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CALIFORNIA INSTITUTE

OF

TECHNOLOGY

ANNUAL CATALOGUE

PASADENA, CALIFORNIA

DECEMBER, 1926

Contents

Calendar

1927

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Calendar

1927

JANUARY 3.....Registration (9 A. M. to 3 P. M.)
JANUARY 22.....Examinations for Removal of Conditions
MARCH 1.....Last Day for Receiving Applications for Graduate Fellowships and Assistantships.
MARCH 16-19.....Term Examinations
MARCH 19.....End of Second Term (12 M.)
MARCH 20.....Notifications of Appointment to Graduate Fellowships and Assistantships Mailed
MARCH 20-27.....Recess
MARCH 26.....Meetings of Registration Committees
MARCH 28.....Registration (9 A. M. to 3 P. M.)
APRIL 16.....Examinations for Removal of Conditions
MAY 9.....Latest Date for Removing Senior Deficiencies
MAY 26.....Last Day for Examinations and Presenting Theses for the Degree of Doctor of Philosophy to be Conferred in June.
MAY 30.....Memorial Day Recess
JUNE 2.....Last Day for Taking Examinations and Presenting Theses for the Degree of Master of Science to be Conferred June, 1927.
JUNE 4.....End of Examinations for Seniors
JUNE 7-11.....Term Examinations for all Students except Seniors
JUNE 7.....Departmental Meetings (9 A. M.)
JUNE 7.....Faculty Meeting (10:30 A. M.)
JUNE 9.....Class Day
JUNE 10.....Commencement
JUNE 10.....Annual Meeting of Alumni Association
JUNE 11.....End of College Year
JUNE 10-11.....Examinations for Admission to Upper Classes
JUNE 20.....Meetings of Registration Committees
JUNE 27-28.....Examinations for Admission to Freshman Class and for Freshman Scholarships
SEPTEMBER 19-20....Examinations for Admission to Freshman Class
SEPTEMBER 20-21.....Examinations for Admission to Upper Classes
SEPTEMBER 21.....Examinations for Removal of Conditions
SEPTEMBER 22.....Registration of Freshmen (9 A. M.)

SEPTEMBER 23	General Registration (9 A. M. to 3 P. M.)
SEPTEMBER 24	General Registration (9 A. M. to 12 M.)
SEPTEMBER 26	Beginning of Instruction
NOVEMBER 24-27	Thanksgiving Recess
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DECEMBER 14-17	Term Examinations
DECEMBER 17	Last Day for Filing Applications for Candidacy for the Degree of Doctor of Philosophy, to be Conferred June, 1928.
DECEMBER 17	End of First Term (12 M.)
DECEMBER 31	Meetings of Registration Committees

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(Arranged in the order of seniority of service)

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Professor of Organic Chemistry, Harvard University

HENDRIK ANTOON LORENTZ, PH.D.
Research Associate in Physics
Professor of Mathematical Physics, University of Leiden

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Nobel Laureate
Research Associate in Physics
Professor of Physics, University of Chicago

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Research Associate in Aeronautics
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Research Associate in Seismology
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Director of the Norman Bridge Laboratory of Physics

Chairman of the Executive Council

A.B., Oberlin College, 1891; A.M., 1893; Ph.D., Columbia University, 1895. Assistant in Physics, University of Chicago, 1896-1897; Associate, 1897-1899; Instructor, 1899-1902; Assistant Professor, 1902-1907; Associate Professor, 1907-1910; Professor, 1910-1921; Director, Norman Bridge Laboratory of Physics, California Institute of Technology, 1921. Vice-President, American Association for the Advancement of Science, 1911; Sc.D., (hon.) Oberlin College, 1911; Sc.D., (hon.) Northwestern University, 1913; Member, American Philosophical Society, 1914; Member, National Academy of Sciences, 1915; Member, American Academy of Arts and Sciences, 1915; Sc.D., (hon.) University of Pennsylvania, 1915; Sc.D., (hon.) Amhurst College, 1917; Sc.D., (hon.) Columbia University, 1917; LL.D., (hon.) University of California, 1924; Sc.D., (hon.) University of Dublin, 1924; LL.D., (hon.) Yale University, 1925; Ph.D., (hon.) King John Casimir University, Lwów, Poland; President, American Physical Society, 1916-1918; Vice-Chairman, National Research Council 1916-; Lieutenant-Colonel, U. S. A., and Chief, Science and Research Division of Signal Corps, 1917-1919; Corresponding Member, Société Batave de Philosophie Expérimentale à Rotterdam, 1919; Hon. Member, Royal Institution of Great Britain, 1920; American Representative, Troisième Conseil de Physique Solvay, Brussels, 1921; Exchange Professor, Belgium, 1922; Member, La Société Hollandaise des Sciences, 1922; American Representative Committee on Intellectual Co-operation, League of Nations; Hon. Member, Royal Irish Academy, 1924; Corresponding Member, Académie des Sciences de Russie, 1925; Corresponding Member, Institut de France, Académie des Sciences, 1925; Member, Die Gesellschaft der Wissenschaften zu Göttingen, 1926. Recipient of Comstock Prize, National Academy of Sciences, 1913; of Edison Medal of the American Institute of Electrical Engineers, 1922, of the Nobel Prize in Physics of the Royal Swedish Academy, 1923, of the Hughes Medal of the Royal Society of Great Britain, 1923, of the Faraday Medal of the London Chemical Society, 1924, of the Matteucci Medal of the Societa Italana della Scienze, 1925, and of the Gold Medal of the American Society of Mechanical Engineers, 1926. California Institute, 1916-

300 Palmetto Drive

ARTHUR AMOS NOYES, Ph.D., LL.D., Sc.D.

Director of the Gates Chemical Laboratory

S.B., Massachusetts Institute of Technology, 1886; S.M., 1887; Ph.D., University of Leipzig, 1890; LL.D., (hon.) University of Maine, 1908; Clark University, 1909; University of Pittsburgh, 1915; Sc.D., (hon.) Harvard University, 1909; Yale University, 1913. Assistant and Instructor in Analytical Chemistry, Massachusetts Institute of Technology, 1887-1892; Instructor in Organic Chemistry, 1892-1894; Assistant and Associate Professor of Organic Chemistry, 1894-1899; Professor of Theoretical Chemistry, 1899-1919; Director of the Research Laboratory of Physi-

cal Chemistry, 1903-1919. Acting President, Massachusetts Institute of Technology, 1907-1909; President, American Chemical Society, 1904; President, Pacific Division of American Association for Advancement of Science, 1926-7; Honorary Fellow, Royal Society of Edinburgh; Member, National Academy of Sciences, American Philosophical Society, and American Academy of Arts and Sciences; Willard Gibbs Medal, American Chemical Society, 1915. California Institute, 1913-

1025 San Pasqual Street

LEWIS M. ADAMS, LIEUT. COLONEL

Corps of Engineers, U. S. Army (Rtd.)

Professor of Military Science and Tactics

Graduate, U. S. Military Academy, West Point, 1903, with rank of 2nd Lieutenant, Corps of Engineers; Engineer School, 1907; Honor Graduate, Army Field Engineering School, 1914; graduate, Army Staff College, 1915. Colonel (temporary), Corps of Engineers, 1918-1920; District Engineer (Galveston District, Gulf Division) 1920-1924. California Institute, 1924-

1855 San Pasqual Street

EDWARD CECIL BARRETT, B.A.

Secretary of the Institute

B.A., State University of Iowa, 1906. Assistant Secretary, Board of Regents, 1906-1907; Registrar and Secretary to the President, State University of Iowa, 1907-1911. California Institute, 1911-

942 North Chester Avenue

HARRY BATEMAN, PH.D.

Professor of Mathematics, Theoretical Physics, and Aeronautics

B.A., Cambridge University, 1903; Smith Prize, 1905; Fellowship, Trinity College, Cambridge, 1905-1911; Universities of Göttingen and Paris, 1905-1906; M.A., Cambridge University, 1906; Ph.D., Johns Hopkins University, 1913. Lecturer in Mathematics, University of Liverpool, 1906-1907; Reader in Mathematical Physics, University of Manchester, 1907-1910; Lecturer in Mathematics, Bryn Mawr College, 1910-1912; Lecturer in Applied Mathematics, Johns Hopkins University, 1915-1917. California Institute, 1917-

310 Commonwealth Avenue, La Canada

Mail Address: Box 163, Route 4, Pasadena

STUART JEFFERY BATES, PH.D.

Professor of Physical Chemistry

B.A., McMaster University, Toronto, 1907; M.A., 1909; Ph.D., University of Illinois, 1912. Chemist, Comfort Soap Works, Toronto, 1907-1908; Research Assistant, McMaster University, 1909-1910; Fellow in Chemistry, University of Illinois, 1910-1912; Research Associate in Physical Chemistry, 1912-1913. Instructor in Analytical Chemistry, University of Illinois, 1913-1914; Research Associate in Physical Chemistry, Massachusetts Institute of Technology, 1922-1923 (on leave from California Institute of Technology). California Institute, 1914-

1671 Oakdale Street

ERIC TEMPLE BELL, PH.D.

Professor of Mathematics

A.B., Stanford University, 1904; A.M., University of Washington, 1908; Ph.D., Columbia University, 1912. Instructor, Assistant Professor, Associate Professor, University of Washington, 1912-1922; Professor, 1922-1926. Bôcher Prize, American Mathematical Society, 1924; Vice-President, American Mathematical Society, 1926-; Colloquium Lecturer, American Mathematical Society, 1927. Professor, summer quarters, University of Chicago, 1924-1927; Visiting Lecturer, Harvard University, first half 1926. California Institute, 1926-

434 South Michigan Avenue

JAMES EDGAR BELL, PH.D.

Professor of Chemistry

S.B., University of Chicago, 1905; Ph.D., University of Illinois, 1913. Graduate student, University of Chicago,, 1908-1910; Graduate student and assistant, University of Illinois, 1911-1913; Instructor in Chemistry, University of Washington, 1910-1911, 1913-1916. California Institute, 1916-

Sierra Madre Villa, R. D. 3, Box 639

GILMOR BROWN

Director of Public Speaking and Dramatics

Formerly with Ben Greet Players; Producing Director of Pasadena Community Playhouse since its organization, 1917; lecturer on Community Drama, Drama League Institute, Chicago, 1921; Summer Art Colony, Pasadena, 1922-1923, University of Southern California, summer of 1923. California Institute, 1925-

251 South Fair Oaks Avenue

JOHN PETER BUWALDA, PH.D.

Professor of Geology

B.S., University of California, 1912; Ph.D., 1915. Instructor, University of California, 1915-1917; Assistant Professor of Geology, Yale University, 1917-1921; Associate Professor of Geology, University of California, 1921-1925; Professor of Geology, 1925; Dean of the Summer Sessions, 1923-1925. Associate Geologist, U. S. Geological Survey. California Institute, 1925-

296 South Chester Avenue

W. HOWARD CLAPP, E.M.

Professor of Mechanism and Machine Design

E.M., University of Minnesota, 1901. Instructor in Mathematics, Macalester College, 1897-1898. Superintendent and Designing Engineer, Sherman Engineering Company, Salt Lake City, 1905-1909; Superintendent, Nevada-Goldfield Reduction Company, Goldfield, Nevada, 1909-1910. California Institute, 1911-

95 South Mentor Avenue

ROBERT L. DAUGHERTY, M.E.

Professor of Mechanical and Hydraulic Engineering

A.B. in Mechanical Engineering, Leland Stanford Junior University, 1909; M.E., 1914. Assistant in Mechanics, Leland Stanford Junior University, 1907-1908; Assistant in Hydraulics, 1908-1909; Instructor in Mechanical Engineering, 1909-1910; Assistant Professor of Hydraulics, Sibley College, Cornell University, 1910-1916; Professor of Hydraulic Engineering, Rensselaer Polytechnic Institute, 1916-1919. Member of Council, American Society of Mechanical Engineers, 1925- California Institute, 1919-

373 South Euclid Avenue

DONALD RYDER DICKEY, M.A.

Research Associate in Vertebrate Zoology

A.B., Yale University, 1910; M.A., (hon.) Occidental College, 1925. California Institute, 1926-

514 Lester Avenue

PAUL SOPHUS EPSTEIN, PH.D.

Professor of Theoretical Physics

C.Sc., Moscow University, 1906; M.Sc., 1909; Ph.D., University of Munich, 1914. Assistant in Physics, Moscow Institute of Agriculture, 1906-1907; Assistant in Physics, Moscow University, 1907-1909; Privat docent, Moscow University, 1909-1913; Privat docent, University of Zurich, 1919-1922. California Institute, 1921-

709 Maple Street

LUCIEN HOWARD GILMORE, A.B.

Professor of Physics

A.B., Leland Stanford Junior University, 1894. Acting Assistant, Department of Physics, Leland Stanford Junior University, 1894-1895. California Institute, 1895-

649 Galena Avenue

FREDERIC W. HINRICHS, JR., M.A.

Professor of Mechanics

Dean of Upper Classmen

A.B., Columbia University, as of 1902. M.A., (hon.) Occidental College, 1926. Graduate of the United States Military Academy, West Point, 1902. Assistant Professor, Professor of Applied Mechanics, University of Rochester, 1910-1919. California Institute, 1920-

1071 Garfield Avenue

CLINTON KELLY JUDY, M.A.

Professor of English Language and Literature

A.B., University of California, 1903; M.A., 1907; B.A., Oxford University, 1909; M.A., 1913; M.A., Harvard University, 1917. California Institute, 1909-

1325 Woodstock Road, San Marino

GRAHAM ALLAN LAING, M.A.

Professor of Economics and Business Administration

B.A., University of Liverpool, 1908; M.A., 1909; Gladstone Prize in History and Political Science, Rathbone Prize in Economics, Liverpool University, 1907; Workers' Educational Association Lecturer in Economic History for Liverpool University, 1909-1913; Secretary, Department of Education, Government of British Columbia, 1913-1914; Director of Technical Education, Vancouver, B.C., 1914-1917; Instructor in Economics and History, University of California, 1917-1918; Assistant Statistician, United States Shipping Board, 1918-1919; Assistant Professor of Social Science, University of Arizona, 1919-1921. California Institute, 1921-

1081 Elizabeth Street

JOHN ROBERTSON MACARTHUR, PH.D.

Professor of Languages
Dean of Freshmen

B.A., University of Manitoba, 1892; Ph.D., University of Chicago, 1903. Lecturer in Modern Languages, Manitoba College, 1893-1898; Professor of English, New Mexico Agricultural College, 1903-1910, 1911-1913; Professor of English, Kansas State Agricultural College, 1914-1920. Agent of International Committee of Young Men's Christian Association, Ellis Island, 1910-1911. California Institute, 1919-

866 South Pasadena Avenue

WILLIAM BENNETT MUNRO, PH.D.

Lecturer on Modern Civilization*

B.A., Queens University, 1895; M.A., 1896; LL.B., 1898; M.A., Harvard University, 1899; Ph.D., 1900; Parker Travelling Fellow, Harvard University, 1900-1901; M.A. (hon.) Williams College, 1904; LL.D. (hon.) Queens University, 1912. Instructor in History and Political Science, Williams College, 1901-1904; Instructor in Government, 1904-1906; Assistant Professor, 1906-1912; Professor of Municipal Government, 1912-, Harvard University; Chairman of the Division of History, Government and Economics, 1920-; Weil Foundation Lecturer, University of North Carolina, 1921; McBride Foundation Lecturer, Western Reserve University, 1925. Major, United States Army, 1918-1919; Fellow of the American Academy of Arts and Sciences.

268 Bellefontaine Street

ROYAL WASSON SORENSEN, B.S. in E.E.

Professor of Electrical Engineering

B.S. in Electrical Engineering, University of Colorado, 1905. Associated with General Electric Co., Schenectady, N. Y., and Pittsfield, Mass., 1905-1910; Consulting Engineer, Pacific Light and Power Corporation, 1913-1917. Fellow, American Institute of Electrical Engineers; Consulting Engineer, U. S. Electrical Manufacturing Company, 1917. California Institute, 1910-

384 South Holliston Avenue

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*Second and third terms, 1926-1927. On leave of absence from Harvard University.

CHESTER STOCK, PH.D.

Professor of Paleontology

B.S., University of California, 1914; Ph.D., 1917. Research Assistant Department of Paleontology, University of California, 1917-1919; Instructor, 1919-1921; Assistant Professor, Department of Geological sciences, 1921-1925. Investigator, Carnegie Institution of Washington. Vertebrate Paleontologist, Los Angeles Museum. California Institute, 1926-

272 South Chester Avenue

CARL CLAPP THOMAS, M.E.

Associate in Engineering Research

Stanford University, 1891-1894; M.E., Cornell University, 1895. Engaged in Design and Construction of Marine Machinery for Merchant and Naval Vessels, 1895-1904. Professor of Marine Engineering, Cornell University, 1904-1908. Chairman, Department of Mechanical Engineering, University of Wisconsin, 1908-1913; Head of Department of Mechanical Engineering, Johns Hopkins University, 1913-1920. Manager, Machinery Design and Fabrication, United States Government, Hog Island Shipyard, 1917-1919 (on leave from Johns Hopkins University). Vice-President, Dwight P. Robinson & Company, Inc., Engineers and Constructors, 1920. Member American Engineering Council, 1923-. Longstreth Medalist, Franklin Institute, for work on measurement of gases, 1912. California Institute, 1925-

165 Puente Drive

FRANKLIN THOMAS, C.E.

Professor of Civil Engineering

B.E., University of Iowa, 1908; C.E., 1913. Graduate work at McGill University, Montreal. Instructor in Descriptive Geometry and Drawing, University of Michigan, 1910-1912. Construction Foreman, Mines Power Company, Cobalt, Ontario, 1909-1910; Designer, Alabama Power Company, Birmingham, Alabama, 1912-1913. Assistant Engineer, U. S. Reclamation Service, 1919. California Institute, 1913-

685 South El Molino Avenue

RICHARD CHACE TOLMAN, PH.D.

Professor of Physical Chemistry and Mathematical Physics

S.B. in Chemical Engineering, Massachusetts Institute of Technology, 1903; Ph.D., 1910; Student, Universities of Berlin and Crefeld, 1903-1904. Dalton Fellow, Instructor in Theoretical Chemistry, and Research Associate in Physical Chemistry, Massachusetts Institute of Technology, 1905-1910; Instructor in Physical Chemistry, University of Michigan, 1910-1911; Assistant Professor of Physical Chemistry, University of Cincinnati, 1911-1912; Assistant Professor of Chemistry, University of California, 1912-1916; Professor of Physical Chemistry, University of Illinois, 1916-1918; Chief, Dispersoid Section, Chemical Warfare Service, 1918; Associate Director and Director, Fixed Nitrogen Research Laboratory, Department of Agriculture, 1919-1921. Member of National Academy of Sciences, and of American Academy of Arts and Sciences. California Institute, 1921-

345 South Michigan Avenue

HARRY CLARK VAN BUSKIRK, PH.B.

Professor of Mathematics

Registrar

Ph.B., Cornell University, 1897. California Institute, 1904-

3480 East Colorado Street

WILLIAM NOBLE LACEY, PH.D.

Associate Professor of Chemical Engineering

A.B. in Chemical Engineering, 1911, and Chemical Engineer, 1912, Leland Stanford Junior University; M.S., 1913, Ph.D., 1915, University of California; Assistant in Chemistry, Leland Stanford Junior University, 1911-1912; Assistant in Chemistry, University of California, 1912-1915; Research Chemist for Giant Powder Co., San Francisco, 1915; Research Associate, Massachusetts Institute of Technology, 1916. California Institute, 1916-

334 Berkeley Avenue

HOWARD JOHNSON LUCAS, M.A.

Associate Professor of Organic Chemistry

B.A., Ohio State University, 1907; M.A., 1908; Assistant in Organic Chemistry, Ohio State University, 1907-1909; Fellow in Chemistry, University of Chicago, 1909-1910; Chemist, Bureau of Chemistry, United States Department of Agriculture, 1910-1912. Chemist, Government of Porto Rico, 1912-1913. California Institute, 1913-

97 North Holliston Avenue

GEORGE RUPERT MACMINN, A.B.

Associate Professor of English Language and Literature

A.B., Brown University, 1905. Instructor in English, Brown University, 1907-1909; Iowa State College, 1909-1910; University of California, 1910-1918. Manager of the University of California Press, 1912-1913. Editor, University of California Chronicle, 1915. California Institute, 1918-

255 South Bonnie Avenue

ROMEO RAOUL MARTEL, S.B.

Associate Professor of Civil Engineering

S.B., Brown University, 1912. Instructor in Civil Engineering, Rhode Island State College, 1913-1914; Instructor in Civil Engineering, Mechanics Institute, 1914-1915. With Sayles Finishing Plants, Saylesville, R. I., 1915-1918; with Atchison, Topeka and Santa Fe Railway, Amarillo, Texas, 1918. Resident Engineer, California Highway Commission, Willits, California, summer of 1921. Consulting Engineer on Bridge Design for City of Pasadena, 1921-1924. Representative of Southern California Council on Earthquake Protection at Third Pan-Pacific Science Congress, Tokyo, 1926. California Institute, 1918-

690 South Mentor Avenue

WILLIAM WHIPPLE MICHAEL, B.S.

Associate Professor of Civil Engineering

B.S. in Civil Engineering, Tufts College, 1909. With New York City on topographic surveys, 1909-1911; with The J. G. White Engineering Corporation, 1912-1913, and 1915; Instructor, Department of Drawing and Design, Michigan Agricultural College, 1914; with The Power Construction Company of Massachusetts, 1914-1915; in private practice, 1916-1918. California Institute, 1918-

376 South Wilson Avenue

WILLIAM L. STANTON, B.A.

Physical Director

B.A., Dickinson College, 1903. Assistant Director of Physical Education, Pratt Institute, 1903-1904; Director of Athletics and Physical Education, Morristown School, 1905-1906; Professor of English and Director of Athletics, Hamilton Institute, 1906-1908; Graduate student of English, Columbia University, 1907; Director of Athletics and Instructor in Dramatics, Pomona College, 1908-1916; Director of Athletics and Instructor in English and Dramatics, Occidental College, 1916-1917; Director of Athletics and Dramatics, Occidental College, 1919-1921. California Institute, 1921-

515 Manzanita Avenue, Sierra Madre

EARNEST CHARLES WATSON, PH.B.

Associate Professor of Physics

Ph.B., Lafayette College, 1914; Scholar in Physics, University of Chicago, 1914-1915; Assistant in Physics, University of Chicago, 1915-1917. California Institute, 1919-

1124 Stevenson Avenue

LUTHER EWING WEAR, PH.D.

Associate Professor of Mathematics

A.B., Cumberland University, 1902; Ph.D., Johns Hopkins University, 1913. Graduate student and fellow, Johns Hopkins University, 1908-1909, 1910-1913. Instructor in Mathematics, University of Washington, 1913-1918. California Institute, 1918-

68 South Grand Oaks Avenue

IRA SPRAGUE BOWEN, PH.D.

Assistant Professor of Physics

A.B., Oberlin College, 1919; Ph.D., California Institute of Technology, 1926. Assistant in Physics, University of Chicago, 1920-1921. California Institute, 1921-

1170 Steuben Street

LOUIS J. CLATERBOS, B.S. IN C.E. FIRST LIEUTENANT

Corps of Engineers, U. S. Army

Assistant Professor of Military Science and Tactics

Graduate, U. S. Military Academy, West Point, with rank of Second Lieutenant, Field Artillery, 1920. Transferred to Corps of Engineers as Second Lieutenant, 1920. Graduate Engineer School, Fort Humphreys, Virginia, 1921; B.S. in C.E., Rensselaer Polytechnic Institute, 1922. California Institute, 1925-

315 South Mentor Avenue

ROSCOE GILKEY DICKINSON, PH.D.

Assistant Professor of Physical Chemistry

S.B., Massachusetts Institute of Technology, 1915; Ph.D., California Institute of Technology, 1920. Assistant in Theoretical Chemistry, Massachusetts Institute of Technology, 1915-1916; Research Assistant in Physical Chemistry, Research Laboratory of Physical Chemistry, Massachusetts Institute of Technology, 1916-1917. California Institute, 1917-

212 South Grand Oaks Avenue

SAMUEL STUART MACKEOWN, PH.D.

Assistant Professor of Electrical Engineering

A.B., Cornell University, 1917; Ph.D., 1923. Instructor in Physics, Cornell University, 1920-1923; National Research Fellow in Physics, 1923-1926. California Institute, 1923-

615 South Mentor Avenue

WALTER TICKNOR WHITNEY, PH.D.

Assistant Professor of Physics

B.S., Pomona College, 1910; M.S., 1912; Ph.D., University of Chicago, 1916. Staff of Mount Wilson Observatory, 1913 and 1917. Fellow in Physics, University of Chicago, 1914-1916. California Institute, 1917-

988 North Holliston Avenue

CLYDE WOLFE, PH.D.

Assistant Professor of Mathematics

B.S., Occidental College, 1906; M.S., 1907; A.M., Harvard University, 1908; Ph.D., University of California, 1919. Harvard University, 1908-1910. Surveyor, Western States, 1910-1912. Acting Professor of Physics, Occidental College, 1912-1916; Associate Professor of Mathematics, 1916-1917. Teaching Fellow in Mathematics, University of California, 1917-1919. Dean, Santa Rosa Junior College, 1919-1920. California Institute, 1920-

401 South Chester Avenue

JAMES BEEBEE BRINSMADE, PH.D. *

Visiting Research Fellow in Physics

A.B., Yale University, 1906; Ph.D., Harvard University, 1917. Instructor in Physics, Williams College, 1919-1920; Assistant Professor, 1920- California Institute, 1926-

359 South Wilson Avenue

NORTON ADAMS KENT, PH.D. **

Visiting Research Fellow in Physics

A.B., Yale University, 1895; Ph.D., Johns Hopkins University, 1901; Assistant in Spectroscopy, Yerkes Observatory, 1901-1903, Professor of Physics, Wabash College, 1903-1906; Assistant Professor and Professor of Physics, Boston University, 1906- Fellow, American Academy of Arts and Sciences. California Institute, 1926-

672 Oak Knoll Avenue

WILLIAM NOEL BIRCHBY, M.A.

Instructor in Mathematics

A.B., Hope College, 1899; M.A., Colorado College, 1905. Instructor, Colorado College, 1905 and 1907; Instructor in Physics University of Southern California, summer session, 1916. California Institute, 1918-

1500 Sinaloa Avenue

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*On leave of absence from Williams College.
**On leave of absence from Boston University.

GEORGE BICKFORD BRIGHAM, JR.

Instructor in Engineering Drawing

Massachusetts Institute of Technology, 1910-1913. With William L. Mowll, Architect, Boston, Massachusetts, 1913-1916. Instructor in Engineering Drawing, Tufts College, 1918-1919; Instructor in Engineering and Architectural Drawing, Massachusetts Institute of Technology, 1919-1920. California Institute, 1923-

1371 San Pasqual

FRED J. CONVERSE, B.S.

Instructor in Civil Engineering

B.S. in Mechanical Engineering, University of Rochester, 1914. With Cleveland Electric Illuminating Company, Cleveland, Ohio, 1914-1915. With General Electric Company, Lynn, Massachusetts, 1915-1916. Instructor in Applied Mechanics, University of Rochester, 1916-1917. With General Laboratories, Bureau of Aircraft Production, U. S. A., 1917-1918. With Gleason Gear Works, Rochester, New York, 1919. Designer, Bureau of Power and Light, Los Angeles City, 1920. California Institute, 1921-

168 South Craig Avenue

WILLIAM DWIGHT CRANE, A.B.

Instructor in English Language and Literature

A.B., Harvard University, 1916; Columbia University, 1916-1917. California Institute, 1923-

1245 Arden Road

CLARENCE VINCENT ELLIOTT, M.E.

Instructor in Engineering Drawing

M.E., Cornell University, 1911. Instructor in Mechanical Engineering, Cornell University, 1911-1912 and 1913-1914. Dynamometer Test, Packard Motor Car Company, 1915; Research Engineer, General Electric Company, 1916-1918; Instructor in Mechanical Engineering, Louisiana State University, 1918-1919; Draftsman, Commercial Engine Company, Los Angeles, 1920; Draftsman, Miller Engine Works, Los Angeles, 1922. California Institute, 1922-

331 East 33rd Street, Los Angeles

RENE ENGEL, M.S.

Instructor in Geology

B.S., University of Paris, 1909; M.S., 1912; Instructor in Chemistry, Conservatoire des Arts and Metiers, Paris, 1911-1912; Associated with the Anaconda Copper Mining Co., Anaconda and Butte, Montana, 1913-1914 and 1920-1923; Chemical Engineer, Military Research Laboratory, Sorbonne, Paris, 1914-1917; Member, Scientific Commissions, U.S.A. and England, 1917-1918; Geologist, Saar Coal Mines, Saarbrucken, 1918-1919; Professor of Geology, Oklahoma School of Mines, 1923-1924; Assistant Professor of Geology and Mineralogy, New Mexico School of Mines, 1924-1925; California Institute, 1925-

1148 Constance Street

ARTHUR FREDERICK HALL[1]

Instructor in Pattern Making and Machine Shop Practice (Part Time)

With Sullivan Machine Company, Claremont, N. H., 1891-1894; B. F. Sturdevant Company, Jamaica Plain, Mass., 1894-1897; Union Gas Engine Company, San Francisco, 1898-1899; W. P. Kidder Machine Company, Jamaica Plain, Mass., 1899-1907. California Institute, 1912-

1090 North Stevenson Avenue

OSCAR LESLIE HEALD[1]

Instructor in Forging (Part Time)

Graduate, Normal Arts Department, Throop Polytechnic Institute, 1903. Instructor in Manual Arts, California Polytechnic School, San Luis Obispo, 1903-1906; Superintendent, Construction of Buildings, University Farm, Davis, California, 1909-1910; Instructor Engineering-Mechanics Department, State Polytechnic School, San Luis Obispo, California, 1910-1918. California Institute. 1918-

2180 Santa Anita Avenue

GEORGE DANIEL HENCK[2]

Instructor in Pattern Making (Part Time)

Graduate Manual Arts Department, Throop Polytechnic Institute, 1908. California Institute, 1917-

981 Garfield Avenue

LOUIS WINCHESTER JONES, A.B.

Instructor in English Language and Literature

A.B., Princeton University, 1922. California Institute, 1925-

351 California Terrace

ROBERT TALBOT KNAPP, B.S.

Instructor in Mechanical Engineering

B.S., Massachusetts Institute of Technology, 1920. Designer with C. M. Gay & Son, Refrigerating Engineers, 1920-1921. California Institute, 1922-

160 South Greenwood Avenue

WALTER WILLIAM MARTIN[1]

Instructor in Wood Working (Part Time)

Graduate, Normal Arts Department, Throop Polytechnic Institute, 1900. California Institute, 1911-

1782 Rose Villa Street

FRANCIS WILLIAM MAXSTADT, M.A.

Instructor in Electrical Engineering

M.E., Cornell University, 1916; Certificate of E.E., 1916; M.A., California Institute of Technology, 1925. Draftsman and Designer, Otis Elevator Company, 1916-1917. Assistant in the Electrical Research Division, Interborough Rapid Transit Company, 1917-1919. Assistant in the Thomas A. Edison Laboratories, 1919. California Institute, 1919-

3782 Elma Road

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[1]Associated with the Pasadena High School.
[2]Associated with the Pasadena City Schools.

ALBERT ADAMS MERRILL

Instructor in Experimental Aeronautics and in Accounting

California Institute, 1918-

1172 North Michigan Avenue

HAROLD Z. MUSSELMAN, A.B.

Instructor in Physical Education

A.B., Cornell College, 1920; Instructor in Science and Athletic Director, Sterling (Illinois) High School, 1920-1921. California Institute, 1921-

834 East California Street

WALTER WILLIAMS OGIER, JR., B.S.

Instructor in Mechanical Engineering

Assistant Director of Music

B.S., Throop College of Technology, 1919. With Signal Department, Pacific Electric Railway, 1919-1920. California Institute, 1920-

184 South Oak Avenue

FRANCES HALSEY SPINING

Librarian

California Institute, 1914-

1067 North Catalina Avenue

ALEXANDER J. SMITH*

Band Instructor

California Institute, 1924-

1860 West Forty-first Place, Los Angeles

ROGER STANTON, M.A.

Instructor in English Language and Literature

B.S., Colgate University, 1920; M.A., Princeton University, 1924. Instructor in English, Colorado College, 1924-1925. California Institute, 1925-

840 Center Street

ERNEST HAYWOOD SWIFT, PH.D.

Instructor in Analytical Chemistry

B.S. in Chemistry, University of Virginia, 1918; M.S., California Institute of Technology, 1920; Ph.D., 1924. California Institute, 1919-

1131 Lura Street

RAY EDWARD UNTEREINER, A.M.

Instructor in Economics and History

A.B., University of Redlands, 1920; A.M., Harvard University, 1921. Instructor in Economics, Harvard University, 1921-1923; Professor of Public Speaking, Huron College, 1923-1924; Instructor in Economics and Social Science, Joliet Junior College, 1924-1925. Member of California Bar. California Institute, 1925-

967 Dale Street

*Associated with the Roosevelt High School, Los Angeles.

RICHARD MCLEAN BADGER, PH.D.

Research Fellow in Chemistry

B.S., California Institute of Technology, 1921; Ph.D., 1924. California Institute, 1921-

215 Highland Place, Monrovia

ULRIC BANNISTER BRAY, PH.D.

National Research Fellow in Chemistry

B.S., Emory University, 1921; Ph.D., Yale University, 1925. California Institute, 1925-

Faculty Club

A. KEITH BREWER, PH.D.

National Research Fellow in Physics

Ph.B., University of Wisconsin, 1915; M.S., 1921; Ph.D., 1924; California Institute, 1924-

Faculty Club

ROBERT CADY BURT, PH.D.

Research Fellow in Physics

E.E., Cornell University, 1921; Ph.D., California Institute of Technology, 1926. California Institute, 1921-

327 South Michigan Avenue

G. HARVEY CAMERON, PH.D.

Research Fellow in Physics

B.Sc., University of Saskatchewan, 1922; Ph.D., California Institute of Technology, 1926. California Institute, 1922-

371 South Wilson Avenue

GERHARD H. DIEKE, PH.D.

National Research Fellow in Physics

Nat. Phil. Cand., University of Leiden, 1923; Nat. Phil. Doctrs., 1925; Ph.D., University of California, 1926.

141 South Michigan Avenue

LEE ALVIN DUBRIDGE, PH.D.

National Research Fellow in Physics

A.B., Cornell College, 1922; M.A., University of Wisconsin, 1924; Ph.D., 1926. Instructor in Physics, University of Wisconsin, 1925-1926. California Institute, 1926-

355 North Holliston Avenue

CARL ECKART, PH.D.

National Research Fellow in Physics

B.S., Washington University, St. Louis, 1922; Ph.D., Princeton University, 1925. California Institute, 1925-

492 Center Street

FRANK THOMPSON GUCKER, JR., PH.D.

National Research Fellow in Chemistry

A.B., Haverford College, 1920; A.M., 1921; Ph.D., Harvard University, 1925. California Institute, 1925-

406 South Chester Avenue

WILLIAM VERMILLION HOUSTON, PH.D.

National Research Fellow in Physics

B.A. and B.Sc. in Ed., Ohio State University, 1920; M.S., University of Chicago, 1922; Ph.D., Ohio State University, 1925. Instructor in Physics, Ohio State University, 1922-1925. California Institute, 1925-

335 South Parkwood Avenue

ARTHUR JOHN LINDSAY HUTCHINSON, A.B.

Research Fellow in Physics (Standard Oil Company)

A.B., Stanford University, 1919; California Institute of Technology, 1923-1924. Research Engineer, Pacific Gasoline Company, 1924-. California Institute, 1925-

700 California Bank Building, Los Angeles

ROY JAMES KENNEDY, PH.D.

National Research Fellow in Physics

A.B., Cornell University, 1921; Ph.D., Johns Hopkins University, 1924. California Institute, 1924-

1661 North Fair Oaks Avenue

ARTHUR LOUIS KLEIN, PH.D.

Research Fellow in Physics

B.S., California Institute of Technology, 1921; M.S., 1924; Ph.D., 1925. California Institute, 1921-

125 Fremont Place, Los Angeles

JOSEF MATTAUCH, PH.D.

Fellow in Physics of the International Education Board

Ph.D., University of Vienna, 1920. Assistant in Physics, University of Vienna, 1920-1926. California Institute, 1926-

Faculty Club

GLENN H. PALMER, M.S., SECOND LIEUTENANT
Signal Corps, U. S. Army
Research Fellow in Physics (Signal Corps)

Graduate U. S. Military Academy, with rank of Second Lieutenant, Signal Corps, 1923; M.S., Yale University, 1924. Instructor, Signal School, U. S. Army, 1925. California Institute, 1926-

1147 Lura Street

LINUS CARL PAULING, PH.D. *

Research Fellow in Chemistry

B.S., Oregon Agricultural College, 1922; Ph.D., California Institute of Technology, 1925. California Institute, 1922-

CHARLES HOLDEN PRESCOTT, PH.D.

Research Fellow in Chemistry

A.B., Yale University, 1922; Ph.D., California Institute of Technology, 1926. California Institute, 1923-

45 Eureka Street

*On leave of absence for study in Germany, 1926-27, as Fellow of John Simon Guggenheim Memorial Foundation.

ALFRED CRAWFORD ROBERTSON, PH.D.

National Research Fellow in Chemistry

B.S., Oregon Agricultural College, 1922; M.S., University of Wisconsin, 1924; Ph.D., 1925. California Institute, 1925-

940 Del Mar Street

ALFRED WALTER SIMON, PH.D.

National Research Fellow in Physics

B.S., University of Chicago, 1921; Ph.D., 1925. California Institute, 1925-

909 Boylston Street

WILLIAM RALPH SMYTHE, PH.D.

Research Fellow in Physics

A.B., Colorado College, 1916; A.M., Dartmouth College, 1919; Ph.D., University of Chicago, 1921. Professor of Physics, University of the Philippines, 1921-1923. National Research Fellow, California Institute, 1923-1926. California Institute, 1923-

406 South Chester Avenue

LARS THOMASSEN, B.S.

Fellow in Physics of the International Education Board

B.S., Norway Institute of Technology, 1919. Assistant of Norwegian State Raw Material Committee, 1919. Research Assistant, Mineralogical Institute, Oslo, Norway, 1919-. California Institute, 1924-

207 South Catalina Avenue

OLIVER REYNOLDS WULF, PH.D.

National Research Fellow in Chemistry

B.S., Worcester Polytechnic Institute, 1920; M.S., The American University, 1922; Ph.D., California Institute of Technology, 1926. California Institute, 1923-

140 South Bonnie Avenue

DON M. YOST, PH.D.

Research Fellow in Chemistry

B.S., University of California, 1923; Ph.D., California Institute of Technology, 1926. California Institute, 1924-

273 South Hudson Avenue

WLADIMIR M. ZAIKOWSKY

Research Fellow in Physics (Standard Oil Company)

Graduate of Michel's Artillery Academy, 1911. Research Officer of Main Artillery Board (Russia), 1911-1914; Repetitor of Michel's Artillery Academy, 1914-1915. Captain of Russian Artillery, 1914-. Member of Russian Artillery Commissions in the United States, 1915-1921. California Institute, 1923-

346 South Michigan Avenue

FRITZ ZWICKY, PH.D.

Fellow in Physics of the International Education Board

Graduate, Eidg. Technische Hochschule, Zurich, 1920; Ph.D., 1922. Assistant in Physics, Eidg. Technische Hochschule, 1921-1925. California Institute, 1925-

27 South Wilson Avenue

ALPHEUS MESSERLY BALL, B.S.

Assistant in Chemistry

B.S., California Institute of Technology, 1926. California Institute, 1926-

447 South Lake Avenue

ARTHUR PERRY BANTA, A.B.

Teaching Fellow in Engineering

A.B., Stanford University, 1926. California Institute, 1926-

622 Oakland Avenue

WARREN PHELPS BAXTER, M.S.

Teaching Fellow in Chemistry

B.S., California Institute of Technology, 1924; M.S., 1926. California Institute, 1924-

1125 Avoca Avenue

ARNOLD ORVILLE BECKMAN, B.S.

Teaching Fellow in Chemistry

B.S., University of Illinois, 1922; M.S., 1923. With Bell Telephone Laboratories, 1924-1926. California Institute, 1926-

1347 Topeka Street

VICTOR HUGO BENIOFF, B.A.

Assistant in Physics

B.A., Pomona College, 1921. California Institute, 1921-

1295 East Villa Street

JACOB LLOYD BOHN, B.S.

Assistant in Physics

B.S., Pennsylvania State College, 1924; Research Assistant, Harvard University, 1924-1926. California Institute, 1926-

1220 Summit Avenue

WILLARD CHARLES BRUCE, B.A.

Assistant in Physics

B.A., University of Minnesota, 1926. California Institute, 1926-

Faculty Club

JOHN STUART CAMPBELL, B.S.

Research Assistant in Physics (Standard Oil Company)

B.S., California Institute of Technology, 1926. California Institute, 1926-

873 North Chester Avenue

JAMES MAURICE CARTER, B.S.
Du Pont Fellow in Chemistry
B.S., California Institute of Technology, 1926. California Institute, 1926-
7515 Hampton Avenue, Hollywood

CHARLES HAWLEY CARTWRIGHT, B.S.
Teaching Fellow in Engineering
B.S., California Institute of Technology, 1926. California Institute, 1926-
R.F.D. Box 485-6, San Gabriel

CHARLES ROBERT DAILY, A.B.
Assistant in Physics
A.B., Colorado College, 1925. California Institute, 1925-
1122 Division Street

ROBERT HENNAH DALTON, M.S.
Teaching Fellow in Chemistry
B.S., California Institute of Technology, 1925; M.S., 1926. California Institute, 1925-
Faculty Club

RALPH KOHLRAUSCH DAY, PH.B.
Teaching Fellow in Chemistry
Ph.B., Yale University, 1925. California Institute, 1925-
Faculty Club

ROBERT TROUTMAN DILLON, B.S.
Research Assistant in Chemistry (Petroleum Research Institute)
B.S., California Institute of Technology, 1925. California Institute, 1925-
Faculty Club

JESSE WILLIAM MONROE DUMOND, M.S.
Research Fellow in Physics
B.S., California Institute of Technology, 1916; M.S. in E.E., Union College, 1918. California Institute, 1921-
615 South Mentor Avenue

JAMES HUGH HAMILTON, B.S.
Assistant in Electrical Engineering
B.S., California Institute of Technology, 1925. California Institute, 1925-
1634 South Western Avenue, Los Angeles

CLAUDE DEWAYNE HAYWARD, B.S.
Assistant in Electrical Engineering
B.S., California Institute of Technology, 1926. California Institute, 1926-
1156 Steuben Street

HERVEY C. HICKS, M.S.
Teaching Fellow in Physics
Ph.B., University of Chicago, 1921; M.S., 1922. California Institute, 1924-
1464 Atchison Street

ALBERT CLARENCE HODGES, M.A.
Assistant in Physics
B.A., University of Texas, 1921; M.A., 1924. Instructor in Physics, University of Texas, 1923-1926. California Institute, 1926-
425 South Hudson Avenue

KENNETH KNIGHT ILLINGWORTH, M.A.
Assistant in Physics
A.B., Colorado College, 1924; M.A., Dartmouth College, 1926. California Institute, 1926-
1122 Division Street

SYDNEY BETTINSON INGRAM, B.A.
Assistant in Physics
B.A., University of British Columbia, 1925. California Institute, 1925-
1164 Steuben Street

GEORGE ROBERT JAFFRAY, B.S.
Assistant in Modern Languages
B.S., California Institute of Technology, 1926. California Institute, 1926-
225 South Holliston Avenue

NORRIS JOHNSTON, S.M.
Assistant in Physics
S.B., Massachusetts Institute of Technology, 1924; S.M., 1925. California Institute, 1926-
Faculty Club

WILLIAM ABBETT LEWIS, JR., B.S.
Research Assistant in Electrical Engineering
(Westinghouse Electric and Manufacturing Company)
B.S., California Institute of Technology, 1926. California Institute, 1926-
664 South Lake Avenue

FREDERICK CHARLES LINDVALL, B.S.
Assistant in Electrical Engineering
B.S., University of Illinois, 1924. California Institute, 1925-
606 North Mariposa Street, Los Angeles

DONALD HOLT LOUGHRIDGE, B.S.
Teaching Fellow in Physics
B.S., California Institute of Technology, 1923. California Institute, 1922-
2331 North Lake Avenue, Altadena

HALLAM EVANS MENDENHALL, B.S.
Teaching Fellow in Electrical Engineering
B.S., Whitman College, 1921. California Institute, 1922-
371 South Wilson Avenue

CLEMENT DANN MESERVE, M.A.
Teaching Fellow in Geology
B.A., Yale University, 1920; M.A., University of California, 1924. Instructor in Chemistry, Franklin High School of Los Angeles, 1924-1926. California Institute, 1926-
676 South Carondelet Street, Los Angeles

CLARK BLANCHARD MILLIKAN, A.B.
Teaching Fellow in Physics
A.B., Yale University, 1924. California Institute, 1925-
300 Palmetto Drive

ALLAN CHARLES GRAY MITCHELL, M.S.
Teaching Fellow in Chemistry
B.S., University of Virginia, 1923; M.S., 1924. California Institute, 1924-
529 South El Molino Avenue

MARTIN EMERY NORDBERG, M.S.
Teaching Fellow in Chemistry
B.S., Iowa State College, 1924; M.S., 1925. California Institute, 1925-
Faculty Club

JOHN WILFRED PATTERSON, M.A.
Teaching Fellow in Geology
E.Met., Colorado School of Mines, 1925; M.A., University of Wyoming, 1926. California Institute, 1926-
2438 West Avenue 30, Los Angeles

BORIS PODOLSKY, M.A.
Assistant in Physics
B.S. in E.E., University of Southern California, 1918; M.A. 1926. Instructor in Physics, University of Southern California, 1919-1921. California Institute, 1926-
394 South Michigan Avenue

RICHARD DURANT POMEROY, B.S.
Research Assistant in Chemistry (Standard Oil Company)
B.S., California Institute of Technology, 1926. California Institute, 1926-
173 South Meredith Avenue

FRED LLOYD POOLE, M.S.
Teaching Fellow in Electrical Engineering
B.S., Throop College of Technology, 1917; M.S., Union College, 1919. California Institute, 1920-
323 South Chester Avenue

CHARLES FRANCIS RICHTER, A.B.

Assistant in Physics

A.B., Stanford University, 1920. California Institute, 1926-

723 South Bronson Avenue, Los Angeles

OTTO FREDERICK RITZMANN, M.S.

Teaching Fellow in Physics

B.S., in Ech.E., Pennsylvania State College, 1922; M.S. in Physics, 1924. California Institute, 1924-

1109 North Allen Avenue

HERMAN FRANZ SCHOTT, B.S.

Assistant in Chemistry

B.S., California Institute of Technology, 1926. California Institute, 1926-

1650 Francisca Street

NATHAN FROST SCUDDER, B.S.

Teaching Fellow in Chemistry

B.S., California Institute of Technology, 1926. California Institute, 1926-

225 South Holliston Avenue

HAROLD HEIGES STEINOUR, M.S.

Teaching Fellow in Chemistry

B.S. in Chemical Engineering, University of Southern California, 1923; M.S., California Institute of Technology, 1926. California Institute, 1925-

618 West Thirty-fifth Place, Los Angeles

RICHARD MANLIFFE SUTTON, B.S.

Teaching Fellow in Physics

B.S., Haverford College, 1922. California Institute, 1925-

406 South Chester Avenue

LLOYD EDWARD SWEDLUND, B.S.

Assistant in Electrical Engineering

B.S., University of Colorado, 1926. California Institute, 1926-

1156 Steuben Street

DANIEL DWIGHT TAYLOR, A.B.

Assistant in Physics

A.B., Colorado College, 1924. California Institute, 1924-

1122 Division Street

WILLIAM URE, M. OF AP. SC.

Teaching Fellow in Chemistry

B. of Ap. Sc., University of British Columbia, 1923; M. of Ap. Sc., 1924. California Institute, 1924-

940 Delmar Street

WILLY UYTERHOEVEN, C.E.

Fellow in Physics of the Commission for Relief in Belgium Educational Foundation

C.E., University of Brussels, 1925; Physical Research Laboratory of Philips, Eindhoven, 1925-1926. California Institute, 1926-

252C South Catalina Avenue

MORGAN WARD, A.B.

Teaching Fellow in Mathematics

A.B., University of California, 1924. California Institute, 1925-

1371 San Pasqual Street

RALPH EDGAR WINGER, A.B.

Teaching Fellow in Physics

A.B., Baker University, 1914. California Institute, 1922-

1122 Division Street

JOHANNES ARCHIBALD VAN DEN AKKER, B.S.

Assistant in Physics

B.S., California Institute of Technology, 1926. California Institute, 1926-

447 South Lake Avenue

ADRIAAN JOSEPH VAN ROSSEM

Assistant in Vertebrate Zoology

California Institute, 1926-

2656 Foothill Boulevard

LOUIS H. BAILEY, FIRST SERGEANT, D. E. M. L., U. S. ARMY

Assistant, Department of Military Science and Tactics

California Institute, 1920-

686 South Lake Avenue

JOSEPH LARACY, MASTER SERGEANT, ENGINEERS, U. S. ARMY, RETIRED

Assistant, Department of Military Science and Tactics

California Institute, 1920-

1084 Stevenson Avenue

Technical Assistants

H. W. Anderson.....Instrument Maker, Physics Department
500 Elizabeth Street.

William H. Bresler.....Instrument Maker, Physics Department
1680 Locust Street.

William Clancy.....Glass Blower, Physics Department
153 North Mentor Avenue.

Robert Loofbourrow.....Storekeeper, Chemistry Department
709 South Mentor Avenue.

Shepard Macallister.....Instrument Maker, Physics Department
1101 Oxley Court, South Pasadena.

Bruno E. Merkel.....Instrument Maker, Physics Department
515 North Michigan Avenue.

Julius Pearson.....Head Instrument Maker, Physics Department
1318 North El Molino Avenue.

Domenick J. Pompeo.....Glass Blower, Physics Department
79 South Wilson Avenue.

John L. Ridgway.....Scientific Illustrator, Department of Geology and Paleontology
501 Fairmont Street, Glendale.

Elbert H. Searle.....Instrument Maker, Chemistry Department
1009 Tipton Terrace, Los Angeles.

Anna S. M. van Tienhoven.....Storekeeper, Physics Department
406 South Chester Avenue.

William E. Williamson.....Assistant Instrument Maker Chemistry Department
397 South Chester Avenue.

Assistants in Administration

ROBERT E. CRANE.....Superintendent of Buildings and Grounds
704 South Lake Avenue.

JANET CRISTY.....Secretary's Office
549 La Loma Road.

THERESA DIERKES.....Registrar's Office
315 Grant Street.

ALICE HAWKINS.....Secretary's Office
1008 North El Molino Avenue.

MARY A. HEWSON.....House Director
Dormitory.

INGA HOWARD.....Office of the Chairman of the Executive Council
1126 Division Street.

HELEN LEPREVOST.....Secretary's Office
107½ West Tremont Street.

HERBERT H. G. NASH.....Bookkeeper
145 South Michigan Avenue

HELEN PFUSCH.....Secretary's Office
1271 East Villa Street.

LEONORA STUART RENO.....Secretary's Office
Flintridge.

BERTHA M. RITZMANN.....Departments of Engineering
1109 North Allen Avenue.

GRACE E. SAGE.....Secretary's Office
337 South Lake Avenue.

ALICE VAN DEUSEN.....Registrar's Office
402 Alpine Street.

BEATRICE J. WULF.....Department of Chemistry
140 South Bonnie Avenue.

Staff of Instruction and Research Summary

DIVISION OF PHYSICS, MATHEMATICS, AND ELECTRICAL ENGINEERING

R. A. MILLIKAN, Chairman

PROFESSORS

HARRY BATEMAN, Mathematics, Theoretical Physics, Aeronautics
ERIC T. BELL, Mathematics
PAUL S. EPSTEIN, Theoretical Physics
L. HOWARD GILMORE, Physics
ROBERT A. MILLIKAN, Physics
ROYAL W. SORENSEN, Electrical Engineering
RICHARD C. TOLMAN, Physical Chemistry and Mathematical Physics
HARRY C. VAN BUSKIRK, Mathematics

ASSOCIATE PROFESSORS

EARNEST C. WATSON, Physics
LUTHER E. WEAR, Mathematics

ASSISTANT PROFESSORS

IRA S. BOWEN, Physics
SAMUEL S. MACKEOWN, Electrical Engineering
WALTER T. WHITNEY, Physics
CLYDE WOLFE, Mathematics

VISITING RESEARCH FELLOWS

JAMES B. BRINSMADE, Physics
NORTON A. KENT, Physics

INSTRUCTORS

WILLIAM N. BIRCHBY, Mathematics
FRANCIS W. MAXSTADT, Electrical Engineering

INTERNATIONAL RESEARCH FELLOWS

Joseph Mattauch, International Education Board
Lars Thomassen, International Education Board
Fritz Zwicky, International Education Board
Willy Uyterhoeven, C. R. B. Educational Foundation

NATIONAL RESEARCH FELLOWS

A. Keith Brewer
Gerhard H. Dieke
Lee Alvin DuBridge
Carl Eckart
William V. Houston
Roy J. Kennedy
Alfred W. Simon

RESEARCH FELLOWS

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G. Harvey Cameron
Arthur J. L. Hutchinson
Arthur L. Klein
William R. Smythe
Wladimir M. Zaikowsky

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J. Lloyd Bohn
Willard C. Bruce
J. Stuart Campbell
Charles R. Daily
Jesse W. M. DuMond
James H. Hamilton
Claude D. Hayward
Hervey C. Hicks
Albert C. Hodges
Kenneth K. Illingworth
Sydney B. Ingram
Norris Johnston
William A. Lewis
Frederick C. Lindvall
Donald H. Loughridge
Hallam E. Mendenhall
Clark B. Millikan
Glenn H. Palmer
Boris Podolsky
Fred L. Poole
Charles F. Richter
Otto F. Ritzmann
Lloyd E. Swedlund
Richard M. Sutton
D. Dwight Taylor
Morgan Ward
Ralph E. Winger
Johannes A. Van den Akker

DIVISION OF CHEMISTRY AND CHEMICAL ENGINEERING

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James E. Bell, Chemistry
Arthur A. Noyes, Chemistry
Richard C. Tolman, Physical Chemistry and Mathematical Physics

ASSOCIATE PROFESSORS

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Howard J. Lucas, Organic Chemistry

ASSISTANT PROFESSOR

Roscoe G. Dickinson, Physical Chemistry

INSTRUCTOR

Ernest H. Swift, Analytical Chemistry

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Frank T. Gucker, Jr.
Alfred C. Robertson
Oliver R. Wulf

RESEARCH FELLOWS

Richard M. Badger
Linus C. Pauling
Charles H. Prescott
Don M. Yost

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Warren P. Baxter
Arnold O. Beckman
James M. Carter
Robert H. Dalton
Ralph K. Day
Robert T. Dillon
Allan C. G. Mitchell
Martin E. Nordberg
Richard D. Pomeroy
Herman F. Schott
Nathan F. Scudder
Harold H. Steinour
William Ure

DIVISION OF CIVIL AND MECHANICAL ENGINEERING

FRANKLIN THOMAS, Chairman

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HARRY BATEMAN, Mathematics, Theoretical Physics, Aeronautics
W. HOWARD CLAPP, Mechanism and Machine Design
ROBERT L. DAUGHERTY, Mechanical and Hydraulic Engineering
FREDERIC W. HINRICHS, JR., Mechanics
FRANKLIN THOMAS, Civil Engineering

ASSOCIATE IN ENGINEERING RESEARCH

CARL C. THOMAS, Engineering Research

ASSOCIATE PROFESSORS

R. R. MARTEL, Civil Engineering
WILLIAM W. MICHAEL, Civil Engineering

ASSISTANT PROFESSORS

LOUIS J. CLATERBOS, Military Science and Tactics
SAMUEL S. MACKEOWN, Electrical Engineering

INSTRUCTORS

GEORGE B. BRIGHAM, Engineering Drawing
FRED J. CONVERSE, Civil Engineering
CLARENCE V. ELLIOTT, Engineering Drawing
ARTHUR F. HALL, Pattern Making and Machine-Shop
OSCAR L. HEALD, Forging
GEORGE D. HENCK, Pattern Making
ROBERT T. KNAPP, Mechanical Engineering
WILLIAM W. MARTIN, Wood Working
ALBERT A. MERRILL, Experimental Aeronautics
WALTER W. OGIER, Mechanical Engineering

RESEARCH FELLOWS AND ASSISTANTS

ARTHUR P. BANTA
CHARLES H. CARTWRIGHT
HERVEY C. HICKS
CLARK B. MILLIKAN

DIVISION OF NATURAL SCIENCES

J. P. BUWALDA, Chairman

PROFESSORS

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CHESTER STOCK, Paleontology

RESEARCH ASSOCIATE

DONALD R. DICKEY, Vertebrate Zoology

INSTRUCTOR

RENE ENGEL, Geology

TEACHING FELLOWS AND ASSISTANTS

CLEMENT D. MESERVE JOHN W. PATTERSON
ADRIAAN J. VAN ROSSEM

DIVISION OF THE HUMANITIES

C. K. JUDY, Chairman

PROFESSORS

C. K. JUDY, English Language and Literature
GRAHAM A. LAING, Economics, Business Administration
JOHN R. MACARTHUR, Languages

LECTURER

WILLIAM B. MUNRO, Modern Civilization

ASSOCIATE PROFESSOR

GEORGE R. MACMINN, English Language and Literature

INSTRUCTORS

WILLIAM D. CRANE, English Language and Literature
LOUIS W. JONES, English Language and Literature
ALBERT A. MERRILL, Accounting
ROGER STANTON, English Language and Literature
RAY E. UNTEREINER, Economics and History

ASSISTANTS

ALPHEUS M. BALL J. STUART CAMPBELL
GEORGE R. JAFFRAY

DIVISION OF PHYSICAL EDUCATION

R. W. SORENSEN, Chairman

PHYSICAL DIRECTOR

WILLIAM L. STANTON

INSTRUCTOR

HAROLD Z. MUSSELMAN

ASSISTANTS

LOUIS J. CLATERBOS
HAAKON M. EVJEN
RICHARD M. SUTTON
ARTHUR GRIFFITH
DOMENICK J. POMPEO

Historical Sketch

The California Institute of Technology is devoted to instruction of collegiate and university grade in the fundamental sciences and in the various branches of engineering, and to research in these fields.

The work of the Institute on the present campus began in 1910 when the building now known as Throop Hall was erected. The development of the Institute during the last few years has been rapid, owing to the substantial financial support it has received from many individuals and from some of the large national foundations.

In 1917 the chemistry building, named the Gates Chemical Laboratory from its donors, Messrs. C. W. Gates and P. G. Gates, was erected and equipped; and Dr. Arthur A. Noyes became its Director. An extension to this laboratory, made possible by a further gift from the same donors, has just been completed. During the years 1920 to 1923, the Norman Bridge Laboratory of Physics, given by the late Dr. Norman Bridge of Chicago, was erected. Dr. Robert A. Millikan became Director of this Laboratory in 1921. In 1922, Culbertson Hall, an auditorium seating 500 persons, was erected. In 1924, the High-Potential Research Laboratory was built and equipped through the cooperation of the Southern California Edison Company. A new laboratory of Steam Engineering and an Engineering Research Laboratory, and a Seismological Laboratory have been recently erected. All of this construction has been carried out in the style of Spanish architecture, under the direction of the late well-known architect Bertram G. Goodhue and his associates.

Eight acres have recently been added to the campus, giving it an area of thirty acres. On the new extension is an attractive residence which is used as a club-house for the faculty and graduate students. Fuller provision for undergraduate student life on the campus has been made by the erection of a temporary building provided by Mr. and Mrs. Robert Roe Blacker.

Along with the material development of the Institute in the past few years has gone a striking development of its educational and research work. This has been made possible through the liberal support of various national foundations. The General Education Board has given an endowment of $300,000 to be used for salaries; the Carnegie Foundation for the Advancement of Teaching, an endowment of $40,000 for teachers' insurance and annuities; the Carnegie Institution of Washington, $30,000 a year for a period of years for the support of researches on the structure of matter and the nature of radiation, under the direction of Drs. R. A. Millikan and A. A. Noyes; the Carnegie Corporation of New York, $25,000 for the establishment of a department of instruction and research in geology and $100,000 for general endowment. The Rockefeller Foundation has, through the National Research Council, provided payments totalling about $30,000 a year to National Research Fellows now working at the Institute. An endowment of $60,000 has also been given by Robert Roe Blacker and Nellie Canfield Blacker for the support of research and for scholarships for undergraduate and graduate students.

During the summer of 1926, there was established at the Institute the Daniel Guggenheim Graduate School of Aeronautics, provision for which was made by the Daniel Gug-

genheim Fund for the Promotion of Aeronautics, Inc., by an appropriation of about $200,000 for the erection and equipment of a building, and $15,000 a year for support of the School through a period of years. The work of the new School of Aeronautics has already been inaugurated; and the building, which is to house a ten-foot wind tunnel, is under construction.

Educational Policies

In pursuance of the plan of developing an institute of science and technology of the highest grade, the Trustees have adopted the following statement of policies:

(1) The Institute shall offer two four-year undergraduate Courses, one in Engineering and one in Science. Both of these Courses shall lead to the degree of Bachelor of Science and they shall also possess sufficient similarity to make interchange between them not unduly difficult.

(2) The four-year undergraduate Course in Engineering shall be of a general, fundamental character, with a minimum of specialization in the separate branches of engineering. It shall include an unusually thorough training in the basic sciences of physics, chemistry, and mathematics, and a large proportion of cultural studies; the time for this being secured by eliminating some of the more specialized technical subjects commonly included in undergraduate engineering courses. It shall include, however, the professional subjects common to all branches of engineering. It is hoped in this way to provide a combination of a fundamental scientific training with a broad human outlook, which will afford students with engineering interests the type of collegiate education endorsed by leading engineers—one which avoids on the one hand the narrowness common with students in technical schools, and on the other the superficiality and the lack of purpose of many of those taking academic college courses.

(3) Fifth-year Courses leading to the degree of Master of Science shall be offered in the various branches of engineering—for the present in civil, mechanical, electrical, aero-

nautical, and chemical engineering. In these Courses the instruction in basic engineering subjects shall be maintained at the highest efficiency so that the graduates from them may be prepared with especial thoroughness for positions as constructing, designing, operating, and managing engineers.

(4) The four-year undergraduate Course in Science will afford, even more fully than is possible in the Engineering Course, an intensive training in physics, chemistry, and mathematics. In its third and fourth years are included groups of optional studies which will permit either some measure of specialization in one of these basic sciences or the acquirement of the principles of geology and paleontology, or of engineering. This Course shall include all the cultural studies of the Engineering Course, and in addition instruction in the German and French languages. Its purpose is to provide a collegiate education which, when followed by one or more years of graduate study, will best train the creative type of scientist or engineer so urgently needed in our educational, governmental, and industrial development, and which will most effectively fit able students for positions in the research and development departments of manufacturing and transportation enterprises.

(5) Fifth-year Courses leading to the degree of Master of Science shall be offered in the sciences, especially in physics, mathematics, chemistry, geology and paleontology, and chemical engineering. A considerable proportion of the time of these Courses is devoted to research. These are supplementary to the Undergraduate Course in Science, and are intended to continue the training for the types of professional positions referred to in the preceding paragraph.

(6) Throughout the period of undergraduate study every effort shall be made to develop the character, ideals, breadth of view, general culture, and physical well-being of the students of the Institute. To this end the literary, historical, economic, and general scientific subjects shall continue to be taught by a permanent staff of men of mature judgment and broad experience; the regular work in these subjects shall be supplemented by courses of lectures given each year by men of distinction from other institutions; and the weekly assemblies addressed by leading men in the fields of education, literature, art, science, engineering, public service, commerce, and industry shall be maintained as effectively as possible. Great importance is also attached to making the campus attractive in its architectural and landscape features, because of the influence of such surroundings on the students and on the public. Moderate participation of all students in student activities of a social, literary, or artistic character, such as student publications, debating and dramatic clubs, and musical clubs shall be encouraged; and students shall be required to take regular exercise, preferably in the form of intramural games or contests affording recreation. It is the purpose of the Trustees to create as rapidly as possible additional facilities for these student activities by the erection of a student union, a gymnasium, and dormitories.

(7) In all the scientific and engineering departments of the Institute research shall be strongly emphasized, not only because of the importance of contributing to the advancement of science and thus to the intellectual and material welfare of mankind, but also because research work adds vitality to the educational work of the Institute and develops originality and creativeness in its students. To insure

the development of research the Trustees will provide for it financially, not, as is so often the case, out of the residue that may be left after meeting the demands of the undergraduate work, but by duly limiting the extent of this work, and by setting apart, in advance, funds for research and graduate study.

(8) In order that the policies already stated may be made fully effective as quickly as possible, and in order that the available funds may not be consumed merely by increase in the student body, the registration of students at any period shall be strictly limited to that number which can be satisfactorily provided for with the facilities and funds available. And students shall be admitted, not on the basis of priority of application, but on that of a careful study of the merits of individual applicants, so that the limitation may have the highly important result of giving a select body of students of more than ordinary ability. A standard of scholarship shall also be maintained which rapidly eliminates from the Institute those who, from lack of ability or industry, are not fitted to pursue its work to the best advantage.

Requirements for Admission

ADMISSION TO THE FRESHMAN CLASS

Each applicant must be thoroughly prepared in at least fifteen units of preparatory work, each unit representing one year's work in a given subject in an approved high school at the rate of five recitations weekly. Each applicant must offer all of the units in group A, three or more units selected from group B, and the rest from group C.

Group A	English	3
	Algebra	2
	Plane and Solid Geometry	1½
	Trigonometry	½
	Physics	1
	Chemistry	1
	United States History and Government	1

Group B: Foreign Languages, Shop (up to 1 unit); additional English, Mathematics, Laboratory Science, or History.

Group C: Drawing, Commercial subjects, additional Shop, etc.

Applicants who offer for entrance a total of fifteen recommended units, but whose list of subjects is not in accord with this table, may be admitted at the discretion of the faculty, if they are successful in passing the general entrance examinations; but no applicant will be admitted whose preparation does not include English 2 units, Algebra 1½ units, Geometry 1 unit, Trigonometry ½ unit, Physics 1 unit. All entrance deficiencies must be made up before registration for the second year.

Each applicant is expected to show that he has satisfactorily completed the above-stated required preparation, by

presenting a certificate of recommendation from an approved school showing his complete scholarship record.[1]

In addition to the above credentials, all applicants for admission to the freshman class are required to take entrance examinations. These examinations will not take the place of the high-school credentials, but will serve to supplement them. The subjects covered will be those listed in group A. The examinations will be general in character: they are intended to show the applicant's ability to think and express himself clearly, and his fitness for scientific and engineering training, rather than to test memorized information.

Students planning to enter the Institute in September, 1927, may take the examinations Monday and Tuesday, June 27th and 28th, or Monday and Tuesday, September 19th and 20th.

Students living at a distance from Pasadena may, upon request, be allowed to take the spring entrance examinations under the supervision of their local school authorities.

Each applicant must present a physician's certificate showing that he is physically qualified to carry the work of the Institute. All students entering the Institute for the first time are required to be vaccinated or to submit satisfactory evidence of recent vaccination.

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[1]Incomplete certificates of recommendation may be supplemented by examinations in particular subjects taken at the Institute. The scope of subject matter for these examinations is the same as that covered by standard high schools. Applicants taking examinations in Physics, Chemistry, or United States History and Government must present their notebooks at the time of the examination. The schedule for 1927 is as follows: Wednesday, September 21, 9:00 A.M., Mathematics; 2:00 P.M., English. Thursday, September 22, 2:00 P.M., History and Foreign Languages.

These examinations may also be taken under the direction of the College Entrance Examination Board. The examinations are held at various points in the United States on June 20 to 25, 1927. Application for these examinations must be addressed to the College Entrance Examination Board, 431 West One Hundred and Seventeenth Street, New York, N. Y., and must be received by the Board on or before May 23, 1927.

Application for admission to the Institute may be made at any time, but there is a distinct advantage in having it on file by the first of May, or even earlier. This enables the Institute to make full use of all information available from high school sources. Applicants whose preparatory work is complete should submit certificates of recommendation from the principals of their high schools, together with their complete scholastic record before taking the entrance examinations. Applicants who wish to take the spring entrance examinations and who have completed their preparatory work but are not able to secure their scholastic records before the examinations, will be admitted to the examinations if such a request is received from their principals. Certificates of recommendation and scholarship records of students who have taken the examinations under the above arrangement should be forwarded to the Institute as soon as possible after the completion of the preparatory work.

No decision can be reached as to the admission of a student until his principal's recommendation and his complete scholastic record are received. Applicants are advised to take the June examinations if possible.

Blanks for the physician's certificate, application for admission to the Institute, and certificate of recommendation will be provided upon request.

Applicants who comply with these conditions not later than July 10th, will be notified by the Registrar as to their acceptance on or about July 15th. The accepted applicants will, at that time, be sent registration cards; and these should, if possible, be returned to the Registrar not later than August 1st, together with the registration fee of

$10.00 (which will be deducted from the first-term tuition). Checks or money orders should be made payable to the California Institute of Technology.

ADMISSION OF UNDERGRADUATES FROM OTHER COLLEGES TO UPPER CLASSES

For admission to the upper classes of the Institute applicants who have been students (but are not graduates) at other institutions of collegiate rank must present letters of honorable dismissal, together with statements showing in detail the character of their previous training, and the grades which have been received. It is well for students planning to transfer to send their credentials to the registrar at an early date; they should arrange for a personal interview, if possible. Physicians' certificates and certificates of vaccination are required as in the case of students entering the freshman class. They will also take examinations in Mathematics, Physics, and Chemistry; except that the examination in the latter subject is required only of those desiring to pursue the Course in Science. In addition, students desiring credit for work in Engineering Courses taken elsewhere will be required to pass review examinations in these subjects unless both the quality and extent of their previous work appears to be entirely satisfactory. The examinations in Mathematics and Physics taken by students planning to transfer to the third and fourth-year classes are the review examinations required of all students of the Institute before they undertake the work of the third year (see page 51), and are taken at the same time by both regular and transfer students. Copies of previous examination papers will be sent applicants upon request.

For men planning to enter the sophomore year, similar review examinations in Mathematics and Physics covering the work of the freshman year are required.

The examinations may be taken either in June or in September. The schedule for 1927 is as follows: Friday, June 10, 9:00 A. M., Mathematics; 1:30 P. M., Chemistry. Saturday, June 11, 9:00 A. M., Physics. Tuesday, September 20, 9:00 A. M., Mathematics; 1:30 P. M., Physics. Wednesday, September 21, 9:00 A. M., Chemistry.

Applicants for admission to the third and fourth years whose credentials have been approved may take advantage of the review courses in Mathematics and Physics to prepare for their examinations. These courses are offered during the three weeks preceding the opening of the fall term. The fee is $20 for each course. Applicants residing at a distance may take the June examinations elsewhere than at the Institute, provided arrangements are made in advance.

Because of the very thorough, intensive study of physics and mathematics required in the first two years, students from other colleges, unless of ability above the average of Institute students, can not hope to transfer to the higher years of the Institute Courses without incurring much loss of time and serious difficulty in the pursuit of the more advanced subjects. Students intending to complete the Institute Courses are therefore recommended, as far as possible, to take their freshman and sophomore work also at the Institute.

ADMISSION OF COLLEGE GRADUATES

Applicants who are graduates of colleges and scientific schools of recognized standing should also submit a detailed statement of the courses previously pursued, and of the grades received. They will be admitted without examination, provided their previous scholastic record indicates attainment not inferior to the average of Institute students, and provided they have creditably completed thorough courses in the basic scientific subjects required in the first two years of the Institute's Undergraduate Courses. If these provisos are not fulfilled, examinations are required as in case of non-graduates.

Buildings and Educational Facilities

THROOP HALL

Throop Hall, the central building on the campus, contains the offices of administration, the classrooms and drawing-rooms of the engineering departments, and some of the engineering laboratories.

NORMAN BRIDGE LABORATORY OF PHYSICS

The Norman Bridge Laboratory of Physics, the gift of the late Dr. Norman Bridge of Chicago, consists of two units of five floors each, 128 by 58 feet, connected at the north by a third unit of two floors, 80 by 52 feet, so as to form three sides of a hollow square. One of these units has in addition a special photographic laboratory on a partial sixth floor, and each has on its large flat roof excellent facilities for outdoor experimentation.

The first unit contains a lecture room seating 260 persons, two large undergraduate laboratories with adjoining dark rooms and apparatus rooms, three classrooms, three laboratories for advanced instruction, nine offices, a stock and chemical room, the graduate library of physics, and twelve research rooms, besides shops, machinery, switchboard, and storage battery rooms.

The second unit is used primarily for research. It contains forty-five research rooms as well as a seminar room, photographic dark rooms, a chemical room, fourteen offices, and switchboard, storage-battery, electric furnace and machinery rooms.

The third unit houses on one floor eight more research rooms, thus bringing the number of rooms devoted exclusively to research up to sixty-five, and on the other the

Norman Bridge Library of Physics to provide for which Dr. Bridge gave $50,000.

Ample funds are also available for the purchase of special apparatus and supplies and for the upkeep of the laboratory. Capital funds for the support of research in physics specifically now amount to approximately $500,000. The income of this sum does not, however, represent the total amount available for research work in physics. The Trustees have undertaken to provide for the work of the department of physics an income of $95,000 a year. This includes both teaching and research, although the larger portion of this income is to be expended on research. In addition to the Institute funds available for research, the Carnegie Corporation of New York has provided through the Carnegie Institution of Washington $15,000 a year for a period of years to be used in researches in physics to be conducted at the Institute under the direction of Dr. Millikan.

The relations of the Institute with the staff of the Mount Wilson Observatory are most cordial and one of the chief assets of the Institute is its associations with the Observatory group both informally and in the joint Astronomy and Physics Club.

THE HIGH-POTENTIAL RESEARCH LABORATORY

A high-potential laboratory, provided by the Southern California Edison Company, forms a companion building to the first unit of the Norman Bridge Laboratory, which it closely resembles in external design and dimensions. The equipment in this laboratory includes a million-volt transformer specially designed by Professor R. W. Sorensen, which is capable of supplying 1,000 kilovolt amperes at the above potential with one end grounded. It is available both for the pursuit of special scientific problems connected with

the structure of matter and the nature of radiation, and for the conduct of the pressing engineering problems having to do with the improvement in the art of high tension transmission. It also provides opportunities for instruction in this field, such as are not at present easily obtainable by students of science and engineering.

GATES CHEMICAL LABORATORY

The Gates Chemical Laboratory includes laboratories used for the following branches of undergraduate instruction: Inorganic Chemistry, accommodating 160 freshman students; Analytical Chemistry, 40 students; Organic Chemistry, 23 students; Physical Chemistry, 20 students in two sections; Instrumental Analysis, 20 students in two sections. The undergraduate laboratories were intentionally limited in their accommodations, as it is the policy of the department to admit for the present to the upper years of the chemistry courses only a relatively small number of the more competent students, so as to secure the highest efficiency in the instruction, and so that graduate study and research may not be relegated to a secondary position, as happens in many institutions.

The remainder of the Gates Chemical Laboratory is devoted to facilities for research work. There are six unit laboratories for physico-chemical research accommodating two men each; organic and biochemical research laboratories, with space for six workers; and research laboratories of photochemistry and radiation chemistry providing for ten or more research men. In separate rooms special research facilities are also provided, including a well-equipped instrument shop, a students' carpenter shop, a glass-blowing room, a storage battery room, and large photographic dark rooms.

Ample funds are available for the purchase of special apparatus and supplies. An endowment of $400,000 provides an annual income of $20,000 for chemical research. In addition to the Institute funds available for research the Carnegie Corporation of New York has provided, through the Carnegie Institution of Washington, $15,000 a year for five years to be used in researches in chemistry to be conducted at the Institute under the direction of Professor A. A. Noyes.

An addition to the laboratory, for which funds have been provided by C. W. Gates and his brother, P. G. Gates, since deceased, has just been completed. This addition, which adjoins the first unit on the west, is approximately 80 feet by 50 feet in area, and is two stories in height. It contains a lecture room, seating 160 and completely equipped for chemical demonstrations of all sorts; a seminar room, a chemistry library, a small lecture room seating about 30 people, class rooms, four research laboratories, professors' studies, a store room for inflammable chemicals, and the usual machinery, switchboard, and service rooms. The architects for this unit were Bertram G. Goodhue Associates, with Clarence S. Stein as consultant. The research facilities provided in this addition will make possible the development of organic chemistry research to a much greater extent than has heretofore been possible.

RESEARCH LABORATORY OF APPLIED CHEMISTRY

With the Gates Chemical Laboratory is associated the Research Laboratory of Applied Chemistry, which is located in the new Engineering Research Building. This research laboratory is equipped for carrying on chemical reactions on a fifty or a hundred pound scale. The machinery is as nearly like commercial plant equipment as is con-

sistent with its size. It includes apparatus for grinding and pulverizing, roasting, melting, mixing, dissolving, extracting, pumping, decanting, centrifuging, filtering (by gravity, pressure, suction, plate and frame, and leaf filters), evaporating under pressure or vacuum, fractionating, condensing, crystalizing, drying under pressure or vacuum, and absorbing gases and vapors.

LABORATORY OF STEAM ENGINEERING AND ENGINEERING RESEARCH

During the past year, through funds provided in part by the late Dr. Norman Bridge, and in part from other sources, the Institute has erected a new engineering building, designed by Bertram G. Goodhue Associates, 50 by 140 feet in size. One section of this is occupied by a new steam engineering laboratory, which contains a steam unit consisting of two Babcock and Wilcox Sterling boilers, each of 300 H.P. capacity, with all accessory equipment to provide for comprehensive tests of all portions of the installation.

The other half of the building is to be devoted to an engineering research laboratory, in which the research section of chemical engineering has already been installed.

SEISMOLOGICAL RESEARCH LABORATORY

A Seismological Research Laboratory, located on a site west of the Arroyo Seco, has recently been completed. In it will be carried on studies on earth movements. The general program of research will be outlined by the Committee on Seismology of the Carnegie Institution of Washington, of which Dr. Arthur L. Day, director of its Geophysical Laboratory, is chairman. Mr. Harry O. Wood will be in immediate charge of the investigations; and with him Dr. J.

A. Anderson, of the Mt. Wilson Observatory, and Prof. John P. Buwalda of the Institute's Geology Department, will directly cooperate.

CULBERTSON HALL

Culbertson Hall, a beautiful auditorium seating 500 persons, erected in 1922, provides facilities for the Institute assemblies, lectures, and concerts, as well as for various social functions both of students and faculty. It was named in honor of the late Mr. James A. Culbertson, who was a trustee of the Institute and Vice-President of the Board during the years 1908 to 1915.

LIBRARIES

The library of the Institute comprises the General Library and three departmental libraries: for Physics, Chemistry, and Geology. The General Library, situated in the central unit of the Norman Bridge Laboratory of Physics, contains the books, periodicals, and society papers on engineering, literature, history, economics, general science, and other general subjects. With it is incorporated the Webb Library, which is a collection of some 3,000 volumes largely in French and German and in popular science. This library, together with an endowment of $30,000, is the gift of the late William E. Webb of New York.

The Physics Library is situated in the east wing of the Norman Bridge Laboratory of Physics, and contains all books and periodicals required for the advanced study of physics and mathematics. An endowment of $40,000 for books for this library is the gift of the late Dr. Norman Bridge.

The Chemistry Library is located on the first floor of the new unit of the Gates Chemical Laboratory. This library

contains the books and periodicals on chemistry and chemical engineering.

The Geology Library is situated on the second floor of the west wing of the Norman Bridge Laboratory of Physics. Dr. Ralph Arnold has recently given his valuable geological library to the Institute.

More than 150 periodicals are received regularly by the Institute Library.

OTHER BUILDINGS

In addition to these permanent buildings, a temporary dormitory affords accommodations for about sixty students; and other temporary buildings house the hydraulic and steam laboratories, the research work in aerodynamics pending the erection of the new laboratory of the Guggenheim School, and the departments of military engineering and physical education.

Expenses

TUITION

The tuition is two hundred and fifty dollars ($250.00) a year for undergraduate students, payable $90 at the opening of the first term, and $80 at the opening of each of the other terms. (For graduate students see pages 97 and 107.)

The Associated Student Body fee, payable by all undergraduate students, is $10.00 a year. This fee is used for the support of athletics and of other student activities. There is also a fee of 50c a term for locker rental. There are no other fees, but in the Department of Chemistry an annual deposit of $10 is required the first year, and $15 the last three years, to cover breakage and loss of laboratory materials. There are also small deposits for locker keys and for padlocks issued in the drawing rooms. Deposits are also required to cover the expense of inspection trips taken by students in various courses.

The cost of supplies and of books, most of which will be useful in later professional practice, ranges from $60 to $75 the first year, the larger part of which is required the first term, and from $20 to $30 a term thereafter.

LOAN FUNDS

The Cleveland Loan Fund was established by Miss Olive Cleveland for the purpose of aiding students to obtain an education. The income is lent without interest to worthy students who may need such assistance.

In 1923, Mr. Howard R. Hughes, of Galveston, Texas, gave $5,000 to constitute an additional fund for loans to students. Recently Mr. Raphael Herman, of Los Angeles,

has provided a like sum to establish the Raphael Herman Loan Fund, which may be used for loans or for scholarships at the discretion of the Institute. Additional gifts of $5,000 and $1,000 have been made by anonymous donors for the same general purpose.

Applications for loans may be made to the Secretary of the Institute.

THE PUBLIC WORKS FUND

Mr. William Thum, of Pasadena, has established a fund known as the Public Works Scholarship Fund, thereby making provision for the employment of a limited number of students in the various departments of municipal work. Under the provisions of this Fund, students approved by the faculty are employed in the Municipal Lighting Department, and other departments of the city of Pasadena, thereby gaining valuable practical experience.

STUDENT EMPLOYMENT

The Institute endeavors to be of assistance in aiding students to find suitable employment when it is necessary for them thus to supplement their incomes in order to continue their education. The requirements of the courses at the Institute are so exacting, however, that under ordinary circumstances students who are entirely or largely self-supporting should not expect to complete a regular course satisfactorily in the usual time. Students wishing employment are advised to write to the Secretary of the Institute Y. M. C. A. in advance of their coming to the Institute.

DORMITORY

The Institute has provided on the campus one dormitory, of frame construction, two stories in height, with large,

airy, and well-lighted rooms for sixty students. Several of the rooms have sleeping porches, and there are attractive living and recreation rooms. Table board on the cafeteria plan is furnished to the students living in the dormitory, and to other students who desire it.

The minimum room rent is $75 a year, and the maximum $115. The rate for most of the rooms is $85. Each student in the dormitory is required to make a deposit of $10 at the opening of the college year to cover damage to dormitory property.

Registration and General Regulations

Registration for the second term, 1926-1927, will take place January 3, 1927 (9 A.M. to 3 P.M.); for the third term, March 28, 1927 (9 A.M. to 3 P.M.). Registration for the first term, 1927-1928, will take place, for freshmen, September 22, 1927 (9 A.M.), and for other students September 23, 1927 (9 A.M. to 3 P.M.), and September 24, 1927 (9 A. M. to 12 M.). A special fee of two dollars is charged for registration after these dates.

The schedule of studies for each student is made out by the Registration Committee, and the student, after payment of his tuition and fees, is enrolled by the Registrar. No student is admitted to classes without an assignment card from the Registrar's office.

Any change of schedule is made by the Registrar, and after the first week of the term involves a fee of one dollar, unless made at the suggestion of officers of the Institute.

Every student is required to attend all class and assembly exercises for which he is registered, and to satisfy the requirements in each of the subjects in such ways as the instructors may determine.

Any student who is disorderly or persistently inattentive may be excluded from class by the Registration Committee upon recommendation of the instructor.

Students are held responsible for any carelessness or wilful destruction or waste, and at the close of the year, or upon the severance of their connection with any part of the work of the Institute, they are required to return immediately all locker keys, and other Institute property.

It is taken for granted that students enter the Institute with serious purpose, and that they will cheerfully conform to its requirements. The moral tone is exceptionally good; the honor system prevails at examinations, as well as in the general conduct of students, so that cases requiring severe discipline very rarely occur.

Scholastic Grading and Requirements

SCHOLASTIC GRADING

The following system of grades is used to indicate the character of the student's work in his various subjects of study:

4 denotes Marked Distinction,
3 denotes Above Average,
2 denotes Average,
1 denotes Below Average,
C denotes Conditioned,
F denotes Failed,
i denotes Incomplete.

Incomplete means that the student has been prevented from completing the required work of the subject on account of sickness or other emergency. This mark may only be given in those cases where the student has carried with a grade of 2 or better at least three-fourths of the required work of the subject. Upon completion of the required work, the notation of incomplete shall not be considered a deficiency on the student's record.

Conditioned indicates deficiencies other than incomplete that may be made up without actually repeating the subject. A grade of 1 is given when the work is completed.

Failed means that credit may be secured only by repeating the subject.

Term examinations will be held in all subjects unless the instructor in charge of any subject shall arrange otherwise. No student will be exempt from these examinations. Leave of absence may be obtained only from the Deans, and

can be allowed only for serious cause, such as physical inability to be present.

Special examinations may be arranged by the instructor for students having leave of absence, and must be completed within four weeks from the beginning of the following term; or, if in work of the third term, during the week preceding registration.

A condition in any term's work must be removed during the next term in residence on the date fixed for the removal of conditions. Any condition not so removed shall automatically become a failure, unless otherwise recommended by the instructor at the time the condition is given. A student wishing to take examination for removal of a condition should notify his instructor of his intention to take such examination.

A student who is recorded as having failed in a required subject must repeat that subject with the class next taking it, and such subjects will take precedence in the student's time over those that follow.

Reports of class work are prepared at the close of each term. These reports are sent to students, and to parents or guardians.

SCHOLASTIC REQUIREMENTS

The number of credits allowed for any subject is the number of units multiplied by the grade received.

1. A student will be *placed on probation,* if, at the end of any term, he does not receive at least 80 credits.*

2. A student will be *dismissed from the Institute* (a) if,

*At the end of the first term of his first year at the Institute a student who has failed to secure 80 credits may be dismissed from the Institute (instead of being placed on probation), if it has become clear that he has not the qualifications required for the successful prosecution of an engineering or scientific course.

at the end of any term, he does not receive at least 50 credits; or, (b) if he is already on probation and does not receive, at the end of the term, at least 80 credits.

3. A student will in general not be admitted to the next year's work of any specified course, if during the year he has not received 285 credits (corresponding to an average of 95 credits per term). A student who has met the minimum requirements term by term, but has failed to meet this annual requirement should communicate with the Registrar immediately after he receives his record at the end of the school year, stating any reasons why he should be allowed to continue in the work of his course. The Registration Committee, after consultation with the professional department or Faculty Committee representing the student's course, may, in case his general qualifications warrant it, grant him the opportunity to qualify for admission to the work of the following year by additional study during the summer or by the fulfillment of other conditions.

4. The foregoing rules shall apply to all students who are registered for 40 units of work or more per term. If for any reason a student is carrying less than 40 units, the credits required (as above stated) shall be prorated on the basis of 40 as a maximum. For example, a man carrying 32 units of work shall be expected to obtain four-fifths of 80, or 64 credits per term to remain off probation.

5. A total of 1,140 credits is required for *graduation* (corresponding to an average of 95 credits per term), as well as the completing of the prescribed work of a course. A student who makes 1,680 credits for the four years (corresponding to an average of 140 credits per term), will be *graduated with honor.*

6. A student will be given *honor standing* in any term if he has received 140 credits during the preceding term; such honor standing to entitle him to special privileges and opportunities, such as relief from some of the more routine study and laboratory work, and admittance to more advanced subjects and research work. But no student in honor standing will be admitted to an honor section pursuing any particular subject (other than those of the freshman year) unless he has also obtained a grade of 3 or more in the work prerequisite to that subject.

A student who is known to be exercising a harmful influence on the student life of the Institute may be summarily dismissed, whatever be his scholastic standing.

Any student placed on probation for low scholarship should withdraw from student activities or from outside employment, or should reduce the number of subjects he is taking, to a sufficient extent to enable him to meet the requirements stated above; and any such student must report to the Dean of Freshmen in case he is a member of the freshman class, or to the Dean of Upper Classmen in case he is a member of a higher class, before entering upon the work of the ensuing term, and must arrange his schedule of studies and limit his outside activities in accordance with the advice of his Dean.

Petitions for immediate reinstatement from students who are dismissed for low scholarship will not be entertained by the faculty, except in cases of sickness or other unforeseen emergencies. The faculty will consider extension of the period of probation only in the case of students who are placed on probation for low scholarship at the close of the first term of their first year at the Institute, and then only till the end of that year.

With the permission of the Registration Committee, a student of ability who must support himself wholly or in part by outside work and consequently would be unable to meet the scholarship requirements in four years, may be admitted at the beginning of his sophomore year to a part time schedule allowing an extra year for the completion of his course. The scholastic standing of students in these part-time courses shall be determined on the basis of seventy-five per cent of the credits mentioned in scholastic requirements 1, 2, and 3 above. Tuition shall be at the rate of $200 per year.

Applications for registration in excess of the prescribed number of units must be approved by the Registration Committee.

Prolonged leave of absence must be sought by written petition to the faculty, and the student must indicate the length of time, and the reasons, for which absence is requested. In case of brief absences from any given exercise, arrangements must be made with the instructor in charge.

Freshmen should make application, shortly before the close of the school-year, for admission to the second-year of the Course in Engineering or of the Course in Science. Because of limited laboratory accommodations, only 40 students can for the present be admitted to the Course in Science.

Requirements for Graduation

For graduation students must complete such work as is prescribed by the faculty for their respective courses, amounting to approximately 620 units; and must maintain such standing as will give them 1,140 credits (see page 67). Students who make 1,680 credits will be graduated with honor.

A student must file with the Registrar a declaration of his candidacy for the degree of Bachelor of Science on or before the first Monday of December preceding the date at which he expects to receive the degree. His record at the end of that term must show that he is not more than 21 units and not more than 40 credits behind the requirement in the regular work of his course. All subjects required for graduation, with the exception of those for which the candidate is registered during the last term of his study, must be completed by the second Monday of May preceding commencement.

Extra-Curriculum Opportunities

LECTURE AND CONCERT COURSES

Under the auspices of the Pasadena Lecture Course Committee there are given each year at the Institute a number of public lectures on science, literature, and other subjects of general interest. Weekly public lectures in science, profusely illustrated by experiments, are also given by the staff of Norman Bridge Laboratory. Special opportunities are made available to students for attendance at concerts given by the Los Angeles Philharmonic Orchestra and noted artists under the auspices of the Pasadena Music and Art Association. They may also visit the frequent exhibitions of paintings held at the galleries of the Carmelita Gardens.

STUDENT ORGANIZATIONS AND ACTIVITIES

The students are organized into an association known as the Associated Student Body, of which all are members, to deal with affairs of general concern to the students, and to deal with such matters as may be delegated to them by the faculty. The Association elects its officers and a board of control, which investigates breaches of the honor system, or cases of misconduct, and suggests disciplinary penalties to the Associated Student Body for recommendation to the faculty.

Coordination in regard to campus affairs between faculty and students is obtained through periodic conferences of the Faculty Committee on Student Relations and the Executive Committee of the Student Body.

The Associated Students exercise general direction of matters of undergraduate concern in cooperation with the faculty. Athletic contests are managed by the Athletic

Council, composed of faculty and student representatives. The student body, through its elected representatives, manages THE CALIFORNIA TECH, a semi-weekly paper, and the BIG T, the annual. A glee club, an orchestra, and a band are maintained, with assistance from the Institute. There are at the Institute student branches of the American Institute of Electrical Engineers, the American Society of Mechanical Engineers, and the American Society of Civil Engineers. A Chemists' Club includes men interested in this particular field. Other organizations are the Dramatic Club, the Economics Club, the Press Club, the Radio Club, and the Aeronautics Club.

The Astronomy and Physics Club, while composed of members of the faculty, graduate students of the Institute, and members of the staffs of neighboring scientific institutions, admits to its meetings undergraduate students who may be interested in its discussions.

Sigma Xi, an honor society founded for the promotion of scientific research, is represented at the Institute by an active chapter. Graduate students who have demonstrated their ability to prosecute research are eligible for membership. Undergraduate students who have shown particular interest and aptitude in research are elected to associate membership.

A chapter of Tau Beta Pi, the national scholarship honor society of engineering colleges, is maintained at the Institute. Elections are made each year from the highest eighth of the junior class, and from the highest quarter of the senior class. The additional qualifications of personal worth are also considered. Election to membership is regarded as a high honor.

A chapter of Pi Kappa Delta, national forensic honor society, elects to membership students who have represented the Institute in intercollegiate debate, oratorical or extempore contests. At the national conventions held every even-numbered year, the Institute speakers have an opportunity to compete for national honors in the forensic field. On the odd-numbered years they enter the competition for the trophies offered by the Pacific Province of the order.

The forensic interests of the Institute include also membership in the Southern California Public Speaking Association. Under the auspices of this association the Institute debaters engage in an annual schedule of six debates with other Southern California colleges, and in annual oratory and extempore contests. Debates are also scheduled with other nearby colleges, and frequently with eastern teams traveling through California. On the Pi Kappa Delta trips to the National Conventions, debates are scheduled with the best of the institutions that can be met en route. Institute orators also compete in the annual contest of the Peace Association, and the Better America League contest on the Constitution.

To train the Institute speakers for these various intercollegiate contests, a debate course is offered by the English department, and much individual coaching is given the members of the teams. During the second and third terms a special class for freshmen gives the members of that class an opportunity to prepare for the freshman debates, in which the first-year men of six other colleges are met. A number of intramural practice debates, and the annual contest for the Conger Peace Prize, afford all men interested in public speaking an opportunity to develop their abilities.

Exceptional facilities in dramatic work are afforded the student. Each year a classical play, Greek or Roman, is presented under the auspices of Pi Kappa Delta, participation in it, however, being open to the whole student body. A modern play is given under the auspices of the English Department, open likewise to all students. Both of these plays are produced under the direction of Mr. Gilmor Brown, Director of the internationally famous Pasadena Community Playhouse. Mr. Brown also supervises the delivery of the students taking part in forensic contests.

A thriving Young Men's Christian Association with a full time Secretary has its office in Throop Hall and performs many valuable services. Receptions for new students, hikes, meetings, classes for the study of life and other problems are conducted by this organization. Under its auspices has been formed a Cosmopolitan Club, membership in which is evenly divided between foreign and American students.

Scholarships and Prizes

FRESHMAN PRIZE SCHOLARSHIPS

A number of freshman scholarships will be awarded by the Institute, and a further scholarship by its Alumni, for the next school year, and in succeeding years, upon the basis of a competition open to properly qualified male students in the senior class of the high schools or college preparatory schools of California. The Institute Scholarships will carry a payment sufficient to cover either the whole or half of the year's tuition; and the Alumni Scholarship one of $300.

To enter the competition the student must meet the following conditions: He must complete by the end of the current school year at least fifteen units of studies of such a character as will fulfill the requirements for admission to the Institute, as set forth on pages 47-50, and he must, if awarded a scholarship, expect to enter the Institute at the beginning of the next college year. The competitor for the Alumni Scholarship must be elected by vote of the male members of the senior class of his high school. Any competitor for the Alumni Scholarship is eligible for an Institute Scholarship (in case he should fail to receive the Alumni Scholarship).

Each student nominated for the Alumni Scholarship must mail to the Registrar of the Institute not later than June 10th, on forms provided for the purpose, credentials giving the usual statistical information, and showing his high-school record, his participation in student activities, and his outside activities and personal interests.

All competitors for the scholarships must present themselves at the Institute for examination on June 27th and

28th. The examinations will cover the branches of mathematics required for admission to the Institute, high-school physics and chemistry, English, American history, and general information. They will be of such a character as to determine the ability of the student to think and to express himself clearly, and to demonstrate his initiative and resourcefulness in planning experiments, and his power of applying his knowledge to concrete problems, rather than to test memorized information. The ten or twelve most successful applicants will be expected to present themselves later for personal interviews.

The scholarships will be awarded on the basis of all the information available in regard to the applicants—the results of their examinations, their high-school records and recommendations, the statements submitted as to their student activities and outside interests, and results of the personal interviews. The awards will be made without reference to financial need; but any successful student with adequate resources may relinquish the money payment in favor of the next most deserving competitor, while retaining the scholarship as an honorary recognition. The winners of these scholarships will be designated Freshman Scholars, and will be so registered in the Institute Catalogue.

SOPHOMORE AND JUNIOR PRIZE SCHOLARSHIPS

An endowment fund for undergraduate and graduate scholarships and fellowships, known as the Robert Roe Blacker and Nellie Canfield Blacker Scholarship Fund, has recently been given to the Institute. The income of this fund is used for maintaining scholarships covering a part or the whole of the tuition and known as the Blacker

Junior and Sophomore Scholarships. Half of these scholarships are available for the junior year and the other half for the sophomore year. Normally, these scholarships will carry half-tuition; but the awards may be further subdivided, or combined to afford full tuition, when the qualifications of the contestants make this advisable. They are awarded at the end of each year to students of the freshman and sophomore classes, on the basis of a competition of the character described below.

JUNIOR TRAVEL PRIZES

Two Travel Prizes, each carrying an award of $900, have been established through the liberality of anonymous donors, in order to emphasize the educational value of travel as a means of broadening the student's cultural and professional viewpoints.

These two travel prizes are awarded, not later than the end of the second term of each year, to the two most worthy students in the junior class upon the basis of a competition carried out as described below. They are to be used for a trip to Europe during the vacation between the junior and senior years. These tours are planned in consultation with representatives of the Faculty Committee on Honor Students, and include about ten days sightseeing in the United States on the way to Europe and on the return. The winners of the prizes are expected to keep a diary of their experiences, and upon their return to file with the Institute a summarized report of their travels and expenses; and to present an interesting account of some of their experiences at an Assembly of the student body.

CONDITIONS OF THE COMPETITION FOR THE PRIZE SCHOLARSHIPS AND TRAVEL PRIZES

For the competition for the Sophomore and Junior Scholarships and for the Junior Travel Prizes the faculty have adopted the following regulations:

(1) *Eligibility for Travel Prizes and Prize Scholarships.* At the end of the second term of each year the Committee on Honor Students will designate a number of freshmen as eligible for the Sophomore Prize Scholarships and a number of sophomores as eligible for the Junior Prize Scholarships and for the qualifying competition for the Travel Prizes. The students so designated will in general not exceed twelve, and will be those who have received the largest number of credits during the two preceding terms (including any credits for summer reading during the preceding summer). The students so designated will constitute during the third term the first honor section.

(2) *Award of the Blacker Prize Scholarships.* These Scholarships will be awarded to those students who, after having become eligible in the way stated above, receive the largest number of "points" computed as follows:

	Maximum
(a) Rating in scholastic subjects, equal weights being assigned to the total credits received during the three preceding terms (including credits for previous summer reading), and to the ratio of these total credits to total units	350
(b) Grade on "qualifying tests" in physics, mathematics, and chemistry. These "qualifying tests" will be so arranged as to test not detailed knowledge, but (1) general grasp of the important principles of the basic sciences; (2) power to apply them to new concrete problems; and (3) originality in devising new methods of attack, experimental and theoretical	150

(c) Rating by fellow-students of the first honor section on personal qualities, such as integrity and trustworthiness, morals, native ability, disposition, initiative, efficiency, ability to deal with others, judgment, gentlemanliness, and the like 150

(d) Originality, ideals, ability, and personality, as rated by members of the Committee on Honor Students and by individual instructors 150

(e) General information and breadth of interest as shown by special examination 50

(f) Detailed statement of each student as to his "student activities," participation in outside affairs, general reading, etc 50

(g) Physical development and attention to health during the preceding year as rated by the Physical Education Department* 50

(h) Rating on power of clear, forceful expression, written and oral 50

Total 1,000

(3) *Qualifying for the Travel Prizes.* At the end of each year the Committee on Honor Students will designate not more than six students of the sophomore class as having "qualified" for the competition for the Travel Prize of the ensuing year. Such students will be so designated as receiving the largest number of "points."

(4) *Competition for the Travel Prizes.* The competitors qualifying for the Travel Prizes in the way stated above shall report at once (before the summer vacation) to representatives of the Committee on Honor Students; and a plan for summer reading and study and for special work during the first two terms of their junior year to meet the requirements of the competition will be laid out.

*Students desiring to compete for the scholarships or travel prizes should report this fact at the beginning of the school year tc the Physical Education Department, in order that they may receive special instructions.

(5) *Award of the Travel Prizes.* These prizes will be awarded to those students who, having qualified in the way stated above, receive the largest number of points computed as follows:

	Maximum
(a) Rating in scholastic subjects, equal weights being assigned to the total credits received during the sophomore year and first term of the junior year, and to the ratio of these credits to total units	350
(b) Research and other creative ability as rated by instructors who have had contact on this side	250
(c) Power of clear, forceful expression (oral and written), as rated by instructors who have had contact on this side	50
(d) Acquaintance with European geography, politics, social problems, and recent history, with art and nature, with German and French, and other knowledge conducive to the success of a European trip as rated by Dean Macarthur on the basis of the special subject, "Europe," which contestants are recommended to take in the fall term	100
(e) Student activities, physical development, health, as rated at the end of the sophomore year (items f and g of that rating)	50
(f) Personal qualities as rated by fellow students at end of sophomore year (item c of that rating)	100
(g) Personal qualities conducive to fullness of life and success in a scientific or engineering career, as rated by Honor Student Committee and instructors who have had close contact	100
Total	1,000

THE CONGER PEACE PRIZE

Everett L. Conger, D.D., for the promotion of interest in the movement toward universal peace and for the furtherance of public speaking, established in 1912 the Conger

Peace Prize. The income from one thousand dollars is given annually as a prize for the composition and delivery in public of the best essay on some subject related to the peace of the world. The general preparation for the contest is made under the direction of the Department of English.

SCHOLARSHIP AID FOR HONOR STUDENTS

In addition to the prize scholarships described above, certain scholarship funds, limited in amount, are available for students in honor standing whose financial resources might otherwise prevent them from continuing at the Institute. Any such students are requested to consult the Deans.

New Courses in Aeronautics

The Institute announces that it is adding to its major branches of instruction and research new courses in aeronautics. This development has been made possible through a gift of about $300,000 from the Daniel Guggenheim Fund for the Promotion of Aeronautics. Notification of this gift was received through the following telegram from Harry F. Guggenheim, President of the Daniel Guggenheim Fund:

"It gives me great pleasure, as President of the Daniel Guggenheim Fund for the Promotion of Aeronautics, to advise you that the Trustees of the Fund have authorized a grant amounting altogether to approximately $300,000 for the erection of a permanent building at the California Institute of Technology to be devoted to the study of aeronautics and including a provision of fifteen thousand dollars a year for a term of years for the conduct of study and experiments in this rapidly developing science and art. May I remark that this gift is made in recognition not merely of the opportunities for study and research which climatic and other conditions in California make possible, but also as a tribute to the distinguished work in science and education of yourself and associates, and because of our belief that you are developing in Southern California an institution which is destined to make very great contributions to the progress not only of our own country but of the whole world?"

On the basis of this gift the California Institute has established the Daniel Guggenheim Graduate School of Aeronautics, and is constructing a new Aeronautics Building containing a ten-foot high-speed wind tunnel at an expense of approximately $200,000.

The following program of instruction and research is being undertaken:

1. Extension of the Institute's theoretical courses in aero-

dynamics and hydrodynamics, with the underlying mathematics and mechanics, taught by Professors Harry Bateman, Eric T. Bell, and Paul S. Epstein.

2. Initiation of a group of practical courses conducted by the Institute's experimental staff in cooperation with the engineering staff of the Douglas Company, with the aid of the facilities now being provided at the Institute combined with those of the Douglas plant.

3. Initiation of a comprehensive program of research on airplane and motor design, as well as on the theoretical basis of aeronautics.

4. Immediate perfection of the new stagger-decalage, tailless airplane recently developed at the Institute by one of its instructors in aeronautics, A. A. Merrill, a radical departure from standard aeronautical design, which in recent tests has shown promise of adding greatly to the safety of flying.

5. Establishment of a number of research fellowships in aeronautics at the Institute.

6. Building and testing not only of models for wind-tunnel work, but also of full-size experimental gliders and power planes for free flight.

As in the older departments of physics, chemistry, and mathematics, emphasis will be placed primarily upon the development of graduate study and research in the different branches of aeronautical engineering; but provision has also been made in the Four-Year Undergraduate Course in Engineering for a definite option leading to such graduate study and research. This will afford a broad and thorough preparation in the basic science and engineering upon which aeronautics rests, and will include a general course in aeronautics in the senior year. As in the other branches there

will be in aeronautics a definite Fifth-Year Course leading to the degree of Master of Science; and more advanced study and research will be offered to students wishing to specialize further and work for the degree of Doctor of Philosophy.

The Graduate Courses may be taken either by students who have completed a four-year course at the Institute, or by students from other colleges who have had substantially the same preparation. The field of aeronautical engineering is so many-sided that a student who has completed the Undergraduate Course either in Engineering or in Science will be admitted to the Fifth-Year Course. The more advanced work, however, may be taken only by students who have completed the Fifth-Year Course at the Institute or who have had substantially the same preparation elsewhere.

A student working for the Degree of Doctor of Philosophy may spend part of his time working in an airplane factory or in acquiring experience in flying or aerial photography at a recognized flying field. The experience thus acquired will be regarded as the equivalent of a certain amount of other graduate work.

Excellent opportunity for research of all kinds will be afforded by the present four-foot wind channel of the National-Physical-Laboratory type, and more fully by the new Aerodynamical Laboratory to be constructed during the coming year. This laboratory will include a ten-foot high-speed wind channel, a workshop for model and full-scale construction, and laboratories for researches connected with airplane engines. These researches will be supplemented by large-scale work in the plants of the Douglas Airplane Company and by flight-tests on the Army and Navy flying fields.

It is anticipated that, as has already occurred in the other departments of the Institute, a considerable school of research workers, consisting of doctorate candidates, teaching fellows, research associates, Army and Navy officers, and members of the permanent staff, will rapidly be built up.

New Courses in Geology and Paleontology

The Institute has recently added Geology and Paleontology to its major branches of instruction and research.

As in the older science departments of physics, chemistry, and mathematics at the Institute, emphasis is being placed primarily on the development of graduate study and research in geological directions; but provision has also been made for a four-year course of undergraduate study. This will afford an unusually broad and thorough preparation in the basic sciences on which geology depends and an introduction to the fundamental principles of geology itself. This is supplemented, for students desiring to specialize in the subject, by Fifth-Year Courses in Geology and in Paleontology leading to the degree of Master of Science.

These Graduate Courses may be taken either by students who have completed the four-year Course at the Institute, or by students from other colleges who have substantially the same preparation. Properly qualified graduates from other colleges may also pursue as graduate students the geological studies of the senior year of the Undergraduate Course.

During the senior year of the Undergraduate Course and throughout the Fifth-Year Courses in Geology and in Paleontology much time will be devoted to investigation; but students desiring to become research men or professional experts in geology will naturally continue their work at least two years more for the degree of Doctor of Philosophy.

PROFESSIONAL OPPORTUNITIES FOR GEOLOGISTS

An important reason why the Institute selected geology as the direction in which next to develop its departments was that it affords exceptional opportunities for an attractive professional career, both on the scientific and industrial sides. There is a real demand, very inadequately met, for well trained geologists for teaching and research positions in colleges and universities, for government posts in connection with geological and mining surveys, and for places as directors and field explorers in connection with museums, and, above all, for positions as geological experts in the oil and mining industries. So urgent is the demand in these industries that students are often drawn into them before they have properly completed their studies.

Aside from these professional opportunities, the work of the geologist is attractive because it constantly offers new problems to be solved, affords special opportunity for research and expert work, and gives close contact with nature and outdoor life.

THE INSTRUCTION IN GEOLOGY AND PALEONTOLOGY

The elementary geological subjects are given with a threefold purpose. First, they serve to convey a broad concept of the constitution and structure of the earth, of its origin and history, and of the evolution of life upon it; for it is assumed that the intellectual equipment of any educated man, whether he be a scientist or not, is incomplete without some acquaintance with the fundamental principles of evolution. Secondly, the elementary courses afford to engineering students geological knowledge which will often be required by them in their professional practice. Thirdly, the undergraduate subjects give to those who are to special-

ize in geological sciences the preparation required for advanced work and research.

The advanced subjects afford training for the profession of geologist or paleontologist. Students who complete the Fifth-Year Course in Geology are prepared for geological positions with oil and mining companies and on government and state geological surveys; but further graduate work (leading to the Doctor's degree) is very desirable for those who are preparing themselves for university positions in geology or paleontology and for service as professional geologists.

The thorough grounding in physics and chemistry afforded in the freshman, sophomore, and junior years is a most advantageous preparation for geologic studies; for geology is essentially the application of the principles of physics and chemistry to the Earth's crust.

OPPORTUNITIES FOR RESEARCH IN GEOLOGY

No better field for geologic training exists than the region around Pasadena. Within convenient reach is an almost unrivaled variety of rock types, geologic structures, and physiographic forms. Field studies can be carried on comfortably throughout the entire year; and this constitutes an important part of the department program.

Stratigraphic studies may be pursued in the Cenozoic and Mesozoic sedimentary rocks of the southern Coast Ranges, in which the oil fields are located, and in the Mojave Desert region. Thick sections of Paleozoic sediments in the desert region of southeastern California remain almost unexplored.

Within easy reach of Pasadena a great variety of geologic structures is exemplified. Folding and faulting on

a large scale have occurred in the Coast Ranges; and these same structural phenomena in somewhat different form may be studied in their clear development in the higher ranges of Southern California and in neighboring parts of the Great Basin.

Magnificent examples of a large variety of physiographic forms await study; these range from coastal features resulting from recent uplift and subsidence to forms due to recent folding, faulting, and erosion of different rock structures. The effects of humid, glacial, and desert climates can be seen in closely adjacent areas.

The region likewise offers excellent opportunity for studies in physical and geological seismology (in connection with the laboratory mentioned below), and in other branches of geology.

OPPORTUNITIES FOR RESEARCH IN PALEONTOLOGY

Students in both vertebrate and invertebrate paleontology find in Southern California and adjacent regions splendid opportunities for investigational work. Much research remains to be conducted in the phylogenetic history of organisms as revealed by the fossil record and in the succession and relationship of faunas.

Within the Pacific Coast province occur many marine formations, having invertebrate assemblages at numerous horizons. Frequently these horizons are associated with oil-bearing strata of the California Coast Ranges. Many important problems are presented in the field of invertebrate paleontology relating to the evolution of specific types of invertebrates, to oil and its formation, to the age and relationship of marine deposits and faunas of the western border of North America and the correlation of these ac-

cumulations and assemblages with those occurring in the Pacific Basin and elsewhere.

Important contributions in vertebrate paleontology remain to be made in monographic studies of many groups of fossil vertebrates treating of the structure, relationships, and evolution of these forms. Opportunities for studies leading toward contributions of this type are afforded particularly by the extensive collections of excellently preserved materials from the asphalt deposits of Rancho La Brea and McKittrick, California, available at the Los Angeles Museum and at the California Institute of Technology.

Within the Great Basin province of western North America occur many continental deposits of Tertiary and Pleistocene age yielding mammalian remains. Valuable collections from several Tertiary horizons in the John Day region of eastern Oregon are available for study. Paleontological investigations are frequently fundamental in the solution of problems relating to the geologic history of the Great Basin. Studies of the extinct faunas not only bring to light the existence of new forms in these assemblages with suggestions as to the environmental conditions under which the groups existed, but they also yield important data relating to the time correlation of the faunas with assemblages occurring outside the Great Basin province.

Land-laid deposits intercalated in the Cenozoic marine sections of the Pacific Coast province furnish mammalian remains of considerable importance in establishing the time relationship between the marine record and the continental record of western North America. Remains of marine mammals are also frequently encountered in Tertiary and Pleistocene marine formations of this region, revealing im-

portant stages in the evolution of the group and affording a means of establishing world-wide correlation between marine formations.

SEISMOLOGICAL RESEARCH LABORATORY

A Seismological Research Laboratory is now being completed and equipped on a site west of the Arroyo Seco.

Graduate students in the Department of Geology and Paleontology will be received in the laboratory for the purpose of taking part in the researches or of becoming familiar with seismological methods.

TEACHING AND RESEARCH FELLOWSHIPS

Fellowships are available for properly qualified students who desire to pursue advanced work in geology or paleontology. Teaching fellows will be expected to devote about one-fourth of their time to instructional and assistant's duties, and the remainder to graduate study and research in geology. Recipients of teaching fellowships will be subject to a tuition fee of $60 per term; but this fee is reduced to $30 after they have been accepted as candidates for the degree of Doctor of Philosophy. Applicants must be in sound health.

The fellowship stipend will be from $600 to $1,000 a year, depending on the qualifications of the applicant and his promise in research.

Applications for Fellowships should be made on the form provided for the purpose. It is recommended that applicants write also a personal letter to Professor J. P. Buwalda or Professor Chester Stock, stating their interests and their desires with respect to graduate study and their subsequent professional career.

Graduate Study and Research

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Information and Regulations for the Guidance of Graduate Students

I. ADMISSION TO GRADUATE STANDING

1. Applicants for admission to graduate standing at the California Institute of Technology must hold a baccalaureate degree from a college or university of recognized standing. They should present to the Registrar an official transcript of their preparatory and college record showing in detail both its amount and character. They will be admitted to graduate standing at the Institute, provided their previous undergraduate work is of such character as to warrant further study in science, mathematics, or engineering.

2. Admission to graduate standing does not of itself admit to candidacy for a higher degree. For the requirements for the Master's and Doctor's degrees, see pages 100-106.

3. If the applicant's preliminary training in science, mathematics, and engineering, has not been substantially that given by the four year undergraduate courses at the Institute, he must pursue such undergraduate courses as may be suited to his needs. Such students may, with the approval of the Registration Committee, be awarded the degree of Bachelor of Science upon satisfactorily completing those courses in which they are deficient.

4. In exceptional cases, men of suitable age and sufficient attainments, but who are not graduates of a college or university of good standing may, in each case by special vote of the Committee on Graduate Study, be admitted to graduate courses.

II. FEES

1. Tuition for graduate students is in general $250 a year, payable in three installments, $90 at the beginning of the first term and $80 at the beginning of the second and third terms, the same as for undergraduate students (except that holders of Institute Fellowships and Assistantships pay only $180 a year, payable in three installments of $60 each). For graduate students who have been admitted to candidacy for the Doctor's degree, the tuition will thereafter be at one-half the above rates. Graduate students who are permitted to carry on research during the summer will not be required to pay tuition fees; but, in order to obtain credit for such summer work, they must register for it in advance.

2. No other fees except for breakage are required of graduate students. Students in chemistry are required to make a deposit of $15 at the beginning of the school year to cover their breakage charges.

3. No degrees will be granted until all bills due the Institute have been met.

III. REGISTRATION

1. Application for admission (accompanied by official transcript of record) should be made of the Registrar in advance. The official transcript should be accompanied by a catalogue of the applicant's college or leaves therefrom in which the studies he has taken are clearly marked. Letters of introduction or recommendation and copies of publications may be included.

2. All graduate students are required to register and file a program card in the Registrar's office at the beginning of each term of residence whether they are attending regular

courses of study, or only carrying on research or independent reading, or writing a thesis or other dissertation.

3. Before registering the graduate student should consult with members of the department in which he is taking his major work to determine the studies which he can pursue to the best advantage.

4. A student will not receive credit for a course unless he is properly registered, and at the first meeting of each class should furnish the instructor with a regular assignment card for the course, obtained from the Registrar's office.

5. One term of residence shall consist of one term's work of not less than 45 units in which a passing grade is recorded. If less than 45 units are successfully carried the residence will be regarded as shortened in the same ratio, but the completion of a larger number of units in any one term will not be regarded as increasing the residence. Students who are permitted to carry on research during the summer will be allowed credit therefor. *The student himself is charged with the responsibility of making certain that all grades have been recorded to which he is entitled.*

6. The number of units allowed for a course of study or for research is figured on the basis that one unit corresponds roughly to one hour a week of work in the laboratory throughout the term, or a somewhat shorter number of hours of intensive study.

7. In registering for research, students should indicate on their program card the name of the instructor in charge, and should consult with him to determine the number of units to which the proposed work corresponds. At the

end of the term the instructor in charge shall decrease the number of units for which credit is given, in case he feels that the progress of the research does not justify the full number originally registered.

8. Graduate students who are devoting their whole time to their studies will be allowed to register for not more than 60 units in any one term. Students on part time teaching appointments will not be allowed to register for so many units. Teaching fellows will be allowed to register for not more than 45 units.

9. Research Associates, National Research Fellows, Travelling Fellows from other institutions, and other guests of the Institute are requested to file a card in the Registrar's office at the beginning of their work, giving Institute and home address, degrees, nature of work planned, etc.

IV. EXAMINATIONS AND GRADES

1. Term examinations are held in all graduate courses unless the instructor shall, after consultation with the chairman of the division, arrange otherwise. No student taking a course for credit shall be exempt from these examinations when held.

2. Grades for all graduate work are turned in to the Registrar's office at the close of each term.

3. The following system of grades is used to indicate class standing in graduate courses: 4 denotes marked distinction, 3 denotes above average, 2 denotes average, 1 denotes below average, C denotes conditioned, F denotes failed. In addition to these grades which are to be interpreted as having the same significance as for undergraduate courses, the grade P, which denotes passed, may be used at the discretion of the instructor, in the case of

seminar, research, or other work which does not lend itself to more specific grading. Undergraduates, when allowed to carry graduate work, may be graded P in any graduate course, in which case the grade P carries the same credit as grade 2.

4. The Master's degree is awarded with the designation "with honor," or without designation.

5. The Doctor's degree is awarded with the designations *"summa cum laude," "magna cum laude," "cum laude,"* or without designation.

V. REQUIREMENTS FOR HIGHER DEGREES

The Institute gives two higher degrees, the degree of Master of Science, and the degree of Doctor of Philosophy.

Members of the permanent Institute staff of rank higher than that of Assistant Professor are not admitted to candidacy for a higher degree.

The course of study of each candidate will be in charge of the department in which the student is pursuing his major work, which will exercise general oversight over his work.

Each student should consult the chairman of the division in which he is working, as well as his departmental adviser, concerning special divisional and departmental requirements. See Section VI for special requirements in Chemistry.

A. MASTER OF SCIENCE

1. *General Requirements:* The degree of Master of Science in either pure or applied science is awarded for the satisfactory completion of not less than one year's advanced study and research subsequent to the Bachelor's degree.

2. *Technical Requirements:* (a) *Residence:* At least one college year (three terms) of work in residence at the Institute subsequent to a baccalaureate degree equivalent to that of the Institute is required for the Master's degree. It should be understood that this is a minimum requirement. A student whose undergraduate work has been insufficient in amount or too narrowly specialized, or whose preparation in his special field is inadequate must count upon spending more than one year in work for the Master's degree.

(b) *Courses:* The candidate must successfully complete not less than 150 units of advanced work. Of this, not less than one-fourth must consist of research; and not more than one-fourth may consist of subjects included in that undergraduate course of the Institute which pertains to that branch of science in which the graduate study is to be pursued. Although the credit for undergraduate work is thus limited, graduates of other colleges will be expected to become proficient in all of the more important subjects of the corresponding undergraduate course, of which they have not previously had substantial equivalents; and, in case such deficiencies amount to more than 40 units, candidates must expect to devote more than one college year to the work for the Master's degree.

(c) *Examinations:* All candidates are required to pass, in addition to the term examinations on the courses they are taking, a general examination in their main subject or in important branches of it. The student must petition for the examination on a form obtained from the Chairman of the Committee on Graduate Study, after consultation with his departmental adviser. The examination is written or

oral at the discretion of the department, and must be held not later than one week preceding the conferring of the degree.

(d) *Thesis:* The candidate is required to submit to his department one week before the degree is to be conferred two copies of a satisfactory thesis describing his research.

The thesis must be typewritten on paper of good quality 8½ by 11 inches, leaving a margin for binding of not less than one inch, or may consist in part of pages taken from a published article and pasted on paper of the above size. It should be preceded by a title page containing the following items: Title, Thesis by (*name of candidate*), In Partial Fulfillment of the Requirements for the Degree of Master of Science, California Institute of Technology, Pasadena, California, Date (*year only*).

B. DOCTOR OF PHILOSOPHY

1. *General Requirements:* The degree of Doctor of Philosophy is conferred by the Institute in recognition of breadth of scientific attainment and of power to investigate scientific problems independently and efficiently as exhibited by the candidate during his period of graduate work. While the degree is not awarded for the completion of definite courses of study continued through a stated term of residence, the advanced study and research must in general be pursued for at least three college years. Advanced work done at other institutions will be given due credit, but not less than one year must be spent in residence at the Institute.

The work for the degree must consist of scientific research and the preparation of a thesis describing it and of systematic studies of an advanced character in some branch

of science or engineering, which will be termed the "major subject" of the candidate. In addition as "minor subject" (or subjects) studies such as will give a fundamental knowledge and research point-of-view must be pursued in at least one other branch of science or engineering. The choice and scope of the minor subject must be approved in each case by the department in charge of the course of study.

The minor subject must involve not less than 45 units of advanced study. In addition the candidate must have acquired the power of expressing himself clearly and forcefully both orally and in written language, and he must have a good reading knowledge of French and German.

Proficiency in the major and minor subjects which includes the power to use them effectively will be tested by an examination, which may be written or oral or both, at the discretion of the departments concerned.

2. *Technical Requirements.* (a) *Residence:* At least three years of work in residence subsequent to a baccalaureate degree equivalent to that given by the Institute is required for the Doctor's degree. Of this at least one year must be in residence at the Institute. It should be understood that this is a minimum requirement, and students must usually count on spending a somewhat longer time in residence.

Graduate students are encouraged to continue their research during the whole or a part of the summer, but in order that such work may count in fulfillment of the residence requirements, the student must comply with the above regulations and file a registration card for this summer work in the office of the Registrar.

A student whose undergraduate work has been insufficient in amount or too narrowly specialized, or whose preparation in his special field is inadequate must count upon spending increased time in work for the degree.

(b) *Admission to Candidacy:* Any student in graduate standing who has been in residence one term or more, who has satisfied the several departments concerned by written or oral examination or otherwise that he has a comprehensive grasp of his major and minor subjects as well as of subjects fundamental to them, who has satisfied the department of modern languages that he can read scientific German and French with reasonable facility, who has shown ability in carrying on research and whose research subject has been approved by the chairman of the division concerned, and whose program of study has been approved by both his major and minor departments may on recommendation of the chairman of the division in which he is working be admitted by the Committee on Graduate Study to candidacy for the degree of Doctor of Philosophy.

A regular blank is provided for making application for admission to candidacy. This blank may be obtained from the chairman of the Committee on Graduate Study, and the application must be on file in the office of the Registrar before the close of the first term of the year in which the degree is to be conferred. *The student himself is responsible for seeing that admission is secured at the proper time.*

(c) *Examinations:* A final examination is required of all candidates for the Doctor's degree. This examination, subject to the approval of the Committee on Graduate Study, may be taken at such time after admission to candidacy as

the candidate is prepared, except that it must take place at least two weeks before the degree is to be conferred. The examination may be written or oral or both, and may be divided in parts or given all at one time at the discretion of the departments concerned.

The student must petition for examination on a form obtained from the chairman of the Committee on Graduate Study after consultation with the division chairman.

(d) *Thesis:* The candidate is required to submit to the Chairman of the Committee on Graduate Study two weeks before the degree is to be conferred two copies of a satisfactory thesis describing his research, including a one-page digest or summary of the main results obtained.

The thesis must be typewritten on paper of good quality 8½ by 11 inches, leaving a margin for binding of not less than one inch, or may consist in part of pages taken from a published article and pasted on paper of the above size. It should be preceded by a title page containing the following items: Title, Thesis by (*name of candidate*), In Partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy, California Institute of Technology, Pasadena, California, Date (*year only*).

Before submitting his thesis to the Chairman of the Committee on Graduate Study, the candidate must obtain approval of it by the chairman of his division, and the members of his examining committee. This approval must be obtained in writing on a form which will be furnished at the office of the Chairman of the Committee on Graduate Study. *The candidate himself is responsible for allowing sufficient time for the members of his committee to examine his thesis.*

VI. SPECIAL REGULATIONS RELATING TO CANDIDACY FOR THE DOCTOR'S DEGREE FOR STUDENTS MAJORING IN CHEMISTRY

In agreement with the general requirements for higher degrees adopted by the Committee on Graduate Study, as set forth in Section V, the Division of Chemistry has adopted the following special supplementary regulations:

1. To be recommended for candidacy for the Doctor's degree the applicant must pass satisfactorily an examination in chemistry of the character described in paragraph 2. This examination, which will be mainly written but may be partly oral, may be taken at one of four stated dates, namely, just before the opening of the school year, and at end of each term.

2. The examination in chemistry will cover physical chemistry (as treated in Noyes and Sherrill's "Chemical Principles") and inorganic and organic chemistry to the extent that these are treated in the Undergraduate Chemistry Course of the Institute, also atomic structure (a general descriptive knowledge), colloid and surface chemistry, and history of chemistry. In all these subjects a detailed informational knowledge is not so much desired as power to apply general principles to concrete problems.

3. Applicants must also show by examination or otherwise that they are reasonably proficient in mathematics and physics. The requirement in these subjects includes a thorough working knowledge of all the topics covered in the first two years of the Institute Undergraduate Courses.

4. With his application for admission to candidacy the applicant must also submit a carefully prepared complete report on the progress of his research up to the date of his

application. By this report and his laboratory work the applicant must have given evidence of his industry and ability in research, and of his power to present his results in clear, forceful language and with discrimination as to what is essential in scientific papers.

5. Applicants may in some cases be recommended as candidates, but still be required to complete within a specified time their preparation in special subjects in which they have shown themselves to be deficient.

6. After admission to candidacy students must in general pursue advanced study and research not less than 5 terms (counting equivalent summer work) before they will be recommended by the Division of Chemistry for the final examination for the Doctor's degree.

VII. GRADUATE LIFE

The Faculty Club of the Institute is open to graduate students and affords the advantage of intimate associations with fellow students and with members of the Faculty in the midst of scholarly and attractive surroundings. A few rooms are available to graduate students at a cost which is less than would ordinarily be paid elsewhere and dining privileges are furnished at cost.

VIII. FELLOWSHIPS AND ASSISTANTSHIPS

The Institute offers a number of Fellowships and Assistantships, carrying salaries ranging from $500 to $1,000 for ten months' service. (The tuition of such fellows and assistants is $180 until admitted to candidacy for the Doctor's degree, when it becomes $90.)

The primary object of these appointments is to give a group of well-qualified men a training in research which

will prepare them for university teaching and research and for the many important positions in scientific and industrial research laboratories and in development departments of American industries.

Teaching fellows will devote not more than fifteen hours a week to instruction of a character that will afford them useful experience. This time includes that required in preparation and in marking note-books and papers, as well as that spent in classroom and laboratory. Of the remaining time at least one-half must be devoted to research; and the obligation to prosecute this earnestly is regarded as no less binding than that of showing proper interest in teaching. Advanced courses of study may also be pursued as far as time permits.

In general only those men will be appointed Fellows who have had experience equivalent to that required for the Master's degree at a college or university of recognized standing, and who intend to carry on work for the Doctor's degree. Students who have completed thorough undergraduate courses in chemistry and physics and also courses in mathematics through calculus, and who have already demonstrated their interest and resourcefulness in scientific work may, however, be appointed Assistants with a salary which varies with the competence of the man and the character of the work which he pursues. Assistants who show ability in research and are satisfactory teachers may be promoted to Teaching Fellowships the second year.

Blanks for making application for Fellowships or Assistantships may be obtained on request from the chairman of the Committee on Graduate Study. When possible, these applications should reach the Institute before March 1st,

and notices of awards will be mailed to successful applicants on March 20th. Appointments to Fellowships and Assistantships are for one year only; and a new application must be filed before March 1st of each year by all who desire appointments for the following year regardless of whether they are already holders of such appointments or not.

IX. RESEARCH FELLOWSHIPS

1. The duPont Fellowship in Chemistry: This Fellowship established by the duPont Powder Company of Wilmington, Delaware, carrying a grant of $750 is awarded by the Faculty to the graduate student in chemistry or chemical engineering who gives the greatest promise of original productive work in these sciences in the future.

2. The Research Fellowship of the Standard Oil Company: A special fund has been given for three years to the Institute by the Standard Oil Company for maintaining a fellowship on internal combustion engines.

3. Institute Research Fellowships: In cases where the success of the research justifies it, Assistants and Fellows may be relieved from teaching in order to devote all their time to research.

4. The Petroleum Institute has, through the National Research Council, inaugurated researches at the Institute which call, in 1926-1927, for an expenditure of $9,000. These funds are used mainly for supporting the work of research fellows who are carrying on fundamental researches connected with the physics or chemistry of petroleum or of the hydrocarbons of which it is composed.

5. The National Research Fellowships in Physics and Chemistry established by the Rockefeller Foundation are awarded by the National Research Council to men who have

their Doctor's degree. Fellows may choose the institution in which they desire to pursue research. Applications should be made to the National Research Council, Washington, D. C.

X. INSTITUTE GUESTS

Members of the Faculties of other educational institutions who have already received their Doctor's degree and desire to carry on special investigations may be granted the privileges of the facilities of the Institute without payment of fees. Arrangement should be made in advance with the Chairman of the Executive Council of the Institute. Such guests are requested to file a card in the Registrar's office at the beginning of their work, giving Institute and home address, degrees, nature of work planned, etc.

Description of Advanced Subjects

MATHEMATICS

101. Vector Analysis. 15 units; second term.

In this course the fundamental operations of vector analysis are developed, using the notation of Gibbs, and the use of the analysis is illustrated by means of examples in mechanics and other branches of mathematical physics. Complex quantities are also represented by vectors and geometrical applications are indicated.

Instructor: Bateman.

104 a, b, c. Differential Geometry. 6 units; first, second and third terms.

Prerequisites: Ma. 8, a, b, 10.

In this course geometrical ideas gained in previous courses will be extended, and the methods of the calculus applied to twisted curves and surfaces.

(Not given in 1926-1927.)

Instructor: Wear.

105. Integral Equations. 9 units; third term.

Prerequisites: Ma. 8 a, b, 10, 101.

In this course the linear integral equation of the first and second kinds is discussed and the solutions of Abel, Fourier and Fredholm are applied to various physical problems.

(Not given in 1926-1927.)

Instructor: Bateman.

106. Geometrical Transformations and Invariants. 9 units; first, second and third terms.

Prerequisites: Ma. 1 a, b, 2 a, b, c, d.

Linear and bilinear transformations of one variable. Simple algebraic invariants. General theory of linear transformations and their invariants. Conformal transformations. Birational transformations. Contact transformations.

(Not given in 1926-1927.)

Instructor: Bateman.

107 a, b, c. INFINITE SERIES. 15 units, first, second and third terms.

Prerequisites: Ma. 8 a, b, 10.

Uniform convergence, integration of series, methods of summation and expansion, use and applications of complex variable, elliptic functions.

Instructor: Bell.

108. MATHEMATICAL ANALYSIS. 15 units; first, second and third terms.

Prerequisites: Ma. 8 a, b, 10.

Fourier series and integrals, functions of Legendre, Bessel; the fundamental equations of mathematical physics; functions of a complex variable. Numerous applications to physical problems; tensor analysis.

Texts: Byerly's Fourier Series and Spherical Harmonics; Curtis, Complex Variable; MacRobert, Functions of a Complex Variable; Eddington, Mathematical Theory of Relativity; assigned readings.

Instructor: Bell.

109 a. SEMINAR (I) IN ALGEBRA AND THE THEORY OF NUMBERS. 9 units; third term.

Prerequisites: Graduate standing.

The Dedekind theory of algebraic numbers, Kronecker's theory of modular systems with applications to algebraic functions; comparison of recent theories of algebraic numbers.

Instructor: Bell.

109 b. SEMINAR (II) IN ALGEBRA AND THE THEORY OF NUMBERS. 9 units; third term.

Prerequisite: Graduate standing. (A course in elliptic functions desirable.)

Applications of algebra and special functions to the theory of numbers.

(Not given in 1926-1927.)

Instructor: Bell.

PHYSICS

110 a, b, c. KINETIC THEORY. 9 units; first, second and third terms.

Prerequisites: Ph. 2 a, b, c, d; Ma. 2 a, b, c, d.

Theory of gases, treating Boyle-Mariotte's law, Maxwellian distribution law, number of impacts, mean free paths, viscosity, conductivity, van der Waal's equation of state, diffusion, radiometer effect. General statistics, Boltzmann's theorem with applications to general equation of state (thermal and caloric) of gases, liquids and solids; dielectric, magnetic and optical phenomena. Fluctuations, with applications to Brownian motion, colloidal solutions, optical phenomena at the critical point, concentration element, etc. Theory of solutions, especially electrolytes.

Instructor: Zwicky.

111. THERMODYNAMICS. 12 units; third term.

Prerequisites: Ph. 2 a, b, c, d; Ma. 2 a, b, c, d.

The two fundamental laws of thermodynamics. Entropy and the thermodynamical potentials. Equations of reciprocity. Application to gases, perfect and imperfect, and to dilute solutions. Phase rule and chemical equilibrium. Nernst's theorem.

114. ELECTRON THEORY. 6 units; third term.

Prerequisites: Ph. 2 a, b, c, d; Ma. 2 a, b, c, d.

A course of graduate lectures covering the subjects of ionic mobilities, electronic properties, thermionic and photoelectric phenomena, the electronic theory of thermoelectric currents, X-ray spectra, radioactivity, etc.

Instructor: Millikan.

115. STATISTICAL MECHANICS. 6 units; first term.

Prerequisites: Ph. 12 a, b; Ma. 8 a, b, 10.

Discussion of the general principles underlying the statistical interpretation of entropy. Comparison of the points of view taken by Boltzmann and by Gibbs. Equipartition of energy.

(Not given in 1926-1927.)

Instructor: Epstein.

116. ROENTGEN-RAYS AND CRYSTAL STRUCTURE. 6 units; first term.

Prerequisites: Ph. 20 a, b; Ma. 8 a, b, 10.

Discovery of X-rays and early investigations on them. Diffraction by gratings and space lattices. Intensity of reflected X-rays in its dependence on various factors. Various methods of X-ray analysis. Introduction to the theory of space groups.

(Not given in 1926-1927.)

Instructor: Epstein.

121. Potential Theory. 15 units; third term.

Prerequisites: Ma. 8 a, b, 10; 101.

An exposition of the properties of the potential functions occurring in the theories of gravitation, electricity and magnetism, hydrodynamics, conduction of heat, and the theory of elasticity. Solution of special problems.

Instructor: Bateman.

122. Theory of Electricity and Magnetism. 12 units; first term.

Prerequisites: Ph. 7 a, b, 8 a, b; Ma. 8 a, b, 10.

Electrostatics, magnetostatics, ferromagnetism, electromagnetic field of stationary currents, electromagnetic induction, phenomena in moving bodies, Maxwell's equations, ponderomotive forces of an electromagnetic field, introduction to the theory of electrons.

Instructor: Epstein.

123. Theory of Electromagnetic Waves. 12 units; second term.

Prerequisites: Ph. 7 a, b, 8 a, b; Ma. 8 a, b, 10.

Mathematical study of Maxwell's equations, propagation of waves, absorption and reflection, approximate and rigorous treatment of diffraction, theory of dispersion, electro- and magneto-optics.

Instructor: Epstein.

125. Higher Dynamics. 12 units; third term.

Prerequisites: Ph. 12 a, b; Ph. 15 a, b; Ma. 8 a, b, 10.

Methods of solution of the Hamiltonian equations, conditionally periodic motions, contact transformations, introduction to the theory of perturbations, applications to special cases of interest in atomic theory and the theory of quanta.

(Not given in 1926-1927.)

Instructor: Epstein.

126. Heat Radiation and Quantum Theory. 12 units; second term.

Prerequisites: Ph. 7 a, b, 12 a, b; Ma. 8 a, b, 10.

Historical treatment of the development of the mathematical theory of heat radiation and of the application of the theory of quanta to the phenomena of specific heats of solid and gaseous bodies, photoelectricity, photochemistry, chemical constants, etc.

(Not given in 1926-1927.)

Instructor: Epstein.

127. Physical Optics and Quantum Theory of Spectral Lines. 12 units; third term.

Prerequisites: Ph. 12 a, b, 20 a, b; Ma. 8 a, b, 10.

Treatment of dispersion and optical activity on the basis of the classical theory. Rutherford's atom model and the application of the quantum theory to it. Action of magnetic and electric fields on the emission of spectral lines. X-ray spectra and the structure of atoms.

(Not given in 1926-1927.)

Instructor: Epstein.

128. Modern Aspects of the Quantum Theory. 12 units; third term.

Prerequisites: Ph. 12 a, b; Ph. 15 a, b; Ma. 8 a, b, 10; 126, 127.

Principle of correspondence, Heisenberg's form of it, Born and Jordan's matrix calculus, Schroedinger's wave equations, applications to the Kepler motion, Stark effect, Zeeman effect, etc.

Instructor: Epstein.

129. Some Questions in the Quantum Theory. 9 units; second term.

Lectures on special topics of the quantum theory.

Instructor: H. A. Lorentz.

135. Introduction to Mathematical Physics. 6 units; first term.

Deductive methods in physical science. The nature of the measurable quantities of physics. The nature of the equations of mathematical physics. The principle of dimensional homogeneity. The principle of similitude or relativity of size. The relativity of

motion. Hamilton's principle. The principles of mechanics, electromagnetics, and thermodynamics.

(Not given in 1926-1927.)

Instructor: Tolman.

136. Introduction to the Theory of Relativity. 6 units; third term.

Elementary development of the relativity of motion in free space. Simple applications to mechanical and electromagnetic problems. Use of four dimensional language for expressing the results of relativity. Extension to space in the neighborhood of matter. The theory of gravitation.

Instructor: Tolman.

137. Atomic Structure. 6 units; first, second and third terms.

Prerequisites: Ma. 2 a, b, c, d; Ph. 2 a, b, c, d; L. 34 a, b, c.

The last German edition of Sommerfeld's "Atombau und Spektrallinien" is read and discussed.

Instructor: Houston.

138. Seminar in Theoretical Physics. 4 units; first, second and third terms.

Recent development of the theory of quanta for specialists in mathematical physics.

Instructors: Epstein, Bateman.

141. Research Conferences in Physics. 4 units; first, second, and third terms.

Meets twice a week for report and discussion of the work appearing in the literature and that in progress in the laboratory. All advanced students in physics and members of the physics staff are expected to take part.

Instructors: Millikan, Bateman, Epstein, Tolman, Watson.

142. Research in Physics. Units in accordance with the work accomplished.

Astronomy and Physics Club.

This club is a cooperative enterprise carried on by the physicists of the Institute and those of the Mount Wilson Observatory. This group of from thirty to forty physicists meets every week

either at the Institute or the Mount Wilson laboratory, for the discussion of the researches carried on by its members, as well as of those appearing in the physical journals.

CHEMISTRY

150. Statistical Mechanics Applied to Physical and Chemical Problems. 6 units; second term.

The equations of motion in the Hamiltonian form. Liouville's theorem. The Maxwell-Boltzmann distribution law. Application of statistical mechanics to the theory of matter, and of the hohlraum. Application to the theory of rate of chemical reaction. Relation between statistical mechanics and thermodynamics.

(*Not given in 1926-1927.*)

Instructor: Tolman.

152. Surface and Colloid Chemistry. 8 units; third term.

Lectures and classroom discussions with outside reading and problems, devoted to the general principles relating to surface-tension, adsorption, contact catalysis, and to disperse systems and the colloidal state.

Text: Freundlich, Elements of Colloid Chemistry.

Instructor: Badger.

153. Thermodynamic Chemistry. 6 units; second and third terms.

Lectures and classroom exercises on the applications of the laws of thermodynamics to the equilibrium of chemical reactions and to the electromotive force of voltaic cells. The subject is considered from free-energy and entropy standpoints, and at the close of the course practice is given in the computation of the free-energies and entropies of typical substances.

Text: Chemical Principles, Noyes and Sherrill, and mimeographed notes.

Instructor: Bates.

154. Chemical Reaction-Rates (Seminar). 6 units; first and second terms.

The topics considered are the methods of determining the order and mechanism of chemical reactions; the interpretation of exist-

ing data on the rates of photochemical and thermal gas reactions and reactions induced by collisions of activated molecules; and a critique of existing theories for the temperature coefficient of thermal and photochemical reactions.

Instructors: Tolman, Dickinson, Wulf, Yost.

155. Atomic Structure (Seminar). 6 units; first and second terms.

This seminar will be devoted to an elementary discussion of the principles and phenomena which have led to the modern theories of the structure of atoms. It will involve the solution of numerous problems. The work is preparatory to the intensive study of the subject in treatises like that of Sommerfeld. In the second term the work will include a more complete discussion of X-ray spectra and of radioactivity.

Text: Mimeographed notes.

Instructors: Dickinson, Noyes.

160. Inorganic Chemistry (Seminar). 6 units; second term.

Selected groups of inorganic compounds (e.g., the various compounds of nitrogen with hydrogen and with oxygen) will be considered from modern physico-chemical viewpoints; thus with reference to their physical properties, their thermodynamic constants (their heat-contents, free-energies, and entropies); their rates of conversion into one another (including effects of catalysis and energy radiations), the ionization of those that are weak acids or bases, and their electron structure and valence relations. (Offered in 1927-1928.)

Instructors: Noyes, Yost.

161. Organic Chemistry (Special Topics). 6 units; second and third terms.

A series of lectures and discussions on selected topics of organic chemistry that have special interest from theoretical, industrial, or biological view-points.

Instructors: Conant, Lucas.

170-173. Chemical Research.

Opportunities for research are offered to graduate students in all the main branches of chemistry, namely, in analytical or inorganic chemistry (170), physical chemistry (171), organic chemistry (172), and applied chemistry (173).

The main lines of research now in progress in physical chemistry are:

Ionized substances in relation to the ion attraction theory.

Free-energies, equilibria, and electrode-potentials of chemical reactions.

Rates of chemical reactions in relation to the quantum theory.

Crystal structure determined by X-ray methods.

Catalytic mechanism of homogeneous reactions.

Chemical reactions produced by atoms excited by radiations.

Activation of atoms and molecules by electron impact.

For a fuller survey of the researches in progress, see Publications of the Gates Chemical Laboratory, page 131.

178. Research Conference in Chemistry. 2 units; first, second, and third terms.

This subject consists of reports on the researches in progress in the laboratory and on others which have appeared recently in the literature. These conferences are participated in by all men engaged in research in the laboratory.

Instructors: Noyes, Tolman, Dickinson.

GEOLOGY AND PALEONTOLOGY

181. Petrography. 10 units; first, second and third terms.

Use of the microscope in the identification of minerals and rocks. Study of the petrographic characteristics of certain important types of rocks.

183. Seismology. 6 units (2-0-4); second term of odd-numbered years.

Study and conferences on the principles of physical and geological seismology.

Text: Davison's Manual of Seismology.

Instructor: Buwalda.

184. Laboratory Studies in Seismology. First, second or third term.

Laboratory practice in the measurement and interpretation of instrumental earthquake records; investigation of specific seismologic problems.

Instructor: Staff of Seismological Laboratory.

185 a, b, c. Economic Geology. 6 units; first, second, third terms.

Types of economic deposits; non-metalliferous, and metalliferous. Nature and mode of origin or accumulation of metallic ores, coal, petroleum, salines, building materials.

186. Geomorphology. 6 units (2-0-4); second term of even-numbered years.

Nature and origin of the physiographic features of the earth. Geologic processes involved in their development. Use of physiography in elucidating the later geologic history of regions.

Instructor: Buwalda.

187. Research.

Original investigation, designed to give training in methods of research, to serve as theses problems for higher degrees, and to yield contributions to scientific knowledge. These may at present be most advantageously carried on in the fields of (n) general areal geology, (o) stratigraphic geology, (p) structural geology, (q) physiography or geomorphology, (r) mineralogy and petrology, (s) vertebrate paleontology, (t) invertebrate paleontology, (u) seismology. The region within easy reach of Pasadena offers an extraordinary variety of research problems.

189. Geology Seminar. 5 units; first, second and third terms.

Study and critical discussion of current contributions to geologic knowledge, or intensive study of a limited field in geology with periodical conferences.

Instructor: Buwalda.

190. Seminar in Vertebrate Paleontology. 5 units; second and third terms.

Discussion of progress and results of research in vertebrate paleontology. Critical review of current literature.

Instructor: Stock.

ENGINEERING

200. Advanced Work in Engineering.

Special problems in the various engineering courses will be arranged to meet the needs of students wishing to do advanced work in these departments. The following lines of work are

possible: Advanced Hydraulics, Heat Transfer, and Heat Balance in Power Plants under the direction of Prof. R. L. Daugherty; Refrigeration under the direction of Prof. Daugherty and Mr. R. T. Knapp; Diesel Engines under the direction of Prof. W. H. Clapp; Theory of Electrical Machine Design, Electric Transients, and High Voltage Engineering under the direction of Prof. R. W. Sorensen. Stream Regulation and Utilization for Power, Irrigation, and Water Supply under the direction of Prof. Franklin Thomas; Advanced Structures under the direction of Prof. Martel; Sanitation and Sewerage under the direction of Profs. Thomas and Martel; Highways and Geodesy under the direction of Prof. Michael.

201. Water Power Plant Design. 10 units; first and second terms.

A design of a power plant in conformity with the conditions of head, flow, and load fluctuations at a particular site. Includes selection of number and type of units, design of water passages, and general structural features.

Instructor: Thomas.

202. Theory of Elasticity. Units to be based on work done; first, second and third terms.

A study of the behavior of an elastic solid under stress.

Instructor: Hinrichs.

203. Arched Dams. 5 units; first and second terms.

A study of the distribution of stresses in arched dams. Design of and investigation of the stresses in an arched dam for a given site.

Instructor: Martel.

204. Statically Indeterminate Structures. 12 units; first, second and third terms.

A study of such structures as continuous spans, rigid frames and arches by the methods of least work or slope-deflections; analysis of secondary stresses.

Instructor: Martel.

205 Geodesy and Precise Surveying. 6 units; first, second and third terms.

Methods of triangulation and surveying over extended areas. The adjustment of triangulation systems, the adjustment of observations by the method of least squares. Map projections, precise leveling determination of a true meridian.

Instructor: Michael.

206. Highway Problems. Units to be based on work done.

Cooperating with the Highway Research Board of the National Research Council, opportunities are offered for advanced studies in highway engineering. Arrangements may be made for special studies on subgrade materials, wearing surfaces, economics of vehicle operation, and allied subjects.

Instructor: Michael.

207. Sewage Treatment Plant Design. 10 units; second and third terms.

A design of treatment works for a selected community and site involving special conditions of location, volume, and character of disposal. Includes selection of process, arrangement of tanks and equipment, and general design of structures.

Instructors: Thomas, Martel.

208. Sanitation Research. Units to be based upon work done; any term.

Exceptional opportunities in this field are available at the sewage treatment plant of the city of Pasadena, where the activated sludge process is in operation, supplemented by a rotary kiln drier for the reduction of sludge to commercial fertilizer.

Instructors: Thomas, Martel.

209. Hydraulic Machinery. Units to be based on work done; any term.

A study of such machines as the hydraulic turbine and the centrifugal pump and their design to meet specified conditions.

Instructor: Daugherty.

210. Refrigeration Plants. Units to be based on work done; any term.

Design of various types of refrigeration plants best adapted to different conditions of service.

Instructors: Daugherty, Knapp.

220. SEMINAR ON TECHNICAL HIGH VOLTAGE PROBLEMS. Units to be based on work done; first, second, and third terms.

A study of the literature of high voltage phenomena, and insulation problems.

Instructor: Sorensen.

221 a, b. TRANSMISSION LINE PROBLEMS. 15 units; first and second terms.

A study of transmission line transient problems, inductive interference, power limit analysis, etc.

Instructor: Sorensen.

223. ELECTRIC STRENGTH OF DIELECTRICS. 15 units; third term.

A study of the effect of high potentials applied to dielectrics.

Instructor: Sorensen.

AERONAUTICS

The following subjects will be offered in 1927-28, or thereafter:

251. Strength and Properties of Aircraft Materials. 9 units. First term.

Prerequisites: AM. 1 a, b, c, 6 a, b.

Advanced work in strength of materials. Beams and struts of various shapes. Vibration of beams and propeller blades. Properties of timber, plywood, veneer, glue, rubber, steel and duralumin.

Texts: Timoshenko and Lessells, Applied Elasticity. A. Koehler, The Properties and Uses of Wood. J. Case, Strength of Materials. Niles, Airplane Design.

Instructor: Bateman.

252. Properties of Fluids. 9 units. First term.

Prerequisites: Ph. 1 a, b, c, or Hy. 1, 2.

Density, compressibility and viscosity. Equations of motion and theory of steady flow. Flow through pipes and around obstacles. Pitot and Venturi tubes. Principle of similitude. Turbulence and Reynolds' criterion. Theory of lubrication.

Text: The Mechanical Properties of Fluids, A Collective Work. Blackie & Sons, Ltd.

Instructors: Bateman, Bell, Epstein.

253. Stress Analysis for Airplanes. 9 units. Second term.

Prerequisite: CE. 12 a, b, c; 251.

Load factors. Determination of the stresses in the different members of a wing structure in different types of flight. Cantilever wings. Redundant systems. Determination of stresses in the members of a fuselage.

Text: Pippard and Pritchard, Aeroplane Structures.

Instructors: Bateman, Merrill.

254. Airplane Engines. 9 units.

Explosion and combustion in the engine. Mechanics of high speed engine. Engine balance. Carburetion. Conduction, radiation and cooling effects. Power measurement results.

Texts: A. W. Judge, Automobile and Aircraft Engines; Niles, Airplane Design.

Instructor: Knapp.

255. AIRPLANE DESIGN. 9 units. Second and third terms.

To be taken in connection with 253. Methods of design to meet specifications. Each student is required to design a complete airplane.

Instructor: Merrill.

256. WIND CHANNEL. 15 units. First, second and third terms.

Prerequisite: Ae. 1.

Experimental determination of the air forces on model wings, propeller sections and model airplanes for different arrangements of the model. Experiments with biplanes and triplanes. Tests of model airplanes with various types and settings of the control surfaces. Calibration of instruments.

Instructors: Merrill, C. B. Millikan.

257. RESEARCH. 9 units. First, second and third terms.

Tests of new designs of wings, control surfaces, propellers and flying machines may be carried out in the Aerodynamical Laboratory. Tests of new designs of ribs and spars may be made in the Testing Laboratory. Many theoretical problems present themselves in the development of new designs and there are many phenomena in aerodynamics and the behaviour of materials and structures which are imperfectly understood.

258. FLYING. Instruction in flying is not given officially at the Institute, but there are ample opportunities for a student to learn to fly at one of the neighboring flying fields.

259. AERONAUTICAL SEMINAR. 2 units. First, second, third terms.

Study and critical discussion of current contributions to aeronautical engineering.

260. PROPELLER DESIGN. 6 units. Second and third terms.

Design of propellers for airplanes, dirigibles, helicopters and autogiros. Design of fans for wind channels and air turbines.

Text: H. C. Watts, The Design of Screw Propellers for Aircraft.

261. Advanced Thermodynamics. 9 units. First term.

Prerequisites: ME. 15, 16.

Thermodynamics of the internal combustion engine. Ideal and real efficiencies.

Text: Judge, Automobile and Aircraft Engines.

262. Alignment Charts and Mathematical Instruments. 6 units. First term.

Prerequisites: Ma. 1 a, b, c; 2 a, b, c, d.

Methods of constructing alignment charts and other types of charts for facilitating computation. Use of the planimeter and integraph. Calculating machines and machines for drawing curves.

Texts: Brodetsky, Nomography; Horsburgh, Modern Instruments of Calculation.

Instructors: Hicks, Wolfe.

263. Calculus of Observations. 6 units. Third term.

Prerequisite: Ma. 8 a, b, 10, 12.

Methods of determining the roots of algebraic and transcendental equations. Method of least squares. Law of error and theory of graduation of data. Statistics. Periodogram analysis. Numerical solution of differential equations.

Text: Whittaker, Calculus of Observations.

Instructors: Bateman, Bell, Hicks, Wolfe.

264. Advanced Aerodynamics. 15 units. First term.

Theory of soaring flight. Katzmayr effect. Flapping wing flight. Birds and insects. Autorotation. Special types of flight. Theory and discussion of new types of aircraft.

Instructor: Bateman.

265. Theory of Stability and Control. 15 units. Second and third terms.

Discussion of stability based on the mathematical theory of small oscillations. Effect on aircraft of prescribed movements of the control surfaces.

Text: Bairstow, Aerodynamics.

Instructors: Bateman, Hicks, Merrill, C. B. Millikan.

266. Propeller Theories. 15 units.

Various extensions and developments of the theory in which each section of the propeller is treated as an aerofoil. Vortex theory of propellers. Wing theory.

Text: H. Glauert, The Elements of Aerofoil and Airscrew Theory.

Instructor: Bateman.

267. Hydrodynamics. 30 units.

Mathematical theories of sustenance and resistance. Waves and tides. Vortex motion and turbulence. Motion of a viscous fluid. Rotating masses of fluid.

Text: Lamb, Hydrodynamics.

Instructors: Bateman, Epstein.

268. Theory of Elasticity. 30 units.

Stresses in beams, bars, struts, springs, plates, tubes and shells from the standpoint of the mathematical theory of elasticity. Theories of plasticity and failure. Strength of crystals. Waves in elastic solids. Earthquake waves.

Texts: Love, Mathematical Theory of Elasticity; Jeffreys, The Earth; J. Prescott, Applied Elasticity.

Instructor: Bateman.

269. Aerology and Meteorology. 15 units.

Variation with altitude of the pressure, wind velocity, temperature and humidity. General circulation of the atmosphere. Prevailing winds. World's air routes. Studies relating to clouds, fogs, thunderstorms, evaporation and atmospheric eddies. Atmospheric electricity, visibility.

Text: Shaw, Forecasting Weather.

Instructors: Bateman, Bowen.

271. Airplane Construction. 15 units. First and second terms.

Practical construction of a glider, light airplane, commercial, military or naval airplane or seaplane.

Instructor: Claverie.

272. Airplane Design. 9 units. First and second terms.

Work in the drawing office. Calculations of strength and performance. Tests of members in the Aerodynamical and Testing Laboratories. Instruction in the most up-to-date methods of design followed in airplane factories.

Instructors: Engineers from the Douglas Company.

Publications

From October 1, 1925 to October 1, 1926

NORMAN BRIDGE LABORATORY OF PHYSICS

TRANSFORMATION OF EINSTEIN SPACES.
H. P. ROBERTSON, *Proc. Nat. Acad. Sci. 11*, 590-592 (1925).

ON FLUORESCENCE RADIATION OF NITROGEN.
OTTO OLDENBERG, *Proc. Nat. Acad. Sci. 11*, 595-597 (1925).

INDIRECTLY EXCITED FLUORESCENCE SPECTRA.
S. LORIA, *Phys. Rev. 26*, 573-584 (1925).

IONIZATION IN REACTING GASES.
A. KEITH BREWER, *Phys. Rev. 26*, 633-642 (1925).

THE PHOTO-ELECTRIC THRESHOLD FOR MERCURY
C. B. KAZDA, *Phys. Rev. 26*, 643-654 (1925).

THE METASTABLE $2p_3$ STATE OF MERCURY ATOMS
S. LORIA, *Proc. Nat. Acad. Sci. 11*, 673-679 (1925).

THE DIRECTION OF EJECTION OF PHOTO-ELECTRONS PRODUCED BY X-RAYS.
D. H. LOUGHRIDGE, *Phys. Rev. 26*, 697-700 (1926).

THE SECONDARY EMISSION FROM A NICKEL SURFACE DUE TO SLOW POSITIVE ION BOMBARDMENT.
A. L. KLEIN, *Phys. Rev. 26*, 800-806 (1925).

HIGH FREQUENCY RAYS OF COSMIC ORIGIN.
R. A. MILLIKAN, *Proc. Nat. Acad. Sci. 12*, 48-55 (1926); *Science, 62*, 445-448 (1925); *Ann. der Phys. 79*, 572-582 (1926).

LAWS GOVERNING THE PULLING OF ELECTRONS OUT OF METALS BY INTENSE ELECTRICAL FIELDS.
R. A. MILLIKAN AND CARL F. EYRING, *Phys. Rev. 27*, 51-67 (1926).

J. W. FISHERS' EXPERIMENTS AND THE POSSIBILITY OF MAGNETIZATION BY ROTARY FIELDS.
S. J. BARNETT, *Phys. Rev. 27*, 115 (1926).

STRIPPED OXYGEN OVI, THE PP' GROUP IN OV, AND NEW ALUMINUM LINES IN THE EXTREME ULTRA-VIOLET.
I. S. BOWEN AND R. A. MILLIKAN, *Phys. Rev. 27*, 144-419 (1926).

THE SO-CALLED POSITIVE PHOTO-ELECTRIC EMISSION (INVERSE EFFECT) AND THE REALITY OF THE SUB-ELECTRON.
E. J. LORENZ, *Phil. Mag. 1*, 499-509 (1926).

THEORY OF THE SPECIFIC HEAT OF ELECTROLYTES.
F. ZWICKY, *Proc. Nat. Acad. Sci. 12*, 86-92 (1926).

ON THE QUANTITATIVE THEORY OF AN ELECTROSTATIC VOLTAGE MULTIPLIER.
A. W. SIMON, *Phys. Rev 27*, 341-345 (1926).

A NEW KIND OF TEST OF THE CORRESPONDENCE PRINCIPLE BASED ON THE PREDICTION OF THE ABSOLUTE INTENSITIES OF SPECTRAL LINES.
RICHARD C. TOLMAN AND RICHARD M. BADGER, *Proc. Nat. Acad. Sci. 12*, 173-174 (1926); *Phys. Rev. 27*, 383-396 (1926).

AN EXPRESSION FOR THE ENERGY IN A NEW ELECTROSTATICS.
H. BATEMAN, *Mess. of Math., LV*, 161-168 (1926).

HIGH FREQUENCY RAYS OF COSMIC ORIGIN: I. SOUNDING BALLOON OBSERVATIONS AT EXTREME ALTITUDES.
R. A. MILLIKAN AND I. S. BOWEN, *Phys. Rev. 27*, 353-361 (1926).

ATMOSPHERIC ABSORPTION AND TRANSMISSION IN SEARCHLIGHT PRACTICE.
R. M. LANGER, *J. O. S. A. and R. S. I. 12*, 359-373 (1926).

THE HYDROGEN DOUBLET.
WILLIAM V. HOUSTON, *Nature 117*, 590 (1926).

CENTENNIAL OF THE UNDULATORY THEORY OF LIGHT.
PAUL S. EPSTEIN, *Science 63*, 387-393 (1926).

THE RADIATION OF ENERGY AND ANGULAR MOMENTUM.
H. BATEMAN, *Phys. Rev. 27*, 606-617 (1926).

ON THE NATURE OF LIGHT.
RICHARD C. TOLMAN AND SINCLAIR SMITH, *Proc. Nat. Acad. Sci. 12*, 343-347 (1926).

ZUR THEORIE DER SPEZIFISCHEN WÄRME VON LÖSUNGEN.
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Description of the Undergraduate and Fifth-Year Courses

For classes entering the Institute in 1924 and thereafter, two four-year Courses of Undergraduate Study are offered, known as the Course in Engineering and the Course in Science. For the satisfactory completion of these Courses the degree of Bachelor of Science is awarded. The Course in Engineering is supplemented by definitely laid out fifth-year Courses in Civil Engineering, Electrical Engineering, Mechanical Engineering, and Aeronautics. The Course in Science prepares for fifth-year Courses in Chemistry, Chemical Engineering, Physics, Electrical Engineering, Aeronautics, Geology, Paleontology, and Mathematics. For the completion of these fifth-year Courses the degree of Master of Science is awarded.

THE COURSES IN ENGINEERING

The five-year plan of engineering instruction is based on recognition of the fact that a four-year period of study is inadequate to give satisfactorily the combination of cultural, basic scientific, and engineering studies essential to the highest type of engineer, and to afford at the same time leisure for the development of the physical well-being and human interests of the students. The four-year Course will train, more broadly and fundamentally than the Engineering Courses now given at most institutions, the large proportion of students who study engineering not to make themselves engineering experts in a specialized sense, but to fit themselves to fill satisfactorily administrative positions in the manufacturing and transportation industries, and to serve as operating and constructing engineers in such industries.

The fifth-year Courses, based on this broad fundamental preparation, and coordinated with it so as to constitute a harmonious, unified, five-year period of study, with no sharp breaks between the undergraduate and graduate periods, will afford the more intensive training required by the engineer who is to do creative work in his field, for example, by designing new structures or machines, improving and developing processes, or making discoveries or inventions.

The four-year Course in Engineering includes an unusually thorough training in physics and mathematics, and instruction in chemistry and geology; also extended courses, continuing throughout the four years, in humanistic studies, including English writing and speaking, literature, evolutionary science, history of civilization, current social and political problems, and economics; and, finally, those engineering subjects common to all branches of engineering, such as surveying, mechanism, descriptive geometry, machine drawing, applied mechanics, engineering materials, hydraulics, and preliminary courses in civil, mechanical, and electrical engineering.

The fifth-year Courses in Civil, Mechanical, and Electrical Engineering, and in Aeronautics consist mainly of the engineering subjects that are fundamental in these separate branches of engineering. Thus the Civil Engineering Course deals largely with the design and construction of structures, railways, and water systems; the Mechanical Engineering Course, with machine design, steam and gas engineering, and power-plant design and operation; the Electrical Engineering Course with the generation and transmission of electric power; and the Aeronautics Course with the principles of aerodynamics, the design and con-

struction of airplanes, their engines and instruments. Of all these Courses engineering research forms an important part.

THE COURSES IN SCIENCE

The Courses in Science prepare for those scientific and engineering professions in which an intensive training in the basic sciences and in research is of more importance than a knowledge of the principles and practice of engineering. Accordingly, the four-year Course in Science, while including the same humanistic subjects as the Course in Engineering, requires much more extended study of the three sciences of chemistry, physics, and mathematics. Moreover, in its junior and senior years, there are offered a series of Options which, when supplemented by the corresponding fifth-year Courses, afford definite preparation for various scientific professions, as outlined in the following statement.

The Option in Chemistry and the Option in Physics and the fifth-year Courses in Chemistry and Physics prepare students, on the chemical and physical sides respectively, for research and teaching in universities, colleges, and high schools, and for research positions in government laboratories and especially in the research and development departments of the larger chemical, metallurgical, and electrical companies.

The Option and the fifth-year Courses in Chemical Engineering differ from those in Chemistry in that they include, in place of some of the science work, general subjects in mechanical and electrical engineering, and (in the fifth year) an extended treatment of chemical engineering itself.

This Course is designed to fit men for the installation, operation, and the research development of industrial chemical processes.

The Geology Option and the graduate Course in Geology and Paleontology prepare for teaching and research positions in colleges and universities, for government posts in connection with geological and mining surveys, for places as directors and field explorers of museums and, above all, for expert work in geology in the oil and mining industries.

Because of the laboratory accommodations available, the number of students admitted to the sophomore year of the Course in Science is at present limited to 40.

Schedules of the Undergraduate Courses

The school year is divided into three terms. The number of units assigned in any term to any subject is the total number of hours per week devoted to that subject, including class work, laboratory work, and the estimated time for outside preparation. Laboratory assignments include drawing exercises and field work.

The subject numbers correspond to those given in the Description of Undergraduate Subjects on pages 155-205. The abbreviations denote the various branches of instruction as follows:

Aeronautics	Ae
Applied Mechanics	AM
Chemistry	Ch
Civil Engineering	CE
Drawing	D
Economics and Government	Ec
Electrical Engineering	EE
English	En
Geology	Ge
History	H
Hydraulics	Hy
Languages	L
Mathematics	Ma
Mechanical Engineering	ME
Military	Mi
Physical Education	PE
Physics	Ph
Shop	Sh
Thesis	Th

BOTH COURSES

FIRST YEAR, ALL THREE TERMS

SUBJECTS	SUBJECT NUMBER	HOURS PER WEEK			UNITS
		Class	Lab.	Prep.	
English	En 1 a b c	3	0	3	6
Physics	Ph 1 a b c	2	3	4	9
Chemistry*	Ch 1 a b c	3	6	3	12
Mathematics	Ma 1 a b c	4	0	8	12
History	H 1 a b c	2	0	2	4
Assembly**	.....	1	0	0	1
Drawing or Shop†	PE 1 a b c	0	3 or 4	0	3 or 4
Physical Education	PE 1 a b c	0	3	0	3
Military Science	Mi 1 a b c	1	2	1	4
					54 or 55
Summer					
Drawing or Shop					3 or 4

*Honor students may substitute for the summer Drawing or Shop a three weeks' course in Chemical Research Problems.

**A maximum of four credits is allowed for attendance at all Assembly exercises; one credit is to be deducted for each absence, and a record of more than three absences receives a condition. Conditions are removable only by the satisfactory completion of special work imposed by the Department of English. These statements apply also to the other three years of both courses.

†Each student takes altogether 6 units of Drawing and 8 units of Shop, distributed through the three terms and a required summer period of 2 weeks at the beginning of the summer vacation.

COURSE IN ENGINEERING

FOR STUDENTS PREPARING FOR CIVIL, MECHANICAL, AND ELECTRICAL ENGINEERING, AND AERONAUTICS

SECOND YEAR

SUBJECT	SUBJECT NUMBER	HOURS PER WEEK			UNITS	
		Class	Lab.	Prep.	First Two Terms	Third Term
Mathematics*†	Ma 2 a b c	4	0	8	12	8
Physics*†	Ph 2 a b c	3	3	6	12	8
Mathematics Review†	Ma 2 d	4	0	8	. . .	4
Physics Review†	Ph 2 d	3	3	6	. .	4
History	H 2 a b c	2	0	4	6	6
Descriptive Geometry and Drawing‡	D 2 a b c	0	6	0	6	6
Mechanism§	ME 1	3	3	4	10	10
Surveying§	CE 1	3	4	3		
Engineering Chemistry§	Ch 6	4	0	6		
Assembly	. . . . .	1	0	0	1	1
Military	Mi 4 a b c	1	2	1	4	4
Physical Education	PE 2 a b c	0	3	0	3	3
					54	54

*Honor students complete the regular work in Mathematics and in Physics during the first two terms, and take in the third term Differential Equations (Ma 10) and Modern Physics (Ph 3).

†Students not in honor standing take in the first 7 weeks of the third term Physics Ph 2c (8 units) and Mathematics Ma 2c (8 units), and in the last 3 weeks Physics Review Ph 2d (4 units) and Mathematics Review Ma 2d (4 units). A condition in either of these review subjects, unless made up in September, excludes the student from all third-year subjects for which these are prerequisite. To assist students in making up such conditions, and to aid students transferring from other colleges who may not have had such intensive courses as those of the Institute, each of these subjects will be offered as a summer course (with a fee of $20) during the three weeks preceding the opening of the fall term, provided not less than six students apply for it.

‡Drawing D 2d may be substituted for Drawing D 2c by students preparing for Civil Engineering.

§Each student takes one of these subjects in each of the three terms.

COURSE IN ENGINEERING

THIRD YEAR

SUBJECT	SUBJECT NUMBER	HOURS PER WEEK			UNITS	
		Class	Lab.	Prep.	First Two Terms	Third Term
English	En 7 a b c	2	0	4	6	6
Current Topics	H 4 a b c	1	0	1	2	2
Assembly	....	1	0	0	1	1
Economics	Ec 2 3 4	3	0	3	6	..
Business Law	Ec 25	3	0	3	..	6
Geology; Paleontology	Ge 1 a b c	4	1	4	9	9
Applied Mechanics	AM 1 a b c	4	3	7	14	14
Direct Currents[1]	EE 2 3	3	3	6	12	..
Alternating Currents[2]	EE 4 5	3	3	6		
Heat Engineering	ME 15	3	3	6	..	12
Physical Education*	PE 3 a b c	0	3	0	3	3
					53	53

[1]First Term. [2]Second Term.

*Students may substitute Military (6 units) for Physical Education (3 units).

COURSE IN ENGINEERING

FOURTH YEAR

For classes graduating in 1928 and thereafter.

SUBJECT	NUMBER OF UNITS		
	1st Term	2nd Term	3rd Term
Biology	9	..	..
English	..	9	9
Current Topics	2	2	2
Assembly	1	1	1
Engineering Conferences	2	2	2
Hydraulics	..	..	12
Structures	12	..	..
Testing Materials Hydraulic Laboratory * Steam Laboratory	6	6	6
Options as on next page	18	30	18
	50	50	50

*Each student takes one of these subjects in each of the three terms.

COURSE IN ENGINEERING

FOURTH YEAR (Continued)

SUBJECT	NUMBER OF UNITS		
	1st Term	2nd Term	3rd Term
Mechanical Engineering Option:			
Machine Design	9	12	9
Science of Metals	9	..	..
Heat Engineering	..	12	9
Steam Lab. or Elective (see below)	..	6	..
Electrical Engineering Option:			
Differential Equations*	..	..	12
Heat Engineering	..	12	..
Electrical Engineering Laboratory	..	..	6
Electricity*	12	12	..
Electrical Machinery	6	6	..
Civil Engineering Option:			
Advanced Surveying	12	..	..
Railway Engineering	6	6	6
Structures	..	12	9
Highways	..	..	6
Reinforced Concrete	..	6	..
Accounting	..	6	..
Aeronautics Option:			
Advanced Calculus	12	12	..
Differential Equations†	..	..	12
Aeronautics	..	..	9
Science of Metals	9	..	..
Machine Design	..	12	..
Elective	..	6	..
General Electives:			
Advanced Calculus	12	12	..
Differential Equations	..	..	12
Accounting	..	6	6
Business Study	6	6	6
Military Engineering	6	6	6

*Honor students who have taken Differential Equations will substitute for it the third term of Electricity.

†Honor students who have taken Differential Equations may substitute some other mathematical or engineering subject.

COURSE IN SCIENCE

FOR STUDENTS PREPARING FOR CHEMISTRY, CHEMICAL ENGINEERING, PHYSICS, INDUSTRIAL PHYSICS, MATHEMATICS, AND GEOLOGY

SECOND YEAR

For Regular Students

SUBJECT	SUBJECT NUMBER	HRS. PER WEEK			UNITS	
		Class	Lab.	Prep.	First Two Terms	Third Term
Mathematics	Ma 2 a b c	4	0	8	12	8*
Physics	Ph 2 a b c	3	3	6	12	8*
Mathematics Review	Ma 2 d	4	0	8	..	4*
Physics Review	Ph 2 d	3	3	6	..	4*
History	H 2 a b c	2	0	4	6	6
German	L 31 a b c	3	0	3	6	6
Chemistry	Ch 12 a b	2	6	2	10	..
Assembly	..	1	0	0	1	1
Military	Mi 4 a b c	1	2	1	4	4
Physical Education	PE 2 a b c	0	3	0	3	3
Option as below	..	.	.	.	..	10
					54	54
Options†						
Qualitative Analysis	Ch 12 c	2	6	2	..	10
Organic Chemistry	Ch 43	2	6	2	..	10
Surveying	CE 1	3	4	3	..	10

*Students take in the first 7 weeks of the third term Physics Ph 2 c (8 units) and Mathematics Ma 2 c (8 units), and in the last 3 weeks Physics Review Ph 2 d (4 units) and Mathematics Review Ma 2 d (4 units). A condition in either of these review subjects, unless made up in September, excludes the student from all third-year subjects for which these are prerequisite. To assist students in making up conditions, and to aid students transferring from other colleges who may not have had such intensive courses as those of the Institute, each of these subjects will be offered as a summer course (with a fee of $20) during the three weeks preceding the opening of the fall term, provided not less than six students apply for it.

†Students take Qualitative Analysis (Ch 12 c) if they are preparing for the Option in Chemistry or Chemical Engineering, Organic Chemistry (Ch 43) if preparing for the Option in Physics or Mathematics; Surveying (CE 1) if preparing for the Option in Geology.

COURSE IN SCIENCE

SECOND YEAR

For Honor Students

SUBJECT	SUBJECT NUMBER	HRS. PER WEEK			UNITS	
		Class	Lab.	Prep.	First Two Terms	Third Term
Mathematics*	Ma 2 a b c	4	0	8	12	..
Physics*	Ph 2 a b c	4	2	6	12	..
Differential Equations	Ma 10	4	0	8	..	12
Modern Physics	Ph 3	2	6	4	..	12
History	H 2 a b c	2	0	4	6	6
German	L 37 a b c	4	0	6	10	10
Chemistry	Ch 2 a b	2	6	2	10	..
Assembly	..	1	0	0	1	1
Physical Education	PE 2 a b c	0	3	0	3	3
Option as below	..	.	.	.	..	10
					54	54
Options†						
Organic Chemistry	Ch 43	2	6	2	..	10
Chemical Research	Ch 70	0	10	0	..	10
Surveying	CE 1	3	4	3	..	10

*Honor students complete the regular work in Mathematics and Physics during the first two terms.

†Students take Chemical Research (Ch 70) if they are preparing for the Option in Chemistry or Chemical Engineering, Organic Chemistry (Ch 43) if preparing for the Option in Physics or Mathematics; Surveying (CE 1) if preparing for the Option in Geology.

COURSE IN SCIENCE

THIRD YEAR

SUBJECT	SUBJECT NUMBER	HOURS PER WEEK			UNITS	
		Class	Lab.	Prep.	First Two Terms	Third Term
English	En 7abc	2	0	4	6	6
Current Topics	H 4abc	1	0	1	2	2
Assembly	....	1	0	0	1	1
Geology, Paleontology	Ge 1abc	4	1	4	9	9
German or French*	....	4	0	6	10	10
Chemical Principles	Ch 21abc	4	0	6	10	10
Physical Education	PE 3abc	0	3	0	3	3
Options, as below	....	..	..	..	12	12
					53	53
Physics or Mathematics Option:						
Advanced Calculus	Ma 8 a b	4	0	8	12	..
Differ. Equations.**	Ma 10	4	0	8	..	12
Chemistry Option A:						
Mathematical Phys.†	Ph 15 ab	4	0	8	12	..
Phys.-Chem. Lab.‡	Ch 26 c	0	12	0		12
Chemistry Option B:						
Crystallography	Ge 3 a	1	6	2	9	..
Mineralogy	Ge 3 b	1	8	0		
Phys.-Chem. Lab.	Ch 26 b	0	3	0	3	..
Phys.-Chem. Lab.‡	Ch 26 c	0	12	0	..	12
Chemical Engin. Option:						
Applied Mechanics	AM 2 a b	4	0	8	12	..
Phys.-Chem. Lab.‡	Ch 26 c	0	12	0	..	12
Other Options:						
See next page						

*Students who have taken German (L 37 a-c), and those who have shown exceptional proficiency in German (L 31 a-c), take French in the second and third terms; other students continue German throughout the year.

**Honor students who have taken Differential Equations substitute for it some other mathematical, physical, or engineering subject.

†Honor students who desire to pursue later more advanced work in mathematical physics should take Advanced Calculus at this time in place of Mathematical Physics.

‡Honor students substitute in the third term Chemical Research (Ch 71) for Physico-Chemical Laboratory. Such students are in the second term advised to take Physico-Chemical Laboratory (3 units) if necessary as an extra subject.

COURSE IN SCIENCE

THIRD YEAR (Continued)

SUBJECT	SUBJECT NUMBER	HOURS PER WEEK			UNITS	
		Class	Lab.	Prep.	First Two Terms	Third Term
Geology Option:						
Crystallography	Ge 3 a	1	6	2	9	..
Mineralogy	Ge 3 b	1	8	0		
Mineralogy	Ge 3 c	1	5	0	..	6
Drawing	D 2 a b	0	6	0	6	..
Drawing	D 2 d	0	6	0	..	6
Electrical Engineering Option:*						
Direct Currents[1]	EE 2, 3	3	3	6	12	..
Alternat. Currents[2]	EE 4, 5	3	3	6		
Differential Equat.	Ma 10	4	0	8	..	12

*Offered to the class of 1928 only, not to later classes.
[1]First Term. [2]Second Term.

COURSE IN SCIENCE

FOURTH YEAR

For classes graduating in 1928 and thereafter.

SUBJECT	NUMBER OF UNITS		
	1st Term	2nd Term	3rd Term
Biology	9	..	..
English	..	9	9
Current Topics	2	2	2
Assembly	1	1	1
Economics	6	6	..
Options or Elective, as below	30-36	36	36
Elective:	48-54	54	48
German or French Science Reading	4	4	4
Physics Option:			
Analytical Mechanics	12	12	12
Electricity	12	12	12
Electrical Engineering*	12	12	..
Heat Engineering*	..	..	12
Mathematics Option:			
Analytical Mechanics	12	12	12
Electricity	12	12	12
Definite Integrals, Complex Variables, Vector Analysis	12	12	12
Electrical Engineering Option:†			
Applied or Analytical Mechanics	12	12	..
Electricity	12	12	12
Electrical Machinery	6	6	..
Electrical Engineering Lab.	..	..	6
Heat Engineering	..	..	12
Steam Laboratory *or* Testing Materials	..	..	6
Other Options (See next page)			

*Or Research for Honor Students.

†Offered to the class of 1928 only, not to later classes.

COURSE IN SCIENCE

FOURTH YEAR (Continued)

SUBJECT	NUMBER OF UNITS		
	1st Term	2nd Term	3rd Term
Chemistry Option:			
Organic Chemistry	15	15	6
Chemical Thermodynamics	9	9	..
Atomic Structure	..	..	9
Instrumental Analysis	10	..	..
Research	..	12	21
Chemical Engineering Option:			
Organic Chemistry	15	15	6
Chemical Thermodynamics	9	9	..
Electrical Engineering	..	12	12
Heat Engineering	..	..	12
Instrumental Analysis	10	..	..
Industrial Chemistry	..	..	9
Geology Option:			
Petrology	9	9	..
Field Geology	12	..	8
Structural Geology	..	..	8
Vertebrate Paleontology	..	8	..
Invertebrate Paleontology	10	8	..
Thesis	..	8	8

Schedules of the Fifth-Year Courses

The Courses scheduled on the following pages will not be offered till the school-year of 1928-29 (except that in Aeronautics which will be offered in 1927-28). They are here presented in order to show to prospective students the more specialized work to which the Undergraduate Courses lead.

ALL FIFTH-YEAR COURSES

SUBJECTS COMMON TO ALL COURSES, ALL TERMS	NUMBER OF UNITS
Philosophy, Ethics, Psychology	9
Current Topics	2
Assembly	1
Engineering or Research Conferences	2
Professional Subjects	39
	53

CIVIL ENGINEERING

PROFESSIONAL SUBJECTS	NUMBER OF UNITS		
	1st Term	2nd Term	3rd Term
Higher Structures	6	..	..
Masonry	9	..	..
Machine Design	6	..	..
Irrigation and Water Supply	..	12	..
Railway Engineering	..	9	..
Structural and Civil Engineering Design	9	9	12
Sewerage	..	..	9
Research or Other Thesis	9	9	9
Elective	..	..	9
	39	39	39

MECHANICAL ENGINEERING

Machine Design	12	..	..
Power Plant Engineering	..	12	12
Thermodynamics	12	..	..
Heat Engineering Laboratory	15	..	..
Research or Thesis	..	15	15
Elective as below	..	12	12
	39	39	39
Electives:			
Science of Metals	..	12	..
Metallography	..	..	12
Machine Design	..	12	12
Internal Combustion Engine	..	12	12

ELECTRICAL ENGINEERING

PROFESSIONAL SUBJECTS	NUMBER OF UNITS		
	1st Term	2nd Term	3rd Term
Alternating Current Analysis	12	..	..
Alternating Current Machinery	..	12	..
Transmission Lines	..	..	12
Alternating Current Laboratory	6	6	6
Electric Traction	6	..	..
Specifications and Design	6	..	..
Transients	..	6	..
Dielectrics	..	..	6
Electric Communication	..	6	..
Electric Distribution	..	..	6
Research or Other Thesis	9	9	9
	39	39	39
CHEMISTRY OR CHEMICAL ENGINEERING*			
Electives from Four-Year Course in Science or Fifth-Year Course in Physics			
Other Electives as follows:			
Atomic Structure	9	9	9
Physical Chemistry (special topics)	9	9	9
Organic Chemistry (special topics)	9	9	9
Chemical Engineering*	12	12	12
Research	12-18	12-18	12-18
PHYSICS, INDUSTRIAL PHYSICS, OR MATHEMATICS			
Electives as follows:			
Kinetic Theory	12	..	..
Thermodynamics	..	12	..
Electron Theory	..	..	12
Mathematical Physics	12	12	12
Physical Optics	12	12	12
Vacuum Tubes	6	6	6
Definite Integrals, Complex Variables, Vector Analysis	12	12	12
Research	15	15	15

*Candidates for the degree in Chemical Engineering are required to take the subject Chemical Engineering. They must also have taken or take in this year the engineering subjects included in the Chemical Engineering Option of the Four-Year Course in Science.

GEOLOGY AND PALEONTOLOGY

PROFESSIONAL SUBJECTS	NUMBER OF UNITS		
	1st Term	2nd Term	3rd Term
Electives as follows:			
Physics, Chemistry or Engineering Subjects	20	20	20
Economic Geology	6	6	6
Paleontology	10	10	10
Petrography	10	..	..
Geomorphology	..	6	..
Seismology	..	10	..
Research	12-18	12-18	12-18

AERONAUTICS

Aircraft Materials	9	..	..
Properties of Fluids	9	..	..
Stress Analysis for Airplanes	..	9	..
Airplane Design	..	9	9
Airplane Engines	..	..	9
Research	9	9	9
Electives as below	12	12	12
	39	39	39
Electives as follows:			
Subjects of Four-Year Engineering or Science Course	12	12	12
Wind Channel	12	12	12
Flying	..	..	6
Charts and Instruments	..	6	..
Advanced Thermodynamics	9	..	..
Calculus of Observations	..	..	6

Description of Undergraduate Subjects

AERONAUTICS

PROFESSOR: HARRY BATEMAN

INSTRUCTOR: ALBERT A. MERRILL

TEACHING FELLOWS: HERVEY C. HICKS, CLARK B. MILLIKAN

Ae. 1. GENERAL AERONAUTICS. 9 units (3-0-6). Third term, senior year.

Prerequisites: Ph. 2 a, b, c, d.

Mechanics of the kite, airplane, balloon, parachute, glider, kite-balloon, autogiro, and helicopter. Forces on airplane wings, propellers, and bodies of stream-line shape when placed in a stream of air. Theory of model testing. Control of an airplane. Power required and power available for flight. Stability of aircraft.

Texts: Bedell, The Airplane; Monteith, Simple Aeronautics and the Airplane.

Ae. 4 a, b, c. AERODYNAMICAL LABORATORY.—6 units; first, second, and third terms.

Prerequisites: Ph. 2 a, b, c, d.

Determination of the resistance coefficients for a square plate, circular disc, cylindrical rod and spindle shaped body. Exploration of the cross section of the wind channel by means of the Pitot tube. Experimental determination of the air forces on model wings, propeller sections and model airplanes for different arrangements of the model. Full scale tests.

Instructor: Merrill.

Ae. 7. AIRPLANE DESIGN.—15 units (5-5-5); second term.

Prerequisite: Ph. 2 a, b, c, d.

Design and construction of the wings, fuselage and control surfaces of an airplane. Location of the center of gravity and determination of the moments of inertia of an airplane. General considerations regarding the choice and arrangement of the power plant, gasoline tank, chassis and skid.

Instructor: Merrill.

ADVANCED COURSES IN AERONAUTICS, see pages 124-127.

APPLIED MECHANICS

PROFESSOR: FREDERIC W. HINRICHS, JR.
INSTRUCTORS: FRED J. CONVERSE, ROBERT T. KNAPP
TEACHING FELLOW: C. HAWLEY CARTWRIGHT

AM. 1 a, b. APPLIED MECHANICS.—14 units (4-3-7); first and second terms.

Prerequisite: Ma. 1 a, b, c, 2 a, b, c, d; Ph. 1 a, b, c, 2 a, b, c, d.

Action of forces on rigid bodies; composition and resolution of forces; equilibrium, couples, framed structures; cords and chains; centroids; displacement; velocity and acceleration; translation, rotation, and plane motion; moments of inertia; inertia forces; kinetic and potential energy; work and energy; impulse and momentum; impact; power; efficiency.

Text: Maurer and Roark's Technical Mechanics.
Instructors: Hinrichs, Converse, Cartright.

AM. 1 c. STRENGTH OF MATERIALS.—14 units (4-3-7); third term.

Prerequisite: AM. 1 a, b.

Elasticity and strength of materials of construction; theory of stresses and strains; elastic limit; yield point; ultimate strength; safe loads; repeated stresses; beams; cylinders; shafts; columns; riveted joints; structural shapes.

Text: Boyd's Strength of Materials.
Instructors: Hinrichs, Converse, Cartwright.

AM. 2 a, b. APPLIED MECHANICS AND STRENGTH OF MATERIALS. —12 units (4-0-8); first and second terms.

Prerequisite: Ma. 1 a, b, c, 2 a, b, c, d; Ph. 1 a, b, c, 2 a, b, c, d.

An abridged course for students electing the Chemical Engineering Option or the Electrical Engineering Option in the Science Course, condensing in the work of two terms as much as possible of the general field outlined above in Me. 1 a, b, c.

Texts: Poorman's Applied Mechanics, and Boyd's Strength of Materials.

Instructor: Hinrichs.

AM. 6 a, b. TESTING MATERIALS LABORATORY.—6 units (0-6-0); first term.

To be taken in connection with AM. 5.

Tests of the ordinary materials of construction in tension, compression, torsion, and flexure; determination of elastic limit; yield point, ultimate strength, and modulus of elasticity; experimental verification of formulas derived in the theory of strength of materials.

Texts: Upton's Materials of Construction, and Hinrichs' and Martel's Laboratory Manual for Testing Materials.

Instructor: Converse.

CHEMISTRY

PROFESSORS: ARTHUR A. NOYES, STUART J. BATES, JAMES E. BELL, RICHARD C. TOLMAN

ASSOCIATE PROFESSORS: WILLIAM N. LACEY, HOWARD J. LUCAS

ASSISTANT PROFESSOR: ROSCOE G. DICKINSON

INSTRUCTOR: ERNEST H. SWIFT

RESEARCH FELLOWS: RICHARD M. BADGER, DON M. YOST

TEACHING FELLOWS AND GRADUATE ASSISTANTS: ALPHEUS M. BALL, WARREN P. BAXTER, ARNOLD O. BECKMAN, ROBERT H. DALTON, RALPH K. DAY, ROBERT T. DILLON, ALLAN C. G. MITCHELL, MARTIN E. NORDBERG, HERMAN F. SCHOTT, NATHAN F. SCUDDER, HAROLD H. STEINOUR, WILLIAM URE.

Ch. 1 a, b, c. CHEMISTRY.—12 units (3-6-3); first, second, and third terms.

The first and second terms are devoted to lecture and classroom discussions of the general principles of chemistry and of important or typical chemical substances and reactions. The laboratory work consists of experiments illustrating the principles of inorganic preparations. The third term is devoted to systematic qualitative analysis. Honor students substitute in the first and second terms elementary analytical chemistry (mainly volumetric analysis).

Texts: Hildebrand, Principles of Chemistry; Smith's College Chemistry (revised by Kendall); A. A. Noyes, Qualitative Analysis.

Instructors: Bell and Teaching Fellows.

Ch. 6. ENGINEERING CHEMISTRY.—10 units (4-0-6); first, second, or third term.

Prerequisite: Ch. 1 a, b, c.

This course consists of conferences, lectures, and problems, showing the application of chemical principles to engineering problems and the relation of engineering to the chemical industries.

Text: Leighou, Chemistry of Engineering Materials.

Instructor: Lacey.

Ch. 12 a, b. QUANTITATIVE ANALYSIS.—10 units (2-6-2); first and second terms.

Prerequisite: Ch. 1 c.

Laboratory practice, supplemented by lectures and problems in which the principles involved in the laboratory work are emphasized. The course furnishes an introduction to the methods of gravimetric and volumetric analysis.

Text: Blasdale, Quantitative Analysis.

Instructor: Swift.

Ch. 12 c. QUALITATIVE ANALYSIS.—10 units (2-6-2); third term.

Prerequisite: Ch. 1 c.

A laboratory course accompanied by lectures and conferences, which supplements the freshman work in the same subject. It includes a study of the methods for the separation and detection of the acidic constituents and practice in the complete analysis of solid substances, such as alloys, minerals, and industrial products.

Text: A. A. Noyes, Qualitative Analysis.

Instructor: Swift.

Ch. 16. INSTRUMENTAL ANALYSIS.—10 units (0-6-4); first term.

Prerequisite: Ch. 12 b.

A laboratory course designed to familiarize the student with special analytical apparatus and methods, used both for process control and for research.

Text: Lacey, Instrumental Methods of Chemical Analysis.

Instructor: Lacey.

Ch. 21 a, b, c. CHEMICAL PRINCIPLES.—10 units (4-0-6); first, second, and third terms.

Prerequisites: Ch. 12 b, Ph. 1 a, b, c, 2 a, b, c, d; Ma. 2 a, b, c, d.

Conferences and recitations in which the general principles of chemistry are considered from an exact, quantitative standpoint. The course includes a study of the pressure-volume relations of gases; of vapor-pressure, boiling point, freezing point, and osmotic pressure of solutions; of the molecular and ionic theories; of elec-

trical transference and conduction; of reaction rate and chemical equilibrium; of phase equilibria and of thermochemistry. A large number of problems are assigned to be solved by the student.

Text: Noyes and Sherrill, Chemical Principles.

Instructor: Bates.

Ch. 22 a, b. CHEMICAL THERMODYNAMICS.—9 units (3-0-6); first and second terms.

A continuation of subject Ch. 21, given in the same way. The principles of thermodynamic chemistry and of electrochemistry are considered and illustrated by numerous problems.

Text: Noyes and Sherrill, Chemical Principles

Instructor: Bates.

Ch. 26 b, c. PHYSICAL CHEMISTRY LABORATORY.—3 units second term; 12 units third term.

Laboratory exercises to accompany Ch. 21 b, c, respectively. Required in Chemistry and Chemical Engineering courses, junior year.

Text: Sherrill, Laboratory Experiments on Physico-Chemical Principles.

Instructor: Bates.

Ch. 29. COLLOID AND SURFACE CHEMISTRY.—9 units (3-0-6); third term.

Prerequisite: Ch. 22.

Class-room exercises with outside reading and problems, devoted to surface tension, adsorption, contact catalysis, and the general principles relating to disperse systems with particular reference to the colloidal state. Supplementary laboratory work can be provided if desired.

Text: Freundlich, Elements of Colloid Chemistry.

Instructor: Badger.

Ch. 41 a, b, c. ORGANIC CHEMISTRY.—6 units (3-0-3); first, second and third terms.

Prerequisite: Ch. 12.

Lectures and recitations treating of the classification of carbon compounds, the development of the fundamental theories, and the

characteristic properties of the principle classes including hydrocarbons, alkyl halides, alcohols, acids, ethers, esters, amines, carbohydrates, aromatics, etc.

(Not offered in 1926-1927.)

Text: Norris, Organic Chemistry.

Instructor: Lucas.

Ch. 43. ORGANIC CHEMISTRY.—10 units (2-6-2); third term.

Prerequisites: Ch. 1 a, b, c.

Lectures and recitations, accompanied by laboratory exercises, dealing with the more important compounds of carbon and with the structural theory from the electron point of view.

Text: Moore, Outlines of Organic Chemistry.

Instructor: Lucas.

Ch. 46 a, b. ORGANIC CHEMISTRY LABORATORY.—9 units (0-9-0); first and second terms.

Prerequisites: Ch. 12.

Laboratory exercises to accompany Ch. 41 a, b, c. The preparation and purification of carbon compounds and the study of their characteristic properties. Qualified students may pursue work of research nature.

(Not offered in 1926-1927.)

Text: Lucas, Manual of Organic Chemistry.

Instructor: Lucas.

Ch. 61. INDUSTRIAL CHEMISTRY.—9 units (4-0-5); first term.

Prerequisites: Ch. 21 a, b, c, 41 a, b, c.

A study of the more important industrial chemical processes, from the point of view not only of the chemical reactions, but of the conditions and equipment necessary to carry on these reactions.

Text: Thorp, Outlines of Industrial Chemistry.

Instructor: Lacey.

Ch. 66 a, b. CHEMICAL ENGINEERING.—12 units (4-0-8); second and third terms.

Prerequisites: Ch. 61, M. 21.

A lecture, problem, and discussion course to bring the student in touch with modern practice and the problems involved in effi-

ciently carrying out chemical reactions on a commercial scale. The basic operations of chemical industry (such as transportation of materials, mixing, separation, combustion, etc.) are studied both as to principle and practice.

Text: Walker, Lewis and McAdams, Principles of Chemical Engineering.

Instructor: Lacey.

Ch. 70-73. Chemical Research.

Opportunities for research are afforded to undergraduate students in all the main branches in chemistry; thus, in analytical or inorganic chemistry (Ch. 70), in physical chemistry (Ch. 71), in organic chemistry (Ch. 72), and in applied chemistry (Ch. 73). Such research may be taken as electives by students in honor standing in the sophomore and junior years; and every candidate for a degree in the Chemistry course is required to undertake in his senior year an experimental investigation of a problem in chemistry. A thesis embodying the results and conclusions of this investigation must be submitted to the faculty not later than one week before the degree is to be conferred.

Advanced Subjects in Chemistry.—See pages 117-119.

CIVIL ENGINEERING

PROFESSOR: FRANKLIN THOMAS

ASSOCIATE PROFESSORS: ROMEO R. MARTEL, WILLIAM W. MICHAEL

INSTRUCTOR: FRED J. CONVERSE

ASSISTANTS: A. PERRY BANTA, C. HAWLEY CARTWRIGHT

CE. 1. SURVEYING.—10 units (3-4-3); first, second, or third term.

A study of the elementary operations employed in making surveys for engineering work, including the use, care, and adjustment of instruments, linear measurements, angle measurements, note keeping, stadia surveys, calculation and balancing of traverses, topographic mapping and field methods.

Text: Elementary Surveying, F. W. Medaugh.

Instructor: Michael.

CE. 2 a, b. ADVANCED SURVEYING.—12 units (3-6-3); first term.

Prerequisite: CE. 1.

A continuation of CE. 1, covering topographic surveys, plane table surveys, base line measurements, triangulation, determination of latitude and a true meridian by sun and circumpolar star observations, curves, cross-section surveys and earthwork estimates, stream gauging, draughting room methods and mapping and the solution of problems.

Text: Elementary Surveying, Breed and Hosmer.

Instructor: Michael.

CE. 4. HIGHWAY ENGINEERING.—6 units (3-0-3) ~~third term~~.

Prerequisite: CE. 1.

A comparison of various types of highway construction; the design, construction and maintenance of roads and pavements; methods of road improvement; financing, contracts and specifications.

Text: Construction of Roads and Pavements, Agg.

Instructor: Michael.

CE. 8 a. RAILWAY ENGINEERING.—6 units (3-0-3); first term.

Prerequisites: CE. 1, 2 a, b.

A study of economic railway location and operation; railway plant and equipment; signaling; the solution of grade problems.

Text: Elements of Railroad Engineering, Raymond.

Instructors: Thomas, Michael.

CE. 8 b. RAILWAY SURVEYING.—6 units (2-0-4); second term.

Prerequisites: CE. 1, 2 a, b.

The theory of railway location and surveys; problems relating to curves, track layout, grades and earthwork, including a study of the mass diagram as applied to railway earthwork.

Text: Railway Curves and Earthwork, Allen.

Instructor: Michael.

CE. 8 c. RAILWAY SURVEYING.—6 units (0-6-0); third term.

Prerequisites: CE. 8 b.

The class devotes one entire day a week to field surveys of a railroad location, applying the principles as outlined under course CE. 8 b.

Text: Railway Curves and Earthwork, Allen.

Instructor: Michael.

CE. 10. SEWERAGE.—7 units (3-0-4); third term.

Prerequisite: Hy. 1.

Systems for the collection and disposal of sewage; the design of sewers and storm drains; inspection of local sewage disposal plants; the drainage of land; cost assessments.

Text: Sewerage and Sewage Disposal, Metcalf E. Eddy.

Instructor: Martel.

CE. 12 a. THEORY OF STRUCTURES.—12 units (3-3-6); first term.

Prerequisites: AM. 1 c.

Methods used in the proportioning and calculation of stresses in beams, girders, and columns of timber, steel, and concrete; study of the effects of moving load systems; graphic statics applied to roofs and bridges.

Text: Theory of Structures, Spofford.

Instructors: Thomas, Martel.

CE. 12 b, c. THEORY OF STRUCTURES.—12 units (3-3-6) second term; 9 units (3-0-6) third term.

Prerequisites: CE. 12 a.

A continuation of CE 20 a, covering the design of structural parts, connections, portals, and bracing; a study of arches, cantilever and continuous bridges, and deflections of trusses.

Text: Theory of Structures, Spofford.

Instructor: Thomas.

CE. 15. WATER SUPPLY AND IRRIGATION.—10 units (4-0-6); third term.

Prerequisite: Hy. 1.

A study of modern practice of the collection, storage and distribution of water for municipal, domestic and irrigation uses; design, construction and operation of systems; consideration of the conditions adapted to irrigation developments, dams, reservoirs, canals; laws pertaining to irrigation; the economic aspects of projects.

Text: Principles of Engineering Irrigation, Newell & Murphy.

Instructor: Thomas.

CE. 20 a. REINFORCED CONCRETE.—6 units (2-0-4); second term.

Prerequisites: AM. 1 c; CE. 12 a.

The theory of reinforced concrete design, with a study of the applications of this type of construction to various engineering structures.

Text: Reinforced Concrete Construction, Hool.

Instructor: Martel.

CE. 20 b. MASONRY STRUCTURES.—8 units (2-3-3); second term.

Prerequisite: CE. 20 a.

Theory of design and methods of construction of masonry structures; foundations, dams, retaining walls, and arches.

Text: Masonry Structure and Foundations, Williams.

Instructor: Martel.

CE. 21 a. STRUCTURAL DESIGN.—9 units (0-9-0); first term.

Prerequisites: CE. 12 a, b, c.

The design of a plate girder bridge and a truss bridge or a steel frame building; stress sheets and general drawings are made. Designing office practice is followed as affecting both computations and drawings.

Instructors: Thomas, Converse.

CE. 21 b. STRUCTURAL DESIGN.—9 units (0-9-0); second term.

Prerequisite: CE. 12 a.

The design of a reinforced concrete building in accordance with a selected building ordinance, with computations and drawings.

Instructors: Thomas, Martel.

CE. 21 c. CIVIL ENGINEERING DESIGN.—12 units (0-12-0); third term.

Prerequisites: CE. 15, 21 b.

Special problems including preliminary investigations of irrigation or water power projects; study of stream flow data, the effect of reservoir storage upon distributed flow, determination of size and type of economic development.

Instructors: Thomas, Martel.

CE. 25. ELEMENTS OF CIVIL ENGINEERING.—7 units (2-3-2); second or third term.

Prerequisite: AM. 1 c.

An abridged course of design and construction methods for structures of wood, steel, masonry and reinforced concrete.

Text: Elements of Civil Engineering, Thomas.

Instructors: Thomas, Martel, Converse.

ECONOMICS AND GOVERNMENT

PROFESSORS: GRAHAM A. LAING, W. HOWARD CLAPP
ASSISTANT PROFESSOR: CLYDE WOLFE
INSTRUCTORS: ALBERT A. MERRILL, RAY E. UNTEREINER

The subjects in this group have the two-fold purpose of giving the student an insight into fundamental economic principles, and of acquainting him with some of the aspects of the practical operation of business enterprises. They furnish the important connecting link between the technical engineer and the man of affairs.

Ec. 2. GENERAL ECONOMICS.—6 units (3-0-3); first term.

The principles of economics governing the production, distribution, and consumption of wealth, with particular reference to some of the important business and social problems of the day.

Text: Economics, Vol. I, Fairchild.

Instructors: Laing, Untereiner.

Ec. 3. ECONOMIC HISTORY.—2 units (1-0-1); second term.

The general purpose of the course is to show the dynamic nature of economic society. The various stages in the development of economic life from primitive beginnings to the industrial revolution are dealt with. The problems of economic organization that have arisen under a competitive and a quasi-competitive system are considered from the point of view of the causative and developmental influences which have produced them.

Text: Introduction to Economic History, Gras.

Instructor: Laing.

Ec. 4. SELECTED ECONOMIC PROBLEMS.—4 units (2-0-2); second term.

Prerequisites: Ec. 2.

A development of the course in General Economics, presenting a fuller treatment of specific problems such as: transportation, agriculture, labor legislation, socialism, present labor policies.

Text: Economics, Vol. II, Fairchild.

Instructors: Laing, Untereiner.

Ec. 10. Mathematics of Finance.—4 units (1-0-3); first term.

The mathematical theory underlying compound interest, annuities, and mathematical expectation, with application to such subjects as the accumulation of reserves, the amortization of debts, evaluation of bonds, partial payments, capitalized costs, and insurance.

Text: Mathematics of Investment, Hart.

Instructor: Wolfe.

Ec. 11. Statistics.—3 units (1-0-2); second term.

Statistical methods and the graphic portrayal of results, with their application to concrete business problems.

Text: Statistical Method, Mills.

Instructor: Wolfe.

Ec. 12. Economic History.—6 units (2-0-4); third term.

A more detailed treatment of the subjects discussed in Economics 3.

Text: Introduction to Economic History, Gras; and other reading to be assigned.

Instructor: Laing.

Ec. 14. Taxation.—4 units (2-0-2); second term.

A study of the general principles of public expenditure and public revenues with special reference to American taxation methods.

Text: Introduction to Public Finance, Plehn.

Instructor: Untereiner.

Ec. 16 a, b, c. Accounting.—9 units (3-0-6); first, second, third terms.

A study of the principles of accounting, starting with simple double entry bookkeeping and carrying the student through a complete system of accounts for a modern concern. The use of percentages and statistics in accounting will be treated, and the interpretation of financial reports and the graphical method of presenting accounting facts will be studied.

Text: Bookkeeping and Accounting, McKinsey.

Instructor: Merrill.

Ec. 17. Accounting.—8 units (3-0-5); first term.
An abridged course in accounting.
Text: Bookkeeping and Accounting, McKinsey.
Instructor: Merrill.

Ec. 20. Financial Organization.—8 units (3-0-5); third term.
Prerequisites: Ec. 2, 4.
A general study of the financial organization of society. The course includes a study of the following topics: Principles of money; nature and functions of credit; the varieties of credit and instruments; the marketing of low and high grade securities; the functions of the corporation and the stock exchange as capital-raising devices; the development of the banking system and the general principles of banking, including studies of commercial banking, the national banking system, and the Federal Reserve system.
Instructor: Laing.

Ec. 25. Business Law.—6 units (3-0-3); third term.
The principles of law as applied to business affairs, including discussion of such fundamental topics as the definition of law, its sources, and a brief study of the law governing contracts, negotiable instruments, agency, partnership, corporations, and employer's liability.
Text: American Business Law, Frey.
Instructor: Untereiner.

Ec. 26 a, b. Business Law.—8 units (3-0-5); third and first terms.
Similar in scope to Ec. 25, but giving a more extensive treatment of the different subjects considered.
Texts: American Business Law, Frey; Cases on Commercial Law, Bays.
Instructor: Untereiner.

Ec. 30 a, b. Business Administration.—8 units (3-0-5); first and second terms.

General consideration of the problems of business and more detailed study of the main problems, including location of industry and plant, scientific management, wage systems, labor relations, marketing and sales problems, financial organization and business risks, outlining principal forms of risk and methods of dealing with them. Discussion of the forms and varieties of business unit; individual producer, partnership, joint-stock company, and corporation.

Instructor: Laing.

Ec. 34. Corporation Finance.—6 units (2-0-4); first term.

Corporation promotion; the issue and payment of securities; underwriting; the sale of speculative securities. Discussion of the principles of capitalization, the management of corporate income, and the relation of dividend to income. Financial problems of expansion, combination, and reconstruction of corporations.

Text: Corporation Finance, Dewing.

Instructor: Laing.

Ec. 40. Industrial Plants.—6 units (2-0-4); third term.

A study of the methods that are employed in machine shops and manufacturing plants. The course is especially adapted to the needs of the practicing engineer.

Text: Industrial Organization, Kimball.

Instructor: Clapp.

Ec. 45 a, b. Seminar in Social and Economic Organization.—4 units (2-0-2); second and third terms.

This course consists in weekly lectures and discussions of the development of economic and social organization from a broad standpoint, and includes consideration of such subjects as primitive economic and political groupings and methods, development of guild and feudal systems, evolution of the competitive and quasi-competitive systems in economic life and of democratic organization in political life. A considerable amount of outside reading is required from each student. The class meets once a week for two hours, the first being devoted to lecture and the second to discussion of the problems treated in the lecture. The number of students is limited and the seminar is open to juniors and seniors, preference being given to students in the department of Engineering and Economics.

Instructor: Laing.

ELECTRICAL ENGINEERING

PROFESSOR: ROYAL W. SORENSEN
ASSISTANT PROFESSOR: SAMUEL S. MACKEOWN
INSTRUCTOR: FRANCIS W. MAXSTADT
ASSISTANTS: JAMES H. HAMILTON, CLAUDE D. HAYWARD, FREDERICK C. LINDVALL, HALLAM E. MENDENHALL, FRED L. POOLE, LLOYD E. SWEDLUND

EE. 2. DIRECT CURRENTS.—7 units (3-0-4); first term.

Prerequisites: Ma. 2 a, b, c, d; Ph. 2 a, b, c, d.

Theory and practice of direct current motors and generators. Fundamental to courses in operation and design of electrical apparatus. Numerous problems are solved.

Text: Principles of Direct Current Machines, Langsdorf.

Instructors: Mackeown and Maxstadt.

EE. 3. DIRECT CURRENT LABORATORY.—5 units (0-3-2); first term.

Prerequisites: Ma. 2 a, b, c, d; Ph. 2 a, b, c, d; and registration for EE. 2.

Uses of measuring instruments, operation of direct current motors and generators and determination of their characteristics.

Text: Laboratory Instructions, Forster.

Instructors: Maxstadt, Hamilton, Hayward, Lindvall, Swedlund.

EE. 4. ALTERNATING CURRENTS.—7 units (3-0-4); second term.

Prerequisites: Ma. 2 a, b, c, d; Ph. 2 a, b, c, d; EE. 2.

Elementary study of alternating currents by analytical and graphical methods and alternating current machinery. The effect of inductance, capacitance, and resistance loads. Numerous problems are worked dealing with reactive circuits; resonance; coils in series and multiple; single and polyphase alternators; single and polyphase systems; synchronous motors; transformers; induction and single phase motors.

Text: Alternating Currents, Magnusson.

Instructors: Mackeown and Maxstadt.

EE. 5. ALTERNATING CURRENT LABORATORY.—5 units (0-3-2); second term.

Prerequisites: Ma. 2 a, b, c, d; Ph. 2 a, b, c, d; EE. 2, 3, and registration for EE. 4.

Uses of alternating current indicating and recording instruments; operation of alternators, induction and synchronous motors and transformers; determination of characteristics of these machines.

Text: Laboratory Notes, Forster.

Instructors: Maxstadt, Hamilton, Hayward, Lindvall, Swedlund.

EE. 6. Electrical Machinery.—6 units (2-0-4); first term.

Prerequisites: EE. 2, 3, 4, and 5.

Texts: Principles of Direct Current Machines, Langsdorf; Alternating Currents, Magnusson.

(Not given in 1926-1927.)

Instructors: Mackeown, Maxstadt.

EE. 7. Electrical Laboratory.—6 units (0-3-3); third term.

Prerequisites: EE. 2, 3, 4, 5, 6, 40; Ph. 5, 7.

A continuation of EE. 3 and 5. Efficiency tests of direct and alternating current machinery, operation of motors and generators in parallel, calibration of indicating and recording meters.

(Not given in 1926-1927.)

Instructors: Maxstadt, Hamilton, Hayward, Lindvall, Poole, Swedlund.

EE. 20. Alternating Current Analysis.—12 units (5-0-7); first term.

Prerequisites: EE. 7 and preceding courses.

Advanced study of magnetic and electric circuits. Solution of problems involving the symbolic method and complex notation; analysis of electromotive force, and current, nonsinusoidal wave forms; use of the oscillograph.

Instructor: Sorensen.

EE. 21 a, b, c. Alternating Current Laboratory.—6 units (0-3-3); first, second and third terms.

Prerequisites: EE. 2, 3, 4, 5, 6, 7.

Complete tests of the synchronous motor; the operation of synchronous machines in parallel; complete tests of transformers; study of polyphase connections; rotary converter tests; photo-

metric measurements; use of the oscillograph; testing of magnetic materials.

Instructors: Maxstadt and assistants.

EE. 22. Induction Machinery.—12 units (5-0-7); second term.
Prerequisites: EE. 2, 4, 6.

An advanced study of the stationary transformer and the induction motor, with special emphasis upon problems of multiple operation which involve problems of polyphase polarity, together with single and polyphase multiple circuits.

Instructor: Sorensen.

EE. 28. Electric Traction.—6 units (2-0-4); first term.
Prerequisites: EE. 2, 4, 6.

The electric railway, selection of equipment in rolling stock, location and equipment of sub-stations, comparison of systems and power requirements for operation of electric cars and trams.

Text: Electric Traction and Transmission Engineering, Sheldon and Hausman.

Instructor: Lindvall.

EE. 30. Electric Lighting and Power Distribution.—6 units (2-0-4); third term.
Prerequisites: EE. 2, 4, 6.

Electric distribution and wiring; calculation of simple alternating current circuits; installation and operation costs and selling price of electric power.

Text: Electric Lighting, Franklin.

Instructor: Maxstadt.

EE. 40. Advanced Alternating Current Machinery.—6 units (2-0-4); second term.
Prerequisites: EE. 2, 4, 6; Ph. 5, 7.

An advanced study of the principles involved in alternating current machinery, other than the transformer, with particular emphasis upon synchronous machines.

Text: Alternating Current Machinery, Lawrence.

Instructor: Maxstadt.

EE. 44. TRANSMISSION LINES.—12 units (4-0-8); third term.

Prerequisites: EE. 2, 4, 6, 20, 40.

Determination of economic voltage for transmission lines; line protection; elementary transient phenomena; corona; use of hyperbolic functions in line calculations.

Instructor: Sorensen.

EE. 48. SPECIFICATIONS AND DESIGN OF ELECTRICAL MACHINERY.—6 units (4-0-2); first term.

Prerequisites: EE. 2, 4, 6, 40.

Preparation of specifications and design calculations for alternating and direct current machinery.

Text: Electrical Machine Design, Gray.

Instructor: Sorensen.

EE. 52. DIELECTRICS.—6 units (2-0-4); third term.

Prerequisites: EE. 2, 4, 6, 20, 40.

The relations of phenomena of dielectrics in high voltage engineering.

Text: Electric Phenomena in High Voltage Engineering, Peek.

Instructor: Sorensen.

EE. 56. ELECTRICAL COMMUNICATION.—6 units (2-0-4); second term.

Prerequisites: EE. 2, 4, 6, 20, 40.

A study of the elements of telephone, telegraph and signalling devices.

Instructor: Mackeown.

EE. 60. ADVANCED ELECTRICAL ENGINEERING.—6 units (2-0-4); second term.

Prerequisites: EE. 2, 4, 6, 20, 40.

A detailed study of circuits, including advanced work in wave propagation and transient phenomena in electric conductors.

Text: Electric Transients, Magnusson, Kalin and Tolme.

Instructor: Maxstadt.

EE. 62 a, b. VACUUM TUBES.—5 units (2-0-3); first and second terms.

Prerequisites: EE. 2, 4, 6.

Fundamental theory, and uses as detectors, amplifiers, and oscillators. Special uses of vacuum tubes in both radio and line communication.

Instructor: Mackeown.

EE. 63. VACUUM TUBES.—5 units (3-0-2); third term.

Prerequisite: EE. *62* a, b.

Laboratory course in the general operation of vacuum tubes.

Instructor: Mackeown.

ENGINEERING DRAWING

INSTRUCTORS: GEORGE B. BRIGHAM, JR., CLARENCE V. ELLIOTT

D. 1 a. LETTERING.—3 units (0-3-0); first or third terms.

This course presents the subject from the standpoint of design in order to develop a sense of proportion and an appreciation of good lettering. It includes the history of lettering, the principles of composition, and the design and use of the more important commercial types. Problems are given in the design of titles, posters, and inscriptions, accompanied by practice sheets to develop speed and facility in engineering lettering.

Text: French and Meiklejohn, Essentials of Lettering.

Instructors: Brigham, Elliott.

D. 1 b. ELEMENTARY MECHANICAL AND FREEHAND DRAWING.—3 units (0-3-0); second term or first week of summer school.

Prerequisite: D. 1 a.

The mechanical drawing of this course covers the use of drawing instruments and the more important geometrical constructions. Accuracy and precision are required. As soon as the student proves that the quality of his work is up to the standard of the department he may transfer to the freehand drawing class.

The freehand drawing coordinates the eye, mind, and hand and develops the power to present an idea quickly and clearly by graphical means. Classroom sketches are made from text-book drawings and machine parts, and field sketches from buildings, bridges and other structures.

Text: French, Engineering Drawing.

Instructors: Brigham, Elliott.

D. 2 a. DESCRIPTIVE GEOMETRY.—6 units (0-6-0); first term.

This course presents the methods of mechanical projection by means of geometrical problems involving points, lines, planes and solids, and by the graphical representation of objects in orthographic, oblique, isometric and perspective projection. Engineering problems are given to illustrate the practical application of descriptive geometry, but the aim is primarily to develop power to visualize.

Text: Hood, Geometry of Engineering Drawing.

Instructors: Brigham, Elliott.

D. 2 b. Assembly Drawing and Sketching.—6 units (0-6-0); second term.

Prerequisites: D. 1 a, 1 b, 2 a.

This course covers the graphical representation of complete mechanical devices, groupings of mechanical equipment, structural plans, and plot plans and aims, and by means of them to develop ability to visualize problems as a whole. Facility of expression in mechanical, structural, and topographical drawing is gained by studying the conventional representations of each type and by making working sketches and working mechanical drawings.

Text: Engineering Drawing, by French.

Instructors: Brigham, Elliott.

D. 2 c. Detail Drawing and Sketching.—6 units (0-6-0); third term.

Prerequisites: D. 1 a, 1 b, 2 a.

This course is similar to D. 2 b. The same general types of drawing are studied but emphasis is laid upon the accurate representation of details by means of working sketches and mechanical working drawings.

Text: Engineering Drawing, by French.

Instructors: Brigham, Elliott.

D. 2 d. Physiographic Sketching.—6 units (0-6-0); third term.

This course in freehand sketching is given to develop ability to represent landscape forms and details of geological structure.

Instructor: Brigham.

ENGLISH AND HISTORY

PROFESSORS: CLINTON K. JUDY, JOHN R. MACARTHUR, WILLIAM B. MUNRO

ASSOCIATE PROFESSOR: GEORGE R. MACMINN

INSTRUCTORS: WILLIAM D. CRANE, LOUIS W. JONES, ROGER F. STANTON, RAY E. UNTEREINER

The Institute requires for all students a four-years' course in English composition and English literature, complemented by a study of history and current topics, with some excursion into philosophy and related subjects. A thorough grounding is given in the principles and practice of both written and spoken English, with special attention, when called for, to the particular requirements of the technical professions. The instruction in literature is intended to develop the habit of good reading, and to cultivate taste by familiarizing the student with selected masterpieces of past times and of the present. It is recognized, however, that the cultural value of this study would be incomplete without collateral instruction in history and critical discussion of contemporary movements and events. A fusion of English and history is therefore effected, with the general aim of broadening and deepening the student's sense of values in the world of cultivated society, of strengthening his capacity for good citizenship, and at the same time of heightening his ability to use the English language to the best advantage in both professional and social life. It is also to be noted that the formal courses in these subjects do not exhaust the attention given to the student's English; all written work, in whatever department of study, is subject to correction with regard to English composition.

En. 1 a, b, c. ENGLISH.—6 units (3-0-3); first, second and third terms.

This course is designed to give the student a thorough review of the principles of composition, with much practice in writing and speaking, and a broad introduction to good reading. The student is offered every inducement to self-cultivation, and is allowed ample opportunity for the exercise of special talents or the pursuit of special intellectual interests.

The work of the honor section is such as specially to foster the spirit of intellectual initiative. Each member of the section studies some carefully chosen topic in accordance with the elementary principles of research. He is held to high standards of excellence in writing and speaking, and is expected to undertake a considerable amount of cultural, as well as technical, reading.

Texts: Collegiate Handbook, Greever and Jones; Freshman Readings, Loomis.

Instructors: Crane, Jones, MacMinn, Stanton.

En. 7 a, b, c. ENGLISH LITERATURE.—6 units (2-0-4); first, second and third terms.

Prerequisite: En. 4 a, b, c.

A selective survey of English Literature from the beginnings to the end of the 19th century, focused on the most distinguished works of the greater writers in poetry, drama, the novel, and the essay. Special attention is given to the social background of the works assigned for reading, and to the chief cultural movements of the medieval and modern world. In the first term the emphasis is placed on Shakespeare and the English Renaissance; in the second term on the life and literature of the 18th century; in the third term on the Victorian Era.

Texts: The Oxford Shakespeare; The Modern Student's Book of English Literature, Ayres, Howe, Padelford.

Instructors: Crane, Jones, MacMinn, Stanton.

En. 10 a, b, c. ENGLISH LITERATURE.—6 units (3-0-6); first, second, and third terms.

Prerequisite: En. 7 a, b, c.

For the year 1926-1927 this course offers mainly a critical study of selected topics in the fields of philosophy, politics, and social science, with illustration in contemporary literature. The course also includes instruction in the kinds of technical writing that the student nearing graduation should be qualified to undertake.

Texts: A Modern Symposium, Dickinson; Ethics, Moore; Essays Toward Truth, Robinson, Pressey, McCallum; English Literature During the Last Half Century, Cunliffe.

Instructors: Judy, MacMinn.

(In the year 1927-1928 and thereafter this course, continuing the work of En. 7 a, b, c, will consist of a study of modern American and English Literature.)

H. 1 a, b, c. HISTORY.—4 units (2-0-2); first, second and third terms.

Lectures and discussions upon the early civilizations out of which modern Europe developed, and upon the institutions of the Middle Ages.

Text: Ancient Times, Breasted; History of Western Europe, Vol. I, Robinson.

Instructor: Macarthur.

H. 2 a, b, c. HISTORY.—6 units (2-0-4); first, second and third terms.

Prerequisite: En. 1 a, b, c.

The general political and social history of Europe from 1500 to 1926, presented as the background and development of movements underlying present conditions.

Text: The Political and Social History of Modern Europe, Vols. I and II, C. J. H. Hayes.

Instructors: Judy, Munro, Untereiner.

H. 4 a, b, c. CURRENT TOPICS.—2 units (1-0-1); first, second and third terms.

This course is given in connection with En. 7 a, b, c.

The study of current topics is articulated with a selected weekly journal of general information and opinion.

H. 5 a, b, c. CURRENT TOPICS.—2 units (1-0-1); first, second and third terms.

This course is given in connection with En. 10 a, b, c, and is articulated with a selected weekly journal of general information and opinion.

En. 11 a, b, c. JOURNALISM.—3 units (1-0-2).

Elective, with the approval of the Registration Committee.

A study of the principles and practice of newspaper writing, editing, and publishing, especially as applied to student publications at the Institute.

Text: Newspaper Writing and Editing, Bleyer.

Instructor: MacMinn.

En. 12 a, b, c. DEBATING.—4 units (2-0-2).

Elective, with the approval of the Registration Committee, for upperclassmen in the first and second terms; for freshmen in the third term.

Study of the principles of argumentation; systematic practice in debating; preparation for intercollegiate debates.

Instructor: Untereiner.

En. 13 a, b, c. READING IN ENGLISH AND HISTORY.—Units to be determined for the individual by the department.

Elective, with the approval of the Registration Committee, in any term.

Collateral reading in literature, history, and related subjects, done in connection with the regular courses in English and history, or independently of any course, but under the direction of members of the department.

En. 14. SPECIAL COMPOSITION.—2 units (1-0-1); any term.

This course may be prescribed for any student whose work in composition, general or technical, is unsatisfactory.

En. 15. SPELLING.—No credit.

This course may be prescribed for any student whose spelling, general or technical, is unsatisfactory.

En. 20. SUMMER READING.—Maximum, 16 credits.

Credits are allowed to the maximum number of sixteen for vacation reading from a selected list of books in various subjects, and written report thereon. See printed pamphlet for detailed regulations.

GEOLOGY AND PALEONTOLOGY

PROFESSORS: JOHN P. BUWALDA, CHESTER STOCK
INSTRUCTOR: RENE ENGEL
TEACHING FELLOWS: CLEMENT D. MESERVE, JOHN W. PATTERSON

Ge. 1 a. PHYSICAL GEOLOGY.—9 units (4-1-4); first term.
Prerequisite: Ch. 1, Ph. 1 a, b, c, and 2 a, b, c, d.

A consideration of the composition and structure of the Earth and the internal and external processes which modify the crust and the surface. Dynamical and structural geology. Lectures, recitations, laboratory and occasional field trips.

Text: Pirsson and Schuchert's Introductory Geology.
Instructor: Buwalda.

Ge. 1 b. ELEMENTARY PALEONTOLOGY.—9 units (4-1-4); second term.
Prerequisite: Ge. 1 a.

A discussion of the principles on which the history of life is based. Illustrations of evolution taken from certain groups of animals of which the fossil record is essentially complete.

Text: Organic Evolution, Lull.
Instructor: Stock.

Ge. 1 c. HISTORICAL GEOLOGY.—9 units (4-1-4); third term.
Prerequisite: Ge. 1 b.

The astronomical origin and geological history of the Earth. An account of the changing vistas of geological time and of the successive faunas and floras which have peopled the earth's surface from age to age. Lectures, recitations, laboratory, and occasional field trips.

Text: Historical Geology, Schuchert.
Instructors: Buwalda, Stock.

Ge. 3 a. CRYSTALLOGRAPHY AND CRYSTAL STRUCTURE.—9 units (1-6-2); first term.
Prerequisite: Ch. 1 a-c, Ph. 1 and 2.

A study of crystal systems and forms, not only from the classical geometric view-point, but also in light of the modern atomic conceptions of crystal structure; also, the physical properties characteristic of crystals.

Instructor: Engel.

Ge. 3 b, c. MINERALOGY.—9 units second term, 6 units third term.

Prerequisite: Ge. 3 a.

Lectures and laboratory work devoted to the study of the physical properties of minerals and to their identification by chemical and blowpipe tests.

Instructor: Engel.

Ge. 5 a, b. PETROLOGY.—9 units (2-5-2); first and second terms.

Prerequisites: Ge. 3 a, b.

The origin, properties, and identification of the common rocks determined with the aid of hand lens. Lectures and laboratory.

Text: Rocks and Rock Minerals, Pirsson-Knopf.

Instructor: Engel.

Ge. 7 a, b. FIELD GEOLOGY.—12 units first term, 8 units third term.

Prerequisites: Ge. 1 a-c; 3 a, b; 5 a, b.

Technical field methods of mapping the distribution of rocks, determining structure, and deciphering the geological history of a region. Students map a certain area and prepare a report on its structure and history. Eight field days will be scheduled per term, usually on Saturdays, but with one or two trips of several days. Students may be called upon to expend small sums for traveling expenses. Field work, lectures, and laboratory.

Text: Field Geology, Lahee.

Instructor: Buwalda.

Ge. 9. STRUCTURAL GEOLOGY.—8 units (3-0-5); third term.

Prerequisites: Ge. 7 a; may be taken concurrently.

A consideration of the structural features of the Earth's crust; joints, folds, faults, foliation. Computation of thicknesses and depths. Determination of the nature and amount of displacements on faults by use of descriptive geometry. Lectures and laboratory.

Instructor: Buwalda.

Ge. 11 a, b, c. INVERTEBRATE PALEONTOLOGY.—10 units first term, 8 units second term.

Prerequisites: Ge. 1 a, b, c.

A study of the more important groups of invertebrates found fossil. Their significance in indicating the environmental conditions in which the organisms lived and their use in determining the age of the rocks containing them. Laboratory and lectures.

Ge. 12 a, b. VERTEBRATE PALEONTOLOGY.—10 units (2-6-2); second and third terms.

Prerequisite: Ge. 1 b.

Osteology, affinities, and history of the principal groups of fossil mammals and reptiles. History of vertebrate life with special reference to the region of western North America.

Instructor: Stock.

Ge. 21. THESIS PROBLEM IN GEOLOGY.—8 units; second and third terms.

Prerequisites: Ge. 7 a.

The student investigates a limited geologic problem, preferably of his own choosing, under direction, in the field or laboratory. Individual initiative is developed, principles of research are acquired, and practice gained in technical methods. The student prepares a thesis setting forth the results of the research and their meaning.

Ge. 22. THESIS PROBLEM IN PALEONTOLOGY.—8 units; second and third terms.

Prerequisites: Ge. 11 a, b, c, or Ge. 12 a, b.

Special investigations in either invertebrate or vertebrate paleontology. Research on a limited problem involving either field relationships of fossil assemblages or consideration in the laboratory of the structural characters and relations of fossil forms. Preparation of a thesis.

ADVANCED SUBJECTS IN GEOLOGY.—See pages 119 and 120.

HYDRAULICS

PROFESSOR: ROBERT L. DAUGHERTY
INSTRUCTORS: FRED J. CONVERSE, CLARENCE V. ELLIOTT

Hy. 1. HYDRAULICS.—12 units (4-0-8); third term.
Prerequisite: AM. 1 a, b.
Physical properties of water; hydrostatics; flow of water in pipes, nozzles, and channels; theory, construction, and installation of hydraulic turbines, and a study of their characteristics with a view to intelligent selection of the proper type for any given conditions; centrifugal pumps and other hydraulic equipment.
Text: Hydraulics, Daugherty.
Instructors: Daugherty, Converse.

Hy. 2. HYDRAULIC LABORATORY.—6 units (0-3-3); third term.
Prerequisite: AM. 1 a, b.
To be taken at same time as Hy. 1. Experiments on the flow of water through orifices and nozzles, through pipes and Venturi meters, over weirs; use of Pitot tube; tests of impulse and reaction turbines, centrifugal pumps, and other hydraulic apparatus.
Instructors: Converse, Elliott.

LANGUAGES

PROFESSOR: JOHN R. MACARTHUR
ASSISTANTS: ALPHEUS BALL, J. STUART CAMPBELL, G. ROBERT JAFFREY

The courses in this department are primarily arranged to meet the needs of men who find it necessary to read scientific books, treatises, and articles in French and German. In these languages correct pronunciation and the elements of grammar are taught, but the emphasis is laid upon the ability to translate from them into English. An elective course in Greek is offered to students interested in that language.

L. 1 a, b. ELEMENTARY FRENCH.—10 units (4-0-6); second and third terms.

A course in grammar, pronunciation, and reading that will provide the student with a vocabulary of extent and with a knowledge of grammatical structure sufficient to enable him to read at sight French scientific prose of average difficulty. Accuracy and facility will be insisted upon in the final tests of proficiency in this subject.

Texts: French Grammar, Hacker; Technical and Scientific French, Williams.

Instructor: Macarthur.

L. 31 a, b, c. ELEMENTARY GERMAN.—6 units (3-0-3); first, second and third terms.

This subject is presented in the same manner as the Elementary French.

Texts: First German Course for Science Students, Fiedler and Sandbach; German Science Reader, Wright.

Instructors: Macarthur and Assistants.

L. 34 a, b, c. SCIENTIFIC GERMAN.—6 units (3-0-3); first, second and third terms.

Prerequisite: L. 31 a, b, c, or one year of college German.

This is a continuation of L. 31 a, b, c, with special emphasis on the reading of scientific literature.

Text: Aus der Werkstatt grosser Forscher, Danneman.

Instructors: Macarthur and Assistants.

L. 37, a, b, c. ELEMENTARY AND SCIENTIFIC GERMAN.—10 units (4-0-6); first, second and third terms.

This course is a combination of L. 31 and 34 presented in a single year and open to students of exceptional ability.

Texts: First German Course for Science Students, Fiedler and Sandbach; Die Radioaktivitat, Fajans; German Science Reader, Wright.

Instructor: Macarthur.

L. 38. SCIENTIFIC GERMAN.—10 units (4-0-6); first term.

This course is a continuation of L. 37.

Instructor: Macarthur.

L. 51 a, b, c. GREEK.—6 units (3-0-3).

This is a course in the elements of the classical Greek language. Special reference is made to scientific nomenclature. Outside reading upon topics drawn from Greek literature, art, philosophy, and science is reported on in term papers. The course is elective.

Texts: Greek Lessons for Beginners, Morrison and Goodell; The study of Greek Words in English, including Scientific Terms, Hoffman.

Instructor: Macarthur.

MATHEMATICS

PROFESSORS: HARRY BATEMAN, ERIC T. BELL, HARRY C. VAN BUSKIRK
ASSOCIATE PROFESSOR: LUTHER E. WEAR
ASSISTANT PROFESSOR: CLYDE WOLFE
INSTRUCTOR: WILLIAM N. BIRCHBY
NATIONAL RESEARCH FELLOW: CARL ECKART
TEACHING FELLOWS AND ASSISTANTS: HERVEY C. HICKS, CLARK MILLIKAN, BORIS PODOLSKY, CHARLES F. RICHTER, MORGAN WARD

The work in engineering and science is so largely mathematical in character that too much emphasis can hardly be placed upon the necessity of a good foundation in mathematics. Care is taken to present both underlying principles and a great variety of applications, thus connecting the mathematical work closely with the professional studies.

Ma. 1 a, b, c. FRESHMAN MATHEMATICS.—12 units (4-0-8); first, second, and third terms.

Including the fundamentals of Analytical Geometry, certain topics in College Algebra, and some of the principles of the Differential and Integral Calculus.

Text: Course in Mathematics, Vol. I, Woods and Bailey.

Ma. 2 a, b, c. SOPHOMORE MATHEMATICS.—12 units (4-0-8); first and second terms; 8 units third term.

Prerequisites: Ma. 1 a, b, c.

Includes additional topics in Analytical Geometry, and completes the usual subjects of the Calculus, begun in the freshman year.

Text: Course in Mathematics, Vol. II, Woods and Bailey.

Ma. 2 d. MATHEMATICS REVIEW.—4 units (4-0-8).

A comprehensive review of freshman and sophomore mathematics during the last three weeks of the sophomore year.

Courses Ma. 1 a, b, c, and 2 a, b, c, d, form a continuous two-year course in Analytical Geometry, College Algebra, and the Differential and Integral Calculus.

Ma. 8 a, b. ADVANCED CALCULUS.—12 units (4-0-8); first and second terms.

Prerequisites: Ma. 1 a, b, c, 2 a, b, c, d.

Planned to extend the knowledge gained from the previous studies in Calculus and Analytic Geometry and to lay a better foundation for advanced work in mathematics and science.

Text: Advanced Calculus, Osgood.

Instructors: Van Buskirk, Wear.

Ma. 10. DIFFERENTIAL EQUATIONS.—12 units (4-0-8); third term.

Prerequisite: Ma. 8 a, b.

An introductory course in differential equations, designed to be helpful both to the student of mathematics and the student of science or engineering.

Texts: Differential Equations, Murray, Osgood.

Instructors: Wear, Van Buskirk.

Ma. 12. PROBABILITY AND LEAST SQUARES.—5 units (2-0-3); third term.

Prerequisites: Ma. 1 a, b, c, 2 a, b, c, d.

A study of the fundamental principles of probability and their application to statistical data, adjustment of observations, and precision of measurements.

Text: Theory of Errors and Least Squares, Leroy D. Weld.

Instructor: Wolfe.

Ma. 14. VECTOR ANALYSIS.—12 units (4-0-8); first term.

Prerequisite: Ma. 8 a, b, 10.

Elementary vector operations (addition, multiplication) and their application to problems of geometry and physics are treated.

Text: Coffin's Vector Analysis.

Instructor: Eckart.

ADVANCED SUBJECTS IN MATHEMATICS.—See pages 111 and 112.

MECHANICAL ENGINEERING

PROFESSORS: ROBERT L. DAUGHERTY, W. HOWARD CLAPP
INSTRUCTORS: CLARENCE V. ELLIOTT, ROBERT T. KNAPP, WALTER W. OGIER, JR.

ME. 1. MECHANISM.—10 units (3-3-4); either first, second or third term.

Prerequisites: Ma. 1 a, b, c; Ph. 1 a, b, c; D. 1 a, b.

An analytical study of constrained motion in machines and of the relations of machine elements. Desirable types of motion; displacements of machine parts using simple valve motions, cam actuating parts, and other reciprocating and oscillating machine members as examples. Velocity studies; average and instantaneous values; velocity analysis by vectors using centros; relative velocities; application of vectors to cyclic trains and other differential motions. Acceleration analysis; inertia forces. The various linkages and combinations of machine elements are introduced and used as a means of mastering the geometry of machine motion.

Text: Mechanism, Clapp and Ogier.

Instructors: Clapp, Ogier, Elliott.

ME. 2. MACHINE DESIGN.—9 units (3-0-6); first term.

Prerequisites: ME. 1; D. 1 a, b; AM. 1 a, b.

Applications of mechanics of machinery and mechanics of materials to practical design and construction. Riveting and welding; boilers and plate vessels; bolts and screws; force and shrink fits; hydraulic cylinders; cylinders and cylinder heads for steam and gas engines; stuffing boxes and packing; pistons and piston rings; leaf springs; coil springs; piston pins; connecting rods and cross heads; cranks and crank-shafts; flywheels; spur gears; helical gears; bevel gears; worm gears; spiral gears.

Text: Principles of Machine Design, Norman.

Instructor: Clapp.

ME. 3. MACHINE DESIGN.—12 units (2-6-4); second term.

Prerequisite: ME. 2.

A continuation of the work in design with especial reference to

belting; pulleys; rope driving; chains; friction drives; wire rope and hoisting; plain bearings; ball bearings; roller bearings; shafts and couplings; clutches; brakes; high speed disks; piping. Class exercises and drawing board studies.

Text: Principles of Machine Design, Norman.

Instructor: Clapp.

ME. 4. MACHINE DESIGN.—9 units (3-0-6); third term.

Prerequisite: ME. 3.

A study of manufacturing processes with especial reference to the economics of design. Lectures and inspection trips.

Instructor: Clapp.

ME. 5. ADVANCED MACHINE DESIGN.—12 units (4-0-8); first term.

Prerequisite: AM. 1 a, b; ME. 4, 10.

The student electing this course will be expected to have a comprehensive knowledge of the constitution and properties of the principle materials of construction, and to be acquainted with machine shop processes. The various relations developed in mechanics of materials are examined as to their authority and limitations and as to their application. Examples of evolved design for parts subjected to complex stresses are critically studied. Investigation of the failure of materials under repeated stresses.

Text: Applied Elasticity, Timoshenko and Lessells.

Instructor: Clapp.

ME. 6 and 7. MACHINE DESIGN OPTIONS.—12 units (0-12-0); second and third terms.

The work in these terms may follow various lines as the student may elect. He may desire to work out the design of some especial machine, or he may wish to take up internal combustion engine design, or other suitable project. This time may be combined with that for thesis, in case the latter is of a design character.

Instructors: Clapp, Elliott.

ME. 10. SCIENCE OF METALS.—9 units (3-0-6); first term.

Prerequisite: Ch. 6.

A study of the principles underlying the manufacture and heat

treatment of the ferrous metals and some of the non-ferrous alloys.

Instructor: Clapp.

ME. 11. SCIENCE OF METALS.—12 units (4-0-8); second term.
Prerequisite: ME. 10.

A continuation of the course ME. 10 with especial reference to the structure of metallic alloys, their causes, and the relation between structure and physical properties.

Text: Science of Metals, Jeffries and Archer.

Instructor: Clapp.

ME. 12. METALLOGRAPHY.—12 units (2-6-4); third term..
Prerequisite: ME. 11.

The structure of the ferrous alloys; causes and effects of the thermal critical points; theories of hardening and hot and cold working; constitution, properties, heat treatment, and uses of the principal alloy steels; the phase rule; preparation of specimens for microscopic analysis; optics of metallography. Lectures and laboratory exercises.

Text: The Metallography of Iron and Steel, Sauveur.

Instructor: Clapp.

ME. 15. HEAT ENGINEERING.—12 units (3-3-6); third term.
Prerequisites: Ma. 2 a, b, c, d; ME. 1.

Principles of thermodynamics, and their application to steam engines, steam turbines, and internal combustion engines; types of steam, gas, and oil engines, boilers, and auxiliaries. Inspection of local power plants, elementary tests in the laboratory, and computing or drawing room exercises.

Instructor: Daugherty.

ME. 16. HEAT ENGINEERING.—12 units (4-0-8); second term.
Prerequisite: ME. 15.

Additional work in thermodynamics; properties of gases, saturated and superheated vapors; various cycles of steam and internal combustion engines; flow of gases and vapors through orifices, nozzles, and pipes; air compression.

Instructor: Daugherty.

ME. 17. HEAT ENGINEERING.—9 units (3-3-3); third term.

Prerequisite: ME. 16.

A study of the application of thermodynamics to modern practice in power plants and also to refrigeration; heating and ventilating; and other thermal processes. Class room work and computing room problems.

Instructor: Daugherty.

ME. 18. THERMODYNAMICS.—12 units (4-0-8); first term.

Prerequisite: ME. 17.

Advanced work in engineering thermodynamics, with applications to combustion, heat transfer, and similar practical problems.

Instructor: Daugherty.

ME. 19 and 20. POWER PLANT ENGINEERING.—12 units (1-9-2); second and third terms.

Prerequisite: ME. 18.

A study of modern power plant engineering, computation of typical problems, and design and layout for a complete plant. Class room and computing room.

Instructor: Daugherty.

ME. 25. HEAT ENGINEERING LABORATORY.—6 units (0-3-3); second term.

Prerequisite: ME. 15.

Tests of steam engine, steam turbine, and gas engine for efficiency and economy; test of boiler for capacity and economy.

Text: Power Plant Testing, Moyer.

Instructor: Knapp.

ME. 26. HEAT ENGINEERING LABORATORY.—6 units (0-3-3); second term.

Prerequisite: ME. 15.

Additional work in the laboratory on air compressors, fuel and oil testing, and special work on steam and internal combustion engines.

Text: Power Plant Testing, Moyer.

Instructor: Knapp.

ME. 27. Heat Engineering Laboratory.—15 units (1-9-5); first term.

Prerequisites: ME. 17, 26.

Advanced work on steam turbines, internal combustion engines, lubrication, and similar subjects. Each problem will be studied in enough detail to secure a thorough analysis. Conference hour for progress discussion.

Instructor: Knapp.

ME. 30 and 31. Internal Combustion Engines.—12 units (3-3-6); second and third terms.

Prerequisites: ME. 18, 27.

Theoretical, experimental, and design problems. The subject will be approached from the performance point of view rather than from that of the mechanical design. Fuels, carburetion, superchargers, explosion, combustion, detonation, heat transfer. Work with test engine equipped with optical indicator.

Instructors: Elliott and Knapp.

Th. 100. Research or Thesis.—15 units; second and third terms.

Every student shall select a suitable subject for investigation, the results of which shall be presented in a thesis. For problems of suitable merit, and with the approval of the department, part or all of the time allotted for other professional subjects of the second and third terms of the fifth year may be combined with that allowed for thesis.

MILITARY TRAINING

PROFESSOR: LIEUT. COLONEL LEWIS M. ADAMS
ASSISTANT PROFESSOR: LIEUTENANT LOUIS J. CLATERBOS
MASTER SERGEANT: JOSEPH LARACY
MASTER SERGEANT: LOUIS H. BAILEY

By direction of the Secretary of War, an Engineer Unit of the Senior Division, Reserve Officers' Training Corps, is maintained at the Institute, under supervision of an officer of the Corps of Engineers, Regular Army, detailed by the War Department, who is designated as Professor of Military Science and Tactics.

The primary object of the Reserve Officers' Training Corps is to provide systematic military training for the purpose of qualifying selected students as Reserve Officers in the national defense plan of the United States. This object is attained by employing methods designed to fit men physically, mentally, and morally for pursuits of peace as well as defense of the country in the event of war.

The policy of the War Department is to inculcate in the students a respect for lawful authority, to teach the fundamentals of the military profession, to develop leadership, and to give the special knowledge required to enable them to act efficiently in the engineering branch of the military service. The equipment furnished by the government for the instruction of this unit affords to all classes practical training in engineering fundamentals which greatly enhances the student's preparation for his civil career.

All freshmen and sophomores who are American citizens and physically eligible are required to take Military Training. Satisfactory completion of the two years of the basic course is a prerequisite for graduation. Uniforms, text-

books, and other equipment are provided by the Government, and are loaned to the students while pursuing the basic course.

Mi. 1 a, b, c. MILITARY SCIENCE AND TACTICS (Basic Course).—4 units (1-2-1); first, second, and third terms.

Freshman work consists of drills, lectures, and recitations covering the following subjects: Infantry drill and leadership, rifle marksmanship, interior guard duty, hygiene, military courtesy and discipline. Practical instruction is given in knots and lashings, field fortifications, map reading, map making, and pontoon bridge construction. All freshmen are assigned as privates in the R. O. T. C. battalion freshman year.

Mi. 4 a, b, c. MILITARY SCIENCE AND TACTICS (Basic Course).—4 units (1-2-1); first, second, and third terms.

Prerequisite: Mi. 1 a, b, c.

Sophomore work consists of drills, lectures, recitations, and conferences covering the following subjects: Infantry drill, leadership, musketry, and minor tactics. Practical instruction is given in knots and lashings, splicing, blocks and tackles, gins, shears, tripods and field derricks, topographic sketching, and bridge construction. Selected sophomores are assigned as corporals in the R. O. T. C. battalion.

Members of the Reserve Officers' Training Corps who have completed two academic years of service in the basic course (or the authorized equivalent of such service) and have been selected by the head of the Institute and the Professor of Military Science and Tactics as qualified for further training, are eligible and may apply for admission to the advanced course. Such selected students receive a money allowance from the United States Government for commutation of rations of approximately nine dollars ($9) per month. They are required to attend one summer advanced R. O. T. C. Camp for six weeks' duration prior to their graduation before becoming eligible for appointment

as reserve officers. The Government furnishes clothing, food, and quarters, pays travel expenses to and from camp, and pays each student seventy cents (70c) per day for attendance at this summer camp. The advanced course covers the instruction necessary for the training of the students in the duties of a commissioned officer, who must be not only schooled in the theory of war, but skilled also in practical leadership, with trained judgment, resourcefulness, and initiative.

Mi. 7 a, b, c. MILITARY SCIENCE AND TACTICS (Advanced Course).—6 units (2-2-2); first, second and third terms.

Prerequisites: Mi. 1 a, b, c, 4 a, b, c.

Junior work consists of recitations and conferences on the following subjects: Minor tactics, field fortifications, demolitions, roads, and railroads. The junior class furnishes the cadet sergeants and first sergeants for the R. O. T. C. battalion.

Mi. 10 a, b, c. MILITARY SCIENCE AND TACTICS (Advanced Course).—6 units (2-2-2); first, second and third terms.

Prerequisites: Mi. 1 a, b, c, 4 a, b, c, 7 a, b, c.

Senior work consists of recitations and conferences in the following subjects: Military bridges, military history and law, engineer organization and operations. Practical instruction is given in civil-military construction, mapping, and map reproduction. The cadet officers in the R. O. T. C. battalion are selected from the senior class.

In June, 1925, and again in 1926, the California Institute of Technology was designated by the War Department as a "Distinguished College." This much sought-for honor was obtained by its R. O. T. C. battalion demonstrating a superior state of efficiency at the annual inspection of the special War Department board of officers in April.

PHYSICAL EDUCATION

PHYSICAL DIRECTOR: WILLIAM L. STANTON

INSTRUCTOR: HAROLD Z. MUSSELMAN

ASSISTANTS: LOUIS J. CLATERBOS (football and basketball), RICHARD M. SUTTON (intramural sports), DOMENICK J. POMPEO (baseball), HAAKON M. EVJEN (boxing), ARTHUR GRIFFITH (wrestling).

ADVISER IN ATHLETICS: DAVID BLANKENHORN

All freshmen and other new students must pass a medical examination before they will be admitted to the Institute; all other students must satisfy the Department of Physical Education that they are physically qualified to continue the work for which they are registered. A student ambitious to become an engineer must first be a man with a sound body and stored-up nervous energy, fundamental to a sound mind and subsequent success.

The program of physical education is designed to give general physical development to all. When a student has completed the year's work he should exhibit some progress in attaining the following results: (1) strength and endurance, self-respecting and erect carriage of the body, and neuro-muscular control; (2) aggressiveness, self-confidence, courage, decision, perseverance, and initiative; (3) self-control, self-sacrifice, loyalty, cooperation, mental and moral poise, a spirit of fair play, and sportsmanship.

The required work is divided into three parts: (1) corrective exercises for those physically deficient; (2) group games; (3) fundamentals of highly organized athletics. This work is modified by various activities designed to en-

courage voluntary recreational exercises, including football, basketball, baseball, track and field athletics, boxing, swimming, wrestling, and other sports.

PE. 1. Physical Examinations and Strength Tests.—First and third terms.

Used as a basis of comparison with other men of same weight and height; corrective exercises prescribed for underdevelopment and deformities. Required of freshman and sophomores.

PE. 2. Intramural Sports.—3 units each term.

Competition between classes, clubs, fraternities, in all sports, including football, cross-country running, track and field events, baseball, basketball, swimming, boxing, wrestling, tennis, handball, etc. Required of freshmen, sophomores and juniors not taking part in intercollegiate sports.

PE. 3. Intercollegiate Sports.—3 units each term.

The Institute is a member of the Southern California Intercollegiate Conference. Representative freshmen and varsity teams in the major sports are developed and trained by experienced coaches. Fair-spirited and clean-cut athletic competition is encouraged as a part of the physical program for its social and physical values, and as a foundation for genuine college spirit.

PHYSICS

PROFESSORS: ROBERT A. MILLIKAN, HARRY BATEMAN, PAUL S. EPSTEIN, LUCIEN H. GILMORE, RICHARD C. TOLMAN

ASSOCIATE PROFESSOR: EARNEST C. WATSON

ASSISTANT PROFESSORS: IRA S. BOWEN, WALTER T. WHITNEY

RESEARCH FELLOW: WILLIAM R. SMYTHE

TEACHING FELLOWS AND GRADUATE ASSISTANTS: J. LLOYD BOHN, WILLARD C. BRUCE, CHARLES R. DAILY, ALBERT C. HODGES, KENNETH K. ILLINGWORTH, SYDNEY B. INGRAM, NORRIS JOHNSTON, DONALD H. LOUGHRIDGE, OTTO F. RITZMANN, RICHARD M. SUTTON, RALPH E. WINGER, JOHANNES A. VAN DEN AKKER.

Ph. 1 a, b, c. MECHANICS, MOLECULAR PHYSICS, AND HEAT.—9 units (2-3-4); first, second, and third terms.

Prerequisites: A high school course, or its equivalent, and trigonometry.

The first year of a general college course in physics extending through two years. It is a thorough analytical course, in which the laboratory carries the thread of the work, and the problem method is largely used. A bi-weekly demonstration lecture, participated in by all members of the department, adds the inspirational and informational element, and serves for the development of breadth of view.

Text: Mechanics, Molecular Physics, and Heat, Millikan.

Instructors: Gilmore, Daily, Illingworth, Ingram, Johnston, Watson.

Ph. 2 a, b, c. ELECTRICITY, SOUND, AND LIGHT.—12 units (3-3-6); first and second terms; 8 units third term.

Prerequisites: A high school course, or its equivalent, and trigonometry.

Continuation of Ph. 1 a, b, c, to form a well-rounded two-year course in general physics.

Text: Electricity, Sound, and Light, Millikan and Mills.

Instructors: Bohn, Bowen, Ritzman, Sutton, Whitney, Winger.

Ph. 2 d. PHYSICS REVIEW.—4 units; last three weeks of sophomore year.

The last three weeks of the sophomore year are devoted to a comprehensive review and examination covering the whole of the two years' work (Ph. 1 a, b, c, and 2 a, b, c).

Ph. 3. MODERN PHYSICS.—12 units (2-6-4); third term.

Prerequisites: Ph. 1 a, b, c, 2 a, b; Ma. 2 a b.

A brief survey of recent developments in electron theory, quantum theory, radioactivity, and atomic structure. Experiments to determine e, $\frac{e}{m}$, h, and other fundamental constants will be performed. Open only to students on honor standing, sophomore year.

Instructors: Bowen and Whitney.

Ph. 5. ELECTRICAL MEASUREMENTS.—8 units (1-6-1); first term.

Prerequisites: Ph. 1 a, b, c, 2 a, b, c, d; Ma. 2 a, b, c, d.

Deals with the theory and use of electrical and magnetic measurements and methods, with special reference to convenience of use, precision, and possible sources of error.

Text: Advanced Laboratory Practice in Electricity and Magnetism, Terry.

Instructors: Loughridge and Van den Akker.

Ph. 7 a, b. ELECTRICITY AND MAGNETISM.—9 units (3-0-6); second and third terms.

Prerequisites: Ph. 1 a, b, c, 2 a, b, c, d; Ma. 2 a, b, c, d.

A course of advanced work in theoretical electricity and magnetism with many applications to electrical and magnetic apparatus and measurements.

Text: Electricity and Magnetism, Jeans.

Instructor: Loughridge.

Ph. 8 a, b. ELECTRICAL MEASUREMENTS.—6 units (0-4-2); second and third terms.

Prerequisites: Ph. 1 a, b, c, 2 a, b, c, d; Ma. 2 a, b, c, d.

A course in electrical and magnetic measurements designed to accompany Ph. 7 a, b.

Text: Advanced Laboratory Practice in Electricity and Magnetism, Terry.

Instructors: Loughridge and Van den Akker.

Ph. 12 a, b. Analytical Mechanics.—12 units (4-0-8); first and second terms.

Prerequisites: Ph. 1 a, b, c, 2 a, b, c, d; Ma. 2 a, b, c, d.

A study of the fundamental principles of theoretical mechanics; force and the laws of motion; statics of systems of particles; the principle of virtual work, potential energy, stable and unstable equilibrium; motion of particles, systems of particles and rigid bodies; generalized co-ordinates, Hamilton's principle and the principle of least action.

(Not given in 1926-1927.)

Text: Dynamics, Lamb.

Ph. 15 a, b. Introduction to Mathematical Physics.—9 units (3-0-6); first and second terms.

Prerequisites: Ph. 1 a, b, c, 2 a, b, c, d; Ma. 2 a, b, c, d.

An introduction to the application of mathematics to physics and chemistry, and practice in the solution of problems.

Text: Introduction to Theoretical Physics, Haas.

Instructor: Smythe.

Ph. 20 a, b. Physical Optics.—9 units (3-0-6); third and first terms.

Prerequisites: Ph. 1 a, b, c, 2 a, b, c, d; Ma. 2 a, b, c, d.

Lectures and class work dealing with the fundamental theoretical equations of diffraction, interference, etc., and their experimental verification.

Text: Manual of Advanced Optics, Taylor.

Instructor: Whitney.

Ph. 21 a, b. Laboratory Optics.—6 units (0-6-0); third and first terms.

Prerequisites: Ph. 1 a, b, c, 2 a, b, c, d; Ma. 2 a, b, c, d.

A course in advanced laboratory work in light, consisting of accurate measurements in diffraction, dispersion, interference, polarization, and spectrophotometry.

Text: Manual of Advanced Optics, Taylor.

Instructor: Whitney.

Advanced Courses in Physics, see pages 113-117.

SHOP INSTRUCTION

INSTRUCTORS: ARTHUR F. HALL, OSCAR L. HEALD, GEORGE D. HENCK, WALTER W. MARTIN

The aim of the subjects listed under this heading is the experimental determination of the more easily observed properties of the materials used in engineering construction, and the effects on such materials of the various manipulations and treatments common in the mechanic arts. These subjects are given in shop laboratories suitably equipped for wood and metal working, and it is assumed that during the preparation of specimens and the experiments the student will acquire some skill in the handling of tools and machines and an understanding of the practical application of the processes studied.

Sh. 1. WOOD WORKING. PROPERTIES OF WOOD AND OTHER MATERIALS USED IN TIMBER CONSTRUCTION.

Study of wood growth and structure from illustrative timber sections; discussion of the relation of wood-cell structure to strength, hardness, etc., of timber; experimental comparison of wood and metals as to their strength and other properties; strength of joining devices, as glue, nails, joints; study of the general design and operation of wood working tools and machines.

Instructor: Martin.

Sh. 2. FORGING. HOT WORKING OF METALS.

Experimental study of the strength, hardness, ductility, etc., of steel, wrought iron, cast iron and other metals; their behavior when worked at high temperatures; ability to unite by welding in forge or oxy-acetylene flame; effects of case hardening, sudden cooling, annealing on various metals; essential requirements in the design and operation of forges, heating-furnaces and metal working tools or machines.

Instructor: Heald.

Sh. 3. Pattern Making. Metal Castings and the Patterns Therefor.

Lectures on the requirements of patterns for metal castings; the necessity for and the determination of the amount of shrinkage, draft and other allowances; the effects of chilling and other heat treatments on cast metals; study of moulding methods and pattern construction.

Instructor: Henck.

Sh. 4. Machine Shop. Working of Metals.

Experiments in the cutting of metals with shears, files, cold chisels and drills, in lathes and other machine tools, with especial regard to the hardness and other properties of the metals, and the suitability of the tool cutting-edge; effect of speed and feed in machine tool operation; methods of laying out work; experimental determination of necessary accuracy in the fitting of machine parts.

Instructor: Hall.

Sh. 1-4. (Above subjects.) Distributed through the three terms and the summer period of the freshman year. (8 units for the year.)

THESIS

100. Thesis or Special Problems.— A thesis may be prepared, or an equivalent amount of work done in solving assigned problems. The thesis may be either an account of some investigation, or an original design accompanied by a complete exposition. Subjects of theses should be selected with the approval of the professor in charge, and formal "progress" reports submitted at the end of each term. The thesis must be submitted to the faculty for approval at least one week before commencement. The problems will be of a comprehensive nature, selected with a view to correlating various fundamental subjects in their application. All problems and theses, and records of work done in preparation therefor, remain the property of the Institute, and may not be published except by its authority.

[For a description of the Thesis Requirements in the Chemistry and Chemical Engineering Courses, see page 162.]

Degrees Conferred, June 10, 1926

Doctor of Philosophy

Gordon Albert Alles, B.S., California Institute of Technology

Ira Sprague Bowen, A.B., Oberlin College

Robert Cady Burt, E.E., Cornell University

George Harvey Cameron, B.S., University of Saskatchewan

Nephi Willard Cummings, B.A., University of Utah

James Byron Friauf, A.B., University of Montana

Wayne Brockbank Hales, B.A., Brigham Young University

Sterling Brown Hendricks, B.S. in Chem. Eng., University of Arkansas

L. Merle Kirkpatrick, B.S., California Institute of Technology

Edward Joseph Lorenz, B.A. and M.A., University of Cincinnati

Lewis Morton Mott-Smith, B.S., California Institute of Technology

Charles Holden Prescott, A.B., Yale University

Willis Howard Wise, B.S., Montana State College; M.A., University of Oregon

Oliver Reynolds Wulf, B.S., Worcester Polytechnic Institute; M.S., The American University

Don M. Yost, B.S., University of California

Master of Science

Warren Phelps Baxter, B.S., California Institute of Technology.

Carl Trueblood Chase, B.S., Princeton University

Robert Hennah Dalton, B.S., California Institute of Technology

George Forster, E.E., Lehigh University

Harvey House, B.S., California Institute of Technology

Harold Heiges Steinour, B.S. in Chem. Eng., University of Southern California

Degrees Conferred—Continued

Bachelor of Science

Electrical Engineering

Constantin Ivanovitch Anissimoff
*Albert Elliott Byler
George Elmer Crocker
Daniel George Dinsmore
Manley Warren Edwards
*George Maurice Farly
*Melvin Earnest Gainder
Roscoe Gockley
Wayne Emmett Granger
Frey Hamburger
*Claude Dewayne Hayward
*John Roscoe Howell
Herbert Victor Ingersoll
Maurice Townley Jones
*Clarence Frank Kiech
Seerley Gnagy Knupp
*Alex Alexevich Kroneberg
Allen Lee Laws
*William Abbett Lewis, Jr.
*Harold Wilbur Lord
Percy Edwin Parker
Merle Ivan Pyle
*Alfred Edward Schueler
Frank Hershey Streit
James Frederick Patterson Thomson
Arthur Clinton Werden, Jr.

Mechanical Engineering

Jack Correll Baker
Raymond Frank Childs
Carl Gustav Ericsson
Henry Phillips Henderson
Harold Ferris Huggins
Walter Stuart Johnson
Eugene Kirkeby
Lawrence George Maechtlen
Sam Parnall
*George Lee Paulus
Harry Leslie Remington
Harold Frank Richards
Bruno Rudolph Schabarum
Ira Ellis Triggs
Myron Eldo West

Civil Engineering

Robert Bogen
*Wayne Holden Clark
Harry Earl Cunningham
Felix Oscar Fricker
Glenn Graham
*Ching Yun Hsiao
Yu Hsien Huang
William Stephen Kingsbury, Jr.
Kenneth C. McCarter
*John Elwert Michelmore
Bruce Hopf Mills
*Robert Wardwell Moodie
Allan James Morrison
Wallace Clay Penfield
Earl Randolph Peterson
Vladimir Porush
*George Wesley Russell
Mark Usona Serrurier
Stuart Lewis Seymour
*Vito August Vanoni

*With honor.

Degrees Conferred—Continued

Chemical Engineering

ARTHUR BARNARD ALLYNE
*ALPHEUS M. BALL
HUNG YUAN CHANG
*JOHN LOUIS FAHS
JAMES WILBERT HASTINGS
JEN CHIEH HUANG
VADIM SOKOLOFF
EDGAR PETERSON VALBY
JOACHIM FRANK VOELKER
EDWARD C. WARD
BURNETT BLANCHARD WISEGARVER

Chemistry

KAI JIN YANG
*JAMES MAURICE CARTER
*RICHARD DURANT POMEROY
*HERMANN FRANZ SCHOTT
*NATHAN FROST SCUDDER
*SIDNEY ZABARO

Physics and Engineering

*CHARLES HAWLEY BIDWELL
*JOHN STUART CAMPBELL
*C. HAWLEY CARTWRIGHT
VICTOR FREDERICK HANSON
DOMENICK JOSEPH POMPEO
*JOHANNES ARCHIBALD VAN DEN AKKER

Physics

*RALPH VILLAMIL BLACKMAN
*GEORGE WIRT CLAPP
*ALFRED LEON FOSTER
*GEORGE ROBERT JAFFRAY

Physics and Chemistry

ROBERT BARCLAY BOWMAN

Engineering and Economics

C. LE ROY ASHLEY
ORRIN HAYWARD BARNES
THEODORE CLEAVELAND COLEMAN
WALTER LE ROY DIXON, JR.
*CHARLES FUNSTON HUMPHREY
DOUGLAS WILLIAM KEECH
JOHN EDWARD KINSEY
*DONALD PETER MACFARLANE
LESLIE WILLS MARGISON
*JOSEPH MATSON, JR.
WARD WILSON MCKENZIE

General Course

BURT BEVERLY, JR.
ROGER B. S. BRYAN
IVAN LONSDALE FARMAN
ARCH HIGMAN
ERNST MAAG

*With honor.

Honors, 1926

DUPONT FELLOWSHIP IN CHEMISTRY: JAMES MAURICE CARTER

JUNIOR TRAVEL PRIZES: CARL DAVID ANDERSON, FRED JUNIOR EWING

BLACKER JUNIOR SCHOLARS: ROBERT ISHAM COULTER, ROBLEY DUNGLISON EVANS, GEORGE THOMAS HARNESS, CHARLES COYLE LASH, ALBERT EATON LOMBARD, JR., EDWIN MATTISON MCMILLAN, JOE WILLIAM SCHWEINFEST, KENNETH ALFRED SOLOMON

BLACKER SOPHOMORE SCHOLARS: HENRY HOWARD CARY, PHILIP CRAVITZ, EMORY LEON ELLIS, THOMAS HAYHURST EVANS, ALBERT EDWARD MYERS, BOLIVAR ROBERTS

FRESHMAN SCHOLARS:

JOE FOLADARE, Manual Arts High School, Los Angeles
JOHN W. GAYLORD, Pasadena High School
DONALD CAMERON GRANT, Lomita High School
*LOWELL FORREST GREEN, Santa Barbara High School
DAVID WALTER SCHARF, Los Angeles High School
DAVID SHEFFET, Venice High School
GEORGE ORVAL SHULL, Jefferson High School, Los Angeles
THEODORE F. STIPP, Glendale High School
NATHAN DAVIS WHITMAN, South Pasadena High School

CONGER PEACE PRIZE: WARD DON FOSTER

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*Alumni Scholarship.

Roster of Students

GRADUATE STUDENTS

Name	Major Subject	Home Address
BALL, ALPHEUS MESSERLY B.S., California Institute, 1926	Chem.	Santa Monica
BANTA, A. PERRY A.B., Stanford University, 1926	C.Eng.	Poplar, Montana
BAXTER, WARREN PHELPS B.S., California Institute, 1924; M.S., 1926	Chem.	Pasadena
BECKMAN, ARNOLD ORVILLE B.S., University of Illinois, 1922; M.S., 1923	Chem.	Bloomington, Illinois
BENIOFF, VICTOR HUGO B.A., Pomona College, 1921	Phys.	Pasadena
BILICKE, ALBERT CONSTANT B.A., Williams College, 1924	Chem.	Los Angeles
BOHN, J. LLOYD B.S., Pennsylvania State College, 1924; M.A., Harvard University, 1926	Phys.	Lickdale, Pennsylvania
BRADWAY, WILLISTON LOGGIE B.A., Wesleyan University, 1926	Phys.	Monson, Massachusetts
BRENNER, MORRIS EMBEY B.S., Massachusetts Institute of Technology, 1925	Phys.	Hoboken, New Jersey
BRUCE, WILLARD CHARLES B.A., University of Minnesota, 1926	Phys.	Minneapolis, Minnesota
CAMPBELL, JOHN STUART B.S., California Institute, 1926	Phys.	Pasadena
CARTER, JAMES MAURICE B.S., California Institute, 1926	Chem.	Hollywood
CARTWRIGHT, CHARLES HAWLEY B.S., California Institute, 1926	Phys.	San Gabriel
CLEMENTS, THOMAS B.S. in Mining Eng., University of Texas, 1922	Geol.	Hollywood
DAILY, CHARLES ROBERT A.B., Colorado College, 1925	Phys.	Colorado Springs, Colo.

GRADUATE STUDENTS—Continued

Name	Major Subject	Home Address
DALTON, ROBERT HENNAH B.S., California Institute, 1925; M.S., 1926	Chem.	Pasadena
DAY, RALPH KOHLRAUSCH Ph.B., Yale University, 1925	Chem.	Washington, D. C.
DELSASSO, LEO PETER A.B., University of California, Southern Branch, 1925	Phys.	Los Angeles
DIAMOS, GEORGE K. SURRAPAS B.S., University of Arizona, 1926	El.Eng.	Tucson, Arizona
DILLON, ROBERT TROUTMAN B.S., California Institute, 1925	Chem.	Oroville
ELDER, JOHN DYER B.S., University of Chicago, 1925	Math.	Los Angeles
ENGEL, RENE L. H. B.S. in Ch. Eng., University of Paris, 1909; M.S. in Mineralogy and Applied Geology, 1912	Geol.	Pasadena
EVJEN, HAAKON MUUS E.E., Cornell University, 1926	Phys.	Oslo, Norway
FANG, KUANG CHI B.S., University of Chicago, 1922	Phys.	Yangchow, Kiangsu, China
FOSTER, ALFRED LEON B.S., California Institute, 1926	Math.Phys.	Los Angeles
GAVRILOVICH, VITTALY JOSEPH B.S., University of California, 1924	Geol.	New York, N. Y.
HAMBURGER, FREY B.S., California Institute, 1926	El.Eng.	Pasadena
HAMILTON, JAMES HUGH B.S., California Institute, 1925	El.Eng.	Los Angeles
HAYWARD, CLAUDE DEWAYNE B.S., California Institute, 1926	El.Eng.	Santa Ana
HICKS, HERVEY CRANDALL Ph.B., University of Chicago, 1921; M.S., 1922	Math.Phys.	Pasadena
HINCKE, WILLIAM BERRARD B.S., University of Illinois, 1923	Chem.	Pinckneyville, Illinois

GRADUATE STUDENTS—Continued

Name	Major Subject	Home Address
HODGES, ALBERT CLARENCE	Phys.	Covina
B.A., University of Texas, 1921; M.A., 1924		
HOLROYD, HOWARD BYINGTON	Phys.	Pasadena
B.S. in M. Eng., Iowa State College, 1924		
HOWELL, LYNN GORMAN	Math.Phys.	Winnsboro, Texas
B.A., University of Texas, 1925; M.A., 1926		
ILLINGWORTH, KENNETH KNIGHT	Phys.	Colorado Springs, Colo.
A.B., Colorado College, 1924; M.A., Dartmouth College, 1926		
INGERSOLL, HERBERT VICTOR	El.Eng.	Pasadena
B.S., California Institute, 1926		
INGRAM, SYDNEY BETTINSON	Phys.	Lethbridge, Alberta, Can.
B.A., University of British Columbia, 1925		
JAFFRAY, GEORGE ROBERT	Phys.	Los Angeles
B.S., California Institute, 1926		
JOHNSTON, NORRIS	Phys.	Minneapolis, Minnesota
B.S., Electrochemical Eng., Massachusetts Institute of Technology, 1924; M.S., 1926		
KIRKPATRICK, HARRY ALLISTER	Phys.	Eagle Rock
B.S., Occidental College, 1914		
KIRSCHMAN, H. DARWIN	Chem.	Los Angeles
B.S. in Chem. Eng., California Institute, 1918; M.S., 1919		
KNAPP, ROBERT TALBOT	M.Eng.	Pasadena
B.S., Massachusetts Institute of Technology, 1920		
LAURITSEN, CHARLES CHRISTIAN	Phys.	Pasadena
Odense Tekniske Skole, 1911		
LEWIS, WILLIAM ABBOTT, JR.	El.Eng.	Pasadena
B.S., California Institute, 1926		
LINDVALL, FREDERICK CHARLES	El.Eng.	Los Angeles
B.S., University of Illinois, 1924		
LOUGHRIDGE, DONALD HOLT	Phys.	Pasadena
B.S., California Institute, 1923		
MACDONALD, PATRICK ANDERSON	Phys.	Winnipeg, Canada
B.S., University of Manitoba, 1924		
MACMILLAN, ROY ALEXANDER	Geol.	Pasadena
B.S., Michigan State College, 1925		

GRADUATE STUDENTS—Continued

Name	Major Subject	Home Address
MENDENHALL, HALLAM EVANS B.S., Whitman College, 1921	Phys.	Deer Park, Washington
MESERVE, CLEMENT D. B.A., Yale University, 1920; M.A., University of California, 1924	Geol.	Los Angeles
MILLIKAN, CLARK BLANCHARD A.B., Yale University, 1924	Phys.	Pasadena
MITCHELL, ALLAN CHARLES GRAY B.S., University of Virginia, 1923; M.S., 1924	Chem.	University, Virginia
NORDBERG, MARTIN EMERY B.S., Iowa State College, 1924; M.S. in Phys. Chem., 1925	Chem.	Boone, Iowa
PALMER, GLENN HUNTER 2nd Lieut., U. S. Military Academy Signal Corps; M.S., Yale University, 1924	Phys.	Washington, D. C.
PATTERSON, JOHN WILFRED B.S. in Metallurgical Eng., Colorado School of Mines, 1925; M.A., University of Wyoming, 1926	Geol.	Los Angeles
PEARSON, JOHN MAGNUS B.S., University of Chicago, 1925	Phys.	Portland, Oregon
PODOLSKY, BORIS B.S. in El. Eng., University of Southern California, 1918; M.A. in Math., 1926	Phys.	Los Angeles
POMEROY, RICHARD DURANT B.S., California Institute, 1926	Chem.	Pasadena
POOLE, FRED LLOYD B.S., California Institute, 1917; M.S., Union College, 1919	Phys.	Owensmouth
RENZ, CARL FRED B.S., Iowa State College, 1924	C.Eng.	Wenona, Illinois
RICHARDSON, BURT Ph.B., Yale University, 1919	Phys.	Glendale
RICHARDSON, PAUL E. A.B., Occidental College, 1926	Phys.	Glendale
RICHTER, CHARLES FRANCIS A.B., Stanford University, 1920	Phys.	Los Angeles
RITZMANN, OTTO FREDERICK B.S., Pennsylvania State College, 1922	Phys.	Philadelphia, Pa.
ROLLER, DUANE EMENSON B.A., University of Oklahoma, 1923; M.S., 1925	Phys.	Pasadena

GRADUATE STUDENTS—Continued

Name	Major Subject	Home Address
SCHOTT, HERMANN FRANZ B.S., California Institute, 1926	Chem.	Pasadena
SCUDDER, NATHAN FROST B.S., California Institute, 1926	Chem.	Los Angeles
SHAPPELL, MAPLE DELOS B.S., University of Arizona, 1921	Geol.	Los Angeles
SMITH, WILLIAM OGDEN B.S., University of Pittsburgh, 1921	Phys.	Wheeling, West Virginia
STEINOUR, HAROLD HEIGES B.S. in Ch. Eng., University of Southern California, 1923; M.S., California Institute, 1926	Chem.	Los Angeles
STIRWALT, ERNEST B.A., University of Michigan, 1911	C.Eng.	Glendale
SUTTON, RICHARD MANLIFFE B.S., Haverford College, 1922	Phys.	Pasadena
SWEDLUND, LLOYD EDWARD B.S., University of Colorado, 1926	El.Eng.	Sterling, Colorado
TAYLOR, DANIEL DWIGHT A.B., Colorado College, 1924	Phys.	Colorado Springs, Colo.
THOMASSEN, LARS B.S., Norway Institute of Technology, 1919	Phys.	Oslo, Norway
URE, WILLIAM B.A.Sci., University of British Columbia, 1923; M.A.Sci., 1924	Chem.	West Vancouver, B. C.
UYTERHOEVEN, WILLY C.E., University of Brussels, 1925	Phys.	Eindhoven, Holland
VAN DEN AKKER, JOHANNES ARCHIBALD B.S., California Institute, 1926	Phys.	Los Angeles
WARD, MORGAN A.B., University of California, 1924	Math.	Pasadena
WHITE, DANIEL BECKETT A.B., Occidental College, 1926	Phys.	Fort Sam Houston, Tex.
WOODS, HUBERT KEATING B.S. in Chem. Eng., California Institute, 1923	Geol.	Glendale
YENSEN, TRYGVE D. B.S., University of Illinois, 1907; M.S., 1911; E.E., 1912	Phys.	Pasadena

Undergraduate Students

Abbreviations: Eng., Engineering; Sci., Science; E.E., Electrical Engineering; M.E., Mechanical Engineering; C.E., Civil Engineering; Ch., Chemistry; Ch.E., Chemical Engineering; Ph., Physics; Ph.E., Physics and Engineering; Eng.Ec., Engineering and Economics; Ge., Geology; Ma., Mathematics; G., General Courses.

SENIOR CLASS

Name	Course	Home Address
Akers, John Fred	Ch.E.	La Habra
*Anderson, Carl David	Ph.E.	Los Angeles
Anderson, Henry Pierce	C.E.	Los Angeles
*Aultman, William Whitescarver	Eng.Ec.	Hollywood
*Bailly, Florent Houlding	C.E.	Caracas, Venezuela
Baldwin, Marshall Albert	Eng.Ec.	Pasadena
Baxter, Ellery Read	G.	Pasadena
Belknap, Kenneth Albert	Eng.Ec.	Los Angeles
Blankenburg, Rudolph Carter	E.E.	San Diego
*Bower, M. Maxwell	E.E.	Los Angeles
Boyd, James	Eng.Ec.	Hollywood
Bradley, Charles Alexander, Jr.	CH.E.	Long Beach
*Browder, Edward Marion, Jr.	C.E.	Hollywood
*Capon, Alan Edmonds	E.E.	Los Angeles
*Case, John Gideon	C.E.	Pasadena
Coffee, Garfield Clinton	M.E.	Pasadena
Collins, George Francis	M.E.	Anaheim
Combs, Theodore Carlos	C.E.	Ontario
Copeland, Ray Edwin	Eng.Ec.	Los Angeles
Cox, Raymond Edward	Ch.E.	South Pasadena
*Creveling, Robert	E.E.	Pasadena
Crowther, Dexter Paul	C.E.	Pasadena
Darling, Mortimer Dick, Jr.	C.E.	Hollywood
Datin, Richard Clyde	Ch.	Hollywood
Dix, Charles Hewitt	Ph.	Pasadena
Dodge, Richard Mason	E.E.	Bakersfield
*Ewing, Fred Junior	Ch.	Pasadena

*Students whose names are starred earned honor standing during the preceding year.

SENIOR CLASS—Continued

Name	Course	Home Address
*Farrar, Harry King	Ph.	Tustin
*Forster, John Blinn	E.E.	Pasadena
*Foster, Ward Don	Eng.Ec.	Los Angeles
Gardner, David Z., Jr.	E.E.	South Pasadena
*Gazin, Charles Lewis	Ge.	Los Angeles
Gilmore, Albert Munro	Ge.	El Monte
*Gottier, Thomas Larimer	E.E.	Los Angeles
*Gubser, Regis Samuel	E.E.	Los Angeles
Hale, Frank Sherman	C.E.	Moneta
Hall, Ray Irvin	C.E.	Los Angeles
*Haserot, Clarence Lewis	Ge.	Los Angeles
*Heilbron, Robert Frederick	Ph.E.	San Diego
Hinkston, Donald Robert	E.E.	Pasadena
*Hoover, Vaino Alexander	E.E.	Hollywood
Jones, Edward Palmer, Jr.	C.E.	Alhambra
Kaye, George Robert	Ch.E.	Los Angeles
Kibort, Leon	Eng.Ec.	Pasadena
King, Archie Paul	Ph.E.	Pasadena
Krelle, William Hay	C.E.	Hollywood
*Larson, Hilmer Edwin	E.E.	Pasadena
Lilly, Forrest James	Eng.Ec.	Los Angeles
*Logan, Mason Arnold	Ph.E.	Pasadena
Loxley, Benjamin Rhees	E.E.	Pasadena
*Marsland, John Ely	Ch.	Venice
Maxson, John Haviland	Ge.	Pasadena
Medlin, Lewis Everett	Eng.Ec.	Los Angeles
Mesenkop, Louis Henry	E.E.	Hollywood
Meserve, Frank Pierce, Jr.	C.E.	Redlands
Minkler, William Annin	E.E.	Pasadena
*Montgomery, Carol Gray	Ph.	Pasadena
*Moore, Bernard Nettleton	Ge.	Los Angeles
Moore, George Edward	Ph.	Los Angeles
Moore, Robert Merrell	Ph.	Pasadena
*Nickell, Frank Andrew	Ge.	Los Angeles
*Nordquist, Carroll Oscar	C.E.	Los Angeles
*Petersen, Frank Fred	M.E.	San Diego
Peterson, Hilmer Fred	C.E.	San Bernardino

SENIOR CLASS—Continued

Name	Course	Home Address
*Peterson, Thurman Stewart	G.	Los Angeles
*Philleo, Rolland Alson	C.E.	Covina
*Ralston, Lee Walter	M.E.	Redlands
Randolph, Engle Fitz	E.E.	Pasadena
Reynolds, Roland William	Ch.E.	Stirling City
Riggs, Eugene Howard	Eng.Ec.	Pasadena
*Rodgers, Vincent Wayne	C.E.	Los Angeles
Ross, Leonard Wikoff	C.E.	San Diego
Ross, Robert Trowbridge	Ph.	Pasadena
Schell, Frederick Taylor	G.	Pasadena
Schultz, Murray Navarre	Ch.E.	Los Angeles
Shuster, John Davis	E.E.	Pasadena
Snyder, Leonard Leroy	M.E.	Pasadena
Southwick, Thomas Scott	Ge.	Los Angeles
*Stanton, William Layton	Ge.	Sierra Madre
*Starke, Howard Richard	M.E.	South Pasadena
St. Clair, Raymond Earl	G.	South Pasadena
*Swartz, Charles Albert	Ph.	Pasadena
*Thearle, Frederick George	M.E.	Pasadena
Thompson, Donald Raw	Ch.E.	South Pasadena
Thompson, Russell Edgar	E.E.	Los Angeles
Turner, Francis Earl	Ge.	Anaheim
*Vaile, Robert Brainard, Jr.	E.E.	Alhambra
Wallace, C. Jackley	E.E.	San Gabriel
*Watson, Ralph Mayhew	M.E.	Pasadena
Weisel, John Levi	M.E.	Los Angeles
*Wells, Carlos Kenyon	M.E.	Pasadena
Wiegand, Frank Hale	E.E.	Pasadena
Zbradovsky, Boris Vassilievich	E.E.	Harbin, Manchuria, China

JUNIOR CLASS

Name	Course	Home Address
Arnold, William Archibald	Sci.	Van Nuys
Aussieker, Richard Carl	Sci.	Cedar Rapids, Iowa
Austin, Henry Carter	Eng.	Azusa
Baustian, Wilbert Wiese	Eng.	Pasadena
Bell, Frank Wagner	Sci.	Santa Ana
*Berman, Jack	Sci.	Los Angeles

JUNIOR CLASS—Continued

Name	Course	Home Address
Berry, William Littel	Eng.	Huntington Beach
Bosserman, Charles Ashton	Eng.	Glendale
*Brighton, Thomas Herbert	Eng.	Alhambra
*Buchanan, Robert Dugan	Eng.	Glendale
*Burke, Maxwell Follensbee	Sci.	Los Angeles
Byrkit, Wakefield Blackburn	Eng.	Los Angeles
Campbell, Clifford Daniel	Eng.	Claremont
Campbell, Horace Allen	Eng.	Riverside
Chilberg, Guy Lewis	Eng.	Azusa
Clark, Alexander	Sci.	Whittier
Compton, Thomas Henry	Sci.	Los Angeles
*Coulter, Robert Isham	Sci.	South Pasadena
Crane, George Richard	Eng.	Pasadena
Crosher, Kenneth Ross	Sci.	Pasadena
Cuellar, Eutimio Albert	Eng.	Saltillo, Coah., Mexico
*Cutler, Ralph Waldo	Eng.	Douglas, Arizona
Durfee, Philip Thaddeus	Eng.	San Marino
*Duval, Richard Henri	Eng.	Claremont
*Eastman, Luther Judd	Eng.	Glendale
*Evans, Robley Dunglison	Sci.	Pasadena
Fenwick, Kenneth Macdonald	Eng.	Los Angeles
*Ficklen, Joseph Burwell	Sci.	Fredericksburg, Virginia
*Folsom, Richard Gilman	Eng.	Los Angeles
Ford, Frank Hubert	Eng.	Porterville
Forney, Morgan Thomas	Sci.	Los Angeles
George, Wallace Sanborn	Eng.	Highlands
Gewertz, Moe William	Eng.	Los Angeles
Gilmore, Edward Raymond	Eng.	Pasadena
*Goodall, William McHenry	Sci.	Beverly Hills
Graham, Thomas Clifford	Sci.	Whittier
*Gramatky, Ferdinand Gunner	Eng.	Wilmar
*Harness, George Thomas	Sci.	Glendale
Hisserich, Charles Albert	Eng.	Pasadena
Hookway, Lozell Charles	Sci.	Pasadena
Hossack, Hugh Alger	Eng.	Ventura
Houda, Milton	Eng.	Hollywood
Hughes, Herbert Alan	Eng.	South Pasadena

JUNIOR CLASS—Continued

Name	Course	Home Address
Huston, Harold Milton	Eng.	Huntington Park
Jacobs, William Morton	Eng.	Los Angeles
*Jacobson, Ray Kenneth	Eng.	Hollywood
Johnson, Josef Jerome	Sci.	South Pasadena
*Joujon-Roche, Jean Edward	Sci.	Alhambra
Kaneko, George Shinichiro	Eng.	Riverside
*Kingman, Douglas George	Eng.	Alhambra
Kuhn, Jackson G.	Eng.	Santa Ana
*Lash, Charles Coyle	Sci.	Los Angeles
Lewis, Charles Finley	Eng.	Alhambra
*Lombard, Albert Eaton, Jr.	Sci.	Pasadena
*Love, Russell James	Eng.	Los Angeles
McComb, Harry Thurlow	Eng.	Pasadena
*McFaddin, Don Everette	Eng.	San Dimas
*McMillan, Edwin Mattison	Sci.	Pasadena
Miller, Elbert Edward	Eng.	Santa Monica
Minkler, Cyrus Gordon	Eng.	Pasadena
*Nash, Henry Edward	Sci.	Los Angeles
Nestle, Alfred Clifford	Sci.	Long Beach
*Nichols, Donald Sprague	Eng.	Los Angeles
Noel, Francis N.	Eng.	Los Angeles
Olsen, William Lewis	Eng.	Sierra Madre
*Pierce, Firth	Sci.	Pomona
*Preble, Bennett	Sci.	Pasadena
*Pugh, Evan Ellis	Eng.	Pasadena
Righter, Walter Hammond	Eng.	Orange
Robinson, Kenneth Hall	Eng.	Pasadena
Robinson, True William	Sci.	Pasadena
Ross, Ellwood Hart	Eng.	Los Angeles
Schmid, George Christian	Eng.	Pasadena
Schroter, George Austin	Sci.	Los Angeles
*Schweinfest, Joe William	Sci.	Anaheim
Scullin, James Conrad	Eng.	Alhambra
*Sechler, Ernest Edwin	Eng.	Pasadena
*Senatoroff, Nicolai Kiprianoff	Sci.	Kazan, Russia
*Shaffer, Carmun Cuthbert	Eng.	Pasadena
Shepley, Halsey	Sci.	Escondido

JUNIOR CLASS—Continued

Name	Course	Home Address
Skafte, John Egon	Eng.	Denmark
*Smith, Hampton	Sci.	Monrovia
*Solomon, Kenneth Alfred	Sci.	Eagle Rock
Sperling, Milton Heyer	Sci.	South Pasadena
Steward, Willard Palmer	Sci.	Santa Ana
Suzuki, Tomizo	Eng.	Fukushima Ken, Japan
Tarr, Donald Tolman	Eng.	Pasadena
Taylor, Huston Warfield	Eng.	Pasadena
*Templin, Edwin Wilson	Eng.	Los Angeles
*Thacker, Ralph Scott	Eng.	Riverside
Thatcher, John William	Eng.	Whittier
*Tuttle, Edward Eugene	Sci.	Los Angeles
*von Beroldingen, Linton Paul E.	Sci.	Pasadena
Wagner, Paul Berthold	Eng.	Los Angeles
Walker, William Henry	Eng.	Woburn, Mass.
Weber, Ralph Clarence	Eng.	San Bernardino
Wingfield, Baker	Sci.	Pasadena

SOPHOMORE CLASS

Name	Course	Home Address
Allen, Wayne Carl	Eng.	Los Angeles
Allison, Donald Kreeck	Sci.	Los Angeles
*Asquith, Harlan Robert	Eng.	Los Angeles
Atwater, Eugene	Eng.	Los Angeles
Baker, Bill	Eng.	Piru
Baker, Howard Eugene	Eng.	Los Angeles
*Barre, Benjamin Alfred	Eng.	Los Angeles
Berman, Isadore	Sci.	Los Angeles
Bewley, Frederick Winslow	Eng.	Long Beach
Birge, Knowlton Root	Eng.	Pasadena
Bode, Francis Dashwood	Sci.	Anaheim
Booth, William Walter	Eng.	Zelzah
Briegleb, Harold Evans	Eng.	Los Angeles
*Cary, Henry Howard	Sci.	Los Angeles
Clark, Donald Sherman	Eng.	Alhambra
*Cline, Frederick	Eng.	Covina

SOPHOMORE CLASS—Continued

Name	Course	Home Address
Corbin, Harold Alton	Sci.	Sawtelle
Cramer, Alphonse	Eng.	Los Angeles
*Cravitz, Philip	Sci.	Los Angeles
Cruzan, Walter	Eng.	San Francisco
Daly, John Warlaumont	Sci.	Buena Park
de Camp, Lyon Sprague	Eng.	Hollywood
Dickerman, Charles Edwin	Eng.	Pasadena
Dodge, Howard Grindal	Eng.	Pasadena
Donner, Ludwig	Eng.	Pasadena
*Downs, Roscoe Phillips	Eng.	Lankershim
*Dunham, James Waring	Eng.	Pasadena
Dunn, Allen Winfield	Eng.	Lankershim
Edson, Thomas Farrer	Eng.	Pasadena
*Ellis, Emory Leon	Sci.	San Diego
*Evans, Thomas Hayhurst	Eng.	Los Angeles
Everett, Monroe Miller	Eng.	Moorpark
*Exley, Sidney Thomas, Jr.	Eng.	Pasadena
*Findlay, Willard Alexander	Sci.	Anaheim
*Fracker, Henry Edward	Eng.	Pasadena
Fredendall, Beverly Frank	Eng.	Ontario
*Ganssle, Karl Albert	Sci.	Cavalier, North Dakota
Gilbert, John Gustav	Eng.	Long Beach
Goodwin, John Stewart	Eng.	Plainview, Texas
Grant, Edmund Glen	Sci.	Long Beach
Grimes, Walter Bert	Eng.	Pasadena
*Grunder, Lawrence Jacob	Eng.	Los Angeles
Harris, Bertram Samuel	Eng.	Los Angeles
*Hasler, Maurice Fred	Sci.	West Hollywood
*Hatch, William Bell, Jr.	Eng.	Ypsilanti, Michigan
Hiyama, Thomas	Eng.	Hollywood
Hoch, Winton Christoph	Sci.	Pacific Palisades
Holdaway, Vivian Lyman	Eng.	Elgin, Nevada
Hull, Robert Holcomb	Eng.	Alhambra
*Imus, Henry Oscar	Sci.	Los Angeles
Johnson, Donald Hall	Sci.	Pasadena
Jones, Harlen E. R.	Eng.	Fresno
Keeley, James Henry	Eng.	El Monte

SOPHOMORE CLASS—Continued

Name	Course	Home Address
Keeling, Harry James	Eng.	Los Angeles
Kemp, Walter Kenneth	Eng.	Pasadena
*Kingman, Kenneth Edward	Sci.	Alhambra
*Kircher, Reymond John	Eng.	El Paso, Texas
Kuert, William Ford	Sci.	Los Angeles
Langsner, George	Eng.	Ontario
Larrecq, Anthony James	Eng.	Los Angeles
*Lau, Kam Hu	Sci.	Honolulu, T. H.
Lee, Edson Churchill	Eng.	Petoskey, Michigan
Lindhurst, Roland William	Eng.	Los Angeles
Lockhart, Ross Monroe	Eng.	Pasadena
*Lohman, Stanley William	Sci.	Los Angeles
Lohman, Kenneth Elmo	Sci.	Los Angeles
Lufkin, George Schild	Eng.	Los Angeles
Lynn, Laurence Edwin	Eng.	Glendale
Macdonald, Edwin	Eng.	Phoenix, Arizona
Mason, Harry Shattuck	Eng.	Los Angeles
McMillan, Wallace Angus	Sci.	Alhambra
McWilliams, Homer Gore	Sci.	Los Angeles
Milliken, Donald Booth	Eng.	Pasadena
Mitchell, Gordon Sylvester	Eng.	Hollywood
Mohr, William Henry	Eng.	Santa Monica
Muff, Elmer Mason	Eng.	Glendale
*Myers, Albert Edward	Sci.	Cucamonga
*Nagashi, Masahiro Howard	Eng.	Beryl, Utah
Newcomb, Daniel Albert	Sci.	Corona
O'Haver, Hubert Maurice	Eng.	Los Angeles
Olman, Samuel	Eng.	Los Angeles
*Olson, Donald Kieth	Sci.	Alhambra
Ovington, James Roland	Eng.	Pomona
Owen, Winthrope Harold	Sci.	Covina
*Perry, Douglass Brill	Sci.	Hollywood
Peterman, Harry Arnold	Eng.	Ocean Park
*Raitt, Russell Watson	Sci.	South Pasadena
Rapp, John Clay	Eng.	Wasco
Reed, Albert Clark	Eng.	Los Angeles
Reed, Homer Charles	Eng.	Glendale

SOPHOMORE CLASS—Continued

Name	Course	Home Address
Reilly, James Thomas	Sci.	Pasadena
Reinen, Otto Frank, Jr.	Sci.	Long Beach
*Roberts, Bolivar	Eng.	Pasadena
Rofelty, Richard Goebel	Eng.	Pasadena
Ross, Richard Goodhue	Eng.	Arcadia
Scott, Leslie Owen	Eng.	Pasadena
Shields, Clyde Emerson	Eng.	San Diego
*Shields, John Charles	Eng.	Altadena
Shields, Morton Kingman	Eng.	San Diego
*Sinram, Maurice Harold	Eng.	Hollywood
Slick, Wilfred Larson	Eng.	Portersville
Snyder, Robert Earl	Sci.	Pasadena
Springsholz, Charles Adolph	Eng.	Santa Barbara
Steele, Donald Eugene	Sci.	Los Angeles
Stickney, Clinton Murray	Eng.	Los Angeles
Stillwell, John Edward	Sci.	South Pasadena
Sturgess, John Bainbridge	Sci.	Glendale
Sutherland, John Clark	Eng.	Pasadena
Taylor, George Frederic	Sci.	Los Angeles
Terry, Paul M.	Eng.	San Pedro
Towne, Alfred Edward	Eng.	Van Nuys
Tutschulte, Alvin Carl	Eng.	Los Angeles
Ulmar, Boris	Eng.	Los Angeles
*Vose, Edward Rich	Eng.	East Eddington, Maine
Waite, Howard Winfred	Eng.	Los Angeles
Walton, Arthur Frank	Eng.	Long Beach
Watson, George Gilbert	Eng.	Torrance
Weismann, George Francis	Eng.	Alhambra
West, Lloyd Eldo	Eng.	Riverside
*Wheeler, Fred Aston	Eng.	Los Angeles
*White, Robert James	Sci.	Hollywood
Whittington, Richard Byrne	Sci.	Long Beach
Wiley, Charles Alfred	Eng.	Los Angeles
Wilson, Fred Russell	Eng.	Pasadena
*Wineland, Jeff Andrew	Eng.	Durham
Zahn, Oswald Francis, Jr.	Eng.	Coronado

FRESHMAN CLASS

Name	Course	Home Address
Alderman, Frank Edward	Sci.	Santa Ana
Allen, Horace Donovan	Sci.	San Fernando
Arndt, William Frederick	Sci.	Hollywood
Ayers, Wilbur Walter	Eng.	Highgrove
Bernhardi, Tom George	Eng.	Los Angeles
Booth, Eugene Charles	Eng.	Anaheim
Boyle, James Robert Lester	Eng.	Santa Ana
Bungay, Robert Henry	Eng.	Glendale
Bussey, George Leland	Eng.	Los Angeles
Carberry, Deane Edwin	Eng.	Pasadena
Clark, Willis Henry, Jr.	Sci.	Los Angeles
Cohen, William Maurice	Eng.	Los Angeles
Cordes, Nelson Myers	Eng.	Los Angeles
Crane, Horace Richard	Sci.	Turlock
Crawford, Franklin Goodrich	Eng.	Pasadena
Crawford, John Henry	Eng.	Los Angeles
Cromley, Raymond Avolon	Eng.	Long Beach
Deardorff, Herbert Hadley	Eng.	Pasadena
Dickinson, John Lovewell	Eng.	Pasadena
Dmytryk, Edward	Sci.	Hollywood
Doherty, Norman Frederick	Sci.	Los Angeles
Douglass, Paul William	Eng.	Pasadena
Eaton, Myron Lansing	Eng.	Sawtelle
Effmann, Karl Herman	Eng.	Los Angeles
Elliott, Orrin Mathews	Sci.	San Diego
Ely, Paul Marcellus	Eng.	Fortuna
Fink, Kenneth Charles	Sci.	Kingsburg
Foladare, Joe	Sci.	Los Angeles
Folckemer, William Honnold	Eng.	Camp Point, Illinois
Friess, Edward William	Eng.	Rosemead
Frye, Calvin Barton	Eng.	San Diego
Gates, Clinton Eugene	Eng.	Pasadena
Gaylord, John Wallace	Sci.	Pasadena
Gordon, Joseph Morris	Eng.	Los Angeles
Grant, Donald Cameron	Eng.	Lomita
Green, Frederick Hammond	Eng.	Sierra Madre
Green, Lowell Forrest	Sci.	Santa Ana

FRESHMAN CLASS—Continued

Name	Course	Home Address
Hacker, William Dillon	Sci.	Pasadena
Hamilton, John Douglas	Sci.	Sawtelle
Hawes, Roland C.	Eng.	Riverside
Hemming, Robert Le Grande	Sci.	Coronado
Herd, Charles Melvin	Eng.	Valyermo
Hesse, John Fred	Eng.	Las Vegas, Nevada
Hillman, Ernest Christian	Eng.	Los Angeles
Hoeppel, Raymond Winfield	Sci.	Arcadia
Hollister, Ezra Robinson	Eng.	Orange
Holmes, Howard Oyen	Eng.	Arcadia
Hopper, Rea Earl	Eng.	Riverside
Hopson, Howard Elverton	Eng.	Hemet
Horton, Warren Birch	Eng.	Pasadena
Howse, Samuel Eric	Eng.	Sherman
Hubbard, Walton, Jr.	Eng.	Los Angeles
Humphreys, Wendell Lewis	Eng.	Oxnard
Infield, Jack Floyd	Sci.	Los Angeles
Janssen, Otto Philip	Sci.	Pomona
Kleinbach, Hugo Otto	Eng.	Los Angeles
Koehm, Edward	Eng.	Los Angeles
Kubow, Henry Hidemaro	Eng.	Long Beach
Kuhn, Truman Howard	Sci.	Glendora
Lea, William Francis	Eng.	Los Angeles
Leonard, Edward Watson	Sci.	Monrovia
Leppert, Melvin Lawrence	Eng.	Monrovia
Levine, Ernest	Eng.	Los Angeles
Liedholm, George Edward	Eng.	Long Beach
Long, Spencer William	Eng.	Redondo Beach
Lord, Roy Stanley	Eng.	Pasadena
MacDonald, James Harrington	Sci.	Glendora
Maitland, William Blackstock	Sci.	Glendale
Meyer, Glenn Harold	Eng.	South Pasadena
Miles, Kenneth Leonard	Eng.	Santa Barbara
Morton, William	Eng.	Portland, Oregon
Moss, Harland Ray	Eng.	Hollywood
Moyers, Frank Neff	Eng.	Venice
Murray, John Stalker	Sci.	Pasadena

FRESHMAN CLASS—Continued

Name	Course	Home Address
Musset, Roger Marx	Eng.	Glendale
Nelson, Warren Campbell	Sci.	Los Angeles
Nomann, Arthur Behrend	Eng.	Whittier
Norden, Eugene Gustave	Eng.	Hollywood
Oaks, Robert Martin	Eng.	Hollywood
Orelli, Christopher Camillo	Eng.	Placerville
Parker, William	Eng.	Los Angeles
Pearson, Vern Allen	Sci.	Kingsburg
Ramey, Robert Clark	Eng.	Hollywood
Read, George Wilber	Eng.	Glendale
Reynolds, George Lawrence	Eng.	Glendale
Riggs, William Christopher	Eng.	Pasadena
Ross, George Arthur	Eng.	Fillmore
Ruff, Theodore Frederick	Sci.	Los Angeles
Russell, Lloyd Wallace	Eng.	Pasadena
Sass, Otto	Sci.	Los Angeles
Sawyer, Herbert Goodman	Sci.	Napa
Scharf, David Walter	Sci.	Los Angeles
Schuck, Anthony Goodrum	Sci.	South Pasadena
Scott, Frederick Schell	Sci.	Pasadena
Scott, Paul Lyman	Sci.	Glendale
Sheffet, David	Eng.	Venice
Sherer, Hiram Fred	Sci.	Glendora
Shull, George Orval	Sci.	Los Angeles
Silverman, Michael Morris	Eng.	Hollywood
Smith, Richard Hale	Sci.	Pasadena
Sogawa, Kazuo	Eng.	Los Angeles
Stein, Myer Edna	Eng.	Los Angeles
Stevenson, Clinton Howard	Eng.	Los Angeles
Stipp, Theodore Frank	Sci.	Glendale
Strong, Austin Webber	Eng.	San Diego
Stroud, Robert Addiss	Eng.	Los Angeles
Swift, Frederick Thayer	Sci.	Altadena
Thayer, Merlin	Eng.	Huntington Park
Todorovitch, Victor Douchan	Eng.	Tokyo, Japan
Towler, John William	Eng.	Atascadero
Triggs, Matthew Lovell	Eng.	Atascadero

FRESHMAN CLASS—Continued

Name	Course	Home Address
Tucker, Merrill Douglas	Sci.	Alhambra
Uecke, Edward Harry	Eng.	Los Angeles
Van Beveren, Oscar Franz	Eng.	Hollywood
Vance, Gordon Burnell	Eng.	Hemet
Vanderburg, Smith Phillip	Eng.	Long Beach
Walker, James Nathan	Eng.	Arcadia
Wern, Andrew William	Eng.	Los Angeles
West, Samuel Stewart	Sci.	Lankershim
Wheeler, Richard George	Eng.	Richgrove
White, Fletcher Harmon	Eng.	Sierra Madre
Whitman, Nathan Davis, Jr.	Eng.	South Pasadena
Widess, Rubin	Sci.	Pasadena
Wilkinson, Walter Dunbar	Eng.	Santa Barbara
Wilmot, Richard Channing	Eng.	Los Angeles
Wilson, Robert Warren	Sci.	Los Angeles
Wixson, Frank Melvin	Eng.	Santa Monica
Zipser, Sidney	Eng.	Los Angeles

SUMMARY

Graduate School		
National and International Research Fellows, and Research Fellows of the Institute	24	
Candidates for Advanced Degrees	82	106
Undergraduate College		
Seniors		92
Juniors		97
Sophomores		126
Freshmen		128
		549

Index

COURSES FOR WHICH STUDENTS ARE REGISTERED

	Freshmen	Sophomores	Juniors	Seniors	Graduates	Totals
Eng.	81 ~~86~~ 87	75 ~~89~~	57 ~~60~~			~~235~~ 236
Sci.	42 ~~41~~	38 ~~37~~	28 ~~37~~			115
EE.				22	8	30
ME.				10	1	11
CE.				17	3	20
Eng.Ec.				~~9~~ 10		9
Ch.				3	17	20
Ch.E.				7		7
Ph.				7	~~38~~ ~~39~~ 40	~~45~~ ~~46~~ 47
Ph.E.				4		4
Geology				9	8	17
Ma.					2	2
Ma.Ph.					3	3
General				4		4
	123	113	85	~~95~~		526
	~~127~~ 128	~~126~~	97	~~98~~ 93	~~80~~ ~~81~~ 82	~~522~~ ~~524~~ ~~525~~

* Indicates new student
\# Indicates that student is registered for less than 33 units.
Omissions are indicated by red arrow. Name omitted may be found at the end of list.

October 20, 1926, Total Registration 522
October 26, 1926, Total Registration 524