to the Charlestown Navy Yard and to the Watertown Arsenal; to the foundery and iron works at Bridgewater; to the iron, copper and yellow-metal works at Canton; to the copper works at Point Shirley; and to the copper works and coal mine at Bristol, R. I., and the works of the Gorham Manufacturing Company and the Corliss Steam Engine Company at Providence, as well as to several docks and ship yards, and to various manufactories of soap, paint, varnish, glass, artificial stone, brick, fire-brick, etc., etc., established within easy reach of the Institute.



## DIPLOMAS AND CERTIFICATES.

As 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 of science to which it relates, it will be conferred on such students only as give proof by examinations and other tests that they possess the prescribed qualifications; and all persons who fulfil this requirement shall be entitled to the testimonials of the Institute, without regard to the length of time they may have spent in the School.

The degrees or diplomas corresponding to the leading departments of the School are as follows:—

1. A DEGREE IN MECHANICAL ENGINEERING.
2. “ “ “ CIVIL AND TOPOGRAPHICAL ENGINEERING.
3. “ “ “ CHEMISTRY.
4. “ “ “ GEOLOGY AND MINING ENGINEERING.
5. “ “ “ BUILDING AND ARCHITECTURE.
6. “ “ “ SCIENCE AND LITERATURE.

To be entitled to either of these degrees, the student must pass a satisfactory examination on the whole course of studies and exercises prescribed in his department, including the elementary and general, no less than the advanced and special subjects. He must, moreover, prepare a dissertation on some subject included in the course of study, an account of some research made by himself, 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. He will be required, also, to have sufficient familiarity with French and German to be able to read without difficulty works in these languages, relating to science and the arts.

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



The form of the degree given by the Institute is "Graduate of the Massachusetts Institute of Technology in the Department of \_\_\_\_\_."

Beside the degrees or diplomas covering the complete courses of study above referred to, certificates of attainment in special subjects will be given to such students as on examination are found to have attained the required proficiency in them.

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## REGULATIONS OF THE SCHOOL.

*School-year.* The School-year begins on the first Monday in October, and ends on the Saturday preceding the first Monday in June. On legal holidays the exercises of the School are suspended.

*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 regular fee for each year is \$150, payable by students who have given bonds, \$100 at the beginning, and \$50 at the middle (first Monday in February) of the School-year. For one-half, or any less fraction of the School-year, the fee is \$100. Students who pursue a partial course pay, in general, the full fee. The fees for special students vary according to

the character of the study chosen, and cannot be specified, except for such special courses as from time to time may be advertised.

*Attendance.* Students are expected to attend all the exercises of the class to which they belong. Special students are expected to attend all the exercises of the course or courses of study which they have chosen. A weekly 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. All students, except special students, are expected to devote themselves to the work of the School between the hours of 9, A. M., and 5, P. M., 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 good order of the School, if repeated after admonition, will be followed by the dismissal of the offender.

## EVENING COURSES OF INSTRUCTION.

This department of the School is intended for the benefit of persons of either sex who are prevented from availing themselves of scientific instruction during the day, but are desirous of pursuing such studies in a systematic way, by the aid of afternoon or evening lessons and lectures. It will embrace a number of distinct courses, more or less varied from year to year by the omission or interchange of particular subjects, but including in their entire scope instruction in mathematics, physics, chemistry, geology, natural history, the English and other modern languages and literatures, navigation and nautical astronomy, architecture, and engineering.

The programme of subjects, and the extent of the several courses, will be made known early 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.

Except in the case of courses in which provision may be made for gratuitous instruction, a fee will be required, payable in advance.

THE TRUSTEE OF THE LOWELL INSTITUTE has established, under the supervision of the Institute of Technology, courses of instruction open to students of either sex, free of charge.

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 occu-

- pations; 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.
  4. It is expected that all persons attending these courses will cheerfully comply with the regulations prescribed for the class or lecture-room.

The courses for 1869-70 are as follows:—

- A course of eighteen lectures on Outlines of Zoölogy, by Dr. Kneeland, on Tuesdays and Fridays, at 7½, P.M., beginning November 9.
- A course of ten lectures on the Mineral Resources of the United States, by Prof. Rockwell, on Mondays and Wednesdays, at 7½, P.M., beginning November 8.
- A course of eighteen lectures in Algebra and Trigonometry, by Prof. Osborne, on Tuesdays and Thursdays, at 7½ P.M., beginning November 9.
- A course of ten lectures on Sound, by Prof. Pickering, on Mondays and Wednesdays, at 7½, P.M., beginning December 13.
- A course of eighteen lectures on Machines and Motors, by Prof. Watson, on Tuesdays and Fridays, at 7½, P.M., beginning January 4.
- A course of eighteen lectures in English History and Literature, by Prof. Atkinson, on Mondays and Thursdays, at 7½, P.M., beginning December 13.
- A course of twenty-four lessons in Mechanical and Machine Drawing, by Mr. Schubert, at 7½, P.M., beginning November 8.

## 1869--70, First Half (Oct.--Feb.) of 1st and 2d Years.

YEAR OF CLASS	9—10	10—11	11—12	12—1	3—4	4—5
MONDAY	First .. I Mathematics .. .. II Mathematics ..	.. II Mathematics .. .. I German ..	.. I German .. .. II English ..	.. II German .. .. I English ..	{ II Draw I Chemical } .. .. Surveying ..	ing .. .. Manipulation ..
TUESDAY	Second .. Desc. Geometry .. .. French ..	.. I Desc. Geometry .. .. I English .. .. I Mathematics ..	.. II English .. .. II Mathematics ..	.. Chemistry .. .. Physics ..	.. Draw .. Chemical	ing .. .. Analysis ..
WEDNESDAY	First .. I Mathematics .. .. German ..	.. II Mathematics .. .. English ..	.. I German .. .. II English ..	.. II German .. .. I English ..	.. Draw .. Surveying ..	ing .. ..
THURSDAY	First .. I Mathematics .. .. Desc. Geometry ..	.. II Mathematics .. .. II Desc. Geometry ..	.. I English .. .. Drawing ..	.. II English .. .. Physics ..	{ I Draw II Chemical } .. .. German ..	ing .. .. Manipulation .. .. French ..
FRIDAY	First .. English .. .. French ..	.. Chemistry .. .. I Mathematics ..	.. I German .. .. II Mathematics ..	.. II German .. .. English ..	.. Draw .. Chemical	ing .. .. Analysis ..
SATURDAY	First .. Mathematics .. .. German ..	.. Military Drill ..	..	..	..	..



## 1869--70, Second Half (Feb.--June,) of 1st and 2d Years.

YEAR OF CLASS	9—10	10—11	11—12	12—1	3—4	4—5
MONDAY						
First	I Mathematics	II Mathematics	I German	II German	II Draw	ing.
Second	Draw	ing	Astronomy		I Chemical	Manipulation
TUESDAY						
First	I English	II English	Physics	Chemistry*	Draw	ing.
Second	French	Mathematics	or Mechanics	Physics	Chemical Analysis	or Organ. Chemistry
WEDNESDAY						
First	I Mathematics	II Mathematics	Physics	German	Draw	ing.
Second	German	English	Draw	ing	Surveying	
THURSDAY						
First	I Mathematics	II Mathematics	I German	II German	I Draw	ing.
Second	Draw	ing	Astronomy	Physics	II Chemical	Manipulation
FRIDAY						
First	I English	II English	Physics	Chemistry*	Draw	ing.
Second	French	Mathematics	or Mechanics	English	Chemical Analysis	or Organ. Chemistry
SATURDAY						
First	Mathematics	} Military Drill.				
Second	German					

\* French will take the place of Chemistry after March 1st.



## 1869--70, First Half of Third Year.

	9-10	10-11	11-12	12-1	3-5
MONDAY	Mechanical Engineering Civil Engineering Chemistry Geology and Mining Building and Architecture Science and Literature	Drawing do Quant. Analysis do Drawing do Quant. Analysis	Drawing Spherical Astron. Laboratory Practice Drawing do Physical Manipulation	Stereotomy do Drawing Stereotomy Physical Manipulation	Machine Drawing Plan Drawing Laboratory Practice Blowpipe and Mineralogy Architectural Design Drawing
TUESDAY	Mechanical Engineering Civil Engineering Chemistry Geology and Mining Building and Architecture Science and Literature	French do do do do do	German do do do do do	Drawing and Perspective do do do do	Mechanical Engineering Civil Engineering Laboratory Practice Civil Engineering Drawing Laboratory Practice
WEDNESDAY	Mechanical Engineering Civil Engineering Chemistry Geology and Mining Building and Architecture Science and Literature	Drawing do do do do do	History do do do do do	Physics do do do do do	Drawing do Laboratory Practice do Architectural Practice Laboratory Practice
THURSDAY	Mechanical Engineering Civil Engineering Chemistry Geology and Mining Building and Architecture Science and Literature	English (U.S. Const.) do do do do do	Drawing Spherical Astron. Laboratory Practice Blowpipe and Mineralogy Drawing Physical Manipulation	Stereotomy do Laboratory Practice do Blowpipe and Mineralogy Stereotomy Physical Manipulation	Drawing Civil Engineering Drawing Civil Engineering Drawing do
FRIDAY	Mechanical Engineering Civil Engineering Chemistry Geology and Mining Building and Architecture Science and Literature	French do do do do do	German do do do do do	Physics do do do do do	Mechanical Engineering Civil Engineering Laboratory Practice Civil Engineering Drawing Laboratory of Physics
SATURDAY	Mechanical Engineering Civil Engineering Chemistry Geology and Mining Building and Architecture Science and Literature	English do do do do do	Military Drill		

Students may join a Spanish Class Tuesdays and Fridays, 4-5 P. M.

1869-70, Second Half of Third Year.

	COURSES IN	9-10	10-11	11-12	12-1	3-5
MONDAY	Mechanical Engineering. Civil Engineering. Chemistry. Geology and Mining. Building and Architecture. Science and Literature.	Mechanics do Indust. Chemistry Mechanics do do	Geology do do do do do	Stereotomy do Laboratory Practice Assaying Stereotomy Physical Manipulation		Drawing Plan Drawing Laboratory Practice Drawing Architectural Design Drawing
TUESDAY	Mechanical Engineering. Civil Engineering. Chemistry. Geology and Mining. Building and Architecture. Science and Literature.	Mechanics do Drawing Mechanics do do	French do do do do do	German do do do do do	Geology do do do do do	Mechanical Engineering. Civil Engineering Laboratory Practice Civil Engineering do Laboratory Practice
WEDNESDAY	Mechanical Engineering. Civil Engineering. Chemistry. Geology and Mining. Building and Architecture. Science and Literature.	Drawing do Quant. Analysis do Drawing Quant. Analysis	Machine Drawing Drawing do do do do	History do do do do do	Physics do do do do do	Machine Drawing Drawing Laboratory Practice do Architectural Practice Laboratory Practice
THURSDAY	Mechanical Engineering. Civil Engineering. Chemistry. Geology and Mining. Building and Architecture. Science and Literature.	Mechanics do Drawing Mechanics do do	English (U.S. Const) do do do do do	Drawing do Laboratory Practice Assaying Drawing Physical Manipulation		Mechanical Engineering. Civil Engineering Drawing Civil Engineering do Drawing
FRIDAY	Mechanical Engineering. Civil Engineering. Chemistry. Geology and Mining. Building and Architecture. Science and Literature.	Mechanics do Drawing Mechanics do do	French do do do do do	German do do do do do	Physics do do do do do	Drawing Civil Engineering Laboratory Practice Civil Engineering do Laboratory or Physics
SATURDAY	Mechanical Engineering. Civil Engineering. Chemistry. Geology and Mining. Building and Architecture. Science and Literature.	English do do do do do	Military Drill			

Students may join a Spanish Class Tuesdays and Fridays, 4-5 P. M.



## 1869-70, Second Half of Fourth Year.

	COURSES IN	9—10	10—11	11—12	12—1	3—5
MONDAY	Mechanical Engineering. Civil Engineering Chemistry Geology and Mining Building and Architecture Science and Literature	Mech. Engineering Civil Engineering Indust. Chemistry Geology Drawing do	..... Drawing do Laboratory Practice do Physiocal Research	..... Drawing do Laboratory Practice do Research	..... Drawing do ..... Drawing do Machinery, Motors do Machinery, Motors do Machinery, Motors	..... Drawing do Laboratory Practice do Architectural Design do
TUESDAY	Mechanical Engineering. Civil Engineering Chemistry Geology and Mining Building and Architecture Science and Literature	..... English do do do do do	..... French do do do do do	..... German do do do do do	Machinery, Motors do Drawing do Machinery, Motors do Drawing do Machinery, Motors	..... Drawing do Laboratory Practice do Modelling do Laboratory Practice
WEDNESDAY	Mechanical Engineering. Civil Engineering Chemistry Geology and Mining Building and Architecture Science and Literature	Mech. Engineering Civil Engineering Quant. Analysis do Drawing Quant. Analysis	..... Drawing do Mining Drawing do do	..... Machine Drawing do do do do do	English (Political Economy) do do do do do	..... Machine Drawing do Drawing do Laboratory Practice do Architectural Practice do Drawing
THURSDAY	Mechanical Engineering. Civil Engineering Chemistry Geology and Mining Building and Architecture Science and Literature	Natural History do do do do	..... Drawing do Laboratory Practice do Drawing Physical Research	..... Drawing do Laboratory Practice do Drawing do	..... Drawing do ..... Geology do Philosophy do	..... Drawing do Laboratory Practice do Drawing do Laboratory Practice
FRIDAY	Mechanical Engineering. Civil Engineering Chemistry Geology and Mining Building and Architecture Science and Literature	Mech. Engineering Civil Engineering Drawing Mining Drawing do	..... French do do do do do	..... German do do do do do	Machinery, Motors do Drawing do Machinery, Motors do Drawing do Machinery, Motors	..... Drawing do Laboratory Practice do do Drawing do do
SATURDAY	Mechanical Engineering. Civil Engineering Chemistry Geology and Mining Building and Architecture Science and Literature	..... Drawing do do Mining Drawing do	..... Military Drill do	.....	.....	..... do do do do do do do

Students in either of the courses may join an Italian class, on Wednesdays, from 11 to 12 A. M., and Fridays, from 3 to 4, P. M.

