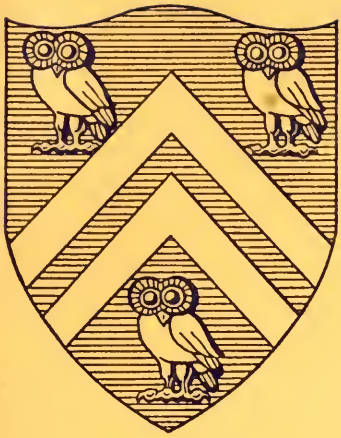


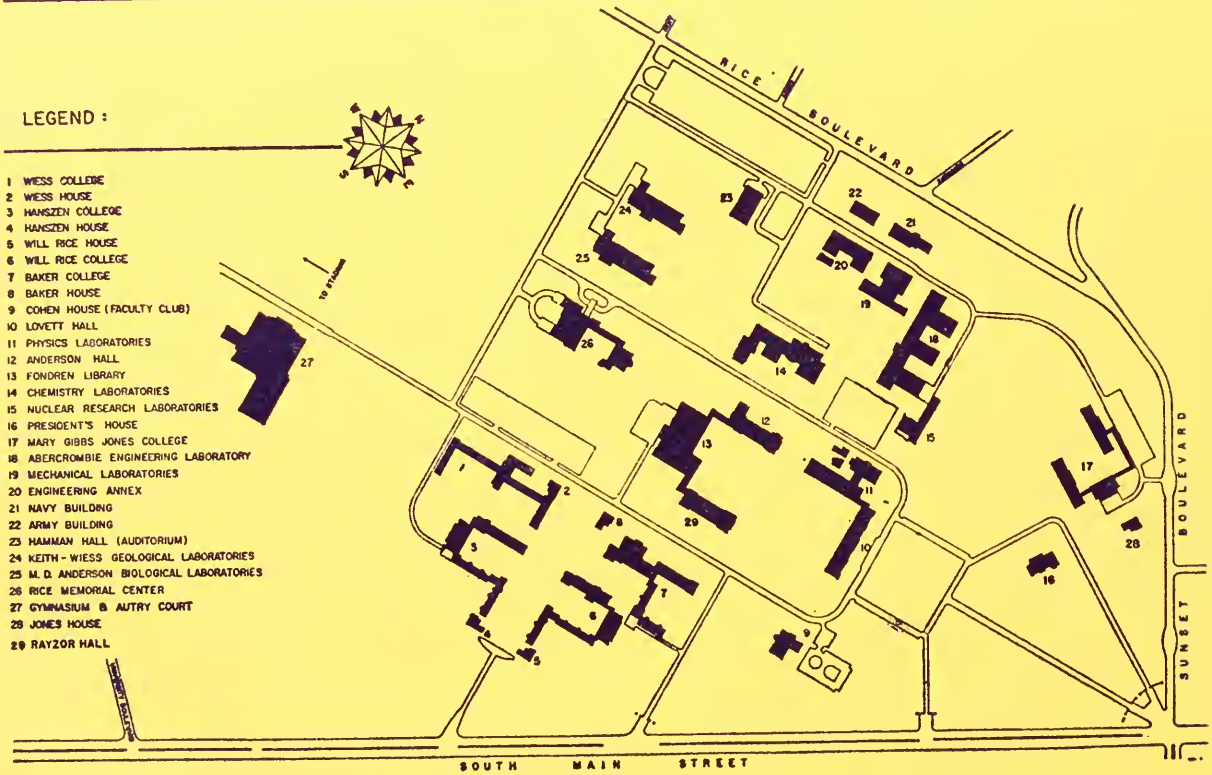
FIFTIETH
ANNIVERSARY
YEAR

Rice University

GENERAL ANNOUNCEMENTS

September, 1962–June, 1963

GENERAL PLAN OF RICE UNIVERSITY



William Marsh Rice University

GENERAL ANNOUNCEMENTS

September, 1962–June, 1963

FOUNDED BY WILLIAM MARSH RICE

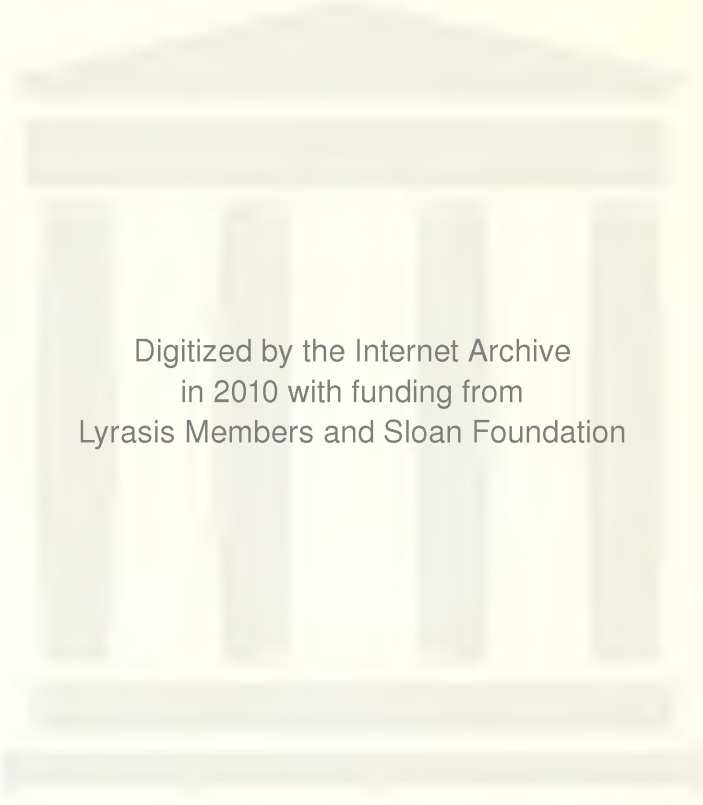
FIFTIETH ANNIVERSARY YEAR

OPENED FOR THE RECEPTION OF STUDENTS IN THE AUTUMN OF NINETEEN HUNDRED AND TWELVE

DEDICATED TO THE ADVANCEMENT OF LETTERS, SCIENCE, AND ART

Houston, Texas

1962



Contents

1962

JULY

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8	9	10	11	12	13	14
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OCTOBER

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1963

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JULY

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SEPTEMBER

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OCTOBER

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NOVEMBER

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DECEMBER

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Academic Calendar 1962-63

First Semester

Saturday, September 8	Last Day for Returning Registration Cards
Sunday, September 9	Arrival of Freshmen
Monday, September 10-14	Freshman Week
Monday, September 10	Matriculation Address, 5:00 P.M.
Monday, September 17	Opening of Courses
Wednesday, October 10-13	Rice University Semicentennial Celebration
Wednesday, November 21	Beginning of Thanksgiving Recess, 6:00 P.M.
Monday, November 26	Resumption of Courses, 8:00 A.M.
Thursday, December 20	Beginning of Christmas Recess, 6:00 P.M.
Thursday, January 3	Resumption of Courses, 8:00 A.M.
Saturday, January 12	Last Day of First-Term Classes
Tuesday, January 15	Beginning of Mid-Year Examinations

Second Semester

Monday, January 28	Resumption of Courses, 8:00 A.M.
Tuesday, April 9	Beginning of Easter Recess, 6:00 P.M.
Tuesday, April 16	Resumption of Courses, 8:00 A.M.
Tuesday, May 14	Last Day of Classes
Thursday, May 16	Beginning of Final Examinations
Friday, May 31	Baccalaureate Exercises
Saturday, June 1	Fiftieth Commencement

Part One

Administration and Staff

Officers of Administration
Board of Governors
The Rice University Associates
The Instructional and Research Staff
University Standing Committees

Officers of Administration

KENNETH SANBORN PITZER, PH.D.
President

CAREY CRONEIS, PH.D., LL.D., D.SC., D.ENG.
Chancellor

WILLIAM VERMILLION HOUSTON, PH.D., D.SC., LL.D.
Honorary Chancellor

GEORGE HOLMES RICHTER, PH.D.
Dean of Graduate Studies

WILLIAM HENRY MASTERSON, PH.D.
Dean of Humanities

LEVAN GRIFFIS, PH.D.
Dean of Engineering

SANFORD WILSON HIGGINBOTHAM, PH.D.
Dean of Students

(TO BE APPOINTED)
Adviser to Women

JAMES BERNARD GILES, M.A.
Director of Admissions

MICHAEL VINCENT MCENANY, M.A.
Registrar

LEO S. SHAMBLIN
Treasurer and Business Manager

(TO BE APPOINTED)
Bursar

HOWARD ALEXANDER THOMPSON, M.A.
Director of Development

Board of Governors

Trustees

George R. Brown, *Chairman*
J. Newton Rayzor, *Vice Chairman*
John S. Ivy
William A. Kirkland
Lamar Fleming, Jr.
Harmon Whittington
Daniel R. Bullard
Gus S. Wortham, *Emeritus*

Term Members

Laurence H. Favrot
James W. Hargrove
Howard B. Keck
Wendel D. Ley
John W. Mecom
John D. Simpson, Jr.
Milton R. Underwood
James O. Winston, Jr.

Governor Advisors

Herbert Allen
Robert P. Doherty
Francis T. Fendley
J. Sayles Leach
Mason G. Lockwood
H. Malcolm Lovett
Jack C. Pollard
John T. Rather, Jr.
Robert H. Ray
John R. Suman

The Rice University Associates

Mr. and Mrs. James S. Abercrombie
Mr. and Mrs. K. S. Adams, Jr.
Mr. and Mrs. Dillon Anderson
Mr. and Mrs. W. Leland Anderson
Mr. and Mrs. Forrest L. Andrews
Mr. and Mrs. Isaac Arnold
Mr. and Mrs. Raymond I. Arsht
Mr. and Mrs. J. Evans Attwell
Mr. and Mrs. James A. Baker, Jr.
Mr. and Mrs. W. Browne Baker
Mr. and Mrs. Paul F. Barnhart
Mr. and Mrs. Edward R. Barrow
Mr. and Mrs. W. O. Bartle
Mr. and Mrs. Dupuy Bateman, Jr.
Mr. and Mrs. Abraham M. Battelstein
Mr. and Mrs. Joe D. Beasley
Mr. and Mrs. Henry M. Beissner
Mr. and Mrs. Alfred Bessell, Jr.
Mr. and Mrs. Albert P. Beutel
Mr. and Mrs. Val T. Billups
Mr. and Mrs. John H. Blaffer
Mr. and Mrs. Charles M. Blair
Mr. and Mrs. James C. Boone
Mr. and Mrs. Isaac S. Brochstein
Mr. and Mrs. Philip H. Broun
Mr. and Mrs. Hart Brown
Mr. and Mrs. Herman Brown
Mr. and Mrs. Harold Burrow
Mr. and Mrs. Ernest D. Butcher, Jr.
Mr. and Mrs. George A. Butler
Mr. and Mrs. Charles L. Bybee
Mr. and Mrs. John C. Bybee
Mr. and Mrs. Allen H. Carruth
Mr. and Mrs. Lyle Cashion
Mr. and Mrs. H. Merlyn Christie
Mr. and Mrs. Geo. S. Cohen
Mr. and Mrs. Stewart P. Coleman
Mr. and Mrs. Raymond A. Cook
Mr. and Mrs. Theodore W. Cooper
Mr. and Mrs. John H. Crooker
Mr. and Mrs. John H. Crooker, Jr.
Mr. and Mrs. H. M. Crosswell, Jr.
Mr. and Mrs. Lloyd K. Davis
Mr. and Mrs. Harold Decker
Mr. and Mrs. John M. de Menil
Mr. and Mrs. John L. Doré
Mr. and Mrs. C. W. Duncan, Jr.
Mr. and Mrs. Edmund M. Dupree
Mr. and Mrs. James A. Elkins
Mr. and Mrs. Joseph W. Evans
Mr. and Mrs. Thomas Cartter Evans
Mrs. W. S. Farish
Mr. and Mrs. William G. Farrington
Mr. and Mrs. Albert B. Fay
Mrs. Walter W. Fondren
Mr. and Mrs. Charles I. Francis
Mr. and Mrs. J. R. Frankel
Mr. and Mrs. Kenneth Franzheim, II
Mr. and Mrs. Claude T. Fuqua, Jr.
Mr. and Mrs. Raymond H. Gaston
Mr. and Mrs. Grover J. Geiselman, Jr.
Mr. Alfred C. Glassell, Jr.
Mr. and Mrs. J. A. Gray
Mr. and Mrs. George L. Gudenrath
Mr. and Mrs. Cecil R. Haden
Mr. and Mrs. Walter G. Hall
Mr. and Mrs. Charles W. Hamilton
Mr. and Mrs. David Hannah, Jr.
Mr. and Mrs. Karl F. Hasselmann
Mr. and Mrs. J. W. Hershey
Mr. and Mrs. Wilbur E. Hess
Mr. and Mrs. Maurice Hirsch
Mr. and Mrs. William P. Hobby
Mr. and Mrs. Roy M. Hofheinz
Miss Ima Hogg
Mr. and Mrs. Oscar F. Holcombe

Mr. and Mrs. John G. Holland
Mr. and Mrs. George F. Horton
Mr. and Mrs. Lynn G. Howell
Mr. Edward J. Hudson
Mr. and Mrs. Curtis Johnson
Mr. and Mrs. Gaylord Johnson
Mr. and Mrs. John M. Johnson
Mrs. Jesse Holman Jones
Mr. Ervin F. Kalb
Mrs. Edward W. Kelley
Mr. and Mrs. Edward Kelley, Jr.
Mr. and Mrs. Carl M. Knapp
Mr. and Mrs. Alfred W. Lasher, Jr.
Mr. and Mrs. Theodore N. Law
Mr. and Mrs. Max Levine
Mr. and Mrs. G. Burton Liese
Mr. and Mrs. John W. Link, Jr.
Mr. and Mrs. William R. Lloyd, Jr.
Mr. and Mrs. James M. Lykes, Jr.
Mr. and Mrs. John F. Lynch
Mr. and Mrs. S. Maurice McAshan, Jr.
Mr. and Mrs. O. J. McCullough
Mr. and Mrs. A. T. McDannald
Mr. and Mrs. R. Thomas McDermott
Mr. and Mrs. Curtis McKallip
Mr. and Mrs. J. W. McLean
Mr. and Mrs. D. E. McMahon
Mr. and Mrs. John T. Maginnis
Mr. and Mrs. John F. Maher
Mr. and Mrs. Francis H. Maloney
Mrs. Greer Marechal
Mr. and Mrs. George P. Martin
Mr. and Mrs. Harris Masterson, III
Mr. and Mrs. John S. Mellinger
Mr. and Mrs. Leopold L. Meyer
Mr. and Mrs. Frank W. Michaux
Mr. and Mrs. M. E. Montrose
Mr. and Mrs. Alvin S. Moody
Mr. and Mrs. Dan M. Moody
Mr. and Mrs. Harvin C. Moore
Mr. and Mrs. William T. Moran
Mr. and Mrs. Jacques Mossler
Mr. and Mrs. James P. Nash
Mr. and Mrs. Charles E. Naylor
Mr. and Mrs. Wheeler Nazro
Mr. and Mrs. Fred M. Nelson
Mr. and Mrs. Hugo V. Neuhaus, Jr.
Mr. and Mrs. Gustav M. O'Keiff
Mr. and Mrs. R. A. Parker
Mr. and Mrs. George A. Peterkin
Mr. and Mrs. Louis L. Pulaski
Mr. and Mrs. Edward Randall, III
Mr. and Mrs. Leonard Rauch
Mr. and Mrs. T. R. Reckling, III
Mr. and Mrs. Lawrence S. Reed
Mr. and Mrs. Fisher Reynolds
Mr. and Mrs. Raymond D. Reynolds
Mr. and Mrs. Edward S. Rothrock
Mr. and Mrs. Clive Runnells, Jr.
Mr. and Mrs. Patrick R. Rutherford
Mr. and Mrs. Simon Sakowitz
Mr. Fayez Sarofim
Mr. and Mrs. Raymond G. Schindler
Mr. and Mrs. Eddy C. Scurlock
Mr. and Mrs. Dudley C. Sharp
Mr. and Mrs. W. Bedford Sharp
Mr. and Mrs. Thomas H. Shartle
Mr. and Mrs. James L. Shepherd, Jr.
Mr. and Mrs. Stuart Sherar
Mr. and Mrs. E. Joe Shimek
Mr. and Mrs. Harry K. Smith
Mr. and Mrs. William A. Smith
Mr. and Mrs. W. McIver Streetman
Mr. and Mrs. H. Gardiner Symonds
Mr. Ben Taub
Mr. and Mrs. Henry J. N. Taub
Mr. and Mrs. Howard T. Tellepsen
Mr. and Mrs. Russell Thorstenberg
Mr. and Mrs. Wash Bryan Trammell
Mr. Jack T. Trotter
Mr. and Mrs. P. E. Turner
Mr. and Mrs. Joe Weingarten
Mr. and Mrs. Wesley W. West
Mrs. Harry C. Wiess
Mr. and Mrs. I. M. Wilford
Mr. and Mrs. Wallace D. Wilson
Mr. and Mrs. Benjamin N. Woodson
Mr. and Mrs. Andrew Jackson Wray

The Instructional and Research Staff

Emeritus Faculty

ALTENBERG, EDGAR. *Professor Emeritus of Biology*
A.B. (Columbia) 1911; A.M. (Columbia) 1912; Ph.D. (Columbia) 1916

BATTISTA, JOSEPH LLOYD. *Associate Professor Emeritus of Romance Languages*
Certificat d'Études françaises (Bordeaux) 1919; Diplome d'Études supérieures (Bordeaux) 1919; B.A. (Michigan) 1920; M.A. (Washington University) 1923; M.A. (Harvard) 1929

DEAN, ALICE CROWELL. *Librarian Emerita*
B.A. (Rice) 1916; M.A. (Rice) 1919

FREUND, FRIEDRICH ERNST MAX. *Professor Emeritus of German*
Ph.D. (Leipzig) 1902

HARTSOOK, ARTHUR J. *Professor Emeritus of Chemical Engineering*
A.B. (Nebraska Wesleyan) 1911; B.S. in Ch.E. (M.I.T.) 1920; M.S. (M.I.T.) 1921

MCCANN, SAMUEL GLENN. *Emeritus Director of Admissions and Honorary Associate of Wiess College*
Ph.B. (Wooster) 1914; M.A. (Rice) 1917

MCCANTS, JOHN THOMAS. *Bursar Emeritus and Honorary Associate of Baker College*
B.S. (Marion Institute) 1902; B.A. (Marion Institute) 1905; M.A. (Virginia) 1906; M.A. (Yale) 1909

MORAUD, MARCEL. *Professor Emeritus of French*
Agrégé de l'Université (Paris) 1919; Docteur ès Lettres (Paris) 1933

NICHOLAS, HENRY OSCAR. *Associate Professor Emeritus of Chemistry*
A.B. (Oberlin) 1919; Ph.D. (Yale) 1923

RYON, LEWIS BABCOCK. *Professor Emeritus of Civil Engineering and Honorary Associate of Hanszen College*
C.E. (Lehigh) 1917

SLAUGHTER, JOHN WILLIS. *Lecturer Emeritus in Civics and Philanthropy*
A.B., B.D. (Lombard) 1898; Ph.D. (Michigan) 1901

WHITING, GEORGE WESLEY. *Professor Emeritus of English*
A.B. (West Virginia) 1908; A.M. (Harvard) 1913; Ph.D. (Chicago) 1926

WILSON, HAROLD ALBERT. *Professor Emeritus of Physics and Honorary Associate of Hanszen College*
M.Sc. (Leeds) 1897; D.Sc. (London) 1900; M.A. (Cambridge) 1904; F.R.S.

Faculty

ABBOT, WILLIAM WRIGHT. *Associate Professor of History*
A.B. (Georgia) 1943; M.A. (Duke) 1951; Ph.D. (Duke) 1953

ADAMS, JOHN ALLAN STEWART. *Professor of Geology*
Ph.B. (Chicago) 1946; B.S. (Chicago) 1948; M.S. (Chicago) 1949; Ph.D. (Chicago) 1951

AKERS, WILLIAM WALTER. *Professor of Chemical Engineering and Nonresident Associate of Baker College*
B.S. in Ch.E. (Texas Tech.) 1943; M.S. in Ch.E. (Texas) 1944; Ph.D. (Michigan) 1950

ASIMOW, ROBERT MAX. *Assistant Professor of Mechanical Engineering*
B.S. (U.C.L.A.) 1953; M.S. (U.C.L.A.) 1955; Ph.D. (U.C.L.A.) 1958

ATKINSON, BERNARD. *Assistant Professor of Chemical Engineering*
B.Sc. (Birmingham) 1957; Ph.D. (Manchester) 1960

AUSTIN, WALTER JAMES. *Professor of Civil Engineering*
B.S. in C.E. (Rice) 1941; M.S. in C.E. (Illinois) 1946; Ph.D. in Eng. (Illinois) 1949

AUTEN, JOHN H. *Associate Professor of Economics*
B.S. (Ohio State) 1947; Ph.D. (M.I.T.) 1954

AWAPARA, JORGE. *Associate Professor of Biology*
B.S. (Michigan State) 1941; M.S. (Michigan State) 1942; Ph.D. (Southern California) 1947

BACKUS, KERBY DEWEL. *Instructor in Engineering Graphics and Resident Associate of Wiess College*
B.S. (East Texas S.C.) 1956

BARBER, WILLIAM DEARMOND. *Assistant Professor of History*
B.A. (Cincinnati) 1953; M.A. (Cincinnati) 1954; Ph.D. (Wisconsin) 1961

BARKER, J. R. *Assistant Professor of Health and Physical Education*
B.S. in P.E. (Rice) 1949; M.Ed. (Texas) 1954

BARNARD, ANTHONY CHARLES LANGRISH. *Assistant Professor of Physics*
B.Sc. (Birmingham) 1953; Ph.D. (Birmingham) 1957

BEARDEN, FRANCIS W. *Associate Professor of Health and Physical Education and Nonresident Associate of Will Rice College*
B.S. (Texas Tech.) 1947; M.A. (Columbia) 1949; Ed.D. (Columbia) 1954

BECKMANN, HERBERT K. W. *Associate Professor of Mechanical Engineering*
Dipl. Ing. (Hanover) 1944; Dr. Ing. (Hanover) 1957

BLACK, HUGH CLEON. *Associate Professor of Education and Nonresident Associate of Baker College*
B.A. (Rice) 1941; M.Ed. (Texas) 1947; Ph.D. (Texas) 1949

BLAND, ROBERT L. *Assistant Professor of Health and Physical Education and Nonresident Associate of Hanszen College*
B.A. (Central Washington) 1953; M.A. (Columbia) 1954

BOURGEOIS, ANDRÉ MARIE GEORGES. *Professor of French*
Bachelier ès Lettres (Paris) 1921; Bachelier en Droit (Paris) 1923; Certifié d'Études supérieures de lettres (Paris) 1930; M.A. (Texas) 1934; Docteur de l'Université (Paris) 1945; Officier de l'Instruction publique 1945

BOURLAND, HARDY MACK. *Instructor in Electrical Engineering*
B.S. in E.E. (Texas Tech.) 1955; S.M. in E.E. (M.I.T.) 1957

BRACKETT, THOMAS E. *Assistant Professor of Chemistry and Nonresident Associate of Will Rice College*
B.S. (Maine) 1954; Ph.D. (California) 1958

BRAY, HUBERT EVELYN. *Trustee Professor of Mathematics and Nonresident Associate of Jones College*
B.A. (Tufts) 1910; M.A. (Harvard) 1916; Ph.D. (Rice) 1918

BROTHERS, DWIGHT STANLEY. *Associate Professor of Economics and Nonresident Associate of Wiess College*
B.A. (Colorado College) 1951; M.A. (Princeton) 1954; Ph.D. (Princeton) 1957

BROTZEN, FRANZ RICHARD. *Professor of Mechanical Engineering and Nonresident Associate of Jones College*
B.S. (Case Institute) 1950; M.S. (Case Institute) 1953; Ph.D. (Case Institute) 1954

BROWN, HERBERT ARLEN, JR. *Associate Professor of Mathematics*
Ph.B. (Chicago) 1948; B.S. (Chicago) 1949; M.S. (Chicago) 1950; Ph.D. (Chicago) 1952

BRYAN, ANDREW BONNELL. *Lecturer in Physics*
B.A. (Rice) 1918; M.A. (Rice) 1920; Ph.D. (Rice) 1922

BURCHFIEL, BURRELL CLARK. *Assistant Professor of Geology*
B.S. (Stanford) 1957; M.S. (Stanford) 1958; Ph.D. (Yale) 1961

BURGHARD, HERMAN C., JR. *Assistant Professor of Mechanical Engineering*
B.S. in M.E. (Rice) 1950; M.S. (Rice) 1958

BUSCH, ARTHUR WINSTON. *Associate Professor of Environmental Engineering*
B.S. (Texas Tech.) 1950; S.M. (M.I.T.) 1952

CAMDEN, CHARLES CARROLL. *Professor of English and Nonresident Associate of Hanszen College*
A.B. (Centre) 1925; M.A. (Iowa) 1928; Ph.D. (Iowa) 1930

CAMPBELL, JAMES WAYNE. *Assistant Professor of Biology*
B.S. (Southwest Missouri) 1953; M.S. (Illinois) 1955; Ph.D. (Oklahoma) 1958

CASON, CAROLYN. *Director of Food Services and Lecturer in Dietetics*
B.S. (Texas) 1934; M.A. (Columbia) 1939

CASTAÑEDA, JAMES A. *Assistant Professor of Spanish and Resident Associate of Will Rice College*
B.A. (Drew) 1954; M.A. (Yale) 1955; Ph.D. (Yale) 1958

CAUDILL, WILLIAM W. *William Ward Watkin Professor of Architecture*
B.Arch. (Oklahoma State) 1937; M.Arch. (M.I.T.) 1939; LL.D. (Eastern Michigan) 1957

CHAPMAN, ALAN JESSE. *Professor of Mechanical Engineering*
B.S. in M.E. (Rice) 1945; M.S. (Colorado) 1949; Ph.D. (Illinois) 1953

CHILLMAN, JAMES HENRY, JR. *Trustee Professor of Fine Arts and Nonresident Associate of Jones College*
B.S. in Arch. (Pennsylvania) 1913; M.S. in Arch. (Pennsylvania) 1914; F.A.A.R. (Am. Acad. in Rome) 1922; Fellow A.I.A. 1950

CLASS, CALVIN MILLER. *Associate Professor of Physics and Master of Jones College*
A.B. (Johns Hopkins) 1943; Ph.D. (Johns Hopkins) 1951

CONNER, JACK EDWARD. *Associate Professor of English and Nonresident Associate of Will Rice College*
B.A. (Texas A. and I.) 1939; B.S. (Texas A. and I.) 1942; Ph.D. (Stanford) 1952

COPE, JACKSON IRVING. *Professor of English*
B.A. (Illinois) 1950; Ph.D. (Johns Hopkins) 1952

CRAIG, HARDIN, JR. *Professor of History, Librarian, and Nonresident Associate of Will Rice College*
A.B. (Princeton) 1929; A.M. (Harvard) 1931; Ph.D. (Harvard) 1937

CRONEIS, CAREY. *Harry Carothers Wiess Professor of Geology and Chancellor*

B.S. (Denison) 1922; M.S. (Kansas) 1923; Ph.D. (Harvard) 1928; LL.D. (Lawrence) 1941; D.Sc. (Denison) 1945; D.Sc. (Ripon) 1945; D.Eng. (Colorado Mines) 1949; LL.D. (Beloit) 1954

CURL, ROBERT FLOYD, JR. *Assistant Professor of Chemistry*

B.A. (Rice) 1954; Ph.D. (California) 1957

DAVIES, JOSEPH ILOTT. *Professor of Biology and Nonresident Associate of Hanszen College*

B.A. (Rice) 1928; M.A. (Rice) 1929; Ph.D. (Rice) 1937

DAVIS, SAM H., JR. *Associate Professor of Chemical Engineering*

B.A. (Rice) 1952; B.S. in Ch.E. (Rice) 1953; Sc.D. (M.I.T.) 1957

DAWKINS, GEORGE SPANGLER. *Associate Professor of Chemical Engineering*

B.S. in Eng. (Princeton) 1953; Ph.D. in Chem. Eng. (Illinois) 1957

DEANS, HARRY ALEXANDER. *Assistant Professor of Chemical Engineering*

B.A. (Rice) 1953; B.S. in Ch.E. (Rice) 1954; M.S. in Ch.E. (Rice) 1956; Ph.D. (Princeton) 1960

DE BREMAECKER, JEAN-CLAUDE. *Associate Professor of Geology*

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Dottore in Matematica (Firenze) 1949

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Research Associates and Postdoctoral Fellows

BEAMES, CALVIN G., JR. *Postdoctoral Fellow in Biology*
B.A. (New Mexico Highlands) 1955; M.S. (New Mexico Highlands) 1956; Ph.D. (Oklahoma) 1961

BRACKETT, ELIZABETH BECKER. *Postdoctoral Fellow in Chemistry*
B.S. (Missouri) 1953; Ph.D. (California) 1957

BUCHARDT, OLE. *Postdoctoral Fellow in Chemistry*
Ph.D. (Copenhagen) 1959

CLAYTOR, RICHARD N. *Research Associate in Physics*
B.S. (Rice) 1957; M.A. (Rice) 1959; Ph.D. (Rice) 1961

DROBNIES, SAUL I. *Postdoctoral Fellow and Tutor in Mathematics*
B.S. (Texas) 1955; M.A. (Texas) 1958; Ph.D. (Texas) 1961

FISHER, FRANK M., JR. *Postdoctoral Fellow in Biology*
B.A. (Hanover) 1953; M.S. (Purdue) 1958; Ph.D. (Purdue) 1961

FORSYTH, PETER DAVID. *Research Associate in Physics*
B.S. (London) 1955; Ph.D. (Manchester) 1959

HAKE, EVELYN M. *Research Associate in Biology*
B.A. (Rice) 1930; M.A. (Rice) 1932

HEIER, KNUT SIGURDSON. *Postdoctoral Fellow in Geochemistry*
Cand. Real. (Oslo) 1954; Ph.D. (Oslo) 1960

INSOLE, JOAN MARGARET. *Postdoctoral Fellow in Chemistry*
B.Sc. (London) 1958; Ph.D. (London) 1961

JONES, CHARLES MILLER. *Research Associate in Physics*
B.S. (Georgia Inst. of Tech.) 1957; M.A. (Rice) 1959; Ph.D. (Rice) 1961

LEVIN, FRANK S. *Research Associate in Physics*
A.B. (Johns Hopkins) 1955; Ph.D. (Maryland) 1961

MAINSBRIDGE, BRUCE. *Research Associate in Physics*
B.Sc. (Tasmania) 1951; Ph.D. (Australian National) 1961

OKUDA, SHIGEO. *Research Associate in Mechanical Engineering*
B.Eng. (Tokyo) 1953; M.Eng. (Tokyo) 1956; D.Eng. (Tokyo) 1959

PERRY, ROBERT RILEY. *Research Associate in Physics*
B.S. (Rice) 1957; M.A. (Rice) 1958; Ph.D. (Rice) 1960

PILLAY, M. G. KRISHNA. *Postdoctoral Fellow in Chemistry*
B.Sc. (Travancore) 1950; M.Sc. (Banaras Hindu) 1953; M.Sc. (Annamalai) 1955; Ph.D. (Annamalai) 1959

ROOS, OTTO. *Postdoctoral Fellow in Chemistry*
Dipl. Chem. (Techn. Hochschule, Karlsruhe, Germany) 1954; Dr. rer. nat. (Techn. Hochschule, Karlsruhe, Germany) 1960

ROTHMAN, ALVIN HARVEY. *Research Associate in Biology*
B.A. (U.C.L.A.) 1952; M.A. (U.C.L.A.) 1954; Sc.D. (Johns Hopkins) 1958

SANDMAN, ROBERT P. *Research Associate in Biology*
B.S. (St. Louis) 1947; M.A. (Texas) 1952; Ph.D. (Texas) 1954

SCOTT, HUBERT D. *Research Associate in Physics*
B.Sc. (Liverpool) 1957; Ph.D. (Liverpool) 1961

STRICKLER, STEWART JEFFERY. *Postdoctoral Fellow in Chemistry*
B.A. (Wooster) 1956; Ph.D. (Florida State) 1961

TAYLOR, IVOR J. *Research Associate in Physics*
B.Sc. (Manchester) 1955; M.Sc. (Birmingham) 1956; Ph.D. (Manchester) 1960

TOLLES, WILLIAM MARSHALL. *Postdoctoral Fellow in Chemistry*
B.A. (Connecticut) 1958; Ph.D. (California) 1962

WEIL, JESSE L. *Research Associate in Physics*
B.S. (California Inst. of Tech.) 1952; Ph.D. (Columbia) 1959

WEINMANN, CLARENCE JACOB. *Postdoctoral Fellow in Biology*
B.S. (California) 1950; Ph.D. (California) 1958

WITTE, KARSTEN. *Postdoctoral Fellow in Chemistry*
Diplom-Vorprüfung (Kiel) 1955; Diplom-Hauptprüfung (Tübingen) 1959; Dr. rer. nat. (Tübingen) 1961

YOUNGBLOOD, JAMES LUTHER. *Research Associate in Mechanical Engineering*
B.A. (Rice) 1953; B.S. (Rice) 1957; M.S. (Rice) 1959; Ph.D. (Rice) 1962

Staff of the Library

ALLSPACH, ELIZABETH ANN. *Catalog Librarian*
B.A. (Rice) 1960; M.L.S. (California) 1961

BATTEN, BARBARA BRIANT. *Circulation Librarian*
B.A. (Hendrix) 1956; M.A. (Peabody) 1957

BISHOP, MARTHA. *Catalog Librarian*
Ph.D. (Munich) 1947

BLAKE, RUTH. *Catalog Librarian*
B.A. (Rice) 1950; M.A. (Rice) 1951

BULAS, CASIMIR. *Acquisitions Research Librarian*
Ph.D. (Cracow) 1927

CARTER, CLAUDIA J. *Assistant Order Librarian*
B.A. (New Hampshire) 1950; M.S. in L.S. (Columbia) 1958

CRAIG, HARDIN, JR. *Librarian*
A.B. (Princeton) 1929; A.M. (Harvard) 1931; Ph.D. (Harvard) 1937

DEAN, ALICE CROWELL. *Librarian Emerita and Archivist*
B.A. (Rice) 1916; M.A. (Rice) 1919

DE ZURKO, MADITH SMITH. *Music and Fine Arts Librarian*
B.S. in Mus. Ed. (Illinois) 1941

HAMILTON, MARY ALICE. *Gifts and Exchanges Librarian*
B.A. (Rice) 1932

HOOKER, LLOYD. *Circulation Librarian*
B.S. (Houston) 1958; M.A. (Peabody) 1959

JAMESON, FLORENCE. *Serials Librarian*
B.A. (Rice) 1918

LANE, SARAH LOUISE. *Head of Circulation Department*
B.A. (Rice) 1919; B.S. in L.S. (Columbia) 1932

O'KEEFFE, RICHARD L. *Assistant Librarian and Science Librarian*
Ph.B. (Mount Carmel) 1949; M.S. in L.S. (Louisiana State) 1956

PERRINE, RICHARD H. *Reference Librarian*
B.F.A. (Yale) 1940; M.L.S. (Texas) 1961

REDMON, ALICE JANE. *Catalog Librarian*
B.A. (Denver) 1937

RODELL, ELIZABETH GOODSON. *Head of Catalog Department*
B.A. (Rice) 1931; B.S. in L.S. (Denver) 1940

TURNBULL, PENDER. *Bibliographer and Curator of Rare Book Room*
B.A. (Rice) 1919

ZINGLER, GILBERTA M. *Head of Acquisitions Department*
A.B. (Butler) 1932; B.S. in L.S. (Illinois) 1935

Staff of the Athletic Department

BALE, ALLEN MELBERT. *Assistant Coach of Football*
BRUNSON, EMMETT EVANDER. *Business Manager of Athletics and Coach of Track and Field*
DAVIS, JOE WALLACE. *Line Coach of Football*
ERFURTH, AUGUST FRED, JR. *Assistant Coach of Track and Concessions Manager*
FRANKIE, JOHN. *Coach of Basketball*
GIAMMALVA, SAMUEL ANTONE. *Coach of Tennis*
GRIGG, CECIL BURKETT. *Backfield Coach of Football*
HAGAN, HAROLD B. *Assistant Coach of Football*
LANZA, NICK. *Coach of Freshman Football*
MOORE, CHARLES EDWARD, JR. *Assistant Coach of Football*
MORGAN, JOHN O. *Assistant Coach of Football and Coach of Baseball*
NEELY, JESS CLAIBORNE. *Director of Athletics and Head Coach of Football*
WHITMORE, WILLIAM ROGERS. *Athletic Publicity Director*
WOJECKI, EDWARD J. *Head Athletic Trainer and Assistant Instructor in Physical Education*

University Standing Committees 1961-62

The President is a member, *ex officio,* of all committees.

Committee on Admissions: Mr. Giles, *chairman;* the Dean of Graduate Studies, the Dean of Humanities, the Dean of Engineering; Messrs. Austin, Auten, Brotzen, Donoho, Kolenda, Mackenzie, Morehead, and Rabson; Mrs. Drew and Mrs. Savage.

Committee on Buildings and Grounds: Mr. Wischmeyer, *chairman;* Messrs. Campbell, Conner, Dunaway, Hellums, Roberts, and Sims.

Committee on Disasters and Emergencies: Mr. Wischmeyer, *chairman;* Captain Dean, Messrs. Griffis, Phillips, Turner, and Waters.

Committee on Examinations and Standing: Mr. McEnany, *chairman;* Messrs. Dvoretzky, Holt, Leland, Lewis, W. H. Nelson, Phillips, and Thomas.

Faculty Council: The President; the Chancellor; the Dean of Graduate Studies; the Dean of Humanities; the Dean of Engineering; Messrs. MacLane (term expires 1962), Camden (1963), Chapman (1963), Turner (1964), Brotzen (1965), and Edwards (1965).

Committee on Graduate Instruction: Mr. Cronеis, *chairman;* Mr. Richter, *vice chairman;* Messrs. Griffis and Masterson.

Committee on the Library: Mr. Masterson, *chairman;* Messrs. Auten, Camden, Chapman, Lewis, L. Mackey, W. Mackey, and Phillips; Mr. Craig, *consultant.*

Committee on Outdoor Sports: Mr. Waters, *chairman;* Messrs. Chapman, Hermance, and Vandiver; Mr. Lou Hassell as representative of the R Association; Mr. William Hudspeth as representative of the Alumni Association; Mr. J. Newton Rayzor as representative of the Board of Governors.

Professional Advisory Committee: Mr. McEnany, *chairman;* Messrs. Fulton, Hudspeth, Parish, Read, Rorschach, and Sanders.

Committee on Public Lectures: Mr. Higginbotham, *chairman;* Messrs. Asimow, Gallegly, Hall, Loewenheim, L. Mackey, Norbeck, and Purdy; the Director of Development, *ex officio.*

Committee on Publications: Mr. Higginbotham, *chairman;* Messrs. Beckmann, Lehnert, MacLane, McEnany, Myers, Rimlinger, Thomas, Vandiver, and Williams.

Committee on Religious Activities: Mr. Nielsen, *chairman;* Messrs. Brackett, Graham, Pfeiffer, Ransom, Thomas, and Tsanoff.

The Rice University Marshals: Mr. Akers, *Chief Marshal;* Messrs. Marsh, Connor, Wann, Sass, Roberts, and Rogers.

R.O.T.C. Committee: Mr. Chapman, *chairman;* the Professor of Naval Science; the Professor of Military Science; Messrs. Adams, Edwards, Phillips, Wann, and Wilhoit; the Dean of Students, *ex officio.*

Committee on Schedules: Mr. McEnany, *chairman;* Messrs. Brown, Davis, Griffis, J. E. Hodges, and Myers.

Committee on Scholarships and Awards: Mr. McEnany, *chairman;* Messrs. Brackett, Donnelly, McDonald, Nielsen, and Wilhoit; Mrs. Savage.

Committee on Student Health: Mr. Weston, *chairman;* Dr. Skaggs; Messrs. Fulton, Plapp, and Wann; Miss Cason; Mr. Garner; the Dean of Students, *ex officio.*

Part Two

General Information

The University and Its Campus

Historical Sketch of the University

William Marsh Rice University was founded in Houston, Texas, as the Rice Institute by William Marsh Rice. The founder did not live to see the beginning of instruction at the institution, but his ashes rest in the base of a bronze statue by John Angel located in the center of the Academic Court. The Rice Institute became William Marsh Rice University on July 1, 1960.

The Rice Institute was incorporated in 1891 under a charter permitting large freedom in the organization of a university to be dedicated to the "Advancement of Literature, Science, and Art." The Board of Trustees on December 28, 1907, appointed Dr. Edgar Odell Lovett, professor of mathematics and head of the astronomy department at Princeton University, to be the first president of the Rice Institute. After careful and extended planning, the new university was opened in September, 1912, to an entering class of seventy-seven students. A three-day academic festival was held on October 10-12, 1912, as a formal celebration of the opening. A similar festival on October 10-12, 1962, will commemorate the fiftieth anniversay of the University.

Enrollment expanded rapidly during the early years, and by 1924 a policy of admitting annually only about 450 undergraduate students was established. No restriction has yet been placed on the acceptance of qualified graduate students.

Dr. Lovett, who died in 1957, became president emeritus in 1946, when Dr. William V. Houston, professor of physics at the California Institute of Technology, assumed the presidency. When Dr. Houston retired as president in 1960, Dr. Carey Croneis, provost and professor of geology at Rice, served as acting president. In July, 1961, Dr. Kenneth S. Pitzer, professor of chemistry and dean of the College of Chemistry at the University of California at Berkeley, became Rice's third president and chief executive officer. At that time Dr. Croneis became chancellor and Dr. Houston honorary chancellor of the University.

A new era of rapid development for the University began at the close of World War II. The Board of Trustees developed during the war years a long-range plan based upon the goal of providing especially good training for a limited number of students, "with a well-developed and strong curriculum in the arts and letters and with the emphasis on science and research that is required to meet changing

circumstances." These plans were vigorously executed. New departments were added, the faculty was increased from less than seventy to more than two hundred, admission requirements were raised, curricula were revised, and a great expansion was made in graduate study and research. In the academic year 1961-62 there were 423 postgraduate students. More than thirty postdoctoral fellows and research associates were engaged in investigations in the University laboratories.

In 1961 the University made available to the National Aeronautics and Space Administration a site on Clear Lake near Houston for the construction of a $80,000,000 Manned Space Flight Laboratory. The University will also cooperate with N.A.S.A. in developing certain phases of its program.

In September, 1949, the directing body of the University was enlarged to a fifteen-man Board of Governors, composed of the seven permanent trustees and eight governors appointed by the trustees for staggered terms of four years. In 1954 a new body, the Rice University Associates, was formed to provide a channel for the free exchange of ideas between the faculty and a group of representative citizens with influence in the civic, cultural, and educational affairs of the region.

The University Campus and Buildings

Rice University occupies a spacious and well-kept campus of some three hundred acres on South Main Street about three miles from the center of the city of Houston. There are at present twenty-nine major buildings and groups of buildings exclusive of the Rice Stadium. The harmonious proportions of these buildings and their intriguing architectural features combine with the natural beauty of the campus to form a setting of rare charm in which the students and faculty may pursue their respective tasks.

Architectural distinction was an acknowledged goal of the trustees in 1910 when they accepted a general long-range plan prepared by Ralph Adams Cram, which combined beauty and utility and exhibited attractive elements of Italian, French, and Spanish architecture. When the Rice Institute was formally opened in the fall of 1912, the administration building (now Lovett Hall), the mechanical engineering building and powerhouse, and two residential halls for men had been completed—all in a style inspired by the Romanesque of Lombardy. The same style of achitecture was exhibited in the physics and chemistry laboratories, two additional residential halls, and Cohen House (the faculty club) erected from 1915 to 1928.

There was little further change in the campus until after World War II, but there has been a spectacular growth in the physical plant since that time as the long-range plans of the trustees began to be implemented. The new buildings are somewhat less ornate than the older ones, but they have all been carefully designed to harmonize with

them, and they exhibit architectural excellence in their own right. Anderson Hall (an office and classroom building), the Abercrombie Engineering Laboratory, the Fondren Library, Wiess Hall (a residential hall for men), and the president's home were built between 1947 and 1949. In the next three years the 70,000-seat Rice Stadium, a new Gymnasium, and a nuclear research laboratory with a six-million-volt Van de Graaff generator were constructed. A twelve-million-volt Van de Graaff tandem generator was added to the laboratory in 1961.

The establishment of residential colleges in 1956 and 1957 not only gave a new direction to student life; it added many new structures to the campus. The existing residential halls for men were enlarged; dining rooms, lounges, and houses for the masters were added; and from this came the four men's residential colleges—Baker, Hanszen, Wiess, and Will Rice. With the opening of Mary Gibbs Jones College in the fall of 1957, women students were housed on the campus for the first time.

In 1958 Hamman Hall auditorium, the Keith-Wiess Geological Laboratories, and the M. D. Anderson Biological Laboratories were opened. In the following year the Rice Memorial Center and the Rice Memorial Chapel were completed. The most recent building is Rayzor Hall (an office and classroom building) which was occupied in 1962.

Still in the planning stage is a new civil engineering laboratory to be constructed in part with a gift of $750,000 from Professor and Mrs. L. B. Ryon. Professor Ryon served as chairman of the Department of Civil Engineering from 1929 to 1958.

Chairs and Lectureships

Throughout its history, Rice University has been especially fortunate in the number of its friends and benefactors. Some of these are memorialized in the names of buildings and special physical facilities; others have generously provided for the enrichment of the University's intellectual life by establishing chairs and lectureships either on temporary or permanent bases. Rice takes pleasure in recognizing on these pages some of these contributors to its academic excellence.

The Bartlett Aesthetics Program

In the fall of 1959 the chamber music concerts which had been for several years supported by Dr. and Mrs. H. L. Bartlett were expanded into an Aesthetics Program consisting of lectures and concerts which, it is hoped, will be an annual feature of the University calendar. The first three Bartlett Lecturers were Dr. Theodore Greene, Dr. Iredell Jenkins, and Dr. Radoslav A. Tsanoff.

The Reginald Henry Hargrove Chair of Economics

The Hargrove chair was established in 1958 in memory of Mr. Hargrove by Mrs. R. H. Hargrove and the Texas Eastern Transmission Corporation. The Hargrove Professor took up residence in 1959.

The Harris Masterson, Jr., Chair in History

The late Reverend Harris Masterson, Jr., was deeply interested in Rice University through his activities as director of Autry House and his close personal association with Rice students through many years. His will provided a bequest to the University with which the Board of Governors established a memorial to him in this chair.

The J. Newton Rayzor Chair in Philosophy and Religious Thought

This chair was established in 1953 by Mr. J. Newton Rayzor, a trustee of Rice University. Its purpose is to provide in the Rice curriculum for distinguished instruction in religious and philosophical ideas which have powerfully influenced the history of civilization.

The Rockwell Lectures

These lectures are made possible by the Rockwell Fund, Inc. They were inaugurated by Sir Robert Alexander Falconer in April, 1938. Among the distinguished lecturers in the series have been Dean Roscoe Pound, Professor William Ernest Hocking, Dr. Ralph W. Sockman, Dr. George A. Buttrick, Professor Charles W. Hendel, Professor

Kenneth S. Latourette, Mr. Charles P. Taft, Dr. Henry P. Van Dusen, Dr. Conyers Read, Professor Theodore Greene, and Dr. Joseph Sittler.

The Shepherd School of Music

Mrs. Sally Shepherd Perkins of Asheville, North Carolina, provided in 1950 for the establishment of a school of music at the University. It is contemplated that when the income from this endowment is of sufficient size, appropriate buildings and other facilities will be provided for outstanding instruction in musical theory and appreciation. At present, income from the gift maintains a professorship and a number of courses and activities in music.

The Harry Carothers Wiess Chair of Geology

In 1952 Mrs. Olga Keith Wiess gave a substantial endowment to the University for the establishment of a chair of geology to be named in memory of her husband, late Vice Chairman of the Board of Governors of the University, in recognition of his profession and of his distinguished service to the University. Work in this department was inaugurated at both graduate and undergraduate levels in 1954.

The Rice University Lectures

From time to time Rice University invites scholars of distinction to lecture for varying periods. In most cases these lectures are open to the public as well as to the faculty and students. Recent lectures have been delivered by Sir John Sheppard, Dr. William B. Hesseltine, Dr. Felix Block, Dr. Edwin G. Nourse, Dr. Arne Tiselius, and Professor David Ogg.

"Research At Rice" Television Series

For several years Rice University has presented a series of programs in cooperation with KTRK-TV, Houston, representing to the region some aspects of research in the various areas of study in science, engineering, and the humanities at the University.

The Academic Program

Curricula and Degrees

Rice University offers baccalaureate degrees in arts and sciences, engineering, architecture, commerce, and health and physical education. Students completing the requirements for the Bachelor of Arts degree with outstanding records are given recognition with a designation of *summa cum laude, magna cum laude,* or *cum laude* when the degree is awarded. Majors may be taken in anthropology, architecture, biology, chemistry, classics, commerce, economics and business administration, English, French, geology, German, history, mathematics, philosophy, physics, psychology, or romance languages. Curricula leading to the Bachelor of Science degree in engineering require five years for completion. Degrees are available in chemical engineering, civil engineering, electrical engineering, and mechanical engineering. Course work is offered in nuclear and sanitary engineering. The Bachelor of Arts degree is awarded on successful completion of four years of study in the engineering curricula. The course of study in architecture is of five years duration and leads to the professional degree of Bachelor of Science in Architecture; the Bachelor of Arts is conferred upon those who have satisfactorily completed the first four years in this curriculum. The degrees of Bachelor of Commerce and Bachelor of Science in Health and Physical Education are awarded after four years of study in their respective curricula. A program of teacher training within the Bachelor of Arts curriculum may be followed by those interested in teaching in the secondary schools. Similarly, programs satisfying requirements for admission to dental, medical, and law schools are available.

Between the academic years 1962-63 and 1965-66 the University with the assistance of the Ford Foundation will be engaged in a special program for college teacher education. In this program, by a rearrangement of courses, the student is enabled to complete all requirements for the master's degree in five years; in addition, he will have substantially completed course and language requirements for the doctorate. Students interested in this program—which includes majors in anthropology, biology, economics, English, French, geology, German, history, philosophy, physics, psychology, and sociology—should correspond with the chairman of the appropriate department.

Graduate study is offered in the arts and sciences, architecture, and engineering. In the arts and sciences, programs are offered leading to

the Master of Arts and Doctor of Philosophy degrees. In engineering, study may lead to the Master of Science and Doctor of Philosophy degrees. The graduate program in architecture may lead to the degree of Master in Architecture.

Courses of Study

Undergraduate Programs

During their first two years the students are registered in the five basic curricula—humanities (academic), science-engineering, architecture, commerce, and health and physical education. A considerable part of the work is prescribed during these two years, but throughout his four-year course each student pursues a broad program in the fundamental sciences and humanities rather than a narrow course of specialization.

In each of the last two years, the schedule of every student must be approved by his department of specialization. Special arrangements may be made through the appropriate dean's office for modification of any curriculum leading to a bachelor's degree in order that courses in naval or military science may be taken, or that premedical, prelegal, or teacher-training requirements may be met.

To assure that students will distribute choices of electives over an adequate range of subjects, courses are divided into three groups, and certain minimum requirements are specified in each group. The groups are listed below:

Group A—architecture, classics, English, fine arts, foreign languages, history, humanities, music, and philosophy

Group B—anthropology, economics and business administration, education, political science, psychology, and sociology

Group C—biology, chemistry, engineering, geology, mathematics, and physics

Humanities (Academic)

First Year

(1) Fundamental Concepts of Mathematics (Mathematics 101) or Elementary Analysis (Mathematics 100)

(2) General Biology (Biology 100), General Chemistry and Qualitative Analysis (Chemistry 120), or Mechanics, Heat, and Sound (Physics 100)

Students may elect to substitute a general Humanities course (Humanities 100, 101, or 102) for either (1) or (2). However, either (1) or (2), if not taken in the first year, must be taken in place of an elective in the second or third year.

(3) Introduction to Critical Reading, Thinking, and Writing (English 100)
(4) Europe and America since 1500 (History 100) or American History (History 110)
(5) Foreign language[1] (May be *postponed* in favor of another science by students anticipating majoring in biology or fulfilling premedical requirements.)
(6) Physical Training
(7) R.O.T.C., if elected

Second Year

(1) Science or Mathematics
(2) English, general literature, or philosophy
(3) Foreign language
(4) Elective in Group B
(5) Elective
(6) R.O.T.C., if elected

NOTE: No second-year student may take more than two courses in one department of the University.

Third and Fourth Years

Majors are offered in anthropology, biology, classics, economics and business administration, English, French, German, history, mathematics, philosophy, psychology, and romance languages. A major in biology or mathematics may be taken in either a humanities (academic) or science curriculum.

Ten courses are required, including two in Group A and two in Group B. At least seven of the ten courses must be advanced (numbered 300 or higher). Not less than three nor more than five of the third- and fourth-year courses and not more than six of the total courses offered in fulfillment of the requirements for the degree may fall within a student's major field.

At the discretion of his major department, a student in R.O.T.C. may substitute military science or naval science courses for one of the requirements in each of the last two years, except that substitution may not be made in the same elective group both years. For example, a student is not permitted to substitute military science or naval science for both Group A electives.

Science and Mathematics

Students majoring in science register in the basic science-engineering curriculum specified below in the first two years. Before selecting

[1] Students having two or more high school units in a foreign language are not permitted to enroll in a beginning course in that language. To satisfy degree requirements, each student must attain a level of competence equivalent to completion of a third-year college course in a foreign language. Students so certified may choose an elective in any group in place of the specified foreign language course.

electives in the Sophomore year, the student should seek advice from the chairman of the department of his intended major.

In the Junior and Senior years specific requirements in the major field and in related subjects, as well as selection of electives, are determined in consultation with an appointed adviser in the appropriate department. The student's registration in each of these years must be approved by his adviser.

First Year

(1) Elementary Analysis (Mathematics 100)
(2) Mechanics, Heat, and Sound (Physics 100)
(3) General Chemistry and Qualitative Analysis (Chemistry 120)
(4) Europe and America since 1500 (History 100) or American History (History 110)
(5) Introduction to Critical Reading, Thinking, and Writing (English 100)
(6) Physical Training
(7) R.O.T.C., if elected

Second Year

(1) Differential and Integral Calculus (Mathematics 200 or 210)
(2) Electricity and Magnetism (Physics 200a, first semester); Atomic Physics (Physics 200b, second semester) or engineering elective
(3) Foreign language[1]
(4) English or general literature elective
(5) Elective
(6) Elective or Military Science or Naval Science

Third and Fourth Years

Science majors are available in biology, chemistry, geology, mathematics, and physics. A major in biology or mathematics may also be taken in the humanities (academic) curriculum.

Ten courses are required, including at least four in the major field of study, two in Group C outside the major field, one in the language started in the Sophomore year, and of the remaining three courses two must be chosen from Groups A or B. Seven of these ten courses must be advanced (numbered 300 or higher). Not more than six of the total courses in fulfillment of the requirements for the Bachelor of Arts degree may fall within the major field.

At the discretion of his major department, a student in R.O.T.C. may substitute military science or naval science courses for one of the requirements in each of the last two years.

[1] Students having two or more high school units in a foreign language are not permitted to enroll in a beginning course in that language.

Engineering

During the first two years students with an interest in engineering register in the basic science-engineering curriculum. They should consult with the chairman of the department of interest or the Dean of Engineering for information and advice about details of the program and choice of electives, and about engineering as a profession. In each of the third and fourth years every student's registration must be approved by an adviser in his major department.

On completion of the Bachelor of Arts degree at the end of the fourth year the student is expected to have a firm foundation in basic engineering principles and fundamental sciences and a broad understanding of the humanities. All students desiring admission to fifth-year studies must apply to the Committee on Examinations and Standing. Students transferring from other institutions or from other courses of study within the University who have not completed work equivalent to the first four years of the Rice University engineering curriculum must also submit transcripts of all previous work to the Dean of Engineering for evaluation. Acceptance or rejection is determined after consideration of past academic performance and the recommendation of the department concerned.

First Year

(1) Elementary Analysis (Mathematics 100)
(2) Mechanics, Heat, and Sound (Physics 100)
(3) General Chemistry and Qualitative Analysis (Chemistry 120)
(4) Europe and America since 1500 (History 100) or American History (History 110)
(5) Introduction to Critical Reading, Thinking, and Writing (English 100)
(6) Physical Training
(7) R.O.T.C., if elected

Second Year

(1) Differential and Integral Calculus (Mathematics 200 or 210)
(2) Electricity and Magnetism (Physics 200a, first semester); Atomic Physics (Physics 200b, second semester) or engineering elective
(3) Foreign language[1]
(4) English or general literature elective
(5) Elective
(6) Elective or Military Science or Naval Science

Third and Fourth Years

Eleven courses are required for completion of the Bachelor of Arts degree, eight to be in Group C and two chosen from Groups A or B.

[1] Students having two or more high school units in a foreign language are not permitted to enroll in a beginning course in that language.

The other is an undesignated elective. At least seven courses must be advanced (numbered 300 or higher).

At the discretion of his major department, a student in R.O.T.C. may substitute military or naval science courses for one of the requirements in each of the last two years, except that these substitutions may not be made in Groups A or B.

Fifth Year

Chemical Engineering. Five advanced courses in engineering, science, and economics approved by the major department plus a departmental seminar and Unit Operations Laboratory. For particularly qualified students with directed interests, flexibility in course planning may permit some specialization during this year in nuclear, petroleum, process, or sanitary engineering.

Civil Engineering. Five advanced courses in Civil Engineering numbered 500 or higher approved by the major department plus a departmental seminar.

Electrical Engineering. Five advanced courses in Electrical Engineering numbered 500 or higher approved by the major department plus a departmental seminar.

Mechanical Engineering. Four advanced courses numbered 500 or higher in Mechanical Engineering and one elective in engineering or science approved by the major department plus associated laboratories and departmental seminar. For properly qualified and prepared students, flexibility in courses offered may permit specialization in engineering mechanics, thermodynamics and heat transfer, or physical metallurgy.

Although separate curricula are not offered in *nuclear engineering* or *sanitary engineering,* these two branches of the sciences are available as options within the Chemical Engineering program with somewhat more emphasis than is possible in other specializations of this branch. Those interested in learning more details of either of these branches should write the Dean of Engineering.

Architecture

First Year

(1) Elementary Analysis (Mathematics 100) or Fundamental Concepts of Mathematics (Mathematics 101)
(2) Mechanics, Heat, and Sound (Physics 100)
(3) Introduction to Critical Reading, Thinking, and Writing (English 100)
(4) Europe and America since 1500 (History 100) or American History (History 110)
(5) Principles of Architecture I (Architecture 100)
(6) Physical Training
(7) R.O.T.C., if elected

Second Year

(1) Mathematics, English, or Philosophy
(2) French or German[1]
(3) History of Architecture, Sculpture, and Painting of the Ancient World (History of Art 215) or elective in Group A or B
(4) Elective
(5) Principles of Architecture II (Architecture 200)
(6) Freehand Drawing and Painting (Drawing 255)
(7) R.O.T.C., if elected

Third and Fourth Years

Architectural students will be required to take their work in Principles of Architecture in each of the third and fourth years. In addition, they will be required to take two courses in History of Art and two electives chosen from Group A, Group B, or Group C, except that both electives may not be chosen from the same group. Students who have already completed History of Art 215 will register for only one course in History of Art and will take an additional elective. Advanced students in Architecture will also be required to take one course in Drawing.

Fifth Year

Students registered in Architecture will be required to take their major departmental work in Principles of Architecture and two electives in Group A, B, or C. Beginning in June, 1965, candidates for the degree of Bachelor of Science in Architecture will be required to complete a minimum of twelve weeks of training in the office of a registered architect and four weeks of travel directed toward architectural study. A report of such employment and travel will be required by the Department of Architecture.

Commerce

With the approval of the Department chairman appropriate courses in the science-engineering and humanities (academic) curricula may be substituted for required commerce courses. Seven of the ten courses of the last two years must be numbered 300 or higher. Not less than three nor more than six of the total courses offered in fulfillment of the degree requirements may be in commerce. With the approval of the department chairman, students in R.O.T.C. may substitute military science or naval science courses for one of the requirements each year, but two substitutions may not be made in the same subject or group, as, for instance, the foreign language or Group B.

[1] Students having two or more high school units in a foreign language are not permitted to enroll in a beginning course in that language.

First Year

(1) Business Mathematics (Commerce 110), Elementary Analysis (Mathematics 100), or Fundamental Concepts of Mathematics (Mathematics 101)
(2) Science elective
(3) Introduction to Critical Reading, Thinking, and Writing (English 100)
(4) Foreign language[1]
(5) Introduction to Business (Commerce 100)
(6) Physical Training

Second Year

(1) Laboratory science or mathematics elective
(2) English elective
(3) Language elective (continuation of language elected in first year)
(4) Elective
(5) Financial Control (Commerce 200)

Third Year

(1) Group A elective
(2) Group B elective
(3) Group C elective
(4) Elective
(5) Business Statistics (Commerce 310a, first semester); Finance and Currency (Commerce 315b, second semester)

Fourth Year

(1) American History (History 110)
(2) Law and Society (Political Science 310)
(3) Group A elective
(4) Marketing (Commerce 410a, first semester); Business Finance (Commerce 415b, second semester)
(5) Business Organization I (Commerce 420a, first semester); Business Organization II (Commerce 425b, second semester)

Health and Physical Education

First Year

(1) Introduction to Critical Reading, Thinking, and Writing (English 100)
(2) General Biology (Biology 100 or 120)
(3) Introduction and Principles of Health and Physical Education (H. & P. E. 100a, first semester); Physiological Hygiene (H. & P. E. 110b, second semester)

[1] Students having two or more high school units in a foreign language are not permitted to enroll in a beginning course in that language.

(4) Laboratory (H. & P. E. 125)
(5) Fundamentals of Chemistry and Physics (Physical Science 150)
(6) Foreign language[1] or Military Science or Naval Science

Second Year

(1) English or literature elective
(2) Intramural Sports, School-Community Recreation Programs, and Safety Education (H. & P. E. 200a, first semester); History and Philosophy of Physical Education and Athletics (H. & P. E. 210b, second semester)
(3) Laboratory (H. & P.E. 225)
(4) Foreign language (continuation of language begun in first year)
(5) Elective
(6) Elective or Military Science or Naval Science

Third and Fourth Years

At least ten courses are required, including at least three in the major, one in psychology, and one in anatomy and public health. A minimum of seven of the ten courses must be advanced (numbered 300 or higher).

Students planning to enter educational work should consult the teacher-training adviser of the department concerning his electives.

Graduate Degrees

Fields of Study

The degree of Doctor of Philosophy may be awarded in the fields of biology, chemical engineering, chemistry, civil engineering, economics, electrical engineering, English, French, geology, German, history, mathematics, mechanical engineering, philosophy, or physics. This degree is awarded after the successful completion of a program of advanced study extending to the frontier of knowledge and an original investigation reported in an approved thesis. Normally, three or more years of study are required after the award of a suitable bachelor's degree. As final evidence of his preparation for this degree, the candidate must pass a public oral examination.

The degree of Master of Arts is available in the humanities and scientific fields of study, and the degrees of Master in Architecture or Master of Science may also be obtained, the latter being awarded in chemical, civil, electrical, or mechanical engineering. Each of these degrees represents the completion of at least one full year of advanced work in a special field. Programs will generally include a piece of original work embodied in a thesis, and the candidate's preparation will be evidenced by a public examination. Students whose undergrad-

[1] Students having two or more high school units in a foreign language are not permitted to enroll in a beginning course in that language.

uate preparation has not included sufficient specialized work, or whose time is partly occupied with teaching duties, usually will require at least two years to complete the requirements for a master's degree.

Language Requirements

A candidate for the master's degree will be expected to demonstrate a reading knowledge of one foreign language to a committee composed of one representative of the appropriate language department and one representative of the candidate's major department.

A candidate for the degree of Doctor of Philosophy will be expected to demonstrate a reading knowledge of either French or German to a committee composed of one representative of the appropriate language department and one representative of the candidate's major department. In addition, he will be expected to demonstrate to the satisfaction of the Committee on Graduate Instruction a reading knowledge of one other language approved by his major department.

The Committee on Graduate Instruction has authorized three scheduled periods for the language examinations required of all candidates for the M.A. and Ph.D. degrees. The initial examination will be held during the first week after registration. This is the latest period in which Ph.D. candidates may fulfill the language requirements for graduation the following June. A second examination will be scheduled during the first week of the second semester, and the third examination will be conducted in the first week of May. Candidates for the M.A. degree may satisfy the language requirements in any of these three examination periods.

Graduate students must consult with the language department to determine the exact time and place of these examinations and must inform their major departments, which will supply suitable material for examinations in the disciplines concerned. Examination results will be reported to the student's department.

Oral Examinations

The committee for an oral examination is appointed by the Committee on Graduate Instruction upon request of the candidate's thesis director and the chairman of the department. Such request must be made prior to the beginning of the second semester of the year in which the degree is expected. The oral committee consists of at least three members: the thesis director, one other member from the department, and one member in a related field outside the department.

It is the responsibility of the candidate to inform the members of his committee of the nature of his research and his progress; before April 1 the members of his committee must approve his thesis in preliminary form.

The oral examination may be scheduled at any time prior to the first Friday of Examination Week of the academic year in which the degree

is expected, provided that the examination is announced in the Rice weekly Calendar of Events the previous week. In the event that the examination is scheduled during the summer, the posting of an appropriate notice on the bulletin board of Fondren Library the preceding week will be acceptable as the public announcement.

The length of the examination and the character of the subject matter on which the candidate will be examined is left to the judgment of the committee. In the event of the failure of the candidate, the chairman may reschedule the examination a second time. In the event of a second failure, the student will be required to withdraw from the University.

Thesis Regulations and Procedure

The thesis is the principal record of work for an advanced degree. It will be bound in buckram and permanently preserved in the library, and it is important that the standard form indicated below be followed.

1. The thesis in final form, including an abstract of not more than 600 words, should be presented in triplicate to the professor in charge of the thesis work, not later than the beginning of the final Examination Week. It should be fastened together in such a way as to avoid loss or mutilation of pages without punching holes in the sheets. A compression binder is recommended.
2. After securing the approval of the three members of the oral committee on the title page, the candidate must then present the three copies, together with a fee of $9.00 to cover the cost of binding ($3.00 per copy), to the office of the Dean of Graduate Studies on the second floor of the Chemistry Building, *not later than the Friday before Commencement.* Theses more than one inch in thickness must be bound in more than one volume. Candidates may have additional copies of the theses bound for their own use at the rate of $3.00 per copy.

All dissertations for the Ph.D. degree after June, 1962, will be microfilmed, and the abstract will be published in *Dissertation Abstracts.* An additional fee of $20.00 will be required of doctoral candidates to cover this cost.

More specific information about requirements for advanced degrees in each field of study is given under department headings in the section of this catalogue describing course offerings, which begins on page 79.

By special arrangement with the head of the department in which he is specializing, a graduate student who is already a candidate for an advanced degree may enroll in an approved research course during the summer. Such enrollment will be for a twelve-week period starting with the end of the regular academic year. Laboratory fees only will be charged.

Reserve Officers' Training Corps Programs

Rice University offers two Reserve Officers' Training Corps programs—the Army and the Navy. The mission of these programs is to train college students so that they may qualify upon graduation as commissioned officers in a component of the United States Army or Navy. Upon successful completion of one of the R.O.T.C. programs and graduation with a baccalaureate degree, the student may be given a commission in the appropriate service. The Navy has two categories of midshipmen, one working toward a reserve commission and the other toward a regular commission. The Army normally awards reserve commissions; however, certain selected distinguished military students may be offered commissions in the Regular Army.

Any student dropped by the University for academic failure or other cause is immediately disenrolled from the R.O.T.C. programs. Any student performing unsatisfactory work in military or naval science courses, or possessing unsatisfactory officerlike qualities may be disenrolled from the R.O.T.C. programs regardless of the quality of his academic work. Students taking five-year courses are considered eligible for enrollment at the beginning of their first or second year. In view of the heavy academic loads for fifth-year engineering students and scheduling difficulties, all students are encouraged to enroll in the regular manner during Freshman matriculation. Enrollment in the R.O.T.C. programs at Rice University is made at the beginning of the fall term only.

Military Science

The Department of Military Science was established in the fall of 1951. A U. S. Army officer, designated the Professor of Military Science, with assistance of officers and men of the U. S. Army, administers the program. Training in military leadership is emphasized, with instruction being given in subjects common to all branches of the Army and in tactics and techniques of the Corps of Engineers. The course is a four-year program consisting of two main subdivisions: (1) Basic and (2) Advanced. Students electing the A.R.O.T.C. do so for only two years at a time. The first election is for the two-year Basic Course; after which, if the student is recommended for further training, he may elect the Advanced Course. Both courses include one hour of drill per week.

In the Basic Course, Freshmen attend class one hour per week and Sophomores three hours per week.

The Advanced Course includes four classroom hours per week during the second semester of the Junior year and the first semester of the Senior year in management and command responsibilities. The remaining semester in each year includes one classroom hour per week of military instruction and one academic elective selected to meet the need for a broad background for the candidate for commissioned rank. Advanced Course students are required to attend one summer camp, which normally comes between the Junior and Senior years. This camp consists of practical military instruction.

The Advanced Course provides a stipend of about one dollar per day during the last two years and affords a draft deferment during these years.

Naval Science

The Department of Naval Science at Rice University was established in the fall of 1941 and is an integral part of the organization of the University. It is administered by a senior U. S. naval officer who is the Professor of Naval Science. He is assisted by officers and men of the U. S. Navy and Marine Corps. The purpose of the Naval Reserve Officers' Training Corps is to train highly select young men for either naval service as commissoned officers of the Regular Navy and Marine Corps (Regular Program) or as reserve officers.

There are, therefore, two categories of N.R.O.T.C. students: (1) Regular; (2) Contract.

Regular Students. A regular N.R.O.T.C. student is appointed a Midshipman, U. S. Naval Reserve, on a nationwide competitive basis and receives retainer pay at the rate of $50.00 per month for a maximum of four years, with all fees, books, and equipment paid for by the government. Required uniforms are furnished. He is required to complete twenty-four semester hours of naval science subjects (one course per term, including those courses taught by the civilian faculty which are a part of the Navy curricula) and other training prescribed during the summer months, and upon graduation with a baccalaureate degree to accept a commission as Ensign in the U. S. Navy or Second Lieutenant in the U. S. Marine Corps.

Contract Students. Contract students are civilian college students who enter into a mutual contract with the Secretary of the Navy in which they obligate themselves to take naval science courses and drills and one summer training cruise. In return, the Navy provides the required uniforms, pays them a subsistence allowance (currently about $30.00 per month) during their Junior and Senior years, provides draft deferment, and offers a reserve commission in the Navy or Marine Corps upon graduation.

Contract students are *not* selected by the competitive procedure indicated above for Regular students; rather they are selected by the Commanding Officer (Professor of Naval Science) from among those students who apply who are either selected for admission by Rice University or who are already in attendance. Contract students are deferred from the draft.

U. S. Marine Corps. N.R.O.T.C. students, either Regular or Contract, may apply for transfer to the Marine Corps program during the Sophomore year. Such selectees are referred to as Marine Corps option students and attend separate classes under a Marine officer instructor during their Junior and Senior years.

The N.R.O.T.C. course of training consists of courses of instruction, laboratory periods, and drill, together with such training duty or training cruises as may be prescribed.

The Navy prescribes certain course requirements for N.R.O.T.C. students as follows:

1. By the end of the Sophomore year each Regular student must have satisfactorily completed one year of college physics.
2. By the end of the Sophomore year every student must have satisfactorily completed mathematics through trigonometry.
3. Every student must achieve proficiency in written and oral expression.

Rice University will prescribe standards of proficiency and determine procedures necessary to achieve them.

Academic Regulations

All students seeking a bachelor's degree are subject to the rules of the faculty Committee on Examinations and Standing. The Committee administers the rules described below. Under unusual circumstances any student may submit a written petition to the Committee requesting special consideration.

Registration

All currently enrolled students register in May for the following academic year. Entering students are sent registration materials during the summer. All registrations must be completed by September 1.

The course registration card of each student must be approved and signed by an adviser. Registrations of Freshman and Sophomore students are approved by faculty advisers appointed in the colleges; others are approved by an adviser appointed by the head of the department of the student's major field of study.

No student can be registered in or allowed to enter any course or section later than two weeks after the date of opening of courses as given in the Academic Calendar (page v). A student who makes a change of course or section within the first two weeks of the term is charged a fee of $10.00 per course. This fee is not charged when a change in a student's registration is a result of modification of the course offerings or class schedules of the University. However, any stipulation of this paragraph may be waived at the discretion of the Committee on Examinations and Standing.

Course Programs

Normal course programs for all undergraduate students are described on pages 37-44 and in more detail in supplementary sheets supplied each student before registration. Any variation from normal course programs, including reduced course loads, must be approved by the Committee on Examinations and Standing except that a student failing to complete a first baccalaureate degree within four full years is permitted to register for only those courses actually needed for graduation, provided he is not on probation.

Approval of Majors

In the second semester of the Sophomore year, each student is required to submit his choice of major to the Committee on Examina-

tions and Standing. The Committee's action is guided by (1) aptitude shown by the student's record during the first two years; (2) limitations of departmental capacities for receiving students in the various major programs. Until a student's major has been approved he cannot enter the Junior courses of that curriculum.

Change of Curriculum

Any proposed change of curriculum is subject to the approval of the Committee on Examinations and Standing. At its discretion, the Committee may require any student to change his curriculum when his work is unsatisfactory.

Examinations

Written three-hour examinations are given in all undergraduate courses at the close of each semester. Late semester examinations are given only when an examination is missed because of illness or some other unavoidable circumstance, and only on approval of the Committee on Examinations and Standing.

Other tests are given from time to time at periods decided by the instructors. All tests and examinations are conducted under a student honor system (see p. 73). In determining grades, instructors consider both performance during the term and the record of examinations.

Grade Symbols

Grade symbols have the following meanings: *1*—Very high standing; *2*—High standing; *3*—Satisfactory standing; *4*—Poor standing; *5*—Failure. Most courses require two consecutive semesters for completion. Grades are recorded for the first semester in February; in June, grades are recorded for the second semester and for the year in year courses. In the latter, the yearly grade determines the student's credit in the course.

Dean's List

Outstanding students are honored each semester through the publication of the Dean's List, which includes all students who have no grade less than 2 in any course. This distinction is made a part of the student's permanent record, and he is also granted certain special privileges.

Probation

A student who fails to do academic work of high quality is placed on probation by the Committee on Examinations and Standing if:

(1) he does not earn passing grades in at least 75 per cent of his full schedule in any semester.

(2) he does not earn grades of 3 or higher in at least 50 per cent of his normal course program in any semester.

The period of probation extends to the end of the next semester in which the student is enrolled in the University. A student is not placed on probation more than twice during his residence, but instead of a third probation is required to withdraw from the University.

A student who goes on probation at the end of the year in which he is a degree candidate but who is eligible to reregister may complete his degree requirements by earning grades, in a program of at least four additional courses, that remove him from probation.

A student on probation, either academic or disciplinary, is not permitted to be a candidate for or to hold any elective or appointive office or honor; or to serve as editor, assistant editor, business manager, or assistant business manager of any University publication.

Special Probation

At its discretion, the Committee on Examinations and Standing may grant the privilege of special probation to an individual student who otherwise would not be permitted to continue at Rice University in his desired program. Special probation requires that a student shall have no grade less than 3 during the period of his special probation and, further, that he must remain off probation thereafter.

Enforced Withdrawal

A student shall be required to withdraw from the University:

(1) If he fails to earn passing grades in at least 50 per cent of his normal course program in any semester, or for any academic year. This clause does not apply to an undergraduate student at the end of his first semester at the University.
(2) If he has already been placed on probation twice and his semester grades, at any subsequent time, are such as would result in a third probation.
(3) If he fails to fulfill all the terms of special probation as described above.

Voluntary Withdrawal and Readmission

A student who withdraws voluntarily while not on probation will ordinarily be readmitted within three years. Any student desiring to withdraw voluntarily from the University must do so in person or by letter at the Registrar's Office to be eligible for readmission. If withdrawal occurs within five weeks of the beginning of any semester examination period, grades as of the date of withdrawal may be used to determine eligibility for readmission.

Removal of Course Deficiencies

Course deficiencies resulting from failing grades or changes in curriculum may be removed by satisfactory work in summer school. To obtain credit for summer school work, prior approval of the Committee for specific courses must be obtained, and a transcript showing the student has satisfied all conditions stipulated by the Committee must be submitted. Credit is not given for more than two summer school courses taken to remove deficiencies, nor is credit for future courses in a student's program granted for work done in summer school.

Graduation

To be recommended for any bachelor's degree, a student must have earned grades of 3 or better in at least 50 per cent of work prescribed for that degree, including grades of 3 or better in at least 50 per cent of work undertaken in his major field after completion of the Sophomore year. He must not go on probation at the end of the year in which he is a degree candidate.

Honors

The Committee on Examinations and Standing reviews each student's record at the time of graduation and recommends to the faculty outstanding students to be granted degrees *cum laude, magna cum laude,* or *summa cum laude.*

Information for New Students

Admission of Undergraduates

Admission of Freshmen

In selecting members of the Freshman class from the large number of well-qualified candidates who apply for admission, William Marsh Rice University undertakes to identify and to admit those with exceptional ability and potential who appear best prepared to grow to intellectual maturity during their residence at the University.

The criteria used in the prediction of such development are of four basic types: 1) past scholastic performance as evidenced by high school grades; 2) scores made on the Scholastic Aptitude and Achievement Tests administered by the College Entrance Examination Board; 3) the evaluation made by teachers, counselors, and interviewers; and 4) performance on the College Entrance Examination Board Writing Sample. Scholastic performance provides a reasonable indication of the applicant's study habits, scholastic enthusiasm, and desire to learn. College Entrance Examination Board scores furnish a credible basis to compare one individual with a very large number of other persons of similar background when set to a specific scholastic assignment. Interviews and ratings obtained from high school teachers and counselors give some insight into such currently unmeasurable factors as motivation, family background, and emotional stability, which must also be considered.

The experience of Rice University indicates that those most likely to succeed are the applicants who have, in addition to the obvious desirable personal traits, scholastic standing in the upper five per cent of their graduating classes and very high College Entrance Examination Board scores. Not all students with high scholastic standing in high school and good College Entrance Examination Board scores become outstanding Rice students; however, nearly all well-adjusted, well-motivated students of high intellectual capacity and intellectual curiosity have good chances of success.

Students are selected on a competitive basis in accordance with admission quotas in the Architectural, Humanities (Academic), and Science-Engineering programs of the University.

For further information or application forms, candidates for admission as undergraduates should communicate with the Director of Admissions. When requesting application forms, the candidate should

clearly indicate whether he is a prospective high school graduate or a prospective transfer from another college. Application forms should be requested and filed between November 1 and February 20 for entrance the following September.

A student who has been admitted to the University is required within two weeks after the date on the notice of his acceptance to submit a written statement of his intention to enroll, accompanied by a payment of $25.00 which will be credited to his account as part payment of the fees required at the opening of the session. The payment will be returned if the student changes his plans and serves notice before June 1. After June 1, it will be refunded only in cases of hardship, such as illness. Should a student fail to register, without giving notice of his intention prior to June 1, the $25.00 payment will be forfeited.

1. The High School Record. Graduation from an approved public or private high school with not less than sixteen acceptable units is required. These units should include:

English	4	Laboratory science	2
Social studies	2	(Biology, chemistry,	
Algebra	2	physics)	
Plane geometry	1	Additional credits	
Trigonometry	½	in solid subjects	2½
Foreign language	2		
		Total	16

An introductory high school course in chemistry, or the equivalent, must be taken if any chemistry is to be studied at Rice. Likewise, a high school course in physics, or the equivalent, should precede the study of any physics at Rice. Variations from the above distribution of units will be approved only in cases of exceptionally high scholastic and examination standing.

2. Entrance Examinations. The entrance examinations and the writing sample are administered by the College Entrance Examination Board. The C.E.E.B. publishes a "Bulletin of Information" which contains an application blank and gives full details regarding the procedures for taking the entrance examination and the writing sample, and also a schedule showing the time and place of administration. Applicants should write to the C.E.E.B. and request a copy of this bulletin. Interested persons in the Southwest and other areas east of the Rocky Mountain states should address the College Entrance Examination Board, Box 592, Princeton, New Jersey. Applicants attending schools in New Mexico, Colorado, and points west should address the College Entrance Examination Board, Box 27896, Los Angeles 27, California. A supply of C.E.E.B. bulletins is available on the Rice campus for those individuals who find it convenient to call for them. These examinations may be taken in December, January, or March.

The following examinations are specified, according to the curriculum involved:

Academic and Architecture

(1) Scholastic Aptitude Test
(2) Three Achievement Tests as follows:
  (a) English composition
  (b) Any two of the following:
    A foreign language
    Social studies
    Mathematics
    A science
(3) The Writing Sample

Science-Engineering

(1) Scholastic Aptitude Test
(2) Three Achievement Tests as follows:
  (a) English composition
  (b) Advanced mathematics
  (c) Chemistry or physics
(3) The Writing Sample

A list of the courses of study and majors offered may be found on pages 36-44.

3. Personal Interviews. All applicants who can conveniently present themselves at the University will be interviewed between December 15 and March 1 of each academic year. Applicants living at such a distance that they cannot conveniently come to Houston will be given opportunities for interviews during the month of March in such population centers as Beaumont, Dallas, Fort Worth, and San Antonio. Each applicant who has filed all his application forms by February 20 and has requested such an interview will be sent a notice of the time and place of the interview. Applicants who have completed their application files and who are unable because of distance to meet interview engagements in Houston or in one of the other interview centers will be interviewed individually by alumni. If an applicant cannot readily be interviewed by one of these methods, the interview may be waived, without prejudice.

4. Ratings From High School Counselors and Teachers. Confidential rating sheets submitted by the applicant's high school teachers and counselors are considered in connection with every application.

The Committee on Admissions cannot give final consideration to applications until the results of the March College Board tests are available in April. Notices regarding the action taken by the Committee are sent to applicants during the early part of May. Detailed information about residence in the colleges and room application forms will be sent when admission is granted.

Admission of Transfer Students

The number of candidates who may be accepted as transfers from other colleges and universities is limited by the capacity of the Univer-

sity to absorb them. In order to be considered for admission as a transfer student, the applicant must have completed five full-year courses which are applicable to the degree he will seek at Rice.

Candidates for transfer should communicate with the Director of Admissions before March 1, if possible. When requesting application forms, the applicant should indicate clearly the number of years of work he will have completed in his present college by the following June. The transfer applicant who has never taken the C.E.E.B. tests will improve his chances by securing high scores on the Scholastic Aptitude Test.

Decisions regarding transfer applications are usually made during May.

Advanced Placement

Entering Freshman students who have done work beyond the usual high school courses in certain subjects and who make superior scores on the Advanced Placement examinations offered by the Educational Testing Service may be given recognition for their achievements. Degree credit and advanced standing may be given in the following subject-matter fields: mathematics, American history, English, French, German, Spanish, physics, chemistry, and biology.

Scholarships and Loans Available to New Students

William Marsh Rice University has a number of modest scholarship awards available to incoming students. These awards, ranging from $200 to $500, are limited to entering Freshmen; transfer students may compete for scholarships after one year of residence.

The University has a loan fund which attempts to meet the needs of students for loans on a long-term as well as a short-term basis. The loans are limited to $1,000 per year for one person.

Admission of Graduate Students

An applicant for admission to graduate study should address all communications to the chairman of the department in which he wishes to study. The chairman will provide the relevant information about the graduate program and the appropriate application form. The completed form, with the transcript and photograph, should be returned to the chairman of the department. After the members of the staff have made a preliminary evaluation, the application form with the letters of recommendation will be transmitted by the chairman to the Committee on Graduate Instruction for final action.

In addition to any specific requirements of the department, the applicant will be expected to have at least a "B" average in his under-

graduate work. Preference will be given to applicants who earn high scores on the Graduate Record Examination. Arrangements to take this examination may be made directly with the Educational Testing Service, 20 Nassau Street, Princeton, New Jersey. Applicants in the Houston area may also apply in person to the Director of Admissions at Rice for the necessary forms.

Fees and Expenses

Tuition

The opportunities for study and research offered by Rice University are open without tuition to men and women who are accepted for admission. Students are expected to meet all expenses incurred for textbooks and supplies, room and board, clothing and incidentals, and certain fees.

Undergraduate Fees

Regular Fees

Each student, resident or nonresident pays a comprehensive fee of $112.00 per year which covers a registration fee, a library fee, an examination fee, a fee for student activities, admission to athletic contests, use of the health service, use of the gymnasium, use of the Memorial Center, and participation in college activities. In addition, each student pays $10.00 for each semester of the laboratory courses he is taking.

Special Charges

Freshman Week	$15.00
Late registration	15.00
Late examination (each course)	10.00
Diploma	6.00
Army R.O.T.C. (Deposit)	10.00

Graduate Fees

Once a year, at registration, each student will pay $126.00 in General Fees for registration and for use of the library, the laboratories, the gymnasium, the infirmary, and other campus facilities. In the year in which he is a candidate for a degree he will also pay $6.00 for his diploma. There will be no additional fees for laboratory courses. If a student is not in residence in the year of his degree, he will pay only $90.00 in General Fees, plus the $6.00 for his diploma.

A graduate student may purchase a Student Athletic Card, at a cost of $4.00, which will entitle him to admittance to all regularly scheduled athletic events. If married, he may purchase one additional card at the same price.

Guaranty Bond

Every student, both graduate and undergraduate, is required to provide a $300.00 guaranty signed by himself and a parent, guardian, or other responsible person.

Refund of Fees

If a student withdraws during the two weeks following the opening day of classes all fees will be refunded. When withdrawal occurs within the third or fourth week one-third of the fees will be refunded. No refund of fees is made after the end of the fourth week of classes.

Delinquent Accounts

No student in arrears in any financial obligation to Rice University as of September 1 of any year will be registered. All accounts must be paid or satisfactory arrangements for payment made before a student will be issued any certificate of attendance, diploma, or transcript of credit.

Living Expenses

Undergraduates

Residence fees to cover costs of dining halls, operation of residences, and the Health Service are established from year to year as requirements dictate. For 1961-62, the yearly fee for residence in the men's colleges was $950.00, in the women's college $1,000.00. This charge provides for room and three meals per day excluding the evening meals on Saturdays and Sundays. Meals are not served during the Thanksgiving, Christmas, mid-term, and Easter recesses. A room deposit of $50 is required of each student by June 1 in order to secure his assignment for the academic year to follow. New students are required to make a similar deposit upon notification of room assignments during the summer. These deposits are returnable only upon individual application and for good and sufficient cause. One-half of the residence fee should be paid upon taking up residence in September. The remaining sum should be paid before the commencement of classes in February.

Students whose financial situation makes difficult the usual method of payment outlined above may make arrangements with the cashier to make a substantial payment in September followed by monthly payments throughout the year.

All items included, the young man or woman who is a resident member of one of the colleges will need to have available about $1,500 for a year's work. For a student living at home the cost will run from $250 to $350. These figures are based on 1961-62 experience.

Graduate Students

At present the University has no housing on the campus for graduate students. However, within walking distance of the campus there are many rooms and apartments for rent at reasonable prices. For the convenience of new students the Dean of Students keeps a record of rooms and apartments about which he has been notified, and the daily newspapers list still others. Incoming graduate students are advised to arrive in Houston a day or two early in order to find lodging.

Occasionally room and board for a graduate student may be available in one of the four undergraduate residential colleges for men ($950 per year) or in Mary Gibbs Jones College for Women ($1,000 per year). A graduate student wishing to be considered for such a room may write to the Dean of Students or to the Adviser to Women asking to be put on the waiting list. It will be advisable, however, to assume that lodging must be found off campus, since obtaining an accommodation on the campus is unlikely and since the Dean and the Adviser to Women cannot know before the term begins about vacancies in the colleges.

Scholarships, Fellowships, Grants, Loans, and Employment

Undergraduate Scholarships and Grants

To encourage students in devotion to learning and in striving to develop creative capacity in productive scholarship many friends of Rice University have established undergraduate scholarships and grants-in-aid. These are reserved principally for students who have been in residence at least one year although a few are designated for entering Freshmen with exceptional records. Honorary scholarships without stipend are also awarded to students who have demonstrated outstanding ability and promise of future development.

The *Alcoa Foundation Scholarships* are awarded to four students of engineering who are in either the Junior, Senior, or fifth year of study.

The *American Institute of Chemical Engineers, South Texas Section,* annually provides a scholarship for a student of chemical engineering who is a resident of the area served by the Section.

The *American Society for Metals, Texas Chapter,* has established a scholarship fund for an advanced student in engineering whose primary interest is in metallurgy.

The *Samuel S. Ashe Scholarship* is awarded annually to the student having highest standing at the end of the Freshman year.

The *Max Autrey Memorial Scholarships* were established under the will of the late Mrs. Nettie S. Autrey in memory of her son. First awarded in 1942, they are open annually to all current students.

The *Axson Club's Ellen Axson Wilson Scholarship* was established in 1922 for a young woman student of Junior or Senior standing.

The *Axson Club's Katie B. Howard Scholarship* for young women, in memory of Mrs. A. R. Howard, has been awarded annually since 1937.

The *B. & H. Instrument Company* has provided two scholarships annually since 1956 to encourage and assist worthy students in electrical and mechanical engineering.

The *Mr. and Mrs. Val T. Billups Scholarship* fund was established by the named donors in 1953 for students of engineering above Freshman standing.

The *Black-Brollier Scholarship* was established in 1956 for students in architecture above Sophomore standing. Awards are made annually during the first semester.

The *Blum Scholarship* in architecture was established by a gift from Mr. Max Blum of Pittsburgh, Pennsylvania. It will be awarded for 1962-63 to a third-, fourth-, or fifth-year architectural student on recommendation of the faculty in architecture.

The *Borden Freshman Prize* is given to the student having the highest grades for all work of the Freshman year.

The *Cabot Engineering Scholarships* are two-year and three-year awards made available to Junior students in engineering by the Cabot Foundation.

The *Chapman-Bryan Memorial Scholarship* was created in 1937 by the bequest of Miss Johnelle Bryan on behalf of her sister, Mrs. Bryan Chapman, and the donor.

The *College Women's Club of Houston* established a fund in 1942 to provide a scholarship to assist a young lady in her first year of graduate study. The scholarship is awarded annually to a graduating Senior.

The *Millie Tutt Cook Scholarship* is for the benefit of a Junior or Senior student preparing for a career in teaching.

The *Thomas A. and Pauline M. Dickson Scholarships* were established in 1932 to assist young men and women students who are largely self-supporting.

The *John L. and Exna Doré Scholarship* provides a fund annually to assist deserving students of the Sophomore, Junior, and Senior classes.

The *Edwards Scholarships* are given to entering Freshman students who are planning careers in government service.

The *Elizabeth Baldwin Literary Society Scholarship* is available to both men and women students of the University on recommendation of the officers of the Society.

The *Elks Scholarship* is provided by the B. P. O. Elks Lodge, No. 151, of Houston for a Sophomore student of the University.

The *Engineering Alumni Scholarship* is awarded a student who is a candidate for a Bachelor of Science degree in one of the four branches of engineering.

The *Farb, Miller & Beerman Company Scholarship* in accounting is awarded to a student entering the Junior year.

The *Thomas R. and Julia H. Franklin Scholarship Fund,* established in 1937, provides income to be devoted to the awarding of annual scholarships to well-qualified necessitous students.

The *Mary Parker Gieseke Scholarship* is awarded annually to a student who has been in residence at least one year.

The *Graham Baker Studentship* was the first undergraduate scholarship established at the Rice Institute. It is awarded annually to the student in the three lower classes earning the highest scholastic standing for the academic year.

The *Blanche Randall Haden Scholarship* is awarded annually to a deserving undergraduate specializing in economics.

The *Wm. D. and Lucy L. Haden Scholarships* were founded by Mr. Cecil R. Haden for entering students in architecture.

The *Haskins & Sells Foundation Scholarship* in accounting is awarded to one of the five Senior students having the highest academic standing in accounting.

The *Hohenthal Scholarships* are awarded to students of high scholastic standing who are earning a substantial part of their expenses.

The *Will Hogg Memorial Fund* was established by the will of the late William Clifford Hogg in 1936. From this fund two scholarships are awarded annually, the *Will Hogg Memorial Distinguished Studentship* and the *Will Hogg Memorial Scholarship.*

The *Houston Engineering and Scientific Society Scholarship* is awarded to a Senior or fifth-year engineering student who is recommended to the Society by a committee of the University faculty.

The *Hughes Tool Company Scholarship* is an award to a student entering the fifth year of the curriculum in mechanical engineering.

The *John McKnitt Alexander Chapter* of the Daughters of the American Revolution provides an endowed undergraduate scholarship for a young woman student of Rice University.

The *Jones College Scholarships* are made available by the Mary Gibbs Jones College Cabinet for a member of the college who has maintained high academic standing and has contributed significantly to the college life.

The *Grant William Jordan and Cora Jordan Memorial Fund* is available in trust to assist young men and women in obtaining an education at Rice University.

The *Lady Washington Texas Centennial Award* is made annually to a young woman student from funds donated by the Lady Washington Chapter of the Daughters of the American Revolution.

The *Patrons of E. L. Lester and Company Scholarship* is an annual award provided by E. L. Lester and Company in honor of its employees and customers for an entering male student in engineering, physical science, or related fields.

The *Margaret Brokaw McCann Scholarship,* established by her husband, S. G. McCann, first Rice Registrar, by their son, Dr. S. M. (Donald) McCann, and by many friends, is awarded to a high-ranking, deserving young woman of one of the three upper classes, who plans advanced work in nursing, medicine, or other welfare fields. It will be first awarded for the 1963-64 academic year.

The *Achille and Malline Meyer Memorial Scholarship* is awarded annually to a fully or partially self-sustained student of the University.

The *Leonard S. Mewhinney Scholarship,* established in 1952 by the Brown Foundation, is awarded to a Naval R.O.T.C. student enrolled in a five-year engineering program at Rice University who has attained high academic standing and demonstrated aptitude for the naval service.

The *Mission Manufacturing Company Scholarships* in mechanical engineering are supported by the Mission Manufacturing Company for meritorious students in that field of study who show potential capacity for leadership.

The *Jesse H. Jones Naval Scholarships* honor Fleet Admiral William F. Halsey, Jr., and General Alexander Archer Vandergrift. All members of the N.R.O.T.C. unit, including entering students, are eligible.

The *Ida R. and Hannah E. Nussbaum Scholarship* provides an undergraduate scholarship in memory of the late Miss Ida Nussbaum and her sister.

The *Rebecca and Lilly G. Nussbaum Scholarship* was established under the will of the late Miss Ida R. Nussbaum in memory of her mother and sister.

The *Pallas Athene Literary Society Scholarship* is available to young women students of Rice University on recommendation of the officers of the Society.

The *Emanual and Mose Raphael Scholarship* was established by bequest of Miss Ida R. Nussbaum in memory of her uncles.

The *Richardson Fund* for Rice students was bequeathed in trust by Mrs. Libbie A. Richardson, widow of Alfred S. Richardson, who was a charter member of the Board of Trustees of Rice University.

The *Daniel Ripley Scholarship* was established in 1927 to be awarded to a self-supporting young man or woman completing the Freshman year with outstanding scholarship.

The *Edith Ripley Scholarships* are awarded annually to three young women students from the income of a fund donated by Mrs. Edith Ripley in 1928.

The *James M. and Sarah Wade Rockwell Scholarships* were established by a fund donated in 1958 in memory of the founders of the Rockwell Fund, Inc. The number of awards and the students to receive each scholarship are determined by a committee of the faculty appointed by the President of the University.

The *Benjamin E. and Catharine W. Roper Memorial Scholarships* were established through the will of their daughter, Miss Mary Withers Roper, to assist worthy students of the University.

The *Sarah Lane Literary Society Scholarship* is provided for by the membership of the Society to be awarded to an undergraduate student on recommendation of the officers of the Society.

The *Schlumberger Collegiate Award* is given by the Schlumberger Foundation for an advanced student with high standing in physics, geology, or electrical or mechanical engineering.

The *Sara Stratford Scholarship* for women students of Rice University commemorates the late Mrs. Sara Stratford, first Adviser to Women.

The *Superior Oil Company Scholarships* are provided for through a gift from the Superior Oil Company to assist worthy entering students who are planning to study geology.

The *Texaco Scholarships,* made possible by Texaco, Inc., are awarded to Junior and Senior students of proven scholastic ability who have demonstrated qualities of leadership.

The *Union Carbide Scholarships* at Rice University are a part of a national scholarship program supported by the Union Carbide Corporation.

The *University Women's Alliance of Houston* awards a scholarship, based primarily on need of financial assistance, to a young woman in the Junior or Senior class. The recipient of the award is determined after consideration of scholarship, character, and personality.

The *Walsh Prize in Architecture* is awarded by the faculty in architecture, on the basis of a competition, to an architecture student completing his fourth year of study.

The *Weingarten Scholarship* was endowed by the Weingarten Welfare Corporation in 1957 to assist a worthy scholar of good character.

The *Western Electric Company Scholarship* is maintained by the Western Electric Company for a student in engineering who has demonstrated exceptional promise and ability in his chosen field. Selection of the recipient is made by a committee of the faculty.

The *Westinghouse Achievement Scholarship* is given to Rice University to be awarded to a fifth-year student in electrical or mechanical engineering who has achieved high scholastic standing and demonstrated qualities of leadership.

The *Blanche White Scholarships* are open to students of Rice University who have completed at least one year in residence.

The *Woman's Club of Houston* provides an annual award for an entering student, based upon scholarship and financial need.

Graduate Fellowships and Scholarships

Fellowships

Provision is made for a variety of fellowships available to graduates of this and other universities. There are several memorial fellowships that have been founded and endowed by gift or bequest on the part of friends of Rice University. These provide a stipend designed to enable the holder to devote his time to study and research in his chosen field. There are also several industrial fellowships maintained by companies interested in the development of technical fields and the training of competent scientists and engineers.

Persons desiring to be considered for appointment as fellows should consult with the department in which they desire to work.

American Oil Company Fellowship in chemical engineering.

American Society for Testing Materials Fellowship in civil engineering.

M. D. Anderson Fellowships in physics.

M. D. Anderson Foundation Postdoctoral Fellowship.

Ora N. Arnold Fellowship Fund. Graduates of Rice University or of Mexico may be appointed. An incumbent from Rice may study in Mexico, the South American states, the West Indies, or the Philippine Islands; an incumbent from the University of Mexico is expected to study at Rice University.

Samuel Fain Carter Fellowship. Established in 1932 for graduate study in economics.

Celanese Corporation Fellowship in chemical engineering.

John B. Coffee Graduate Awards in geology.

Continental Oil Company Fellowship in chemical engineering.

N. M. Davidson Fellowship in architecture.

Dow Chemical Company Fellowships. One fellowship is restricted to the field of chemistry, chemical engineering, or physics; a second fellowship is restricted to the field of mechanical engineering.

Fluor Corporation Fellowship. The field of study is unrestricted.

Humple Oil and Refining Company Fellowships. A total of three fellowships is available for research in the following fields: chemical engineering, chemistry, civil engineering, electrical engineering, geology, mathematics, mechanical engineering, and physics.

Ideal Cement Company Fellowship in civil engineering.

Kobe Steel Works Fellowship in chemical engineering.

Edgar Odell Lovett Fellowship in mathematics.

Magnolia Petroleum Company Fellowship in physics.

National Aeronautics and Space Administration Fellowships.

National Institute of Health Traineeship Award in civil engineering.

Ohio Oil Company Foundation Fellowship in physics.

Pan American Petroleum Fellowship in chemical engineering.

Petroleum Research Fund of the American Chemical Society. Fellowship in chemical engineering.

Phillips Petroleum Company Fellowship in mathematics.

Schlumberger Foundation Fellowship in mathematics.

Shell Oil Company Fellowships. One fellowship is available for study in physics and another for study in mechanical engineering.

Texas Company Fellowship in electrical engineering.

Texas Eastman Fellowship in chemical engineering.

Texas Gulf Producing Fellowship in geology.

William Ward Watkin Memorial Traveling Fellowship in architecture. Provision for a Rice University traveling fellowship in architecture has been made by the alumni of the Department of Architecture and the Architectural Society of Rice University.

Robert A. Welch Foundation Fellowships.

Graduate Assistantship-Fellowships

Graduate students with high academic records and outstanding qualifications may receive assistance through awards of graduate assistantship-fellowships in the various departments of Rice. These awards are of equal value; the stipend for such dual appointments is $1,800-$2,100 with exemption from fees. A student holding a graduate assistantship must be a candidate for an advanced degree; he will be expected to devote a substantial part of his program to study and research, and at the same time to teach one section in an elementary course or to do an equivalent amount of other departmental work. He will thus get a certain amount of valuable practical training in preparation for an academic career. Appointments carrying larger stipends, with a schedule equivalent to a teaching load of two sections, are occasionally available; such appointments depend on the interests and attainments of the student and on the requirements of the department.

In 1961-62, there were 172 Graduate Assistantship-Fellowships awarded. Graduate students holding these appointments were studying in fourteen different departments, distributed as follows:

Biology	10	English	16
Chemistry	22	Foreign Languages	12
Economics	10	Geology	9
Chemical Engineering	21	History	10
Civil Engineering	7	Mathematics	10
Electrical Engineering	3	Philosophy	8
Mechanical Engineering	10	Physics	24

Graduate Scholarships

Students whose previous records show marked promise but for whom no graduate assistantships are available may, especially in their first year of graduate study at Rice University, be awarded graduate scholarships with exemption from all fees but without stipend. Graduate scholars may carry a full schedule of graduate work and are not required to render any service to the University.

Other Graduate Fellowships

In addition to the above fellowships, students also may pursue advanced studies through Woodrow Wilson Fellowships, National Defense Graduate Fellowships, Cooperative National Science Foundation Fellowships, and awards made from grants to the University through such agencies as the Atomic Energy Commission, the National Institutes of Health, and the National Aeronautics and Space Administration.

The Committee on Graduate Instruction processes applications for fellowships submitted by graduate students of Rice University for research in other institutions and in other countries. Among available fellowships of this nature are the Rotary International Fellowship, the Rhodes Scholarships, the Frank B. Jewett Fellowships awarded by the Bell Telephone Laboratories, and the National Science Foundation Fellowships. Applicants for predoctoral fellowships under the Fulbright Act administered by the Institute of International Education, and for postdoctoral research and teaching exchanges under the same act administered by the Committee on International Exchange of Persons, should also file with the Committee on Graduate Instruction.

Rice is one of the sponsoring universities of the Oak Ridge Institute of Nuclear Studies. The Oak Ridge Institute provides a number of fellowships to doctoral candidates who have completed their residence requirements and who want to work on a thesis problem at Oak Ridge because of the special facilities which are available.

Student Loans

Thanks to the generosity of a number of persons, there are available several student loan funds. Students who wish to make inquiries about loans should see the Bursar, who is chairman of the Loan Fund Committee. Entering students, or those not currently enrolled, may address inquiries to the Bursar, Room 102, Lovett Hall.

Loans are available to assist students in payment of fees, room and board charges, or other necessary academic expenses. Terms of repayment are arranged individually at the time a loan is made.

Student Employment

It is strongly recommended that students in their first year do not plan part-time employment unless absolutely necessary to meet expenses. A college course of study is a full-time job requiring fifty to sixty hours per week to do justice to the educational opportunities presented through course work. In addition, every student should take

advantage of the many other opportunities for growth and development that come through participation in the social, political, and cultural activities of the colleges and the student government. New students who must supplement their income are advised to consult the Director of Admissions and the Director of Placement.

There are on the campus and in the city opportunities in considerable variety for worthy and deserving students to earn a part of their expenses. Interested students should visit the Placement Office in the Memorial Center as early as possible.

Academic Honors and Prizes

Honor Societies

Phi Lambda Upsilon, an honorary chemical society, has as its purpose "the promotion of high scholarship and original investigation in all branches of pure and applied chemistry." The Alpha Alpha Chapter was installed at the University in 1927.

The *Phi Beta Kappa Society.* The Senate of the United Chapters of Phi Beta Kappa at its meeting in December, 1927, voted to recommend the establishment of a chapter at the University and at a meeting of the National Council held in September, 1928, the institution of the Rice, or Beta of Texas, chapter was duly authorized. The chapter was formally installed on March 1, 1929, by the secretary of the United Chapters.

The *Pi Delta Phi Society,* organized to interest students of French in competing for high standing in scholarship, authorized in May, 1930, the formation of a chapter of the Society at Rice. The Theta Chapter was formally installed in that year by a delegate of the national organization.

The *Society of the Sigma Xi,* for the promotion of research in science, on the occasion of its thirty-eighth annual convention in December, 1937, acting upon the recommendation of the Executive Committee, duly authorized the establishment of a chapter of the Society at the University. The formal installation of the Rice chapter by the president of the national organization took place on March 23, 1938.

The *Tau Beta Pi Association,* organized to interest engineering students in competing for high standing in scholarship, authorized at its annual convention in October, 1940, the establishment of a chapter of the Association at the University. The Rice chapter, the Gamma of Texas, was formally installed on December 18, 1940, by the national secretary of the Association.

Delta Phi Alpha, German national honorary society, was founded to promote among university students an interest in the German language and literature. The National Council in April, 1949, authorized the organization of the Gamma Xi Chapter at Rice.

Sigma Delta Pi, Spanish national honorary society, was founded to promote among university students an interest in the Spanish language and literature. The chapter at the University was installed on May 14, 1953.

Sigma Gamma Epsilon is a college honor society in the earth sciences. The Beta Sigma Chapter was established in the Geology Department of the University on March 31, 1958.

The Alpha Zeta Chapter of *Sigma Tau,* an engineering society devoted to scholarship, practicality, and sociability, was installed at the University on May 20, 1953.

Prizes and Awards

Several prizes and awards are presented annually in recognition of accomplishment in various endeavors. They are made possible by individuals and organizations who wish to encourage students in certain activities and honor the name of a friend or relative. These prizes constitute a signal honor to the recipient.

The *Ralph Budd Award* is a medal given for the best thesis in engineering.

The *Max Freund Prize* was established in 1954 by former students of Professor Emeritus Max Freund for a student of high academic standing who is pursuing a course of study in German language or literature.

The *John W. Gardner Award* is a medal given to a student presenting outstanding achievement in research in the humanities or social sciences.

The *Lady Geddes Prize in Writing* is awarded annually on the basis of competition which is open to all Freshman and Sophomore students of Rice University.

The *Hamilton Watch Award* is provided by the Hamilton Watch Company for the fifth-year engineering student who has most successfully combined proficiency in his major field with notable work in the humanities.

The *Robert Pilcher Quinn Award* is presented annually to a student who has demonstrated outstanding qualities in athletics, leadership, scholarship, and sportsmanship.

The *Sigma Xi Awards* are given annually by the Rice University Chapter of the Society of the Sigma Xi for proficiency in research. Candidates for degrees at both the master's and doctor's level are eligible.

The *H. A. Wilson Memorial Award* provides a substantial prize for the best research in physics done by a graduate student.

The *Eloise Szabo Witte Studentship* in history is awarded to the member of the Freshman class who has demonstrated the greatest promise in that subject and has indicated a desire for further study of history, preferably Biblical or ancient history.

Student Life

The Honor System

One of the oldest and proudest of the Rice traditions is its honor system, which was adopted by a vote of the student body in 1916. All examinations are conducted under this honor code, which is administered by the Honor Council, whose members are elected by the student body annually. The Honor Council is responsible to the faculty, through the Dean of Students, for the validity of all examinations and for the investigation and prosecution of cases of violation of the system.

The Residential Colleges

On entering Rice, every undergraduate student becomes and thereafter remains a member of one of five colleges: Baker, Hanszen, Wiess, and Will Rice for men, and Mary Gibbs Jones College for women. Each of the colleges is a self-governing community of students, whose elected officers and representatives have powers commensurate with their responsibilities for maintaining not only an orderly routine of daily life, but also broad social, cultural, and athletic programs. While uniformity has not been sought and practices differ from college to college, all are alike in seeking to foster in their members the intellectual awareness and the sense of individual honor and group responsibility that distinguish educated persons. Each college also has a Master who, with his family, occupies the Master's House adjacent to the college. Members of the faculty serve as resident and nonresident Associates.

Students are assigned to membership in a particular college by the Masters' Office, as authorized by the five Masters. Two students who are entering Rice for the first time may ask to be assigned to the same college, but may not designate which college. A new student may request membership in the same college as a brother who is currently enrolled. No other choice of college can be allowed.

The buildings of each college include a dining hall and common rooms, available to resident and nonresident alike, as well as quarters for an average of about 215 students of all classes. Rooms are completely furnished except for linens.

A prospective student should indicate on his application for admission whether or not, if admitted as a student, he desires to reside on the campus. Detailed information about residence in the colleges and room application forms will accompany the notice of admittance sent to each new undergraduate. To reserve rooms it is essential that applications be submitted as directed. New undergraduate women students who do not live with their families in metropolitan Houston are required to live in Jones College. All other undergraduate women, except those who live with their families, must secure permission from the Adviser to Women if they wish to live off campus. Undergraduate women students are not permitted to live either alone or with other undergraduate women students in apartments, unless chaperoned by a responsible adult.

Correspondence from new students regarding housing in the residential colleges for men should be addressed to the Office of the Masters. Similarly, correspondence from new women students regarding residence in Jones College should be addressed to the Adviser to Women, Lovett Hall.

The Student Health Service

A Health Service located in Hanszen College is maintained for students. This service includes dispensary and infirmary care. The school physician makes scheduled sick calls and can be called in case of emergency. A registered nurse is on duty during school hours; qualified attendants are available at all hours. Information about the facilities and care, and about insurance, can be secured at the office of the Student Health Service. A hospitalization and accident insurance policy with a nationally known company is available for students who desire this coverage.

Memorial Center Facilities

Through the generosity of friends and alumni, the Rice Memorial Center was built. Ground was broken for this building on November 9, 1957, and it was dedicated on Homecoming weekend in the fall of 1958. The center and chapel comprise a memorial to those Rice alumni who have died in the service of their country, and provision was made in the plans for commemorative inscriptions.

The center includes a chapel with associated offices. The chapel is utilized for regular nondenominational religious services, directed by a faculty committee with the assistance of a student chapel committee.

The center provides offices for the Association of Rice Alumni, the Student Association, the Honor Council, and various student publications. It also contains the Campus Store and Sammy's, the snack bar, as well as lounge and ballroom facilities.

Student Government and Activities

Student Government

All undergraduates and those graduate students who have paid a blanket tax are members of the Rice Student Association. This organization of the student body is governed through the Student Senate, made up of the five elected officers of the Student Association, the five college presidents, the president of the Freshman class, and two senators from each college. Except for those student functions under the colleges, all student activities are directly or indirectly under the jurisdiction of the Student Senate. In addition, each of the five classes —Freshman, Sophomore, Junior, Senior, and Class II Graduate—has its elected officers. The Honor Council, already mentioned, is a student organization charged with the administration of the University's honor system.

Student Activities

A full variety of student activities is available on the campus. The official publications include the *Thresher,* the weekly campus newspaper, and the *Campanile,* the University annual. Rice engineering students publish the quarterly *Rice Engineer.*

Student organizations are numerous. Many are associated with special academic and professional disciplines. These include the foreign language clubs, the Architectural Society, the Prelaw Society, the Premedical Society, the Engineering Society, the student affiliate of the American Chemical Society, and student branches of the American Institute of Chemical Engineers, the American Institute of Electrical Engineers and the Institute of Radio Engineers, the American Society of Civil Engineers, and the American Society of Mechanical Engineers. The Army and Navy R.O.T.C. students, respectively, have the Chevron and the Sextant to represent their special interests. A Radio Society, a Film Society, and a Forensic Society exist for those interested in these matters. The Rice Players is a dramatic group sponsored by the Department of English. For the musically inclined there are the Rice Band and other musical and choral groups.

Women students may affiliate with one of the six literary societies—the Chaille Rice, the Cleveland Lovett, the Elizabeth Baldwin, the Owen Wister, the Pallas Athene, or the Sarah Lane. The Rally Club is a special service organization for men.

Rice students are affiliated with a number of denominational religious organizations. These include the Baptist Student Union, the Canterbury Association, the Christian Science Organization, the Church of Christ Club, the Hillel Society, the Lutheran Student Association, the Methodist Student Movement, the Newman Club,

the Presbyterian Student Association, and the Disciples Student Fellowship. These organizations are represented on the Student Interfaith Council, a group chartered by the Student Association.

Through the generosity of the late Mrs. James L. Autry, as a memorial to the late James L. Autry of Houston, the Diocese of Texas of the Protestant Episcopal Church maintains Autry House in the immediate vicinity of Rice University as a social and religious center. The cornerstone of Autry House was laid during the commencement ceremonies of the Class of 1921. To this community group of the Episcopal church, the late Mrs. E. L. Neville of Houston, in memory of her brother, contributed the beautiful Edward Albert Palmer Memorial Chapel, which was dedicated November 27, 1927. All the opportunities of these establishments are available to the students of Rice University irrespective of religious affiliation. Other religious bodies are considering provision for similar undertakings in the neighborhood of the University.

Student Association Service Award

In memory of Hugh Scott Cameron, first Dean of Students at the University, the Student Association annually presents the Rice Service Award, in the form of a bronze medallion, to those currently enrolled or former students who have been most exemplary in rendering distinguished service to the school and to the student body. This coveted honor is sparingly bestowed after careful consideration of possible recipients by a committee of faculty and students appointed by the Association.

Part Three

Courses of Instruction

Courses of Instruction

Course descriptions are listed alphabetically by departments of instruction. For most of the departments these descriptions are preceded by statements of specific requirements for students majoring in the department both at the undergraduate and the graduate levels. These statements are supplemental to the general degree requirements described on pages 36-46.

Course numbers below 200 designate courses designed primarily for Freshmen; courses numbered from 200 to 299 are considered second-year courses and are open to Freshmen only with permission. Numbers from 300-499 are designated as advanced courses. They are open to students of the lower classes with permission and to graduate students on approval of the individual student's adviser.

Courses designed for graduate students are numbered 500 and above. The methods of presentation and quality of work expected make them generally unsuited to undergraduate participation. Hence an undergraduate is permitted to enroll in a graduate-level course only after consultation with his adviser and with the instructor of the course.

The letters "a" and "b" following the course numbers indicate first-semester and second-semester courses respectively. Thus, Geology 330a is taught only the first semester and Geology 401b only the second semester. Courses for which the number is not followed by a letter *a* or *b* are two-semester or year courses in which it is necessary to take both semesters in normal sequence to secure credit for the course. In some cases, however, registration for only one semester is permissible, in which case the course number is followed by both letters as 400a, b.

Figures entered in parentheses following the title of each course signify the number of class hours per week, the number of laboratory hours per week, and the semester-hours credit for the completed course, in that order. Thus, the entry (3-3-8) in Physics 100 means that the course meets three hours per week, has three hours of laboratory work per week and is evaluated at eight-semester-hours credit upon completion of the full year's work.

Anthropology and Sociology

Professor Norbeck, *Chairman*
Assistant Professor Hole
Lecturer Giles

Additional faculty members are anticipated for the academic year 1962-63; other courses will be added as new instructors join the staff.

ANTHROPOLOGY COURSES

Anthropology 200a. Physical Anthropology (3-0-3).

Human evolution, fossil man, human genetics, races of man and problems of race; the beginnings of culture. *Mr. Norbeck*

Anthropology 200b. Cultural and Social Factors (3-0-3).

Major aspects of culture (social organization, economics, religion); cultural patterns and sociocultural change; late prehistory of man and the evolution of culture. *Mr. Norbeck*

Anthropology 300a. The Nature of Culture (3-0-3).

The nature and basic processes of culture; cultural and social change; dynamics of cultural life. Illustrative data taken from primitive and culturally advanced societies. *Not open to students who have taken or are currently enrolled in Anthropology 200b.* *Mr. Norbeck*

Anthropology 300b. Primitive Religion (3-0-3).

Comparative survey of religion and magic; the relation of religion and magic to other aspects of culture, and their roles with respect to society and the individual. *Mr. Norbeck*

Anthropology 310a. World Ethnology (3-0-3).

A survey of selected non-Western societies which illustrate varying modes of adaptation to geographical and cultural environments. *Mr. Hole*

Anthropology 310b. North American Ethnology (3-0-3).

A general survey of native cultures north of Mexico. Intensive study of selected peoples in light of the processes of culture. *Mr. Hole*

Anthropology 320a. Old World Prehistory (3-0-3).

The origin and development of human culture during the Pleistocene period; man's achievement of food production and the beginnings of literate civilizations in the Near East. *Mr. Hole*

Anthropology 320b. New World Prehistory (3-0-3).

Man's entry into the Americas; his dispersal with varied ecological adaptations over the continent; and the attainment of civilized societies in Meso-America and Peru. *Mr. Hole*

SOCIOLOGY COURSES

Sociology 200a. An Introduction to Sociology (3-0-3).

Principles of sociology; interrelations of personality, culture, and society; social organization, processes, and functions.

Sociology 200b. Social Problems and Deviant Behavior (3-0-3).

The relationship of social problems and deviant behavior to social structure; special attention is given to crime, mental disorders, suicide, alcoholism, drug addiction, and problems of race.

Sociology 400a. Seminar on the Foundations of Social Thinking (3-0-3).

The development of sociological thought through the integration of contributions from biology, philosophy, anthropology, and other social sciences. Special emphasis is given to the culture concept, social values and social institutions, and the social process in relation to problems of social disorganization and adjustment. *Mr. Giles*

Architecture

Professors Caudill, *Chairman*, Grillo, and Morehead
Associate Professors Dunaway, Ransom, and Todd
Assistant Professors Lacy, *Assistant Chairman*, and Leifeste

Staff Specialists

Paul Baker, Director, Dallas Theatre Center
Felix Candela, Architect and Engineer, Mexico, D.F.
Arthur Dyess, Lawyer, Houston
William Pena, Architect and Programming Specialist, Houston
Charles Schorre, Artist, Houston

Preceptors

Richard L. Aeck, F.A.I.A., Aeck Associates, Architects, Atlanta, Georgia
O'Neil Ford, F.A.I.A., O'Neil Ford and Associates, Architects, San Antonio, Texas
Charles Granger, A.I.A., Fehr & Granger, Architects and Planning Consultants, Austin, Texas
David G. Murray, A.I.A., Murray, Jones & Murray, Architects, Tulsa, Oklahoma
George F. Pierce, Jr., F.A.I.A., Pierce & Pierce, Architects, Houston, Texas
E. Davis Wilcox, A.I.A., E. Davis Wilcox Associates, Architects-Engineers, Tyler, Texas

A four-year undergraduate course in architecture is offered leading to a Bachelor of Arts degree. The professional degree of Bachelor of Science in Architecture is a five-year course of instruction. Each year's study in architecture is organized into a single course called, "Principles of Architecture," which embodies the five areas requisite to the study of architecture: Theory and Philosophy, Design, Communication, Profession and Practice, and Construction. This integration of subjects is achieved under the supervision of one teacher for each year's class, who directs the students' work and utilizes faculty specialists in the five areas to augment his instruction.

Supplementing the general instruction, there are several auxiliary programs, such as visiting lecturers and critics, field trips, an Alumnus Critic Program, and the Preceptorship Program. The Alumnus Critic Program enables the student to receive criticism in an architect's office on his student projects once each semester. The Preceptorship provides for a two-week visit by outstanding students to the offices of some of the leading architects of the South and Southwest. These programs are designed to help bridge the gap between school and practice.

Graduate work in architecture, leading to the degree of Master in Architecture, is open to students who hold the degree of Bachelor of

Science in Architecture, or the equivalent five-year degree, and who give evidence of their qualifications to the satisfaction of the Department of Architecture and the Committee on Graduate Instruction. A minimum of one year of graduate study is required for the master's degree when the candidate has completed five years' work in a recognized school of architecture and has received his degree with a record of high scholarship. The candidate must have had at least two years of college work in a foreign language. Applications of students who have a minimum of one year of practical experience in architecture will receive preferential consideration. The candidate for the master's degree must take Architecture 600 and one advanced course outside the department, and must pass a public oral examination given by the faculty.

COURSES

Architecture 100. Principles of Architecture (0-10-6).

a. Theory and Philosophy: An elementary study of the place of history in architecture.
b. Architectural Design: Projects introducing basic design elements through elementary architectural problems with a brief introduction to the types and functions of buildings.
c. Architectural Communication: Introduction of basic communicative systems and media in all fields.
d. Architectural Construction: Awareness of materials, structure, and building equipment.
e. Profession and Practice. The basic understanding of the practice of architecture, its obligations, and opportunities. Laboratory fee required.

Staff and Associates

Architecture 200. Principles of Architecture (1½-14-12).

a. Theory and Philosophy: A beginning knowledge of history and the theory and philosophy of architecture through a study of the relation of past architecture to past society. An elementary study of people and their reactions to the arts, particularly architecture.
b. Architectural Design: Beginning standards of skill in architectural design, and an elementary knowledge of building types through individual study under the problem system. Introduction to functional requirements of buildings.
c. Architectural Communication: Continued use of all media with the development of competence in their use; detailing, specification, etc., as a communicative art.
d. Architectural Construction: Introduction to basic materials and their characteristics; basic structural systems; introduction to types of building equipment and miscellaneous building components.
e. Profession and Practice. Introduction to the accomplishment of architecture within the current social framework. Laboratory fee required.

Staff and Associates

Architecture 300. Principles of Architecture (6-18-24).

a. Theory and Philosophy: A continuation of the study and understanding of the relation of history and society to architecture as demonstrated in specific civilizations. Group reaction to society and architecture. A study of the temporary and permanent values in today's society. Study of architectural philosophies.
b. Architectural Design: Development of greater breadth in design through individual effort in the problem system on work of increasing complexity. Development of design values and skills in details.
c. Architectural Communication: The development of personal skill in the use of all media; expansion of the communicative arts to additional fields.

d. Architectural Construction: Basic principles and theory in structure; development of increased knowledge of materials; integration of building equipment.
e. Profession and Practice. Study of the fields in which architecture operates and of the architectural processes involved; expansion of the areas of obligation and opportunity. Laboratory fee required. *Staff and Associates*

Architecture 400. Principles of Architecture (6-18-24).

a. Theory and Philosophy: Instruction in the origin and development of concepts. Social problems and their solution in the modern world, with instruction in the social forces in effect today; their strengths, weaknesses, and duration. Beginning development of a personal philosophy.
b. Architectural Design: Individual work in the problem system on projects involving multiple elements; testing design philosophies; refining design processes.
c. Architectural Communication: Development of technique and expression in communicative media. Study of law, contracts, specifications, working drawings as communication.
d. Architectural Construction: Development of skill in integration of all building techniques and systems; philosophy in construction.
e. Profession and Practice: Active participation in the profession; solving of architectural problems; service to university, community, and profession; dealing with the total architectural problem. Laboratory fee required.
Staff and Associates

Architecture 500. Principles of Architecture (7-18-26).

a. Theory and Philosophy: Development of a personal philosophy, conviction, and set of values. Analysis of trends and projections into the future.
b. Architectural Design: Exploration and experiment in design.
c. Architectural Communication: Exploration and experiment in communicative media.
d. Architectural Construction: Exploration and experiment in structure and building systems.
e. Profession and Practice: Development of a personal approach to the profession; increased active participation in the profession; analysis of trends and projections into the future of architecture. Laboratory fee required.
Staff and Associates

Architecture 600. (8-15-26).

a. Elective choices in approach and subject matter in the area of teaching, specialization for architectural practice, and research in the fields of perspective, design, history, architecture, building types, environmental design, surveys and documentation, shell structures, theatre, etc. The instruction is organized around a series of design problems intended to develop the student's ability to derive and present new architectural values, completely and comprehensively, in the framework of today's architecture and society. The design and research work culminates in a thesis report of some consequence which meets University requirements for a master's degree. Laboratory fee required.
Staff Specialists, University Staff

Art

(*See* page 120)

Biology

Professors Davies, Read, and Talmage, *Chairman*
Associate Professors Awapara, Enders, and Woodward
Assistant Professors Campbell and Segal
Lecturer Pulley

A biology major may be taken either in the humanities (academic) or the science-engineering program. The course requirements will differ slightly according to the specific requirements of these curricula. All majors are required to have introductory courses in biology, chemistry, physics, and mathematics. Specifically, Biology 200a, Biology 210b, and Chemistry 200 are required. A total of six to eight semester courses in biology must be taken in the Junior and Senior years to bring the biology courses taken to a total of ten (five year courses equivalent). One of these courses must be either physiology or biochemistry. Those students who decide to major in biology too late to get all the Freshman science requirements may take an approved course instead of Physics 100 in summer school. Biology majors who plan to go into high school teaching can take one advanced biology course (two semesters) in summer school if practice teaching is necessary in the Senior year. This summer school course must be approved by the Department of Biology and the Committee on Examinations and Standing.

Honors Program in Biology: Qualified biology majors are encouraged to undertake a research problem under the supervision of a faculty adviser. Such students will substitute Biology 400 for a minimum of two and a maximum of three advanced biology semester courses. For more complete information concerning this program, consult with members of the departmental staff.

Graduate work in biology is open to qualified applicants who hold a bachelor's degree or its equivalent, with a major in a biological science. Graduate specialization is limited to fields related to the research interests of the staff. Prospective graduate students should take the Graduate Record Examination before applying, or as soon thereafter as practicable. If it is not taken prior to matriculation, it may be required during the first year of residence.

The following areas of specialization are currently offered in biology: biochemistry, cellular physiology, cytology, embryology, endocrinology, environmental physiology, general physiology, genetics, marine biology, microanatomy, parasitology, and symbiotic relationships.

Program for the Degree of Doctor of Philosophy:

(a) Usually four or more years of graduate study with at least the last two years at Rice University.

(b) At least six graduate courses in biological and related sciences (a course is here considered at least six semester-hours credit) other than thesis work, of which at least three must be taken at Rice University.
(c) Completion of an original investigation worthy of publication in a recognized scientific journal, and the submission of a doctoral thesis as described on page 46.
(d) Completion of language requirements as described on page 45.
(e) Each student must pass three written examinations by June 15 of the year prior to that in which the Ph.D. degree is awarded. These are given in his major and two minor fields as selected by the student with permission of his advisory committee.
(f) An oral examination in defense of the thesis during the last year of residence.

The Degree of Master of Arts. The degree of Master of Arts may be obtained after two years of graduate study upon the successful completion of the language requirements, four graduate courses, satisfactory work in three of the written examinations, and the acceptance of a thesis embodying the results of original investigation, in defense of which an oral examination is taken. The taking of this degree is not required as a prerequisite for the degree of Doctor of Philosophy and may be omitted with the approval of the departmental staff.

Laboratory Instruction. Financial assistance in the form of graduate assistantships, predoctoral fellowships, research assistantships, and scholarships is available. All graduate students in biology are expected to engage in some laboratory instruction regardless of type of appointment, as this instruction is considered an important part of the training of the candidate. Graduate students are assigned to different courses from year to year to obtain the maximum benefit from this phase of training.

The Biological Laboratories. The Biology Department is located in the Anderson Biological Laboratories. These are new facilities completed in 1958 and furnished with all standard modern equipment for biological, physiological, and biochemical studies.

COURSES

Biology 100. General Biology (3-3-8)

An introductory course in biology covering the general principles underlying living things. A general vertebrate type is considered first, and this is used as a basis for an introduction to physiology, immunology, embryology, cytology, genetics, ecology, and classification. Structure and function are, when possible, considered together; emphasis is placed on the former in the laboratory, and the more dynamic aspects are presented in lecture with the aid of demonstrations and motion pictures.

The latter part of the course deals with various animal forms and their evolution, with emphasis on progressive differentiation of structure and adaptation to environment. *Mr. Davies*

Biology 120. General Biology (3-3-8).

This course is designed as a science requirement for students taking a B.S. degree in either commerce or health and physical education. It is open only to these students. The laboratory work is identical with that taken by students enrolled in Biology 100, but the lecture material is modified. Biology 120 is a terminal course, but it fulfills the prerequisite requirement for Biology 390. *Mr. Davies*

Biology 200a. Comparative Zoology (3-3-4).

A phylogenetic study of the invertebrate phyla, including the prochordates. Prerequisite: Biology 100. *Mr. Segal*

Biology 210b. Comparative Anatomy (3-6-5).

The structure of the vertebrates is studied. The lecture material emphasizes the evolutionary patterns in the development of structures and the natures of homologous and analogous structures in various taxonomic groups. The laboratory is primarily devoted to learning the structure of the shark and cat in sufficient detail that references to homology and function may be meaningful. Prerequisites: Biology 100 and 200a. *Mr. Enders*

Biology 215b. Botany (3-3-4).

A comparative study of the plant kingdom with emphasis on phylogenetic relations. Prerequisite: Biology 100. *Mr. Woodward*

Biology 310b. Genetics (3-3-4).

A study of the gene from the points of view of genetic recombination, mutation, function, and chemical composition. Prerequisite: Biology 100. *Mr. Woodward*

Biology 320a. Parasitism and Symbiosis (3-3-4).

An introduction of the biology of symbiosis, with special emphasis on parasitism. The life histories, morphology, and physiology of parasites and hosts will be discussed with considerable emphasis on the evolution of parasitism. Illustrative examples demonstrating principles will be drawn from the plant or animal kingdom. Some attention will be given to the parasitic worms and protozoans responsible for human and animal disease. Prerequisites: Biology 100, Chemistry 120. *Mr. Read*

Biology 340a. General Physiology (3-3-4).

The fundamental processes of living systems are considered at the cellular level. The cellular environment is examined and some of the homeostatic mechanisms whereby the cell maintains a steady state are studied. The structure of the cell in terms of its chemical composition and physiochemical and functional organization is taken up. Certain aspects of cellular metabolism are considered. These include permeability, respiration and energy metabolism, synthesis, and growth and differentiation. Specialized cellular functions such as excitation and contraction are also studied. Prerequisites: Biology 100 and Chemistry 200 or concurrent registration. *Mr. Campbell*

Biology 350b. Embryology (3-3-4).

Early developmental stages from fertilization to germ layer formation are studied. Reference is made to determination, differentiation, organizers, and other ontogenetic phenomena. Implantation, placentation, and organogenesis of mammals are studied. The laboratory work is primarily concerned with the development of organs and systems of vertebrates. Prerequisite: Biology 210 (can be taken concurrently). *Mr. Segal*

Biology 360a. Marine Biology (3-3-4).

A study of the marine and estuarine environments with particular attention given to the local fauna. The laboratory will include weekend field trips, and class size is limited to fifteen students. Prerequisite: Invertebrate Zoology or Invertebrate Paleontology. *Mr. Pulley*

Biology 370a. Histology (3-3-4).

Cells, tissues, and organs are studied microscopically. Much of the material studied is mammalian, but, whenever desirable and feasible, comparable materials from other animals are presented. Laboratory work includes observation, drawings, and introduction to histological technique and study of electron micrographs. Prerequisites: Biology 100, 210b. *Mr. Enders*

Biology 380b. Field Biology (3-3-4).

A review of the principles of ecology based primarily on field observations of the local flora and fauna. The laboratory will include weekend field trips, and class size is limited to fifteen students. Prerequisites: Biology 200a, 215b. (Not given 1962-63). *Mr. Pulley*

Biology 390. Anatomy and Public Health (3-3-8).

A course of lectures and laboratory work open only to students of physical education. The first term is devoted to the study of human anatomy and physiology and the physiology of exercise. The second term covers health legislation, social problems, vital statistics, epidemiology, care of water, milk, and other foods, sewage disposal, housing, and ventilation. It includes trips to study the health practices and conditions of public utilities. *Mr. Welsh and Mr. Bland*

Biology 400 (a or b). Special Problems and Honors Work (2-6-4) or (2-6-8).

Open only to Senior biology majors, and with permission of the chairman of the department. For use primarily in honors programs. *Staff*

Biology 440b. Comparative Physiology (3-3-4).

The specialized physiology of the different animal phyla is considered. This includes a study of feeding and digestion, circulation and oxygen transport, respiration and intermediary metabolism, excretion and nitrogen metabolism, behavior, and the hormonal control of growth and development as these processes occur in the different animal groups. Prerequisite: Biology 340a. *Mr. Campbell*

Biology 450a. Introduction to Biochemistry (3-3-4).

The chemistry of proteins, nucleoproteins, lipids, carbohydrates, and growth factors. The application of some physicochemical laws to living systems. Prerequisites: Biology 340a and Chemistry 300. *Mr. Awapara*

Biology 460b. Advanced Biochemistry (3-2-3).

A study of enzymes and their function. Intermediary metabolism and biosynthesis of cell components. Prerequisite: Biology 460a or permission of the instructor. *Mr. Awapara*

Biology 470b. General Microbiology (3-3-4).

Lectures on the classification, evolution, growth, nutrition, and metabolism of unicellular organisms. Consideration will be given to bacteria, fungi, and protozoa, with emphasis on features common to all. Laboratory work will include methods of isolation, culturing, and identification of microorganisms, the chemical basis of staining, mutualism and antibiosis, use of microorganisms for chemical assay, and selected experiments illustrating physiological attributes. Prerequisites: Biology 100 and 200a. *Mr. Read*

Biology 480b. Endocrinology (3-3-4).

A study of the primary endocrine glands of mammals and their relationships to the physiological homeostasis of the mammal. While emphasis is placed on the function, morphology, and interrelationships of the glands of internal secretion of mammals, the comparative anatomy and evolution of these glands in the vertebrates is discussed. Laboratory work is restricted primarily to histological study of the glands, surgical procedures, and simple experiments demonstrating hyposecretion. Prerequisites: Biology 210b and Biology 340a. *Mr. Talmage*

Biology 490a. Radioisotopes in Biology (3-4-4).

An introductory study of the applications of nuclear radiation to biological problems. The purpose of the lectures and laboratory is to acquaint the student with characteristics of nuclear emissions, problems of health physics, an introduction to radiochemistry, study of radiation effects, and the use of isotopes as biological tracers. Prerequisites: At least one previous course in biology, chemistry, mathematics, and physics. *Mr. Talmage*

Biology 500. Biology Seminar (1-0-2).

Held weekly for the purpose of hearing papers on current research by members of the staff, visiting investigators, and graduate students. Graduate students in biology are required to attend, and the seminar is open to visitors from on and off the campus. Undergraduate biology majors are invited. *Staff*

Biology 510. Special Topics in Biochemistry.

Readings, conferences, and laboratory work in current developments in biochemistry. Prerequisites: Biology 450a and 460b. *Mr. Awapara*

Biology 511b. Biophysical Chemistry.

Selected topics of physical chemistry as related to biological phenomena. The following topics will be discussed: the colloidal state, chemistry of respiration, acid-base balance, electrolyte and water balance, biological oxidation and reduction, energy metabolism. *Mr. Awapara*

Biology 519. Research in Biochemistry. *Mr. Awapara*

Biology 520. Advanced Cellular Physiology.

Readings, conferences, and laboratory work in current fields of investigation in cellular physiology and biochemistry. Prerequisite: Consent of instructor.
Mr. Campbell

Biology 521. Advanced Comparative Physiology.

Conferences and laboratory work on the physiology of invertebrate animals. Reading in the literature dealing with ionic and osmotic regulation, permeability, respiration, nutrition, nitrogen metabolism, excretion, energy metabolism, neurosecretion, and muscle-nerve physiology. Prerequisite: Permission of instructor.
Mr. Campbell

Biology 529. Research in Molecular or Comparative Physiology.
Mr. Campbell

Biology 530. History of Biology.

A seminar and reading covering the history of various fields of biology.
Mr. Davies and Mr. Read

Biology 539. Research in Vertebrate Anatomy. *Mr. Davies*

Biology 540. Cytology.

The course consists of student reports and discussions concerning the anatomical and chemical properties of the cell, its formed constituents, and inclusions. Morphological and cytochemical indications of specific activity are emphasized. Students are introduced to the use of the electron microscope. Prerequisite: Biology 210b, 370a. Open to Senior majors by permission of instructor. *Mr. Enders*

Biology 541. Special Cytology.

An analysis of the methods of investigating cellular organization and activity. Particular emphasis is placed on cytochemical studies of parenchymal cells. *Mr. Enders*

Biology 549. Research in Histology and Cytology. *Mr. Enders*

Biology 559. Research in Marine Biology. *Mr. Pulley*

Biology 560. Physiology of Parasitism.

Conferences, student reports, and laboratory work on the physiology of parasites and the functional relationships of hosts and parasites. Attention will be given to growth, metabolism, nutrition, and physiological evolution of parasites, with emphasis on comparative aspects. The basis of pathology and disease will be treated as a series of physiological problems, with examples drawn from the animal or plant kingdom. *Mr. Read*

Biology 561. Protozoology.

Conferences and laboratory study of the protozoan parasites of vertebrates. Attention will be given to the morphology, classification, life histories, and ecology of parasitic protozoa, with some consideration of related free-living species. Laboratory study will include methods of cultivation and husbandry, preparation for study, and specific diagnosis, but emphasis will be placed on the experimental study of protozoan biology. *Mr. Read*

Biology 562. Helminthology.

Conferences and laboratory work on the morphology classification, life histories, and evolution of the helminth parasites of vertebrates. Emphasis will be placed on study of original literature. *Mr. Read*

Biology 563. Medical Entomology.

Conferences and laboratory study of the arthropods involved in the transmission of infectious agents. Attention will be given to morphology, classification, and life histories, in relation to the ecology of viruses, rickettsias, bacteria, and helminths. Some consideration will be given to parasitic arthropods. Control of the medically important arthropods will be discussed. *Mr. Read*

Biology 569. Research in Parasitology or Comparative Physiology. *Mr. Read*

Biology 570. Environmental Physiology.

The functional adaptations of cold-blooded organisms to environmental factors. Analysis of the physiological characters which provide the basis for animal distribution. Readings, conferences, and laboratory work. *Mr. Segal*

Biology 579. Research in Environmental and Comparative Physiology. *Mr. Segal*

Biology 580. Seminar in Endocrinology I.

The thyroid, pancreas, adrenals, and the relationships of hormones to carbohydrate metabolism are studied. Reading; seminar on current literature in endocrinology. *Mr. Talmage*

Biology 581. Seminar in Endocrinology II.

The parathyroids, the pituitary, and the physiology of reproduction. Readings, conferences, and laboratory work. Includes also a weekly seminar on current literature in endocrinology. *Mr. Talmage*

Biology 589. Research in Endocrinology. *Mr. Talmage*

Biology 590. Topics in Genetics.

Readings, conferences, and laboratory work in current problems in microbial genetics. *Mr. Woodward*

Biology 599. Research in Genetics. *Mr. Woodward*

Business Administration

(*See* pages 110-111)

Chemical Engineering

Professor Akers, *Chairman*
Associate Professors Busch, Davis, Dawkins, Kobayashi, and Leland
Assistant Professors Atkinson, Deans, Denny, and Hellums

The undergraduate chemical engineering courses are designed to provide thorough grounding in engineering, science, and mathematics, and afford the student some opportunity for specialization in a particular area of interest. Students finishing the first four years of this curriculum receive the Bachelor of Arts degree with a chemical engineering major, and, if approved, may enter a professional program leading to the degree of Bachelor of Science in Chemical Engineering, or go directly to graduate work in chemical engineering, nuclear technology, chemistry, physics, mathematics, or industrial management.

The basic curriculum through the fourth year is outlined on pages 40-41; and suggested course contents in three areas of specialty (chemical engineering science, nuclear technology, and petroleum production) are available. The year in which courses are taken is not fixed except where prerequisites for other courses require. Students should consult with the department advisers for specific courses of study.

Course content for the fifth year leading to the degree of Bachelor of Science in Chemical Engineering, and requirements for the graduate degrees, are broadly outlined on pages 41, 44-46.

A candidate for the Master of Science degree is required to complete a minimum of eight one-semester courses with high standing.

A candidate for the degree of Doctor of Philosophy must complete a minimum of twelve one-semester courses with high standing and pass a comprehensive written examination.

There are opportunities for research in unit processes, fluid mechanics, heat transfer, thermodynamics, mass transfer, chemical kinetics, nuclear chemistry, and nuclear processes.

COURSES

Chemical Engineering 301a. Chemical Engineering Fundamentals (3-0-3).

A first course in the application of the principles of mathematics; considered are stoichiometric and equilibrium concepts, material balances, energy relationships for both chemical and physical changes, and mechanical equipment, and the thermodynamic properties of fluids and energy.

Chemical Engineering 302b. Separation Processes I (3-0-3).

A systematic approach to the separation of matter based on differences in physical properties. Particular attention is devoted to the equilibrium stage concept.

Chemical Engineering 343. Engineering Measurements (1-3-4).

A laboratory devoted to the development of experimental techniques for the precise measurement of various properties of matter. The use of statistics and error analysis is incorporated.

Chemical Engineering 401a. Introduction to Transport Phenomena (3-0-3).

Fluid dynamics, energy and mass transfer, macroscopic and microscopic analysis of engineering problems.

Chemical Engineering 402b. Applications of Transport Phenomena (3-0-3).

A synthesis course based on the theoretical principles of transport phenomena. The applications of the transport relations to design are stressed.

Chemical Engineering 421b. Plant Inspection (1-3-2).

A critical inspection of neighboring plants, laboratories, and engineering firms engaged in chemical engineering practices is made under the guidance of faculty and company personnel. Detailed reports of each inspection are submitted for examination and criticism.

Chemical Engineering 423a. Modern Computational Methods (1-3-2).

An introduction to numerical solutions of engineering problems. Use will be made of both analogue and digital computers in the course.

Chemical Engineering 443. Unit Operations Laboratory I (1-3-4).

Laboratory work in the unit operations. Particular emphasis is placed on the measurement and analysis of data of important engineering operations.

Chemical Engineering 471a. Applied Mathematics for Chemical Engineers (3-0-3).

A one-semester course concerned with the application of the fundamental laws and principles of mathematics, physics, and chemistry to chemical engineering problems. Emphasis is placed on developing individual capability for representing process situations by suitable mathematical models and formulating properly posed boundary-value problems. Several linear problems are solved in detail, employing various classical approaches; series of calculus of finite differences, separation of variables, integral-transform methods.

Chemical Engineering 472b. Numerical Analysis for Chemical Engineers (3-0-3).

Application of numerical techniques to the solution of nonlinear problems of interest to chemical engineers. Differential equations are approximated by difference equations, and numerical solutions generated algebraically. Emphasis is placed on implicit methods, and the important question of stability and convergence treated in detail. The use of the analogue as well as the digital computer is an integral part of the course.

Chemical Engineering 501a. Rate Processes (3-0-3).

Derivation of basic transport equations. Microscopic analysis of diffusion, conduction, and transport phenomena in laminar flow.

Chemical Engineering 502b. Advanced Rate Processes (3-0-3).

Advanced study of transport phenomena with emphasis on analysis of turbulent transport mechanisms and recent developments in applications to engineering problems.

Chemical Engineering 511a. Thermodynamics (3-0-3).

An advanced treatment of the three laws of thermodynamics. Special attention is given to equations of state, chemical and physical equilibrium, nonideal solutions, and electrochemistry.

Chemical Engineering 512b. Thermodynamics (3-0-3).

An advanced treatment of special problems in thermodynamics and an introduction to statistical thermodynamics.

Chemical Engineering 522a. Plant Design (2-3-3).

The lectures consider the development of chemical manufacturing processes and the design of chemical manufacturing plants from the point of view of location, building, equipment, economics, and organization. The laboratory work consists of calculating and drawing up fundamental data, qualitative flowsheets, specifications, plant layout, and cost estimates for typical processes.

Chemical Engineering 531a. Nuclear Engineering (3-0-3).

An introductory course in nuclear properties, nuclear reactions, radioactive decay, the fission reaction. Theory and design of nuclear reactors using the one-group model, the Fermi age treatment, and neutron diffusion. Nuclear processing, waste disposal, and health physics.

Chemical Engineering 532b. Nuclear Engineering (3-0-3).

A continuation of Chemical Engineering 531 with a more advanced treatment of nuclear reactor theory using the two-group and multigroup methods, neutron transport theory. Calculations for time-dependent reactor operation, temperature and heat transfer effects in a reactor, reactors with reflectors, breeder reactors. A more detailed consideration of related topics of fuel cycles, isotope separation, and shielding.

Chemical Engineering 536. Environmental Engineering Operations I (3-0-3).

The theory of the chemical and physical principles utilized in water and waste treatment operations. Unit operations such as sedimentation, gas transfer, chemical treatment, filtration, and sludge treatment are presented. The synthesis of these operations into water and waste treatment processes is developed.

Chemical Engineering 537. Environmental Engineering Operations II (3-0-3).

The theory of the biological and biochemical principles utilized in water and waste treatment operations. Unit operations such as biological oxidation, aerobic and anaerobic, and disinfection are presented. The synthesis of these operations into water and waste treatment processes is developed.

Chemical Engineering 538a. Environmental Chemistry (3-3-4).

The chemistry of water and waste treatment process. Laboratory practice in the various chemical, physical, and biochemical analytical procedures applicable to process design and evaluation.

Chemical Engineering 539b. Industrial Waste Treatment (3-3-4).

A study of the chemistry and processes applicable to analysis and treatment of industrial wastes.

Chemical Engineering 543. Unit Operations Laboratory II (1-3-4).

A continuation of Chemical Engineering 443. In the second semester students will work on special projects.

Chemical Engineering 550a or b. Petroleum Production (3-0-3).

The nature of porous media, properties of hydrocarbons and associated components at high pressures, homogeneous and heterogeneous flow through porous media, and application of these principles to estimation of reserves and to primary and secondary recovery techniques. Surface production problems are also discussed.

Chemical Engineering 551a. Separation Process II (3-0-3).

A quantitative study of multistage calculations for multicomponent systems. Special attention is given to computer solutions and the development of mathematical models for real stages.

Chemical Engineering 560a or b. Heterogeneous Equilibrium and and the Phase Rule (3-0-3).

The organization of heterogeneous equilibrium behavior of mixtures using thermodynamic principles with special emphasis on the phase rule of Gibbs. The behavior of complex mixtures over extreme ranges of pressures and temperatures is discussed.

Chemical Engineering 561a. General Seminar (1-0-1).

A course for training chemical engineering students in the preparation and oral presentation of formal papers and discussions on topics of engineering interest. The papers and discussions are given by the students, using acceptable material secured from technical publications. This course is required of all fifth-year chemical engineers.

Chemical Engineering 571a. Statistics and Probability (3-0-3).

The application of statistical and probability theory to engineering problems: Analysis of data, design of experiments, evolutionary operation of complex process systems.

Chemical Engineering 575a or b. Process Dynamics (3-0-3).

Study of dynamic behavior of chemical processing equipment.

Chemical Engineering 590a or b. Chemical Reaction Kinetics (3-0-3).

A study of the principal facts and theories relating to the rates at which chemical reactions take place, including a study both of elementary reactions and of the

way in which over-all rates of complex reactions are related to the rates of the individual steps.

Chemical Engineering 612. Irreversible Thermodynamics (3-0-3).

Entropy production ratio; Onsager's reciprocal relation applied to irreversible processes; and nonequilibrium stationary states.

Chemical Engineering 641. Experimental Processes I (2-6-4).

The concept of experimental design is presented as an integral part of studies of new problems in process definition and kinetics affecting process environment.

Chemical Engineering 642. Experimental Processes II (2-6-4).

A continuation of Chemical Engineering 641.

Chemical Engineering 662. Graduate Seminar (2-0-2).

Similar to Chemical Engineering 561 except that the course applies to graduate students above the fifth year.

Chemical Engineering 675. Process Control (3-0-6).

A mathematical approach to the problem of process control with particular emphasis on the analysis of response to process variations.

Chemical Engineering 680. Summer Graduate Research.

Open to students already admitted as candidates for the degree of Master of Science. At least forty hours of laboratory work per week.

Chemical Engineering 683. M.S. Research and Thesis.

At least nine hours of work weekly under the direction of a member of the staff on a problem of chemical engineering importance. Four copies of the accepted report will be required, two for deposit in the University Library and two for the Chemical Engineering Department.

Chemical Engineering 685. Kinetic-Molecular Theory of Fluids (3-0-3).

A course in the kinetic theory of fluids as applied to nonequilibrium phenomena. Among the subjects covered are the properties of the fluids ranging from extremely dilute to dense fluids. Semitheoretical relations to describe the behavior of real fluids are introduced and discussed.

Chemical Engineering 686. Nonequilibrium Statistical Mechanics Applied to Hydrodynamics and Transport Phenomena (3-0-3).

The methods of statistical mechanics are applied to study hydrodynamics and the transport phenomena including evaluation of the transport properties.

Chemical Engineering 690. Kinetics and Catalysis (3-0-3).

Chemical reaction rates, reaction mechanisms, theories of catalysis, diffusion in solids.

Chemical Engineering 691. Reactor Analysis (3-0-3).

The analysis of physical as well as chemical rate steps in reactors. Mathematical simulation of various reactor configurations. Reactor stability and control.

Chemical Engineering 720. Advanced Topics in Chemical Engineering III (3-0-6).

A theoretical treatment of advanced phases of chemical engineering with special emphasis upon the development of individual abilities. *Mr. Hellums*

Chemical Engineering 780. Summer Graduate Research.

Open to students already admitted as candidates for the degree of Doctor of Philosophy. At least forty hours of laboratory work per week.

Chemical Engineering 783. Ph.D. Research and Thesis.

At least twenty hours of work weekly under the direction of a member of the staff on a problem of chemical engineering importance. Four copies of the accepted report will be required, two for deposit in the University Library and two for the Chemical Engineering Department.

Chemistry

PROFESSORS KILPATRICK, LEWIS, MILLIGAN, PITZER, RICHTER, AND TURNER, *Chairman*
ASSOCIATE PROFESSORS ETTLINGER AND SALSBURG
ASSISTANT PROFESSORS BRACKETT, CURL, AND SASS

The Undergraduate Program. Undergraduates electing chemistry as as a major are expected to satisfy the requirements of the science-engineering program set forth on pages 38-39. In general they will take Chemistry 200 in the Sophomore year in place of one of the specified electives. It is desirable for chemistry majors who seek admission to graduate school, but who do not possess advanced high school language credits, to take two years of German and one year of either French or Russian. The Department further requires satisfactory completion of the following courses:

Chemistry 310; taken in the Junior year
Chemistry 311; ordinarily taken in the second semester of the Junior year and first semester of the Senior year
Chemistry 220a; taken in the Junior year
Chemistry 320b; taken in the Junior year
Mathematics 300; taken in the Junior year
Four semesters of approved course work in chemistry in the Senior year. No more than three semesters may be taken in a single field of specialization. Superior students may substitute undergraduate research for one or two semester courses.

The Graduate Program. A student who has completed work for the bachelor's degree in chemistry equivalent to that offered at Rice University may be admitted to graduate standing. Preference is normally given to applicants who earn high scores on the Graduate Record Examination, including the advanced test in chemistry (*See* page 58). A minimum of one year of graduate study is required for the degree of Master of Arts and at least two years for the degree of Doctor of Philosophy.

A candidate for the degree of Master of Arts is required to demonstrate a reading knowledge of scientific German, French, or Russian. He must complete six semesters of course work, present the results of

a program of research approved by the Department, and pass a final comprehensive examination.

To be recommended for the degree of Doctor of Philosophy, the student must complete for publication a thesis which represents a distinctly original and significant contribution to the field of chemistry. He must possess a reading knowledge of scientific German and of scientific French or Russian as a second language. The candidate must further have acquired through course work and independent study a broad fundamental knowledge of chemistry in addition to those areas of the subject encompassed by his own research interests. Cumulative examinations for the Ph.D. degree are given periodically beginning in the second year, and a final oral examination on the thesis is required for all candidates.

COURSES

Chemistry 120. General Chemistry and Qualitative Analysis (3-4-8).

A general introductory course dealing with the basic phenomena and principles of the science. The laboratory work in the first semester deals with the fundamentals and methods of qualitative analysis. The second semester is devoted largely to preparative experiments in inorganic chemistry. The course is required of science-engineering students, and is also open to humanities (academic) majors. Prerequisite: high school chemistry. Laboratory fee required. *Mr. Brackett and Mr. Sass*

Chemistry 200. Organic Chemistry (3-4-8).

The course is designed to give a thorough survey of aliphatic and aromatic chemistry with an introduction to the heterocyclic compounds, and to present the theories relating to their structure and reactions. A special laboratory section in which the work is devoted chiefly to the synthesis of substances of medicinal interest is arranged for premedical students. Prerequisite: Chemistry 120. Laboratory fee required. *Mr. Richter*

Chemistry 220a. Quantitative Analysis (3-4-4).

This course aims at familiarizing the student with the principles and techniques of volumetric and gravimetric analysis. Chemistry majors will normally take Chemistry 220a in conjunction with Chemistry 320b in the Junior year. The course is open to Sophomores with approval of the Department. Prerequisites: Chemistry 120 and Physics 100. Laboratory fee required. *Mr. Curl*

Chemistry 310. Physical Chemistry (3-0-6).

A quantitative study of theoretical and physical chemistry dealing with atomic structure, the forms of matter, kinetics, equilibria, thermodynamics, and elementary principles of quantum mechanics. Prerequisites: Mathematics 200 and Physics 200. *Mr. Salsburg*

Chemistry 311a, b. Physical Chemistry Laboratory (0-4-2).

This course is designed as a laboratory supplement to Chemistry 310. It is normally taken by chemistry majors in the second semester of the Junior year and the first semester of the Senior year. Laboratory fee required. *Mr. Salsburg*

Chemistry 320b. Instrumental Analysis (2-8-4).

A required course for Junior chemistry majors. Special emphasis is given to modern instrumental methods of quantitative analysis. Prerequisite: Chemistry 220a. Laboratory fee required. *Mr. Curl*

Chemistry 400a. Advanced Organic Chemistry (3-0-3).*

Introduction to theoretical organic chemistry with emphasis on reactions of general synthetic importance. *Mr. Ettlinger*

Chemistry 410a. Colloid Chemistry (3-4-4).

An introductory course dealing with the theories of colloid chemistry and their applications. Prerequisites: Chemistry 310. Laboratory fee required. *Mr. Milligan*

Chemistry 420a. Introduction to Quantum Mechanics (3-0-3).*

An introductory course in the principles of quantum mechanics. *Mr. Brackett*

Chemistry 420b. Statistical Mechanics (3-0-3).*

A course in the principles of statistical mechanics. *Mr. Salsburg*

Chemistry 430b. Quantum Chemistry (3-0-3).*

This course is devoted to a discussion of valence theory and to a consideration of structure and reactivity based upon simple quantum mechanical considerations. *Mr. Sass*

Chemistry 440b Qualitative Organic Analysis (2-8-4).

A course in systematic procedures for the separation and identification of organic compounds. It aims to review, by actual laboratory contact, the important reactions of organic substances. Laboratory fee required. *Mr. Lewis*

Chemistry 450a. Thermodynamics (3-0-3).*

Relation of heat and work to chemical and physical systems. A consideration of free energy, entropy, and other thermodynamic functions as applied to equilibria. Special attention to the treatment of solutions. *Mr. Kilpatrick*

Chemistry 460b. Special Topics in Inorganic Chemistry (3-0-3).*

Mr. Pitzer

Chemistry 480b. Chemistry of Natural Products (3-0-3).

A study of important types of naturally occurring substances of current interest in chemistry and biology. *Mr. Turner*

Chemistry 490a, b. Special Study and Research for Undergraduates.

Open only to chemistry majors with superior records, and with the permission of the chairman of the Department. *Staff*

Chemistry 500. Graduate Research.

Staff

Chemistry 505a, b. Advanced Physical Chemistry (4-0-8).

An intensive review of general physical chemistry with emphasis on independent work by the student. A course designed primarily for first-year graduate students. *Staff*

Chemistry 510. Chemistry of the Steroids (3-0-6).

A consideration of the reactions and stereochemistry of the steroids, including a discussion of the physiological importance of these compounds. *Mr. Turner*

Chemistry 520b. Theory of Adsorption of Gases (3-0-3).

An advanced treatment of modern theories of adsorption of gases on solids. *Mr. Milligan*

* Open to Seniors and graduate students.

Chemistry 540b. Special Topics in Organic Chemistry (3-0-3).
Not offered in 1962-63. *Mr. Ettlinger*

Chemistry 545b. Physical-Organic Chemistry (3-0-3).
A study of the mechanisms of various important organic reactions. Prerequisite: Chemistry 400a. *Mr. Lewis*

Chemistry 550a. Reaction Kinetics (3-0-3).
A consideration of the rates of reactions with emphasis on homogenous kinetics as a tool in the study of reaction mechanisms. Prerequisite: Chemistry 400a. Not offered in 1962-63. *Mr. Lewis*

Chemistry 560b. Electrochemistry (3-0-3).
The application of thermodynamics to the study of electrolytic cells. Prerequisite: Chemistry 450a. Not offered in 1962-63. *Mr. Kilpatrick*

Chemistry 570. Absorption Spectra of Organic Compounds (3-0-6).
The application of ultraviolet and infrared absorption spectra to the study of molecular structure. *Mr. Ettlinger*

Chemistry 580a. Special Topics in Alkaloid Chemistry (3-0-3).
A consideration of the chemistry of selected groups of alkaloids. Not offered in 1962-63. *Mr. Turner*

Chemistry 590. Advanced Topics in Theoretical Chemistry.
Mr. Salsburg

Chemistry 610. Application of X-ray Diffraction Methods (3-0-6).
Application of X-ray diffraction methods to inorganic and physical chemistry. Identification of solid phases, determination of crystal size, X-ray analysis of simple types of structures, electron diffraction. *Mr. Milligan*

Chemistry 630b. Statistical Thermodynamics (3-0-3).
A development of the principles of thermodynamics from the standpoint of statistical mechanics. The relation of the structure of molecules to their thermodynamic properties. Prerequisites: Chemistry 450a and Mathematics 300 or 310. Not offered in 1962-63. *Mr. Kilpatrick*

Chemistry 640a. Chemistry of the Terpenes (3-0-3).
Not offered in 1962-63. *Mr. Turner*

Chemistry 650. Quantum Mechanics (3-0-6).
A study of simple mechanical systems from the point of view of wave mechanics with application of these concepts to the chemical bond. Consideration of the energy states of polyatomic molecules. Prerequisite: Mathematics 300 or 310.
Mr. Kilpatrick

Chemistry 660a. X-ray Crystal Structure Analysis (3-0-3).
A course in X-ray analysis including experimental methods, symmetry and space groups, dynamic theory of X-ray diffraction, Fourier and Patterson methods, modification functions, and order-disorder phenomena. Not offered in 1962-63. *Mr. Sass*

Chemistry 690a. Special Topics in Organic Reaction Mechanisms (3-0-3). *Mr. Lewis*

Chemistry 700. Summer Graduate Research. *Staff*

Civil Engineering

Professors Austin and Sims, *Chairman*
Associate Professors Holt, McDonald, and Thibodeaux
Assistant Professors Krahl, Merwin, Salani, and Triandafilidis
Instructors Backus and Weidler

Requirements for the degree of Bachelor of Science in Civil Engineering and for graduate degrees are summarized on pages 40-41 and pages 44-46, respectively.

Representative course contents, showing the typical sequence of courses and registration for each of the five years leading to the Bachelor of Science degree, are available from the Department. Students should consult with the Department advisers for specific courses of study.

Candidates for the degree of Master of Science must complete a minimum of eight one-semester courses and be enrolled in a graduate seminar each year.

Candidates for the degree of Doctor of Philosophy must complete a minimum of sixteen one-semester courses and pass written and oral comprehensive examinations.

The research interests of the Civil Engineering faculty and laboratory research equipment available provide the following areas of specialization: (1) Structural Mechanics and Design; (2) Soil Mechanics and Foundations; and (3) Engineering Materials.

COURSES

Civil Engineering 356. Engineering Measurements (2-3-3).

This course will develop the theory of measurements through a study of such concepts as experimental errors, distribution of errors, propagation of errors, curve fitting, dimensional analysis, and least squares by reference to surveying methods and other engineering measurement. The laboratory will comprise applications of these concepts to some elementary problems in surveying. Laboratory fee required.

Civil Engineering 401. Mechanics of Materials (3-1½-3).

Stresses and deformations due to tensile, compressive, and shearing forces, bending moments, and torque. Consideration of beams, columns, shafts, pressure vessels, axially-loaded members, riveted and welded joints, members with combined loadings, determinate and indeterminate structural systems. Study of engineering properties of materials and failure theories. Laboratory tests of tensile and compressive members, beams, and shafts of steel, aluminum, cast iron, wood, and concrete. Laboratory fortnightly. Laboratory fee required.

Civil Engineering 402. Mechanics of Fluids (3-1½-3).

The emphasis is on the fundamentals of fluid mechanics, including properties, fluid statics, flow concepts, viscous effects, dimensional analysis, dynamic similitude, and two-dimensional ideal fluid flow. Engineering applications of fluid mechanics are presented. Laboratory fortnightly. Laboratory fee required.

Civil Engineering 421. Route Surveying and Highway Design (3-3-4).

Simple and compound horizontal and vertical curves for highway and railway

use. Problems in earthwork. Leveling. Application of error theory. Geometrical and structural design of highways. Laboratory fee required.

Civil Engineering 422. Elementary Structural Analysis (3-3-4).

Consideration of structural stability and determinacy. Analytical and graphical methods of determining stresses in statically determinate beams, frames, and trusses due to fixed and moving loads. Analysis of space frameworks. Approximate analysis of indeterminate structures.

Civil Engineering 441. Civil Engineering Analysis (3-0-3).

A study of certain mathematical methods useful in the field of engineering. Formulation of problems of interest to civil engineers, mathematical methods of solution, interpretation of results. Application of electronic computers to civil engineering problems.

Civil Engineering 442. Special Topics in Civil Engineering Analysis (3-0-3).

A continuation of Civil Engineering 441. Mathematical methods of analysis applied to such topics as theory of elasticity, elastic stability, static and dynamic analysis of structures.

Civil Engineering 490. Civil Engineering Professional Practice and Computer Techniques (3-0-3).

A course to acquaint the student with the professional aspects of engineering works-project financing, elements of contracts and specifications, discussion of A.I.A., A.S.C.E., and A.G.C. agreement forms, manuals of professional practice. Instruction during 1961-62 term on elements of digital computer computation.

Civil Engineering 503. Experimental Problems in Civil Engineering (0-3-2).

Direct and indirect methods of model stress analysis. Strain measurement and stress determination. Photoclastic stress analysis.

Civil Engineering 505. Seminar (1-0-2).

A course devoted to the purpose of training engineering students in collecting and presenting orally formal papers on topics of engineering interest. The papers are given by the students, using acceptable material secured from technical periodicals. The course meets weekly and is conducted in the form of a professional society meeting. Required of all civil engineering students in the year they are candidates for the bachelor's degree in civil engineering.

Civil Engineering 521. Water Supply and Treatment (3-3-4).

Study of the engineering aspects of hydrology pertinent to collection of surface and ground waters. Principles and design of water transmission and distribution systems. Water quality characteristics. Study of unit operations and the synthesis of water treatment processes.

Civil Engineering 522. Waste Treatment and Water Pollution Control (3-3-4).

Study of the sources and characteristics of waste waters. Principles and design of collection systems. Design of sewage treatment plant for small city. Project financing.

Civil Engineering 541. Theory of Concrete Structures (3-3-4).

Properties of concrete. Theory of reinforced concrete. An analytical study of behavior of concrete members in relation to present design codes. Laboratory fee required.

Civil Engineering 542. Design of Reinforced Concrete Structures (3-3-4).

Design of structural members and frameworks of reinforced concrete. Elastic and ultimate strength design. Prestressed concrete. Design of typical parts of buildings, bridges, and foundations. Laboratory fee required.

Civil Engineering 561. Advanced Mechanics of Materials (3-3-4).

Advanced topics in stress analysis. Three-dimensional states of stress and strain; theories of failure of elastic action; shear center; unsymmetrical bending; curved beams; beams on elastic supports; flat plates; torsion of noncircular sections; column theory; local buckling; lateral buckling; stress concentration; plastic analysis. Properties of steel, aluminum, and timber.

Civil Engineering 562. Design of Steel, Aluminum, and Timber Structures (3-3-4).

Design of tension members, compression members, beams, and connections. Design of plate girders, roof trusses, simple bridge trusses, and building frames. Working drawings, estimates of weight and cost. Introduction to plastic design of steel. Laboratory fee required.

Civil Engineering 581. Introduction to Statically Indeterminate Structures (3-3-4).

A study of the stresses and deflections of such structures as continuous spans and rigid frames by the methods of angle changes and moment distribution. Analysis of trussed structures with redundant members, analysis of secondary stresses in trusses. Williot-Mohr diagrams.

Civil Engineering 582. Properties and Behavior of Soils (3-3-4).

Significant physical characteristics of earth materials. Their identification and classification in terms of index properties. Weight-volume relationships. The importance of hydraulic properties of soils. Strength and compressibility characteristics of natural soil masses. The origin, occurrence, and distribution of natural soil deposits. Methods and program of subsurface investigations for the determination of the soil profile. Laboratory testing for the determination of index properties.

Civil Engineering 583. Foundation Engineering (3-2-3).

Different types of foundations such as spread footings, rafts, piles, and piers. Factors determining the proper type of foundation. Ultimate bearing capacity. Settlement predictions. Earth pressure theories. The stability of slopes and open excavations. Damage due to construction operations. The proportioning of foundation elements.

Civil Engineering 605. Graduate Seminar (1-0-2).

Current problems and research developments in civil engineering. Two types of meetings are held: (1) a series of lectures by invited speakers and members of the staff; (2) a series of informal discussions among members of the staff and graduate students, devoted to the presentation and criticism of the research studies currently in progress in the Department.

Civil Engineering 610. Numerical Engineering Analysis (4-0-4).

Study of the nature of complex problems in structural engineering analysis and of the means of obtaining practical solutions. Methods of formulating exact or approximate governing equations for complex physical situations involving discrete (lumped parameter) and continuous systems, including energy methods, variational methods, finite differences, and others. Methods for solving basic types of equations, including relaxation, iteration, and successive eliminations for simultaneous, linear equations; successive approximations, Holzer procedure, and Southwell procedure for characteristic value problems; step-by-step numerical integration procedures for

initial value or propagation problems. Applications to problems in solid mechanics and structural analysis, including equilibrium, buckling, dynamic, and vibration problems of complex systems.

Civil Engineering 620. Advanced Statically Indeterminate Structures (3-0-3).

Classical and modern methods of analysis applied to a study of stresses and deflections in structures such as rigid frames, trusses, continuous beams and arches. Methods to be applied include real work, virtual work, Castigliano's theorem, and least work. Slope deflection and column analogy. Plastic analysis.

Civil Engineering 622. Numerical Methods of Structural Analysis (3-0-3).

Numerical methods for the solution of complex structural engineering problems with applications to bridges, buildings, aircraft, and other structures. Moments and deflections of elastic and inelastic beams with axial and transverse loading, buckling strength of columns, moments and deflections of beams resting on elastic or plastic supports, vibration of beams, analysis of arches. Finite difference method for the solution of ordinary and partial differential equations with applications to the bending of plates and floor slabs, and other problems.

Civil Engineering 624. The Application of Electronic Computers to Structural Problems. (3-3-4).

Introduction to computer programming, matrix methods of structural analysis. Optimization of structures.

Civil Engineering 630. Design of Structures for Dynamic Loads (3-0-3).

Free vibrations, forced vibrations, and transient response of structures and structural components having one or many degrees of freedom. Nature of dynamic loadings and response of structures to explosion blast forces, earthquakes, wind and wave forces, oscillatory forces, and other time-dependent excitations. Study of general design considerations and current design methods. Prerequisite: Civil Engineering 610 or equivalent.

Civil Engineering 632. Buckling of Structures (3-0-3).

Buckling of axially and eccentrically loaded columns. Torsional buckling of columns. Lateral buckling of beams. Stability of frameworks. Local buckling.

Civil Engineering 634. Analysis and Design of Plates and Slabs (3-0-3).

Fundamental theories of bending and buckling of plates. Study of theoretical solutions and correlation of theoretical and experimental results for metal plates and for reinforced concrete slabs. Applications of theories in analysis and design of reinforced concrete bridge and building floors, highway and airport pavements, and structural plate components in metal. Orthotropic plate analysis with applications to gridwork design. Prerequisite: Civil Engineering 610 or equivalent.

Civil Engineering 636. Analysis and Design of Shells (3-0-3).

Fundamental theories for the analysis of the stresses and deformations in shell structures. Membrane and bending analyses of cylindrical shells, shells of revolution, and shells of arbitrary shape. Analysis and design of single- and multiple-bay cylindrical shell roofs, domes, paraboloid, elliptic paraboloid, and hyperbolic paraboloid roofs, folded plate structures, pressure vessels, tanks, tubes, pipes, and other practical shell structures. Buckling of cylindrical shells, tubular columns, etc.

Civil Engineering 640. Introduction to the Mathematical Theory of Elasticity. (3-0-3).

A study of the mechanics of elastic deformable bodies, based upon the fundamental concepts of equilibrium, compatibility of strains, and properties of materials. Exact relations between stresses, strains, and displacements are studied in some detail with special consideration given to their significance in structural engineering problems. Failure theories. Theoretical bases for common experimental methods, such as photoelasticity, membrane analogy, etc. Bending and torsion of prismatic bars. Propagation of waves in elastic media. Bending of plates. Elastic stability of plates. Membrane theory of shells. General theory of shells.

Civil Engineering 642. Theory of Plasticity (3-0-3).

A study of the mechanics of inelastically deformed bodies; mathematical formulation of plastic stress-strain laws; flexure and torsion of prismatic members; application of limit design and shakedown theorems to structures; mixed elastic-plastic problems.

Civil Engineering 650. Steel Design (3-0-3).

Elastic and plastic design of steel members; codes and specifications for buildings; riveted, bolted, and welded construction; evolution of bridge specifications; loads and working stresses; economic proportions.

Civil Engineering 652. Design of Lightweight Structures (3-0-3).

Analysis and design of structures and structural members of minimum weight.

Civil Engineering 660. A Critical Review of Codes for Steel and Concrete Structures (3-0-3).

A study of experimental and analytical investigations which form the basis for design codes. Behavior of steel and reinforced concrete structural members and the behavior of steel and reinforced concrete structures.

Civil Engineering 662. Advanced Design of Reinforced Concrete Structures (3-0-3).

A critical study of modern methods of design of reinforced concrete structures. Evaluation and correlation of certain analytical and mathematical investigations, significant experimental investigations, code provisions, and design practice. A consideration of ultimate strength design and prestressed members.

Civil Engineering 670. Soil Mechanics (3-0-3).

Index properties, weight-volume relationships. Atterberg limits, consistency of clays and density of sands. Detailed approach to textural and plasticity soil classification systems. Geological and pedological soil classification. Permeability, principle of effective stress, seepage pressures, capillarity, and drainage. The use and function of filters. Theory of consolidation, laboratory testing and field data. Shear strength, friction, and cohesion. Mohr's theory of stress. Coulomb's failure hypothesis. Direct and triaxial shear testing. Normally and overconsolidated soils. Effective vs. total stress analysis. Compaction, laboratory testing and field practice. Soil structure. The character of natural soil deposits. Subsurface investigations. Types of boring rigs and types of samplers. Sample disturbance. Layout of subsurface investigation program.

Civil Engineering 671. Applied Soil Mechanics (3-0-3).

State of plastic and elastic equilibrium. Concepts of active and passive earth pressure. Development of Terzaghi's bearing capacity equation. Types of foundations. Bearing capacity and settlement of foundations in sands and clays. Foundations on nonuniform soil deposits. Lateral forces and displacements due to vertical loads. Flow-nets and seepage. Slope stability. Retaining walls and abutments. Stability of anchored bulkheads. Excavations and braced cuts. Caissons and cofferdams.

Civil Engineering 699. Advanced Independent Study.

Individual investigations or studies of any phase of civil engineering selected by the student and approved by his adviser and the staff member who will supervise the investigation.

Civil Engineering 700. Research and Thesis.

This will consist of an original investigation along some approved line of civil engineering work, an original design, or a critical review of existing work. In every case three complete typewritten or printed reports will be required, two for deposit in the University Library and one for the Civil Engineering Department.

Classics

(*See* pages 121-122)

Commerce

Associate Professor Hodges, *Chairman*
Lecturer Johnston

COURSES

Commerce 100. Introduction to Business (3-0-6).

Historical and economic setting of business enterprise; elements of business activity.

Commerce 110. Business Mathematics (3-0-6).

Linear equations; exponents and radicals; quadratic equations; binomial theorem; logarithms; curve plotting. Compound interest and annuities; sinking funds; permutations and combinations; introduction to probability.

Commerce 200. Financial Control (3-0-6).

Introduction to the methods of accounting for partnerships and corporations; concepts of costs, income, and profit; financial analysis; problems in valuation, depreciation, and surplus accounting.

Commerce 310a. Business Statistics (3-2-3).

Collection, classification, and presentation of data; use of graphic methods; frequency distributions; time series; index numbers; correlation.

Commerce 315b. Finance and Currency (3-0-3).

Functions and theory of money and credit; principles of commercial banking; the Federal Reserve System.

Commerce 410a. Marketing (3-0-3).

Marketing functions and institutions; role of commodity characteristics and the choice of distribution channels; financing marketing activities; management and control of marketing risks.

Commerce 415b. Business Finance (3-0-3).

Short- and long-term financing of assets; investment banking; tools of financial analysis; budgets and financial planning.

Commerce 420a. Business Organization I (3-0-3).

Personnel management and employee relations; personnel policies; job evaluation; wage and salary administration; employee services; labor legislation.

Commerce 425b. Business Organization II (3-0-3).

Principles of internal organization and control; selected topics in business policy.

Drawing

(*See* page 120)

Economics and Business Administration

PROFESSOR EDWARDS, *Chairman*
ASSOCIATE PROFESSORS AUTEN, BROTHERS, W. MACKEY, RIMLINGER, AND SIMONS
ASSISTANT PROFESSORS JAKSCH AND STEELE
LECTURERS GILES AND NESS

Information for Undergraduate Major. Students primarily interested in accounting are advised to take Business Administration 200 in their Sophomore year. Those interested in economics should take Economics 200 as Sophomores.

Undergraduate majors are required to take twelve semesters of approved departmental courses. These must include Economics 200, Economics 350a, and Business Administration 200. A student with a principal interest in economics may be permitted to substitute electives outside the Department for up to two semesters of elective courses in economics provided (1) that such substitution complements his major interest, and (2) that he secures approval of the departmental representative in economics.

In lieu of three semesters of course work, the Department offers independent work to a limited number of students having a principal interest in economics who have taken Economics 200 as Sophomores. Selections for this program are made late in the first term of the Junior year.

Departmental representatives are
Mr. Simons—for class of 1964 students in accounting
Mr. Rimlinger—for class of 1964 students in economics
Mr. Mackey—for class of 1963 students in accounting
Mr. Auten—for class of 1963 students in economics

The Graduate Program in Economics. Admission to graduate study in economics will be granted to a limited number of students who hold an undergraduate degree (or the equivalent), whether in economics or another field. Some training in mathematics at the college level is advisable, but it is not a prerequisite of admission. Those can-

didates for the Ph.D. degree who have a good undergraduate preparation in economics should expect to devote two years to full-time study (or the equivalent) before taking the general examination which must be passed before the submission of the doctoral dissertation. A minimum of another year is usually necessary for the completion of the dissertation. Applicants in the United States must take the Graduate Record Examination. Others should do so if possible.

The aim of the graduate program is to provide a thorough training in economic theory supplemented by a knowledge of quantitative tools and an understanding of modern economic institutions and policy problems. Those successfully completing the Ph.D. program will be prepared for careers as professional economists in teaching, business, and government.

Instruction is carried on in small classes, seminars, and tutorials in which student participation is emphasized. Close contact with the faculty is encouraged as a means of stimulating and sustaining student interest in research problems.

Supplemental facilities and opportunities include:

(1) the Economics Seminar which meets at least once a month to hear visiting economists, departmental faculty, and graduate students present results of current research.
(2) a large-scale digital computer which may be used for advanced research.
(3) graduate courses in such related subject areas as history, mathematics, and philosophy.

In addition to the regular staff, distinguished visiting professors are invited to Rice from time to time.

Candidates for the doctor's degree will be expected to:

(1) Pass reading examinations in French and German, one by the end of the first year and the other by the end of the second year of residence. Under special circumstances another language may be approved as a substitute for one of these.
(2) Demonstrate proficiency in statistics and elementary mathematical economics.
(3) Complete an approved program of graduate courses.
(4) Pass a general examination (written and oral) on four approved fields of economics, one of which must be economic theory. The fields offered include:
    1. Economic Theory
    2. Economic History and Development
    3. Mathematical Economics
    4. Quantitative Methods
    5. Labor and Industrial Organization
    6. Monetary Theory and Policy
    7. International Trade and Finance

8. Managerial Economics

Note: Students may offer both fields 3 and 4 with special permission of the Departmental Graduate Committee.

(5) Submit (with the approval of the student's advisory committee) and successfully defend in an oral examination a doctoral dissertation setting forth in publishable form the results of original research.

Candidates admitted for the master's degree in economics will be expected to:

(1) Pass a reading examination in French or German.
(2) Demonstrate proficiency in statistics.
(3) Complete an approved program of graduate courses.
(4) Make a successful oral defense of a thesis presenting in prescribed form the results of original research.

ECONOMICS COURSES

Economics 200. Principles of Economics (3-0-6).

The principles of modern economics and the history of economic thought and controversy. The first part of the course is concerned with the theory of national income determination, price and distribution theory, and the theory of trade. In the second part of the course the great economic ideas and issues of the past and present are studied, with emphasis on those ideas and policy issues of continuing influence in national and international economic affairs. *Staff*

Economics 304b. Junior Independent Work (0-0-3).

Each student is required to undertake research and to write (and rewrite) a short paper on a topic approved by his adviser. A limited number of students are permitted to transfer to this course at the end of the first semester on the basis of interviews with those who apply. Preference is given to Juniors having a principal interest in economics who are contemplating enrolling in Economics 404 as Seniors. Prerequisite: Economics 200. *Staff*

Economics 350a. Elements of Statistical Method (3-2-3).

Collection, classification, and presentation of data; analysis of frequency distributions; analysis of time series; index numbers; correlation; introduction to the theory of sampling and statistical inference. *Mr. Jaksch*

Economics 355b. Money and Banking (3-0-3).

The theory of money and credit; the theory and practice of commercial and central banking; treasury debt-management policy; the nature of the money market. Prerequisite: Economics 200a. *Mr. Brothers*

Economics 370a. Economic Analysis I (3-0-3).

A course in intermediate theory devoted to the study of economic equilibrium and market relationships; the theories of the firm and the household, of income distribution, and of general equilibrium. Prerequisite: Economics 200a. *Mr. Edwards*

Economics 375b. Economic Analysis II (3-0-3).

The theory of national income determination and economic growth; a critical consideration of selected theories of income fluctuations; some application of theory to policy questions. Prerequisite: Economics 200a. *Mr. Edwards*

Economics 404. Senior Independent Work (0-0-6).

Each student is required to undertake intensive research on the Senior thesis topic approved in Economics 304a. The results of his research will be presented in the form of a scholarly paper. Prerequisite: Economics 304b. *Staff*

Economics 410b. The Economics of Labor Relations (3-0-3).

A survey of the history and current status of the labor movement in the United States; organization and structure of labor unions; trends in labor legislation; collective bargaining and the settlement of labor disputes; wage and employment theory; social insurance; current labor problems and issues. Prerequisite: Economics 200a or approval of the instructor. *Mr. Giles*

Economics 420a. International Economics (3-0-3).

A study of the economic relationships between separate countries in the international economy; trade theory; balance of payments analysis; international finance; tariffs and other trade restrictions; current policy issues. Prerequisite: Economics 200. *Mr. Auten*

Economics 430a. Comparative Economic Systems (3-0-3).

Theoretical models of various economic systems are presented as a basis for analyzing the operation and the institutional characteristics of several economies, including the U.S., the U.S.S.R., Great Britain, India, and China. Prerequisite: Economics 200. *Mr. Rimlinger*

Economics 435b. Government Regulation of Industry (3-0-3).

The nature, enforcement, and economic impact of the federal statute laws regulating monopoly and competition in the United States; the development and legal interpretation of the antitrust laws through precedents established in important cases. Prerequisite: Economics 200a or approval of the instructor. *Mr. Steele*

Economics 440a. Managerial Economics (3-0-3).

The meaning of management; criteria for management decisions; organization theory; managerial planning and control with emphasis on capital budgeting; information requirements and problems of measurement. Prerequisite: Economics 200.

Economics 445b. Mathematical Methods in Management (3-0-3).

An introduction to the solution of management problems by elementary methods of mathematical economics and operations research. Prerequisite: Economics 200a. *Mr. Jaksch*

Economics 455a. Financial Policies and Institutions (3-0-3).

The economics of finance; the financial policies of large-scale business organizations; the nature and functions of various financial institutions which serve as intermediaries in the saving-investing process. Prerequisite: Business Administration 200 and Economics 200a. *Mr. Ness*

Economics 475b. Taxation and Fiscal Policy (3-0-3).

An analysis of the financial operations of governmental units at the national, state, and local level, but particularly at the federal level; analysis of monetary and fiscal policies to promote economic stability; economic appraisal of the United States tax structure and of its effects on incentives and on the prospects for long-run economic growth and development. Prerequisite: Economics 200a. *Mr. Steele*

Economics 490a. The Development of Economic Institutions (3-0-3).

A seminar devoted to the analysis of the impact of technological change and political and social developments upon the evolution of economic institutions. Investigation will be made of economic forces which lie beyond supply-and-demand factors in the market economy. The course will survey the works of leading institutional economists and social anthropologists as a point of departure for research and discussion. *Mr. Giles*

Economics 500. Economic Research.

Research on an approved topic in partial fulfillment of the requirements for the master's degree. *Staff*

Economics 501. Price Theory (3-6-5).

A first graduate course in microeconomic theory. Topics studied include the theory of the firm, the theory of consumer behavior, duopoly, bilateral monopoly, imperfect competition, capital theory, and the theory of income distribution. *Mr. Steele*

Economics 502. Income and Employment Theory (3-6-5).

Macroeconomic theory of employment, interest, and income. Considers the work of Keynes and subsequent developments including growth models. *Mr. Edwards*

Economics 503. Capital and Interest Theory (3-6-5).

The development of capital, income, and interest theory from Böhm-Bawerk to the present. Offered in alternate years.

Economics 504. Topics in Economic Theory (3-6-5).

Deals with such topics as utility theory, welfare economics, uncertainty, cyclical models, and game theory.

Economics 505. Monetary Theory (3-6-5).

Modern monetary theory. The economics of money, banking, and finance. *Mr. Brothers*

Economics 506. Monetary and Fiscal Policy (3-6-5).

Selected theories in monetary and fiscal policy and their interrelationships; analysis of selected policy proposals and a study of their operation in practice.

Economics 507. Elementary Mathematical Economics (3-6-5).

The formulation of fundamental economic models and basic economic theory in elementary mathematical terms. *Mr. Jaksch*

Economics 508. Advanced Mathematical Economics (3-6-5).

The application of mathematical tools to special economic problems. Areas covered will include interindustry economics, growth and cyclical models, and selected applications of game theory.

Economics 509. Advanced Statistics (3-0-3).

Statistical inference and the testing of hypotheses; multiple and partial correlation analysis; selected topics in time-series analysis and index-number construction.

Economics 510. Econometrics (3-6-5).

Mathematical models of economic behavior and their numerical evaluation by statistical methods.

Economics 511. Theory of Economic Accounts (3-6-5).

The nature and measurement of income and capital: the construction and use of economic accounts as a basis for analyzing the firm, interindustry relationships, the national economy, and international trade. National income accounts, money flows accounts, and input-output tables are discussed. Offered in alternate years. *Mr. Edwards*

Economics 512. International Trade Theory (3-6-5).

Classical, neoclassical, and modern trade theory; balance of payments equilibrium; some welfare aspects of trade. Offered in alternate years. *Mr. Auten*

Economics 513. Topics in Managerial Economics (3-6-5).

Theory of investment of the firm; organization theory; problems in applying theory in decision-making. *Mr. Edwards*

Economics 514. Industrial Organization and Control (3-6-5).

Industrial markets and public policy; the determinants and implications of price and production policies; a study of the adequacy of the antitrust laws in relation to the problems of industrial organization. *Mr. Steele*

Economics 515. Labor Economics (3-6-5).

The economics of the labor market and the economic implications of trade unions. Attention is given also to major policy questions such as the wage-price issue, the labor monopoly issue, and public control over unions and collective bargaining. *Mr. Rimlinger*

Economics 516. Economic History and Development (3-6-5).

An historical analysis of the economic growth and industrialization of the U. S., Western Europe, and Russia in the last 150 years. Stresses the conditions which favored or retarded growth in different times and places. *Mr. Rimlinger*

Economics 517. History of Economic Thought and Methodology (3-6-5).

The development of economic thought and methodology from the seventeenth century to the present. Emphasis is given to classical and neoclassical doctrines reflected in modern economic theory and analytical techniques.

Economics 518. International Finance (3-6-5).

Analysis of international monetary problems; foreign exchange theory; international investment. Offered in alternate years. *Mr. Auten*

Economics 600. Economic Research.

Research on an approved topic in partial fulfillment of the requirements for the doctor's degree. *Staff*

BUSINESS ADMINISTRATION COURSES

Business Administration 200. Introduction to Business (3-0-6).

Accounting principles; financial statements; business organization and procedures; financial structure, internal organization, and accounting problems of partnerships and corporations; manufacturing costs; analysis and interpretation of financial reports. *Messrs. Simons and Mackey*

Business Administration 391a. Cost Accounting (3-0-3).

The methods of accounting for the various elements of manufacturing costs are treated with special emphasis on the use of cost information in administration and control. Job order, process, and standard cost procedures. Prerequisite: Business Administration 200. *Mr. Mackey*

Business Administration 392b. Principles of Accounting, Intermediate (3-0-3).

Accounting procedures reviewed; working papers, closing; financial statements; net income concepts; capital stock, retained earnings, and dividends; miscellaneous topics relating to stockholders' equity; generally accepted accounting principles; cash; receivables; inventories; investments; tangible and intangible fixed assets; liabilities and reserves. Prerequisite: Business Administration 200. *Mr. Simons*

Business Administration 411a. Advanced Accounting and Federal Taxation (3-3-4).

Analysis and interpretation of statements and operations; application of funds; cash flow; combinations, divisive and quasi reorganizations; income tax allocation; price-level impact on financial statements; partnerships; statement of affairs; receiverships; actuarial science; estates and trusts; parent and subsidiary accounting; consolidations. Laboratory hours devoted to the study of federal taxation of income of individuals. Prerequisite: Business Administration 392b.

Messrs. Simons and Mackey

Business Administration 412b. Auditing and Federal Taxation (3-3-4).

Financial examination theory and procedure as practiced by the independent certified public accountant; internal control; working papers and reports. Largely based on integrated case study. Laboratory hours devoted to a study of federal taxation of the income of fiduciaries, partnerships, and corporations; estate and gift taxation; oil and gas taxation. Prerequisite: Business Administration 391a, 392b, and 411a.

Mr. Mackey

Education

(*See* page 158)

Electrical Engineering

Professors Graham, Pfeiffer, *Chairman*, Waters, and Wischmeyer
Associate Professor McEnany
Assistant Professor Rabson
Instructors Bourland, Emery, and Welch
Lecturer MacPhail

The first two years of the science-engineering program are described on page 40 of the catalog. Sophomore students contemplating a major in electrical engineering should elect Engineering 201 and 211 and a full year of Physics 200 or 210.

Representative programs showing the normal registration in courses for each year leading to the degree of Bachelor of Science in Electrical Engineering are available from the Department. Under suitable conditions, appropriate course substitutions may be made in some areas. Departmental approval is required for any such changes.

Requirements of a general nature for advanced degrees are outlined on pages 44-46. Students should consult the Department advisers for specific courses of study.

A candidate for the Master of Science degree in the Electrical Engineering Department is required to complete the equivalent of at least three full-year courses, one of which is to be an approved course out of the Department. In addition, he is required to complete an acceptable thesis, participate in the departmental graduate seminar, and meet the University language requirements.

The granting of the degree of Doctor of Philosophy presupposes

high quality academic work and demonstrated ability to do independent and creative research. To be admitted to candidacy, the student must show promise of realizing these goals by obtaining high standing in graduate courses and by performing satisfactorily on qualifying examinations designed to test his grasp of fundamentals as well as his ability to think independently. Considerable emphasis is placed on the research leading to a satisfactory dissertation. Each candidate faces a final oral examination, as described on pages 45-46. The doctoral program requires, as a minimum, the equivalent of three full years of Class I graduate study.

COURSES

Electrical Engineering 340. Elementary Electronics and Circuits (4-4-5).

Fundamental principles of vacuum tubes, gaseous conduction tubes, transistors, and their associated circuits. General circuit theory. For students of chemical, civil, and mechanical engineering. Prerequisites: Physics 200a or 210 and Mathematics 200 or 210.

Electrical Engineering 343. Circuits and Electronics (3-2-7).

Analysis of linear circuits. Fundamental principles of vacuum tubes, transistors, and related devices as circuit elements. Four hours of laboratory weekly during the second semester. Prerequisites: Physics 200 or 210 and Mathematics 200 or 210.

Electrical Engineering 412. Introduction to Electrical Machinery and Controls (3-1½-3).

Fundamental principles of electrical machinery and controls for students of chemical, civil, and mechanical engineering. Prerequisites: Electrical Engineering 340 and Mathematics 300 or 310. Laboratory fortnightly.

Electrical Engineering 413. Electrical Machinery (3-2-7).

Theory of d-c machinery, transformers, a-c machinery, and related devices. Prerequisites: Electrical Engineering 343 and Mathematics 300 or 310. Laboratory fortnightly.

Electrical Engineering 441. Electronics (3-4-4).

Continuation of the electronics portion of Electrical Engineering 343. Prerequisites: Electrical Engineering 343 and Mathematics 300 or 310.

Electrical Engineering 460. Topics in Modern Physics (3-4-4).

Some topics in modern physics fundamental to the study of many important electrical components and devices. Prerequisites: Electrical Engineering 343 and Mathematics 300 or 310.

Electrical Engineering 473. Electrical Engineering Analysis I (3-0-6).

Theoretical analysis of the behavior of discrete-parameter time-invariant linear systems. Electromagnetic field theory. Analogous fields and a study of boundary-value problems. Prerequisites: Mathematics 300 or 310.

Electrical Engineering 503. Field Theory. Advanced Circuit Analysis (3-0-6).

Electromagnetic fields; Maxwell's equations; relation to circuit theory; wave propagation; theory of microwave electronics. Advanced circuit theory. Prerequisites: Electrical Engineering 473 and registration in or completion of Electrical Engineering 573.

Electrical Engineering 505. Seminar (1-0-2).

Electrical Engineering 543. Electronics (3-4-8).

Analysis and design of electronic devices, circuits, and systems applicable to a variety of engineering fields. Prerequisites: Electrical Engineering 441 and 460; registration in or completion of Electrical Engineering 503.

Electrical Engineering 573. Electrical Engineering Analysis II (3-0-6).

Electronic differential simulator; functions of a complex variable; Boolean algebra; probability.

Electrical Engineering 593. Electrical Engineering Problems (1-4-4).

Theoretical and experimental investigations under staff direction.

The following one-semester elective courses will be offered according to demand and availability of faculty.

Electrical Engineering 511. Electrical Machinery (3-4-4).

Selected topics in the theory and application of electrical machinery and related controls.

Electrical Engineering 515. Electronic Controls and Servomechanisms (3-4-4).

Theoretical and experimental study of various types of feedback control systems and typical components. Laboratory studies include use of the electronic differential simulator.

Electrical Engineering 531. Communications Systems (3-4-4).

Study of important types of communications systems with respect to propagation media, frequency requirements, information-handling ability, reliability, and noise.

Electrical Engineering 535. Microwave Devices (3-4-4).

Basic physical theory applied to the study of the generation, transmission, control, and radiation of microwave energy.

Electrical Engineering 545. Pulse Circuit Design (3-4-4).

A study of various pulse circuits with an emphasis on those factors and methods of analysis which are important in circuit design.

Electrical Engineering 551. Electric Power Systems (3-4-4).

Selected topics in the study of electric power systems. Prerequisite: Electrical Engineering 511.

Electrical Engineering 561. Solid-State Devices (3-4-4).

Study of some of the important electronic devices based on quantum mechanical principles.

Electrical Engineering 595a or b. Electrical Engineering Problems (0-4-1).

Theoretical and experimental investigations under staff direction; an extension of Electrical Engineering 593. Prerequisite: Registration in Electrical Engineering 593.

The following courses are normally open only to students engaged in a program leading to an advanced degree.

Electrical Engineering 601. Topics in Linear Systems Analysis (3-0-3).

Mathematical models. Physical realizability. Properties of transfer characteristics at real frequencies. Realizability of transfer functions.

Electrical Engineering 605. Graduate Seminar (1-0-2).

Electrical Engineering 607. Nonlinear Circuit Analysis (3-0-6).

Consideration of various electronic circuits whose performance depends on nonlinear phenomena. Physical circuits are examined and the pertinent approximate equations are formulated. This is followed by an analytical treatment of these equations.

Electrical Engineering 613. Advanced Servomechanisms (3-0-6).

Mathematical formulation of the control problem; linear servo analysis and synthesis; design criteria and optimum synthesis; sampled-data systems; nonlinear systems.

Electrical Engineering 614. Topics in Systems Engineering (3-0-6).

Topics in systems engineering selected according to the interest of the class and instructor.

Electrical Engineering 617. Logic and Switching Network Theory (3-0-3).

Analysis and synthesis of combinatorial logic networks. Synthesis based on minority elements. Stability analysis of relay-type networks. Related topics.

Electrical Engineering 643. Advanced Electronics and Communications Engineering (3-0-6).

Electromagnetic theory and wave propagation; angle modulation; frequency analysis; electroacoustical systems; selected topics in related fields of interest.

Electrical Engineering 645. Electronic Circuit Synthesis (3-0-6).

It is assumed that the student is familiar with the analysis of electronic circuits. Performance specifications are considered and circuits are synthesized to meet these requirements. Certain of these are constructed and tested. Particular attention is given to second-order effects on the operation of these circuits.

Electrical Engineering 653. Theory of Electrical Machinery (3-4-8).

Treatment of electrical machinery from concepts of generalized circuit theory and energy flow.

Electrical Engineering 661. Semiconductor Electronics (3-0-6).

Fundamental theory of semiconductor devices. The material of an introductory course in modern physics is assumed. The quantum mechanical theory needed for analysis of the electronic behavior of semiconductors is developed as a part of the course.

Electrical Engineering 671. Foundations of Statistical Communication Theory (3-0-3).

Probability and random processes. Statistical filtering in time-invariant linear systems with stationary inputs. Information theory in discrete systems.

Electrical Engineering 690. Research and Thesis.

Engineering

General Undergraduate Information. Curricula in engineering at Rice University lead to degrees in the fields of chemical engineering, civil engineering, electrical engineering, and mechanical engineering.

The first two years of the science-engineering program taken by all engineers are described generally on page 40 of the catalog. Sophomore students contemplating a major in engineering should pay particular attention to the electives recommended under the special engineering departments.

The following undergraduate courses listed as "Engineering" are offered for the preparation of students majoring in all branches. For requirements of each department, reference should be made to the appropriate section.

COURSES

Engineering 201. Engineering Graphics I (1-5-3).

An engineering course which develops graphics as a method of exchanging ideas. Included are orthogonal projection, sketching, dimensioning, ASA and SAE standards, pictorial projection, and lettering. Staff approval of all drawing instruments is required. Laboratory fee required.

Engineering 202. Engineering Graphics II (1-5-3).

Emphasis on the graphical method of solving technical problems. Included are graphical arithmetic, graphical calculus, nomography, and relationships of algebraic and graphical solutions of problems in space. Prerequisite: Engineering 201 and completion or registration in Mathematics 200 or 210.

Engineering 211. Engineering Mechanics I—Statics and Introduction to Dynamics (3-3-4).

Foundations of mechanics. Methods and applications in statics. Vector methods. Equilibrium, work, potential energy. Stability of equilibrium. Kinematics and dynamics of a particle. Laboratory in use of a digital computer. Prerequisites: Physics 100, Mathematics 100.

Engineering 212. Engineering Mechanics II—Kinematics (3-0-3).

A study of the motion of rigid bodies. Plane motion, including rolling and sliding contact; elementary synthesis; considerations of three-dimensional rigid body motion including orthogonal transformations, Euler's angles, Euler's theorem on rigid body motion, and small rotations. Introduction to relativity. Prerequisites: Physics 100, Mathematics 100, registration in Mathematics 200.

Engineering 213. Engineering Mechanics III—Dynamics (3-0-3).

Methods and applications in the dynamics of systems of particles and rigid bodies in two and three dimensions. Theory of vibrations. Prerequisites: Engineering 211, 212.

English

Professors Camden, *Chairman*, Cope, Dowden, McKillop, and Williams
Associate Professors Conner, Gallegly, Parish, and Thomas
Assistant Professors Grob, Isle, Marsh, and Pickard

Requirements for a Major in English. Six courses in English, one preferably to be English 250, four to be advanced; an advanced course in French, German, or possibly Latin (not Spanish); two approved collateral courses in history, history of art, or philosophy, both to be advanced.

Requirements for the Degree of Master of Arts. Four advanced courses in English; the passing of a reading examination in French or German; the satisfactory completion of a thesis; the passing of an oral examination. Two years are usually required to complete the work for this degree.

Requirements for the Degree of Doctor of Philosophy. Prospective students are urged to take the Graduate Record Examination at the earliest opportunity and to consult the Department well in advance of registration with regard to their qualifications and to the feasibility of their plans for advanced studies in English. The awarding of the doctor's degree is not based on an accumulation of credits or on compliance with formal requirements; the candidate is expected to show a comprehensive knowledge of the field and to prove his command of the processes and results of scholarship. The following requirements are minimal: eight advanced courses in English, including those required for the degree of Master of Arts; the passing of a reading examination in two foreign languages, usually French and German, before taking the preliminary examination; the passing of a preliminary examination, both written and oral, on the general field of English studies, this requirement to be met at least a year before the submission of a thesis; the completion of a thesis which shall constitute an original contribution to knowledge and demonstrate the candidate's power of independent work; the passing of a final oral examination on the thesis and related fields. A graduate student is not admitted to candidacy for this degree until he has passed the preliminary examination.

COURSES

English 100. Introduction to Critical Reading, Thinking, and Writing (3-0-6).

Special attention will be given to expository writing and to the study of literary forms. *Messrs. Conner, Cope, Grob, Isle, Marsh, Dowden, Gallegly, Parish, Pickard, Williams, and others*

English 210. Argumentation and Public Speaking (3-0-6).

Practical training in the fundamentals of effective speech, written argument, and debate. Designed to prepare the student for the ordinary demands of business life.

Platform speaking, themes, conferences. This course is planned for students of physical education. *Mr. Gallegly*

English 230. Selected Great Books of European Literature (3-0-6).

Readings, lectures, discussions, and reports. *Mr. McKillop*

English 240. Modern and Ancient Narrative in Prose, Verse, and Drama (3-0-6).

Through readings, lectures, discussions, and reports, a study will be made of prose fiction, poetic fiction, and drama. Specific forms to be treated are the fable, the tale, the epic, the romance, the dramatic monologue, the short story, the novel, comedy, and tragedy. *Messrs. Conner, Marsh, Parish, Pickard, and Thomas*

English 250. Masters of English Literature (3-0-6).

Readings in the major authors representative of the various periods. The backgrounds and a chronological history of English literature will be provided through lectures and supplementary reading. Recommended for all prospective majors in English. *Mr. Grob*

English 300. English Drama from Its Beginnings to 1642 (3-0-6).

The development of the drama will be traced from the miracle plays and the moralities through the plays of Shakespeare and his contemporaries to the closing of the theaters. Some emphasis will be placed upon the development of Shakespeare as a dramatist and upon the indebtedness of Shakespeare to the earlier drama. *Mr. Cope*

English 310. Modern British Poetry (3-0-6).

A survey of British poetry from 1890 to date, with special emphasis on major intellectual developments of the period as they have been reflected in the poetry. *Mr. Williams*

English 320. Modern Drama (3-0-6).

A study of representative English, American, and Continental plays and dramatic movements since Ibsen against the background of antecedent theatrical traditions of the nineteenth century. Lectures and class discussions will be supplemented by reports on collateral reading. *Mr. Thomas*

English 325a. Conrad, Ford, and James (3-0-3). *Mr. Dowden*

English 330. Advanced Writing (3-0-6).

The writing of essays, stories, plays, and novels. Time is given also to problems of marketing manuscripts. Stories are read and analyzed, and critical theories are discussed. Frequent conferences. *Mr. Williams*

English 340. The English Novel (3-0-6).

Major novelists of the nineteenth and early twentieth centuries. *Mr. McKillop*

English 345b. Intellectual Backgrounds of the Nineteenth Century (3-0-3). *Mr. Grob*

English 350. Poetry and Prose of the Romantic Period (3-0-6).

Study of the poetry from Blake to Keats; reading of selected prose from Lamb to Carlyle. *Mr. Dowden*

English 355. Victorian Literature (3-0-6).

The main procedure is close reading and class discussion of assigned texts from the major writers. Connections with other literatures of the period and with the social and political background will be made through lectures, collateral reading, and reports. *Messrs. Grob and Thomas*

English 360. English Drama from 1660 to 1900 (3-0-6).

This course begins with the opening of the theaters after the Puritan Revolution and covers the drama of the Restoration, the eighteenth century, and the nineteenth century.

English 365. Literature of the Restoration and Eighteenth Century (3-0-6). *Mr. Hughes*

English 380. Poetry of the English Renaissance (3-0-6).

Major poets of the period and their relation to the political, religious, and scientific issues. *Mr. Parish*

English 385. Chaucer (3-0-6). *Mr. Williams*

English 390a. Major American Novelists (3-0-3).

A survey of main figures in American fiction beginning with Cooper and ending with James. *Mr. Isle*

English 390b. American Transcendentalism (3-0-3).

A close examination of Emerson and Thoreau and the literary effects of Transcendentalism on other authors. *Mr. Isle*

English 391a. American Drama (3-0-3).

A survey from the beginnings to the present. *Mr. Pickard*

English 393a. Modern American Fiction (3-0-3).

A survey of main figures from 1880 to the present. *Mr. Pickard*

English 393b. American Poetry (3-0-3).

A general survey of poetry in America from the beginnings to the present. *Mr. Pickard*

English 395. Life and Literature of the West and Southwest (3-0-6). *Mr. Gallegly*

English 400. Shakespeare (3-0-6).

A close study of certain of the comedies, histories, and tragedies, with lectures on the interpretation of these plays in the light of the Elizabethan mind. *Mr. Camden*

English 404. Directed Reading and Independent Work in English Literature (0-0-6).

Open to students of high standing having a principal interest in English or other modern literatures. Opportunity for independent reading and research will be provided for a selected group who wish to develop individual abilities and significant interests. Papers embodying the results of research will be written. Students will be selected for participation after consultation with the instructor in charge. *Mr. Cope*

English 440a. History of the English Language (3-0-3). *Mr. Conner*

English 440b. Modern English Grammar (3-0-3). *Mr. Conner*

English 450. Literary Allegory in the Sixteenth, Seventeenth, and Eighteenth Centuries (3-0-6).

A study particularly of *The Faerie Queene, The Winter's Tale, The Tempest, Paradise Lost, Pilgrim's Progress, Absalom and Achitophel,* and *A Tale of a Tub.* *Mr. Cope*

English 460. Sixteenth-Century Literature (3-0-6).
A survey of nondramatic literature from Malory to the death of Elizabeth, with special emphasis upon *The Faerie Queene* and *Arcadia*. *Mr. Marsh*

English 500. Topics in English Literary History.
Graduate research and thesis for the degree of Master of Arts.

English 505. Chaucer (3-0-6). *Mr. Williams*

English 510a. Old English (3-0-3). *Mr. Conner*

English 510b. Middle English (3-0-3). *Mr. Conner*

English 515. Directed Reading in English Linguistics (3-0-6). *Mr. Conner*

English 520a. Seminar in the Romantic Period: Wordsworth, Coleridge (3-0-3). *Mr. Grob*

English 520b. Seminar in the Romantic Period: Byron, Shelley (3-0-3). *Mr. Dowden*

English 530a. Bibliography and Methodology (3-0-3).
The course is designed to acquaint students with the bibliographical guides and aids to literary research. Attention will also be given to methods of preparing papers, theses, and dissertations. *Mr. Thomas*

English 535. Literary Criticism (3-0-6).
A study of the principles of classical, romantic, and realistic literature as formulated by the major critics from Plato to the present day. *Mr. Dowden*

English 540. Seminar in Seventeenth-Century Literature (3-0-6). *Mr. Cope*

English 550. Shakespeare Seminar (3-0-6). *Mr. Camden*

English 555. Seminar in Elizabethan and Jacobean Drama (3-0-6). *Mr. Camden*

English 560. Eighteenth-Century Prose and Poetry (3-0-6). *Mr. McKillop*

English 570. Milton Seminar (3-0-6). *Mr. Cope*

English 580. Directed Reading in English Literature (3-0-6). *Staff*

English 595. Dryden, Swift, and Pope (3-0-6). *Mr. Hughes*

English 600. Topics in English Literary History.
Graduate research and thesis for the degree of Doctor of Philosophy.

English 700. Summer Graduate Research.
Open only to graduate students already admitted to study for an advanced degree. At least forty hours of library study and research per week.

Fine Arts

Professor Chillman, *Chairman*
Associate Professor De Zurko
Assistant Professor Parsons

The studios of the Department of Fine Arts are located in the north basement of the Fondren Library. They are completely air-conditioned with adequate north light and equipped for drawing, painting, and modeling. The History of Art courses are held in Anderson Hall with complete equipment for slide and motion picture projection.

ART HISTORY COURSES

History of Art 215. History of the Architecture, Sculpture, and Painting of the Ancient World (3-0-6).

Emphasis is placed upon the correlation of the arts and their reflection in Renaissance and contemporary developments. Open to all students. *Mr. Chillman*

History of Art 315. History of the Architecture, Sculpture, and Painting of the Middle Ages. (3-0-6).

A study of outstanding examples of Western sacred and secular art. Open to students in all divisions. *Mr. De Zurko*

History of Art 415. History of the Architecture, Sculpture, and Painting of the Renaissance and the Subsequent Developments to the Present Time (3-0-6).

A general knowledge of ancient and medieval art is desirable. Open to students in all divisions. *Mr. De Zurko*

History of Art 450. Great Works of Architecture and Its Related Arts (3-0-6).

A history of art from 500 B.C. to modern times. Masterpieces of architectural composition which combine sculpture and painting. Examples are the Acropolis at Athens and the cathedral at Chartres. Lectures, discussion, and papers. Open to Juniors, Seniors, and graduate students. *Mr. Chillman*

History of Art 460. The Development of Modern Art (3-0-6).

A study of painting, sculpture and architecture during the past century in western Europe and the United States. *Mr. De Zurko*

DRAWING COURSES

Drawing 255. Freehand Drawing and Painting (0-4-2).

Open to all students. *Mr. Parsons*

Drawing 325. Freehand Drawing and Painting (0-4-2).

Open to all students. *Mr. Parsons*

Drawing 425. Life Drawing and Painting (0-4-2).

Open to all students. *Mr. Parsons*

Foreign Languages

Professors Bourgeois, Louis, and Mackenzie, *Chairman*
Associate Professors Myers and Shelton
Assistant Professors Castañeda, Dvoretzky, Jitkoff, Lehnert, Shreffler, Skarginsky, and Wilson
Instructors Heath, Lauderdale, Mitchell, Pickar, Savage and Tappan

Work is offered in the classical and modern languages: in 1961-62 courses were given in Greek, Latin, French, German, Italian, Russian, and Spanish. Undergraduates may major in Romance Languages, French, German, or Classics, and there are graduate programs in French and German leading to the degrees of Master of Arts and Doctor of Philosophy.

Both the undergraduate and graduate programs in foreign languages are in the process of revision, and additions to the faculty are anticipated. The list of courses which follows represents substantially the course offerings in 1961-62. A fully equipped language laboratory will be in operation in 1962-63, and laboratory work will be an important part of the elementary courses in foreign languages.

Undergraduate Majors. Students who intend to major in Romance Languages, French, or German should consult the section of this catalog dealing with curricula and degrees to familiarize themselves with the University requirements. At least three of the courses offered in fulfillment of major requirements must be numbered 300 or higher. Qualified upperclassmen are offered an opportunity to engage in independent work. All departmental majors and prospective majors must have their programs approved by a representative of the Department.

Graduate Programs. Admission to graduate study in French or German will be granted to a limited number of qualified students. Evidence of qualification would normally include a distinguished undergraduate record in the appropriate language; and a capacity for independent work is considered essential. The award of advanced degrees is not based solely on accumulation of credits or compliance with formal requirements. Candidates are expected to attain a wide general knowledge of the appropriate history and literature and to demonstrate their command of the processes and results of scholarship in their chosen field. In most cases two years will be required for the completion of work for the degree of Master of Arts.

CLASSICS

Professor Mackenzie
Instructor Heath

Note: It is expected that additional courses in Latin and Greek will be offered in 1963-64.

Greek 100. First-Year Greek (3-0-6)

A course designed to develop as rapidly as possible an ability to read simple Greek prose: study of grammar, forms, and vocabulary is combined with practice in reading. *Mr. Heath*

Greek 200. Intermediate Greek (3-0-6).

The course is designed to broaden the skills acquired in Greek 100 through a close study of readings which may include a dialogue of Plato, a tragedy, or selections from Homer. *Mr. Heath*

Latin 200. Intermediate Latin (3-0-6).

A course designed for students who enter with two or three years of high school Latin: rapid review of forms and grammar and practice in reading. In the second term representative selections of Latin prose and poetry will be read, including a play of Terence. *Mr. Mackenzie*

Latin 300a, b. Horace and Pliny (3-0-6).

Reading of a representative selection of *Odes, Epodes, Satires,* and *Epistles.* Among topics studied will be Horace's relation to his Greek predecessors, his place in Augustan culture, and his ethical and literary views. In the second term a number of Pliny's *Letters* will be studied for the light they throw on Roman public and private life. Prerequisite: Latin 200 or the equivalent. *Mr. Heath*

Latin 310a, b. Selected Readings (3-0-6).

Study of selected Latin works, both prose and poetry. The work of the second term will be based on the Latin elegists, Catullus, Tibullus, Propertius, and Ovid. Prerequisite: Latin 200 or the equivalent. *Mr. Mackenzie*

Classics 300. Greek Literature in Translation (3-0-6).

A study of some aspects of the Greek creative achievement. The work of the first term will be based on the Homeric epics and a representative group of tragedies: attention will be paid to literary techniques and to the function of literature as a reflection of the intellectual life of a society. In the second term the major Greek historians will be studied and their work considered in relation to the poetic and philosophical approaches to reality. *Mr. Mackenzie*

FRENCH

Professor Bourgeois
Associate Professors L. Hodges, Myers, and Shelton
Instructors Savage and Tappan

Requirements for the Degree of Master of Arts in French.

(a) Completion with high standing of a program approved by the Department; normally this will include three advanced courses.
(b) Passing a reading examination in one language other than that of the candidate's specialization and approved by the Department.
(c) Passing a preliminary oral examination on the French authors indicated in a reading list provided.
(d) Completion of an acceptable thesis.
(e) Passing an oral examination.

Requirements for the Degree of Doctor of Philosophy in French.

(a) Completion with high standing of a program approved by the Department; normally this will include seven advanced courses, including those required for the degree of Master of Arts.

(b) Passing a reading examination in two languages other than that of the candidate's specialization and approved by the Department.

(c) Passing a preliminary examination on the authors indicated in a reading list provided, and on the literature, culture, and civilization of France; knowledge of a second literature, preferably English, is required, and appropriate reading lists will be available.

NOTE: Requirements (b) and (c) must be met at least a year before the submission of a dissertation.

(d) Completion of a dissertation approved by the Department: the dissertation is expected to represent an original contribution to knowledge.

(e) Passing a final oral examination of the dissertation and related fields.

COURSES

French 100. Beginning French (3-0-6).

A close study of the fundamentals of French grammar and pronunciation. Exercises in written French. Oral practice, dictations and translation of suitable texts. *Staff*

French 200. Intermediate French (3-0-6).

Emphasis on intensified oral, written, and translation practice. An introduction to the main currents in French literature. Readings of significant texts, composition, dictation, and conversation. *Staff*

French 300. French Civilization and Advanced Composition (3-0-6).

A course intended for students who need more drill on syntax; also for those who, although not interested in literature, desire to acquire some knowledge of the development of the institutions, the customs, and the culture of France up to the present time. Discussions, oral and written reports in French. *Mr. Shelton*

French 320. French Classicism (3-0-6).

A study of seventeenth-century authors with particular emphasis on the theatre of Corneille, Racine, and Molière. Selected readings from Malherbe, Descartes, Pascal, Boileau, La Rochefoucauld, La Fontaine, Madame de Sévigné, and others. Discussion and analysis of texts in French. *Mr. Tappan*

French 330. The Age of Enlightenment (3-0-6).

Readings from the representative authors of the eighteenth century: Marivaux, Le Sage, Voltaire, Montesquieu, Diderot, Rousseau, and Beaumarchais. Discussion and analysis of texts in French. *Mr. Myers*

French 350. The French Romantic Movement (3-0-6).

Poetry, novel, and drama. Special emphasis on the study of Chateaubriand, Constant, Lamartine, Vigny, Hugo, Musset, and Mérimée. A thorough study of selected texts with discussions and essays in French. *Mr. Bourgeois*

French 380. Modern French Fiction and Drama (3-0-6).

Study and discussion in French of significant novels and plays of the twentieth century. *Mrs. Savage*

French 404. Directed Study and Senior Thesis (0-0-6).

Open only to Senior students selected after application to the Directing Committee of the Department. An extensive program of research is undertaken, after consultation, with approval of the Department. A paper embodying the results of the research must be submitted. At least two advanced courses in French are prerequisites.

French 450. French Realism and Naturalism (3-0-6).

Special emphasis on the study of Stendhal, Balzac, Flaubert, Maupassant, the de Goncourt brothers, and Zola. Discussion and essays in French. *Mr. Bourgeois*

French 500. Graduate Research.

Graduate research and thesis in partial fulfillment of the requirements for the degree of Master of Arts.

French 521. The Seventeenth Century (3-0-6).

Studies in seventeenth-century French literature. Offered in alternate years: given in 1961-62.

French 543. Voltaire, Part II (3-0-6).

A chronological study of Voltaire's life and work from 1750 to his death. Offered in alternate years: given in 1961-62. *Mr. Myers*

French 544. Diderot (3-0-6).

A systematic inquiry into his esthetics. Offered in alternate years. *Mr. Myers*

French 550. Nineteenth-Century Drama (3-0-6).

The evolution of the dramatic conception in France during the nineteenth century. Offered in alternate years: given in 1961-62. *Mr. Bourgeois*

French 561. Balzac (3-0-6).

A critical study of his most representative novels. Offered in alternate years. *Mr. Bourgeois*

French 572. Proust: A Study of *À la Recherche du Temps Perdu* (3-0-6).

Attention will be given to its background and composition and to the thought and art of Proust. Offered in alternate years; given in 1961-62. *Mrs. Savage*

French 574. Baudelaire and Mallarmé (3-0-6).

A study of their poetry and of certain of their prose writings. Offered in alternate years. *Mrs. Savage*

French 600. Graduate Research.

Graduate research and dissertation in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

GERMAN

Professor Louis
Assistant Professors Dvoretzky, Lehnert, and Wilson
Instructors Mitchell and Pickar

Requirements for the Degree of Master of Arts in German.

(a) Completion with high standing of a program approved by the Department; normally this will include a minimum of four advanced courses.
(b) Passing a reading examination in one language other than that of the candidate's specialization and approved by the Department.
(c) Completion of an acceptable thesis.
(d) Passing an oral examination.

Requirements for the Degree of Doctor of Philosophy in German.

(a) Completion with high standing of a program approved by the Department; normally this will include eight advanced courses, including those required for the degree of Master of Arts.
(b) Passing a reading examination in two languages other than that of the candidate's specialization and approved by the Department.
(c) Passing a preliminary examination on the general field of Germanic studies: this examination will be based in part on a reading list provided by the Department.
Note: Requirements (b) and (c) must be met at least a year before the submission of a dissertation.
(d) Completion of a dissertation approved by the Department: the dissertation is expected to represent an original contribution to knowledge.
(e) Passing a final oral examination on the dissertation and related fields.

COURSES

German 100. Elementary German (3-0-6).
Grammar, conversation, and extensive reading. *Staff*

German 200. Intermediate German: Literary (3-0-6).
Intensive and extensive reading throughout the year: study of *Faust* I in the second semester. *Staff*

German 201. Intermediate German: Scientific (3-0-6).
The work of the first semester is identical with that in German 200. May be offered as prerequisite for advanced courses. *Staff*

German 205. Intermediate German: Literary and Scientific (3-0-6).
The work of the first semester is identical with that in German 200. Study of *Faust* I in second semester. May be offered as prerequisite for advanced courses. Outside reading second semester in field of major study. *Staff*

German 305. Writing, Speaking, Translation (3-0-6). *Staff*

German 307. Philosophical Ideas in German Literature (3-0-6).
Readings in the original will be required. *Mr. Kolenda*

German 309. History of German Literature (3-0-6).
A comprehensive survey of German literature from its beginning to the present. *Mr. Dvoretzky*

German 330. Romanticism and Realism in German Literature (3-0-6).
Offered in alternate years: given in 1961-62. *Mr. Lehnert*

German 360. Lessing and Schiller (3-0-6).
Offered in alternate years. *Mr. Louis*

German 380. German Literature since 1880 (3-0-6).
Offered in alternate years. *Mr. Lehnert*

German 390. Goethe (3-0-6).
Offered in alternate years: given in 1961-62. *Mr. Wilson*

German 404. Independent Work: Special Topics in German Literature (0-0-6).
Independent work for qualified upperclassmen: may be repeated for credit. *Staff*

German 460. German Literature, 1400-1750 (3-0-6).
Offered in alternate years.

German 500. Graduate Research.
Graduate research and thesis in partial fulfillment of the requirements for the degree of Master of Arts.

German 501. Special Topics in Literary Interpretation (3-0-6).
For graduate students: may be repeated for credit. *Mr. Lehnert*

German 502. Special Topics in Germanic Philology (3-0-6).
For graduate students: may be repeated for credit. *Staff*

German 509. Seminar in Bibliography, Research Problems, and Literary Criticism (3-0-6). *Mr. Dvoretzky*

German 520. Germanic Philology (3-0-6).
An introduction to the study of Gothic, Old Norse, Old Saxon, Old High German, and the history of the German language. Offered in alternate years. *Mr. Wilson*

German 530. Middle High German (3-0-6).
Offered in alternate years: given in 1961-62. *Mr. Louis*

German 600. Graduate Research.
Graduate research and dissertation in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

ITALIAN

Italian 100. Elementary Italian (3-0-6).
Oral exercises, grammar, composition, and reading of representative Italian authors.

RUSSIAN

ASSISTANT PROFESSORS JITKOFF AND SKARGINSKY

NOTE: Classes in Russian will meet three hours a week, but students will also be required to spend two half-hour periods each week in language laboratory work.

Russian 100. Elementary Russian (3-0-6).

Pronunciation, grammar, introduction to conversation, graded reading, and practice in composition. *Messrs. Jitkoff and Skarginsky*

Russian 200. Intermediate Russian (3-0-6).

Designed to provide additional practice in reading and comprehension, with emphasis on Russian composition and an introduction to Russian literature. Texts in the fields of geography, history, and science will be read; translation from Russian scientific articles and newspapers. Outside reading. Prerequisite: Russian 100. *Messrs. Jitkoff and Skarginsky*

Russian 201. Intermediate Russian: Scientific (3-0-6).

The work of the first semester is identical with that in Russian 200. Outside reading and translation in field of major study; may be offered as prerequisite for advanced courses. Prerequisite: Russian 100.

Russian 300. Phonetics, Conversation and Reading (3-0-6).

This course stresses phonetics and fluency in conversation. It is supplemented by selected reading of nineteenth- and twentieth-century prose, including expository and technical writings, exercises in Russian syntax, and its application to composition; conversation, oral and written reports on assigned topics. Prerequisite: Russian 100 and 200.

SPANISH

ASSISTANT PROFESSORS CASTAÑEDA AND SHREFFLER
INSTRUCTOR LAUDERDALE

Spanish 100. First-Year Spanish (3-0-6).

Oral exercises, grammar, composition, and study of elementary Spanish texts.

Spanish 200. Second-Year Spanish (3-0-6).

Comprehensive review of grammar, conversation, and introduction to Spanish literature. *Mr. Castañeda*

Spanish 300. Conversation and Composition (3-0-6). *Mr. Castañeda*

Spanish 360. The Golden Age of Spanish Literature (3-0-6).

Poetry, novel, and drama, with particular emphasis on the "Comedia" of Lope de Vega, Tirso de Molina, Alarcón, and Calderón and the prose of Crevantes. *Mr. Castañeda*

Spanish 400. Outlines of the History of Spanish Literature (3-0-6).

Study of major authors representative of the various periods.

French

(*See* pages 122-124)

Geology

Professors Adams and Croneis, *Chairman*
Associate Professors De Bremaecker and Rogers
Assistant Professors Burchfiel, Donnelly, and Purdy

In January, 1952, Mrs. Olga Wiess provided an endowment fund to establish the Harry Carothers Wiess Chair of Geology as a memorial to her husband. As a result, the Department of Geology was created, and a full program of courses in the subject is being offered. The first Senior class in geology was graduated in June, 1955, and the first doctorate was awarded in June, 1958. A new geology laboratory, completed in June, 1958, provides ample space and facilities for undergraduate and graduate instruction and research.

Undergraduate Requirements. In addition to satisfaction of the general requirements of the science-engineering program, undergraduate majors in geology are expected to complete the following courses:

Geology 200a, 201b; ordinarily taken in the Sophomore year, but may be delayed to the Junior year
Geology 310; taken in the Junior year
Geology 330a, 331b; taken in the Junior year
Geology 400a, 401b; taken in the Senior year
One to two year courses (two to four semester courses) of approved geology electives
Geology 390 or other approved summer field course; ordinarily taken in the summer between the Junior and Senior years.

Graduate Requirements. Students with a bachelor's degree in geology or related sciences from Rice University, or an equivalent degree from another institution of similar standing, are considered for admission to graduate work.

Graduate work is conducted in those specialties that are compatible with the equipment available and with the interests of the staff. At present, the Department of Geology is prepared to offer advanced work in geochemistry, geophysics, igneous and metamorphic petrology, stratigraphy, sedimentation, sedimentary petrology, structural geology, and paleontology, micropaleontology, and paleoecology. Graduate work in geology is oriented toward the theoretical and fundamental aspects of the subject rather than directly toward its many applied aspects.

Candidates for advanced degrees in geology will be expected to:

(1) Pass a reading examination in one foreign language for the master's degree; German is ordinarily required, but the Geology Department may permit the substitution of French in some cases. Candidates for the Ph.D. degree must pass reading examinations in two languages, one of which must be German.

(2) Complete at a high level an approved program of graduate courses in geology and related subjects. This program may in-

clude an advanced field course and undergraduate courses in certain supporting sciences, such as mathematics (calculus), chemistry, physics, and biology. Prospective students with deficiencies in such supporting sciences will find their graduate program greatly accelerated by removing those deficiencies prior to enrolling for graduate work.

(3) Pass a set of basic examinations in geology. These examinations are ordinarily given early in a student's graduate career and may, at the discretion of the Department, be repeated one or more times in whole or in part. Ph.D. candidates are expected to achieve higher scores than master's candidates. In some cases, specific examinations may be waived in lieu of high grades in related courses.

(4) Complete for publication a thesis which represents an original contribution to the science.

(5) Pass an oral examination covering the candidate's research work and related phases of geology.

Most graduate students can expect to spend two years beyond the bachelor's degree in order to complete requirements for the master's degree and an additional two years for the Ph.D. degree. Some students of very high ability may be allowed to bypass the master's degree and work directly for the Ph.D.

COURSES

Geology 200a. Physical Geology (3-3-4).

An introduction to the study of the physical, chemical, and geological processes that produce rocks, economic deposits, and landforms. The laboratory includes map and structure interpretation in addition to the identification of hand specimens of rocks and minerals. Prerequisite: Consent of the Department. Prospective majors in geology are expected to have had Chemistry 120, Physics 100, and Mathematics 100. Laboratory fee required. *Messrs. Adams and Rogers*

Geology 201b. Historical Geology (3-3-4).

An introduction to the study of the physical events of the ancient past from the birth of the earth through the most recent ice age, together with a synopsis of the concurrent changing patterns of life. The laboratory includes the analysis of geological maps with emphasis on the structure of the stratified rocks and their organic remains. Prerequisite: Geology 200a or consent of the Department. Laboratory fee required. *Mr. Purdy*

Geology 310. Mineralogy and Petrology, first term (3-4); second term (3-6); Credit: 9.

Basic introduction to the following topics: crystallography, crystal structure, hand-specimen mineralogy, optical mineralogy, petrology and petrography of igneous and metamorphic rocks, and X-ray mineralogy. Laboratory includes work with crystal models, mineral hand specimens, optical techniques such as identification of minerals in immersion oils, hand-specimen and thin-section petrography, and X-ray technique. Prerequisite: Mathematics 200, Physics 200, or consent of the Department, Laboratory fee required. *Messrs. Donnelly and Rogers*

Geology 321b. Mineral Resources (3-0-3).

An introduction to the study of the geology, origin, and general economics of mineral and fuel deposits. Topics for study include the analysis of significant occurrences and methods of exploration. Prerequisite: Consent of the Department.
Mr. Adams

Geology 330a. Structural Geology (3-4-4).

Introduction to structural geology and field methods. Topics covered include description of faults, folds, and other structural features, field methods for recognizing and interpreting structures, mechanics of rock deformation, and elementary tectonics. Laboratory work involves descriptive geometry, plane table surveying, aerial photograph interpretation, and preparation of geologic maps. Prerequisites: Geology 200a and 201b. Laboratory fee required. *Mr. Burchfiel*

Geology 331b. Sedimentation (3-3-4).

Introduction to the study of sedimentary rocks. Emphasis is placed on the processes of weathering, transportation, and deposition and on the petrographic attributes of the more important types of sedimentary rocks. Laboratory work is concerned largely with sedimentation analyses and the description of hand specimens and thin sections. Prerequisite: Geology 310a. Laboratory fee required.
Mr. Burchfiel

Geology 390. Field Geology.

In addition to the various shorter field trips conducted in connection with a number of the geology courses taken in residence, a summer field course of not less than six weeks (ordinarily eight weeks) is required of all majors. The work may be taken at any one of several approved university field stations during the summer prior to the Senior year. Credit variable. Laboratory fee required.

Geology 400a. Invertebrate Paleontology (3-4-4).

An introduction to the morphology and geological record of the major invertebrate groups characterized by significant fossil representation. Prerequisites: Geology 210b and consent of the Department. Laboratory fee required. *Mr. Purdy*

Geology 401b. Stratigraphy and Index Fossils (3-4-4).

The principles of stratigraphy and stratigraphic analysis. Problems of correlation, standard sections, and paleogeography. Prerequisite: Geology 400a. Laboratory fee required. *Mr. Croneis*

Geology 405a. Micropaleontology (2-6-4).

A microscopic study of the plant and animal remains commonly recoverable from drill cuttings. Principles underlying the use of such fossils in local and world-wide correlations. Prerequisite: Geology 401b or consent of the Department. Laboratory fee required. *Mr. Croneis*

Geology 411a. Igneous and Metamorphic Petrology (3-4-4).

Study of the origin and mode of formation of igneous and metamorphic rocks. Emphasis is placed on the application of experimental petrology to field and petrographic evidence concerning major petrologic problems. Laboratory work involves petrographic study of selected suites of important rocks. Prerequisite: Geology 310. Laboratory fee required. *Mr. Donnelly*

Geology 455. Geochemistry (3-4-8).

A study of the geological and chemical processes that produced the observed distribution and abundances of the elements. The age, formation, and heat balance of the earth are some of the topics discussed from a geochemical viewpoint. Laboratory work includes both wet chemical and modern instrumental determinations of major and trace elements in rocks and minerals. Prerequisites: Geology 310a and consent of the Department. Laboratory fee required. *Mr. Adams*

Geology 460. Geophysics (3-3-8).

Gravity, magnetism, potential theory, elasticity, and elastic waves theory. Emphasis is on the principles and the mathematical physics. Laboratory work is concerned with applications of the methods. Prerequisite: Consent of the Department. Laboratory fee required. *Mr. DeBremaecker*

Geology 480. Research in Geology.

Advanced work adapted to the needs of the individual student. Credit variable. Laboratory fee required.

Geology 490. Recent Advances in Geology.

A study of recent research in specific fields under the guidance of a member of the staff. Credit variable. Laboratory fee required.

Geology 500. Special Studies.

Advanced work in certain phases of geology, adapted to the needs of individual graduate students. Registration permitted only with consent of the Department. Credit variable.

Geology 505a. Principles of Paleontology (3-3-4).

A consideration of the genetical, ecological, and biogeographical factors which account for the temporal and geographic distribution of fossil organisms. Emphasis is placed on the reconstruction of the life relationships and habitats of fossil invertebrates. Prerequisites: Geology 400a and 540a (may be taken concurrently). *Mr. Purdy*

Geology 506b. Evolution of the Invertebrates (3-3-4).

A study of the major features of invertebrate evolution as exemplified by the fossil record. Topics considered include rates of evolution, adaptation, and extinction. Prerequisite: Geology 505a. *Mr. Purdy*

Geology 510-517. Seminars in Geology.

Courses covering the subjects listed in sequence under geology research courses numbered 590 to 597. Individual seminars may cover different topics in different years and may be taken more than once. All seminars three units per semester.

Geology 530b. Advanced Sedimentary Petrology (3-4-4).

A survey of sedimentary processes (weathering, transportation, deposition, and diagenesis) and sedimentary rocks. Selected topics will be studied in the fields of sedimentary mineralogy, lithofacies analysis and environmental interpretation, and tectonic sedimentation. Laboratory work includes sedimentation analysis and thin-section study of sedimentary rocks. *Messrs. Rogers and Purdy*

Geology 531b. Advanced Topics in Petrology (3-0-3).

A study of major problems of igneous and metamorphic petrology. Topics include origin of magmas, the granite problem, basalts, and volatiles in silicate systems. A two-year sequence, with roughly the same topics in alternate years. *Mr. Donnelly*

Geology 535b. Optical Mineralogy and X-ray Techniques (3-6-5).

The course is devoted largely to the techniques of making optical measurements on minerals. Rock-forming minerals are studied by universal stage and X-ray powder-diffraction techniques. *Mr. Donnelly*

Geology 540a. Statistical Geology (3-3-4).

Fundamentals of statistical analysis and their application to geologic problems. Topics covered include sampling distributions, comparison of means and variances, correlation and regression, chi-square analysis, variance analysis, and handling of multiple sets of data. *Mr. Rogers*

Geology 550. Chemical Geology (3-3-8).

Survey of physical chemistry and its applications to geologic studies. Topics covered include basic thermodynamics, phase equilibria and solution chemistry, reaction kinetics, crystal chemistry, and crystal growth. *Mr. Rogers*

Geology 560. Advanced Topics in Geophysics (3-3-8).

Study of selected topics in geophysics, including seismology, gravitation, and geomagnetism. *Mr. DeBremaecker*

Geology 565b. Advanced Structural Geology (3-3-4).

Elasticity, viscosity, and plasticity. Properties of anistotropic media. Introduction to photoelasticity. The course will be partly a seminar. *Mr. DeBremaecker*

Geology 566a. Advanced Tectonics (3-3-4).

Mechanics of rock deformation and its relation to field observations and an understanding of faulting, folding, and minor structures. Study of selected structural problems and regional tectonics. *Mr. Burchfiel*

Geology 590. Research in Physical and Structural Geology (0-9-3).

Messrs. Burchfiel and DeBremaecker

Geology 591. Research in Mineralogy (0-9-3).

Messrs. Adams and Donnelly

Geology 592. Research in Petrography and Petrology (0-9-3).

Messrs. Donnelly and Rogers

Geology 593. Research in Geochemistry (0-9-3).

Messrs. Adams and Rogers

Geology 594. Research in Geophysics (0-9-3). *Mr. DeBremaecker*

Geology 595. Research in Invertebrate Paleontology and Stratigraphy (0-9-3). *Messrs. Croneis and Purdy*

Geology 596. Research in Economic and Petroleum Geology (0-9-3).

Staff

Geology 597. Research in Regional Geology (0-9-3). *Staff*

German

(*See* pages 125-126)

Health and Physical Education

Professors Hermance, *Chairman,* and Weston, *Associate Chairman*
Associate Professor Bearden
Assistant Professors Barker and Bland
Instructor Hahamis and R. A. Nelson

Physical Training 100 (0-4-0).

A course to discuss the place and importance of health and physical education in our modern society, to teach the skills and knowledge of physical-education activities, and to familiarize the students with the physical-education facilities and equipment available to them at Rice University. Two two-hour periods each week. Noncredit. *Staff*

Health and Physical Education 100a. Introduction and Principles of Health and Physical Education (Including Athletics) (3-0-3).

A study is made of the sources and data of the principles of health, physical education, athletics, recreation, and camping including orientation, vocational analysis, educational foundations, and the social, psychological, biological, and physiological nature of man. *Mr. Hermance*

Health and Physical Education 110b. Physiological Hygiene (3-0-3).

This course is based upon a study of personal health problems in society, including communicable diseases, mental and emotional health problems, marriage and family health problems, weight control, narcotics, alcohol, venereal diseases, preventive medicine, and personal health as it relates to science and attitudes, fitness and exercise, posture and fatigue, the glands, care of the skin, and the nervous system. *Mr. Nelson*

Health and Physical Education 125. Laboratory (0-3-2).

The following physical-education and athletic activities are included: soccer, speedball, tennis, swimming, diving, Senior Red Cross Life Saving and Water Safety, touch football, and gymnastics. For each activity a study is made of the history, educational values, court and field construction, activity skills and game formations, methods of teaching and coaching, officiating, and audiovisual aids. Laboratory fee required. *Mr. Weston*

Physical Science 150. The Fundamentals of Chemistry and Physics (3-0-6).

During the first semester the subject matter is based upon the fundamental principles of chemistry, including matter, elements, gases, acids and bases, metals and alloys, biochemistry, and the science of nutrition. In the second semester the subject matter is based upon the fundamental principles of physics, including mechanics, motion, force, work and energy, heat, magnetism, electricity, sound, and light. *Mr. Weston*

Health and Physical Education 200a. Intramural Sports, School-Community Recreation Programs, and Safety Education (3-0-3).

A study is made of the educational values of intramural sports and recreation including leadership, organization and administration, units of competition, scoring plans and tournaments, facilities and equipment, publicity, and public relations. Safety education includes a survey of the safety movement in business, industry, and education, the program of safety education, professional liability, and safety standards. *Mr. Barker*

Health and Physical Education 210b. History and Philosophy of Physical Education and Athletics (3-0-3).

A study is made of the history and philosophy of physical education and athletics in Greece, Rome, Germany, Sweden, Denmark, France, England, and the United States. Emphasis is placed upon the social, economic, political, and cultural conditions that affected the programs within each country. Special attention is given to the place of physical education and athletics in American society and education. *Mr. Weston*

Health and Physical Education 225. Laboratory (0-3-2).

The following physical-education and athletic activities are included: archery, handball, squash, volleyball, badminton, fencing, and apparatus. For each activity a study is made of the history, educational values, court and field construction, activity skills and game formations, methods of teaching and coaching, officiating, and audiovisual aids. Laboratory fee required. *Mr. Barker*

Health and Physical Education 300a. Methods, Materials, and Curriculum Construction in School Health Education, Grades 7-12 (3-0-3).

This course is based upon a study of methods of teaching health education, materials of the program, and curriculum construction in school health education including student health service, school health environment, health instruction, resources for health education, appraisal of physical and mental health, the medical examination, school health council, audiovisual and material aids, and demonstrations. *Mr. Weston*

Health and Physical Education 310b. Methods, Materials, and Curriculum Construction in Physical Education and Interscholastic Athletics, Grades 7-12 (3-0-3).

This course of study includes a study of methods of teaching physical education, materials of the program, and curriculum construction in physical education and interscholastic athletics. Special emphasis is placed upon teaching techniques and the learning process, class management, testing and grading, units of instruction, audiovisual and material aids, and curriculum construction based upon sports and games, recreational and lead-up activities, aquatics, social and rhythmic activities, self-testing activities, and the fundamental skills of movement. *Mr. Hermance*

Health and Physical Education 320. Tests and Measurements, Physiology of Muscular Activity, Kinesiology, and Adaptive Physical Education (3-0-6).

A study of tests and measurements includes anthropometric measurements, cardiac functional tests, athletic achievement tests and scoring scales, classification, measurement, motor ability and capacity, motor fitness tests, statistical methods, muscular work, role of oxygen, mechanical efficiency, energy cost of various activities, respiration, effect of muscular activity on the organic system, and ergogenic aids. Kinesiology includes a study of anatomy as it applies to kinesiology, gravity, and applied body mechanics. Adaptive physical education includes a study of society and the disabled, adjustment problems of the handicapped, and the program of physical education for the handicapped student. *Mr. Bearden*

Health and Physical Education 325. Laboratory (0-3-2).

The following physical-education, recreation, and athletic activities are included: golf, boxing, wrestling, softball, basic rhythms, recreational and lead-up games, and first aid. For each activity, a study is made of the history, educational values, court and field construction, activity skills and game formations, methods of teaching and coaching, officiating, and audiovisual aids. A study of first aid leads to the standard certification in first aid by the American Red Cross. Laboratory fee required. *Mr. Bearden*

Health and Physical Education 400a. Organization and Administration of Health and Physical Education (Including Interscholastic Athletics), Grades 7-12 (3-0-3).

This course is based upon a study of the organization and administration of programs of health, physical education, and interscholastic athletics, including administrative policies and procedures, staff, budget, facilities and equipment, office management, schedules, public relations, and publicity. *Mr. Hermance*

Health and Physical Education 410b. History of Medicine and Health Education, Medical Benefit Plans, and Medical Insurance (3-0-3).

This course includes a study of the history of medicine and health education, hospitalization and medical benefit plans, the Social Security system, and life insurance programs. The history of medicine and health education is based upon a study of the philosopher-physicians of ancient Greece and the Hippocratic school of medicine; the early medical schools of Padua, Basle, Leyden, Edinburgh, Paris and London; the age of science and specialization; and the development of medicine in the United States with special emphasis on the modern medical school, the medical specialist, the development of health education, and medical insurance programs. *Mr. Weston*

Health and Physical Education 420. Evaluation, Supervision, and Student Teaching in Health and Physical Education, Grades 7-12 (6 semester hours).

This course includes student teaching and observation in the Houston Public Schools; a study of school-community relationships, evaluation of students, lesson plans, and teaching methods, audiovisual aids, extraclass and special types of school activities, and the nature of learning; and a study of supervision which includes an understanding of visitations, conferences, bulletins, guidance, and counseling. Internship as a student teacher requires one half day of student teaching for sixteen weeks in the Houston Public Schools, grades 7-12. Laboratory fee required. *Messrs. Bearden and Weston*

Health and Physical Education 425. Laboratory (0-3-2).

The following physical-education and athletic activities are included: football, basketball, baseball, track and field, and the care and prevention of athletic injuries. For each activity a study is made of the history, educational values, court and field construction, activity skills and game formations, audiovisual aids, and the psychology and techniques of teaching and coaching interscholastic athletics. The care and prevention of athletic injuries includes a study of weight-control programs in athletics, drugs, massage, reduction of injury hazards, strains, sprains, contusions, dislocations, fractures, taping, impact force in athletics, basic conditioning, and training-room design, equipment, and operation.
Messrs. Bland and Wojecki

History and Political Science

Professors Craig, Higginbotham, Lear,
Masterson, and Vandiver
Associate Professors Abbot, Drew, and Nelson
Assistant Professors Barber, Galambos, Loewenheim,
and Marsak
Lecturers Hudspeth and Muir

Undergraduates majoring in history are normally expected to take twelve semesters of approved departmental courses, including two of

the following: History 100, History 110, and History 200. A limited number of students majoring in history are invited at the end of their Junior year to enroll in History 404 during their Senior year and to write a Senior Thesis.

Graduate students in history are accepted for study leading to either the M.A. or Ph.D. degree. Since the graduate program is designed to train a limited number of carefully selected students, emphasis is on quality rather than quantity. The M.A. degree is offered in selected fields of medieval, modern European, and American history. The Ph.D. degree is ordinarily awarded to students majoring in American history, although occasional applications will be considered in medieval and modern European history.

Assistantship-fellowships as well as graduate scholarships are awarded by the Department to qualified students of demonstrated ability. Assistant-fellows are expected to render limited services to the Department, although these services are not intended to be so heavy as to prevent the student's carrying a full study load. Assistant-fellows working in the field of American history may be given special opportunities in the editing and publishing of the *Journal of Southern History,* sponsored by Rice University.

In addition to University assistance, the Department offers a number of fellowships under the National Defense Education Act. NDEA Fellows are accepted only in the field of Southern American history and are expected to meet the same qualifications as other graduate students.

Candidates for the M.A. degree are expected to complete a certain amount of formal class or seminar work usually equivalent to four year courses, in addition to passing a reading examination in one foreign language (usually French or German) and writing a thesis under the direction of an advisory committee of the Department chaired by his major professor. An oral defense of the thesis is also required. Completion of these requirements usually takes two years.

Candidates for the Ph.D. degree will ordinarily complete the equivalent of seven year courses beyond the bachelor's degree, although requirements here are much less rigid than in the case of the master's candidates, and considerable discretion is left to the student's advisory committee. In addition to such formal course work, the doctor's candidate is expected to pass a reading examination in two foreign languages (usually French and German), pass a comprehensive examination, and present and defend a dissertation embodying the results of original research.

HISTORY COURSES

History 100. Europe and America since 1500 (3-0-6).

This constitutes a basic course in history for Freshmen. It examines the development of European and American civilization since the Renaissance and gives particular attention to the relationship between Europe and America.

Mr. Nelson and others

History 110. American History (3-0-6).

A survey of the growth of the American nation, with considerable attention to its European background. Recommended as fulfilling the requirements of prelegal and premedical students and constituting a basic course in history for Freshmen.
Mr. Masterson and others

History 200. Early Foundations of Western Civilization (3-0-6).

This course is intended to provide an historical background for the various humanistic branches of study. The work of the first semester is largely devoted to the history of ancient Greece and Rome, that of the second semester to the history of the Middle Ages. *Mrs. Drew*

History 300. Cultural History of the United States (3-0-6).

This course deals with the primary trends in the social and intellectual life of the American people from colonial times to the Civil War and seeks to interpret them as expressions of the American national spirit. Prerequisite: History 110.
Mr. Lear

History 310. Jeffersonian and Jacksonian Democracy (3-0-6).

A study of the development of the United States to 1848 with particular emphasis on political philosophy and practice. The first semester covers the American Revolution, the Confederation, and the Constitution, the Federalist decade, and the Jeffersonian era. The second semester deals with expansion and economic change, sectionalism and national politics, reform movements, and the Jacksonians in power. Prerequisites: History 100 or 110. *Mr. Barber*

History 320. Trends in European Culture during Antiquity and the Middle Ages (3-0-6).

This course traces selected aspects of European thought from Periclean Athens to the later Middle Ages, with special reference to Hellenistic and Greco-Roman influences. Religious, philosophical, and scientific implications are examined in some detail. Prerequisite: History 100. *Mr. Lear*

History 330. Early Modern Europe, 1300-1715 (3-0-6).

The work of the first semester covers Europe from 1300 to 1500, including the Italian Renaissance. The second semester covers the Reformation and other aspects of European history from 1500 to 1789. *Mrs. Drew*

History 350. Modern Europe, 1715-1870 (3-0-6).

The first half of this course contains a study of the Old Regime, the French Revolution, and Napoleon. The second half deals with the rise of liberalism, socialism, and nationalism from 1815 to 1871. Prerequisite: History 100. *Mr. Loewenheim*

History 355. British History (3-0-6).

This course deals mainly with the period since 1485, although it includes a survey of the constitutional development of the earlier period. Prerequisite: History 100. *Mr. Nelson*

History 370. Intellectual History of Modern Europe (3-0-6).

A history of scientific ideas and ethical systems from Descartes to Sartre. The first semester will include reading in the works of Descartes, Pascal, Hobbes, Locke, Newton, Bayle, Fontenelle, Montesquieu, Voltaire, and Diderot. The second semester will consider Hume, Rousseau, Kant, Hegel, J. S. Mill, Comte, Marx, Nietzsche, James, and Sartre. *Mr. Marsak*

History 380a. American Economic History (3-0-3).

A study of the economic history of the United States from the colonial period through the Second World War. Examination of principal economic trends will be supplemented by histories of individual firms and business leaders. Prerequisite: History 110. Open to qualified students after consultation with the instructor.
Mr. Galambos

History 385b. American Reform Movements since the Civil War (3-0-3).

This course examines the nation's basic political, social, and economic problems and the evolution of the major political reform movements which arose in response to them. Prerequisite: History 110. Open to qualified students after consultation with the instructor. *Mr. Galambos*

History 390b. History of the American West (3-0-3).

This course traces the westward movement from its beginnings on the Atlantic seaboard to its culmination on the Pacific. Most attention is given to the history, institutions, and problems of the Trans-Mississippi West, with special emphasis on Texas and the Great Plains. Prerequisite: History 110. *Mr. Muir*

History 395. A History of the South (3-0-6).

A study of life and economy of the Southern people from the colonial period. Attention is given to such topics as the frontier, the plantation, slavery, sectionalism, and agrarian, social, and industrial problems. Primary emphasis is placed on the institutions and history of the ante bellum period. Prerequisite: History 110. *Mr. Vandiver*

History 400. The Old Regime and the Enlightenment: 1610-1789 (3-0-6).

A study of the political and economic institutions, and the chief literary, philosophical, and scientific currents in the great age of France. Prerequisite: History 100. *Mr. Marsak*

History 404. Senior Thesis (0-0-6).

A limited number of seniors majoring in the Department are allowed to write a thesis of fifteen to twenty-five thousand words on a subject to be approved in advance by their departmental advisers. Admission only on invitation of the Department. *Staff*

History 420. Medieval Sources (3-0-6).

Survey and translation of typical medieval Latin sources. The selections are studied from the point of view of historical significance and of literary appreciation. This course is intended for students of history and the modern languages who desire some familiarity with ordinary medieval Latin texts. Prerequisite: three or four years of high school Latin. *Mr. Lear*

History 430. Topics in Ancient and Medieval Intellectual History (3-0-6).

This course deals with selective phases of classical and medieval thought based on the cultural monuments of antiquity and the Middle Ages. Intensive reading and reports on special aspects of the field. Prerequisite: History 100. *Mr. Lear*

History 440. Social and Economic History of Europe in the Middle Ages (3-0-6)

The work of this course covers the social and economic history of Europe from the period of the late Roman Empire to the close of the Middle Ages. Open only to advanced students after consultation with the instructor. *Mrs. Drew*

History 445a. Military and Naval History (3-0-3).

A survey of wars and the causes of wars from ancient times to the present, with emphasis on basic military principles and on the importance of sea power in history. *Mr. Craig*

History 450b. Contemporary History (3-0-3)

A survey of current world affairs, with lectures and readings on the background of present-day policies and events. *Mr. Craig*

History 455. Modern Europe since 1871 (3-0-6).

The subject of this course is the political, diplomatic, and cultural history of Europe from the proclamation of the German Empire to the present. Prerequisite: History 100. *Mr. Loewenheim*

History 460, English Constitutional History (3-0-6).

A survey of the development of the English constitution with particular attention to the period since 1485. *Mr. Nelson*

History 465a. American Colonial History (3-0-3).

A study of American society in the colonial period. Particular attention is given to the Revolution. *Mr. Abbot*

History 470. Foreign Relations of the United States (3-0-6).

This course is primarily a study of American diplomatic history, with some emphasis as well on our political, economic, social, and cultural relations with other nations. *Mr. Craig*

History 480. American Politics (3-0-6).

An advanced survey of American political history. Emphasis is placed on the relationship of politics to economic and social events. Prerequisite: History 110. *Mr. Masterson*

History 495. Civil War and Reconstruction (3-0-6).

A study of the rise of sectionalism, the abolition crusade, the secession crisis, United States versus Confederate States, aftermath of the war, reconstruction, economic and social consequences of the war, and emergence of a New South. Emphasis is placed on social, economic, and military events during the years 1861-1865. Prerequisite: History 110. *Mr. Vandiver*

History 500. Historical Research (3-0-6).

Master's thesis. *Staff*

History 510. Directed Reading in American History (3-0-6). *Staff*

History 520. Directed Reading in Medieval History (3-0-6). *Staff*

History 530. Directed Reading in Modern History (3-0-6). *Staff*

History 545. Historiography (3-0-6).

Graduate Seminar. *Staff*

History 550. Studies in the History of the Atlantic Community (3-0-6).

A systematic study of the origins and development of the Atlantic Community from the 1750's to the 1950's. The first semester is devoted to the study of the intellectual and cultural history of the Atlantic Community; the second semester to its diplomatic and military history. Qualified Seniors may be admitted by special permission. *Mr. Loewenheim*

History 570. The First World War (3-0-6).

A study of the causes of World War I, the course of the war itself, and the peace settlement of Versailles. Open to properly qualified students after consultation.

History 590. Seminar in Western American History (3-0-6).

This course includes a study of the leading authorities in Western American history, training in the critical examination of source material, and original research in selected topics of Western history. Open to graduate students and to Seniors who show a proficiency in history, after consultation with the instructor. *Mr. Muir*

History 595. Topics in Confederate History (3-0-6).

This seminar is devoted to original research in various phases of the history of the Southern Confederacy, 1861-1865. Open to properly qualified students after consultation with the instructor. *Mr. Vandiver*

History 600. Historical Research.

Doctoral dissertation. *Staff*

POLITICAL SCIENCE COURSES

Political Science 210. American Government (3-0-6).

A study of the history and operation of constitutional government in the United States with special emphasis on the historical background of the federal government, the structure of the government, the formation of public policy, and the conduct of public business. For additional background and for contrast, reference is made to English constitutional history and to the present structure of the English government. This year course in American government, planned for the general student of government, is also designed to enable prospective lawyers, physicians, and teachers to meet the state requirements of a course in "Constitutions." *Mr. Hudspeth*

Political Science 310. Law and Society (3-0-6).

The study of law as a part of cultural anthropology and the history of organized society. Emphasis is placed upon the sources of legal doctrine, specifically illustrated by case law and legislation in the field of contracts, torts, commercial transactions, and domestic relations. *Mr. Hudspeth*

Political Science 410. Ancient and Medieval Political Theory (3-0-6).

A survey of the main trends in politics and law from antiquity into the later Middle Ages. Open only to advanced students after consultation with the instructor. *Mr. Lear*

Political Science 520. Topics in Legal History and Political Theory (3-0-6).

Much attention is given to methods, materials, and the recent literature in this field. Instruction is based on the translation of several primary sources in Roman and Germanic law, as well as reports on such topics as sovereignty and allegiance. Open to properly qualified students after consultation with the instructor. *Mr. Lear*

Humanities

Humanities 100. Leading Minds in Western Civilization (3-0-6).

A course in intellectual history. It is a study of the most important ideas in Western European and American civilization studied through the lives and works of understanding people from antiquity to the modern world. *Mr. Tsanoff*

Humanities 101. The Classical Foundations of Political Thought (3-0-6).

An examination of the historical and philosophical influences underlying the political theory and institutions of the classical world. The course deals with such subjects as the state, political cycle, republic, god-kingship, citizen and subject, sovereignty, and natural law. *Mr. Lear*

Humanities 102. Political Theory and the Nature of Political Thought (3-0-6).

The first semester will deal with the great political systems which man has devised, and the second semester will be devoted to the theory and practice of modern political systems. *Mr. Lear*

Humanities 300a. The Beginnings of Modern Thought in the Renaissance (3-0-3).

A historical and critical outline of the transition from medieval to modern thought: an examination of the main representative minds of Renaissance culture in its many aspects: philosophical, scientific, literary, social-political. *Mr. Tsanoff*

Humanities 300b. The Idea of Progress in History (3-0-3).

A historical and systematic inquiry into the growing vitality of social values. In the first part of the course the idea of progress is traced in its historical development since classical antiquity. The second part of the term is devoted to an appraisal of the belief in social progress by an examination of the reasons for and against it provided by the evidence in the various social institutions. *Mr. Tsanoff*

Italian

(*See* page 126)

Mathematics

Professors Bray, Douglas, MacLane, Mandelbrojt, and Ulrich, *Chairman*
Associate Professors Brown, Durst, and Johnson
Assistant Professor O'Neil

Rice University has always placed great emphasis on the study of mathematics and has acquired a very complete mathematical library including all the important mathematical journals.

Admission to graduate study in mathematics will be granted to a limited number of students who have earned the bachelor's degree from Rice University, or another institution of similar standing, and whose undergraduate work in mathematics is such as to indicate the ability for advanced and original work. Those students who have completed a large amount of undergraduate mathematics and who devote full time to graduate study may earn the degree of Master of Arts in one year. The minimum time required by candidates for the degree of Doctor of Philosophy is three years. It is to be expected that most students will require longer than the minimum time, particularly holders of graduate assistantships.

For the master's degree, the requirements are:

(a) The completion with high standing of at least four advanced courses.
(b) The presentation of a written thesis on a subject approved by the Department.
(c) The passing of an examination in either French or German demonstrating ability to read scientific literature in the language.

In order to be admitted into candidacy for the doctor's degree the student must pass a comprehensive oral examination on the fundamental concepts and facts in the major fields of mathematics.

For the doctor's degree, the requirements are:

(a) The completion with high standing of at least eight advanced courses.

(b) The presentation of a written thesis on a subject approved by the Department. The purpose of the doctor's thesis is to demonstrate the candidate's ability to make an original contribution to a field of mathematics in which he has become expert. This is a more extensive and advanced type of study than that required for the master's degree and is expected to reveal definite originality and inventiveness and to be suitable for publication.

(c) The passing of examinations in either French or German and a second language approved by the Department, demonstrating ability to read scientific literature in these languages.

(d) The passing of an oral examination given by the faculty in the area of the student's thesis.

In order that they may obtain adequate experience in collegiate teaching, students holding assistantships are assigned a moderate schedule of regular teaching duties in the Department. These duties usually consist of the instruction of one or two small sections in courses of elementary or intermediate character or assisting an instructor in charge of an advanced course. These duties constitute an important part of the training for a teaching career.

COURSES

Among courses which have been offered in recent years, and which may be offered in more or less modified form from time to time in the very near future, are the following:

Mathematics 100. Elementary Analysis (4-0-8).

Calculus and analytic geometry. The ideas of the calculus are introduced by considering the rate and area problems. This course includes differentiation of the elementary functions and some of the simpler integration formulae; plane analytic geometry by a study of the conic sections and the reduction of the general second-degree equation; three-dimensional analytic geometry and vector methods; an introduction to partial differentiation. This course is required of all freshmen enrolled in the science-engineering curriculum and may be elected by students in the humanities (academic) curriculum. *Staff*

Mathematics 101. Fundamental Concepts of Mathematics (3-0-6).

A course designed expressly for students in the humanities (academic) curriculum and intended to convey an appreciation of the edifice of mathematical ideas, the topics treated being largely chosen for the light they shed on the nature and role of mathematics. The elements of algebraic theory of ruler and compass construction. The ideas of the calculus are introduced in connection with the analysis of planetary motion. An important part of the program consists of a critical study of the number systems. The course begins with a brief introduction to the concepts and notation of logic. This course may be elected by students in the humanities (academic) curriculum who, in general, are not planning to continue the study of mathematics beyond one year. *Staff*

Mathematics 200. Differential and Integral Calculus (3-0-6).

The topics treated in this course include systematic integration; definite integrals; improper integrals; infinite series; multiple integrals; applications to physical problems; line and surface integrals; divergence theorem and Stoke's theorem. This course is prescribed for all science-engineering majors who do not take Mathematics 210. Students who have considerable facility in mathematical reasoning should enroll in Mathematics 210. *Staff*

Mathematics 210. Differential and Integral Calculus (3-0-6).

This course has the same scope as Mathematics 200 but is more complete and rigorous. It is open to students who have passed Mathematics 100 with high standing or who otherwise satisfy the instructor of their fitness to take the course. *Staff*

Mathematics 300. Differential Equations and Advanced Calculus (3-0-6).

The topics treated in this course include integration of differential equations of first order by elementary methods; theory of integrating factors; geometry of integral curves; existence and uniqueness theorems for differential equations; properties of linear equations; oscillation and separation theorems; theory of regular singular points; special functions of mathematical physics; orthogonal systems; expansion theorems; solutions of some classical boundary-value problems; an introduction to calculus of variations. *Staff*

Mathematics 310. Advanced Calculus and Differential Equations (3-0-6).

This course is designed for students with considerable facility in mathematical reasoning. The scope is essentially that of Mathematics 300, but the development is more systematic and rigorous. It is open to students who have passed Mathematics 200 or 210 with high standing or who otherwise satisfy the instructor of their fitness to take the course. *Staff*

Mathematics 320. Analytical Mechanics (3-0-6).

The topics treated include reduction of systems of forces; conditions for equilibrium; dynamics of systems of particles and rigid bodies; variational methods; special relativity theory. *Mr. MacLane or Mr. Ulrich*

Mathematics 330. Introduction to Higher Algebra (3-0-6).

Properties of determinants and matrices, theory of linear dependence, bilinear and quadratic form, polynomials, invariants, lambda matrices and applications. *Staff*

Mathematics 360. An Introduction to Mathematical Probability and Statistics (3-0-6).

Topics covered will include conditional probability, Bernouilli's theorem, law of large numbers, distributions, central limit theorem, correlation, large and small sample theory, goodness of fit, testing statistical hypotheses, and the design of experiments. Insofar as possible, the mathematical foundations will be emphasized. Prerequisite: Mathematics 300 (may be taken concurrently). Enrollment with permission of instructor. *Mr. Douglas*

Mathematics 400. Theory of Functions of a Complex Variable (3-0-6).

This course is fundamental in analysis. Besides giving an introduction to basic concepts of analysis, it includes the study of analytic functions of a complex variable, the Cauchy's integral theorem, Taylor's series, calculus of residues, and conformal mapping.

Mathematics 410. Differential Equations and an Introduction to the Calculus of Variations (3-0-6).

Geometry of the integral curves and the classification of the singularities of equations of first order, existence theorems, theory of integrating factors and integration by elementary means, general theory of second-order linear equations, oscillation and comparison theorems, Fuchsian theory of regular singular points, eigenvalue problems, general partial differential equations of first order, boundary-value problems for certain second-order linear systems, and as much calculus of variations as time permits. *Mr. MacLane or Mr. Ulrich*

Mathematics 420. Differential Geometry (3-0-6).

Theory of curves and surfaces, geodesics, mapping of surfaces, the absolute geometry of a surface.

Mathematics 430. Introduction to Modern Geometry (3-0-6).

Synthetic and algebraic geometry, the group of projective transformations and certain subgroups of the group of projective transformations, the geometries defined by these groups, projective correspondences, projective theory of conics. *Staff*

Mathematics 441. Modern Algebra (3-0-6)

An introduction to some of the basic concepts of algebra. Topics discussed will include groups, rings, fields, linear algebra, Galois theory, etc.
Mr. Brown or Mr. MacLane

Mathematics 442. Topology (3-0-6).

The first part of the course covers some of the fundamental facts concerning general topological spaces. The second part is an introduction to combinatorial topology. *Mr. Brown or Mr. McLane*

Mathematics 450. Number Theory (3-0-6).

The fundamental theorem of arithmetic, residue class rings and congruences, quadratic residues, and reciprocity law. Numerical functions. Algebraic number fields, factorization, and ideals. *Mr. Durst*

Mathematics 460. Numerical Analysis (3-0-6).

Approximate integration and differentiation by finite differences, interpolation, functional approximation, linear and nonlinear algebraic equations, eigenvalues, approximate solution of ordinary differential equations and of some simple partial differential equations. A digital computer is available for laboratory use. Prerequisite: Mathematics 300 or 310. *Mr. Douglas*

Mathematics 500. Theory of Normal Families of Functions (3-0-6).

Equicontinuity and Ascoli's lemma, limiting oscillation of Ostrowski and Carathedory's continuous convergence, Orsove's theorem on normal families of potential functions, theorems of Vitali and Montel, Mandelbrojt's theory of kernals, location and description of singularities of families of analytic functions.
Mr. Johnson

Mathematics 501. Theory of Functions of a Complex Variable (3-0-6).

A study of special analytic functions of importance in mathematical physics. The course is usually given as a seminar. *Mr. Ulrich*

Mathematics 505a. Selected Topics from the Theory of Functions of a Complex Variable (3-0-3).

The subject matter of this course varies from year to year. In past years the following topics have been among those presented: singularities of a function defined by a Taylor series, elementary theory of Dirichlet series, approximation theory, constructive theory of functions, and geneatized functions. *Mr. Mandelbrojt*

Mathematics 510. Theory of Functions of a Real Variable (3-0-6).

Theory of real numbers, limits and continuity, Lebesque and Stieljes integrals, general integrals, the theory of differentiation, Fourier series, function spaces, selected topics. The student should be familiar with some of the material of Mathematics 440. These courses could be taken concurrently. *Mr. Brown or Mr. O'Neil*

Mathematics 515. Conformal Mapping and the Theory of Distribution of Values (3-0-6).

The material of the course is selected from the following topics: the Riemann mapping theorem; boundary behavior; theory of prime ends; schlicht functions; covering surfaces; harmonic measure; Nevanlinna theory of meromorphic functions; and the defect relation. *Mr. MacLane or Mr. Ulrich*

Mathematics 520. Trigonometric Series and Related Topics (3-0-6).

Series expansions in terms of orthogonal systems of functions. Trigonometric series. Fourier transforms and integrals. The course is based upon Mathematics 510. *Mr. Bray*

Mathematics 530. Laplace Transformations (3-0-6).

Theory of the Laplace transformation with particular reference to the properties of the transform as a function of a complex variable. Applications to the solution of difference equations, integral equations of the convolution type, and ordinary differential systems. Boundary-value problems. Certain Sturm-Lioville systems. Abelian and Tauberian theorems. Asymptotic representations. *Mr. Ulrich*

Mathematics 535. Partial Differential Equations (3-0-6).

Theorems of Cauchy-Kowalewski and Holmgren, classification of partial differential equations. Cauchy problem for first-order hyperbolic systems and the wave equation, boundary-value problems for second-order hyperbolic, elliptic, and parabolic equations, numerical solution of partial differential equations and systems. Prerequisite: Mathematics 410 or 400; preferably both. *Mr. Douglas*

Mathematics 540. Topological Linear Algebra (3-0-6).

Vector spaces. The elementary geometric and algebraic properties of Banach and Hilbert spaces. Normed rings. Operators and spectral theory. Applications and topics of related interest. Prerequisite: Mathematics 510. *Mr. Brown*

Mathematics 541. Banach Spaces of Function (3-0-6).

The use of Banach spaces in classical and functional analysis; Orlicz spaces; interpolation of operators; fractional integration. *Mr. O'Neil*

Mathematics 550. Geometric Function Theory (3-0-6).

The content of this course, which will vary from year to year, will consist of material selected from the following topics: algebraic functions; elliptic functions; automorphic functions; Riemann surfaces; the problem of type; conformal mapping; uniformization. *Mr. MacLane or Mr. Ulrich*

Mathematics 560. Potential Theory (3-0-6).

Integral theorems of potential theory. Riez's theorem on potentials of negative mass and subharmonic functions, a flux integral for functions which have harmonic support, boundary-value problems, Poisson integral and Green's function, exceptional points of the boundary, theorems of Kellogg and Evans, recent researches on boundary topologies. *Mr. Johnson*

Mathematics 565. Partial Differential Equations (3-0-6).

Advanced topics in the study of partial differential equations. *Mr. Douglas*

Mathematics 570a. Selected Topics from Advanced Analysis (3-0-3).

The subject matter of this course varies from year to year. In past years the following topics have been among those presented: Fourier transforms in the complex domain, analytic continuation and infinitely differentiable functions, theory of composition, general Tauberian theorems, general problem of moments, closure theorems, general asymptotic representations, zeta-function of Riemann, and analytic theory of numbers, ergodic theory, and monogenic and isogenic functionals, harmonic analysis, and approximations in the complex plane. *Mr. Mandelbrojt*

Mathematics 600. Thesis.

Mathematical Colloquium.

The colloquium usually meets one afternoon every week to allow the exposition of original investigations by its members.

NOTE: Mathematics 505a, 515, 550, or 570a may be taken for credit more than once provided the material is essentially different.

Mechanical Engineering

PROFESSORS BECKMANN, BROTZEN, CHAPMAN, *Chairman,* AND GRIFFIS
ASSOCIATE PROFESSORS PASLAY, PLAPP, AND WILHOIT
ASSISTANT PROFESSORS ASIMOW, BURGHARD, ROBERTS, AND WIERUM
INSTRUCTOR VERMEULEN
ASSISTANT HENDRICKSON

Requirements for the degree of Bachelor of Science in Mechanical Engineering are summarized on pages 40-41. Representative courses and normal sequence of registration in courses during the undergraduate years are available from the Department.

Candidates for the degree of Master of Science in Mechanical Engineering must complete eight semester courses and be enrolled in a graduate seminar each year.

In addition to the above requirements for the Master of Science degree, candidates for the degree of Doctor of Philosophy must complete five approved full-year courses and pass written and oral comprehensive examinations.

The research interests of the mechanical engineering faculty and the laboratory research equipment available provide the following areas of specialization in the field of mechanical engineering: (1) Engineering Mechanics, Theory of Elasticity; (2) Physical Metallurgy; (3) Thermodynamics, Fluid Dynamics, Heat Transfer.

COURSES

Mechanical Engineering 380a or b. Manufacturing Processes (3-3-4).

A discussion of some of the principles common to the engineering analysis of manufacturing processes. Detailed analyses of some processes involving forming, casting, thermal treatments, and metal cutting are made. Laboratory periods allow observation of the processes studied and the collection of experimental data required for analysis. One semester. Laboratory fee required. *Mr. Asimow*

Mechanical Engineering 390a or b. Production Metallurgy (3-3-4).

Class and laboratory instruction in the processes utilized in the production of metals. A study is made of the chemistry and thermodynamics of the reactions involved in ore concentration and in the extraction, refining, and alloying of metals. One semester. Laboratory fee required.

Mechanical Engineering 395a or b. Materials Science (3-3-4).

An introductory course in the science of solid materials, covering not only metals, but also ceramics, plastics, and semiconductors. The basic understanding of the nature of solid materials will be stressed. The subject matter is approached from both the atomic and macroscopic points of view. Prerequisites: Physics 100, Chemistry 120. One semester. *Mr. Brotzen*

Mechanical Engineering 401. Thermodynamics (3-0-3).

An introductory course on the laws of classical thermodynamics with some applications to systems of practical importance. A simple, rigorous exposition of the first and second laws of thermodynamics, without resort to molecular concepts, is given. Illustrations and applications of these laws utilize systems of practical importance to electrical engineers. The properties of solids, liquids, gases, and vapors are studied. A brief introduction to the generalized equations of thermodynamics and the criteria of equilibrium is also included. One semester. *Mr. Wierum*

Mechanical Engineering 402. Statistical Thermodynamics (3-0-3).

An introductory course on the laws of statistical thermodynamics. Emphasis is on the use of the fundamental principles and techniques of statistical mechanics in interpreting and predicting the properties of macroscopic systems in terms of the properties of the microscopic systems of which they are composed. Treatment is limited to systems in thermodynamic equilibrium. This course is intended as a companion course to Mechanical Engineering 401 or 403. Prerequisite: Mechanical Engineering 401 or 403. One semester. *Mr. Wierum*

Mechanical Engineering 403. Thermodynamics (3-1½-7).

A general course of lectures, recitation from the text, and laboratory. A detailed exposition of the laws of classical thermodynamics is followed by their application to systems of practical importance. Other topics included are properties of liquids, gases, and vapors, the thermodynamics of high velocity flow, psychometric principles, and the thermodynamics of gas or vapor power systems and of refrigeration systems. Prerequisite: full fourth-year standing. Laboratory fortnightly. Two semesters. Laboratory fee required. *Mr. Chapman*

Mechanical Engineering 405. Dynamics and Thermodynamics of High Velocity Fluid Flow (3-0-3).

An introductory course in the dynamics of high-velocity compressible gas flow. A thorough treatment is made of one-dimensional flows in closed channels involving area change, friction, shock waves, heat addition, and other effects expressible in terms of the mach number parameter. Applications to nozzles and propulsion problems are made. Also included is an introductory treatment of two-dimensional compressible flow, including oblique shock waves. One semester.
Mr. Chapman

Mechanical Engineering 423. Engineering Mathematics (3-0-6).

The application of ordinary and partial differential equations to typical boundary-value problems in vibrations, wave propagation, heat conduction, and fluid flow. An introduction to the theory of complex variables. Two semesters.
Mr. Wilhoit

Mechanical Engineering 483. Introduction to Mechanical Design (3-0-3).

A study of those machine elements that require elementary mechanics and stress theory for their design. Attention is directed toward the manufacture of machine elements and their assembly into a working machine. Two semesters.
Mr. Hendrickson

Mechanical Engineering 505. Seminar (1-0-2).

A course devoted to the purpose of training engineering students in collecting and presenting orally formal papers on topics of engineering interest. The papers are given by the students, using acceptable material secured from technical periodicals. The course meets weekly and is conducted in the form of a professional society meeting. Required of all mechanical engineering students in the year they are candidates for the bachelor's degree in mechanical engineering. *Staff*

Mechanical Engineering 511. Design of Machine Elements (3-0-3).

The design of components of machines including shafting, beams, springs, clutches, and brakes. A study of stress and strain at a point and strain-energy methods. Analysis of curved beams and thick-walled cylinders. One semester. *Mr. Griffis*

Mechanical Engineering 512. Advanced Strength of Materials (3-0-3).

Bending of beams on elastic foundations, elastic stability problems, torsional problems with noncircular cross sections, thin plates and shells, deformations beyond the elastic limit. One semester. *Mr. Griffis*

Mechanical Engineering 515. Machine-Design Laboratory (0-6-2).

Investigation and design of problems in the field of machine design. One semester. Laboratory fee required. *Mr. Griffis*

Mechanical Engineering 521. Applications of Thermodynamics and Other Disciplines in Mechanical Engineering (3-0-3).

Applications of previously developed theory and techniques to a number of fields of mechanical engineering, including combustion equilibrium, refrigeration and air conditioning, instrumentation and controls, and engineering economics. Prerequisites: Mechanical Engineering 403 and 423. One semester. *Mr. Plapp*

Mechanical Engineering 522. Applied Fluid Mechanics and Fluid Machinery (3-0-3).

Applications of fluid mechanics in mechanical engineering. Particular emphasis is placed on flow in pipe networks, compressible and incompressible steady and nonsteady flow in pipes, simple wave theory, and fluid machinery. Prerequisites: Mechanical Engineering 403 and Civil Engineering 402. One semester. *Mr. Plapp*

Mechanical Engineering 525. Advanced Thermodynamics and Heat Power Laboratory (0-6-2).

Advanced laboratory work in thermodynamics, heat transfer, and fluid mechanics, consisting of at least one small research project in addition to a number of tests of common items of equipment. This course is ordinarily taken concurrently with Mechanical Engineering 521. One semester. Laboratory fee required. *Mr. Plapp*

Mechanical Engineering 532. Internal Combustion Engines (3-3-4).

A detailed treatment from a thermodynamic viewpoint of the theory and characteristics of gasoline, diesel, gas turbine including turbojets, ram-jet, liquid and solid fuel rocket engines. The flight performance of the turbojet and rocket will be considered together with the ram-jet if time permits. A survey of the engine control problem will also be included. Prerequisite: Mechanical Engineering 403. One semester. *Mr. Vermeulen*

Mechanical Engineering 541. Physical Metallurgy I (3-3-4).

A study of the fundamentals of solidification, alloying, and heat treatment. The mechanical and nonmechanical properties of metallic systems are discussed from atomic and electronic theory. Structural changes in metals accompanying various basic forming processes are described. An introduction to the oxidation and corrosion of metals. Laboratory experiments will conplement the course work and include experiments for example on X-ray diffraction and resistivity. One semester. *Mr. Roberts*

Mechanical Engineering 542. Physical Metallurgy II (3-3-4).

Precise topics covered may vary but generally include all or in part detailed discussions of X-ray metallography, thermodynamics of alloy systems, mechanism and kinetics of phase transformations, radiation damage, fatigue, creep and damping of metals and alloys. Electron theory of metals and alloys as related to semiconductors, thermal conductivity, and magnetism. Laboratory work generally involves a semester project in one particular phase of metallurgy. One semester. *Mr. Roberts*

Mechanical Engineering 563. Advanced Metallurgical Laboratory (0-4-2).

Students whose interest lies primarily in the fields of materials and metallurgy are given the opportunity for research in these fields. The student will be able to work on problems of a basic nature. Two semesters. *Staff*

Mechanical Engineering 570. Mechanical Vibrations (3-0-3).

Linear vibration theory beginning with a one-degree-of-freedom system and continuing to a multi-degree-of-freedom system and continuous systems. Effects of gyroscopic forces. Optimization of damping. Mobility methods. One-degree-of-freedom nonlinear systems. Prerequisite: Mechanical Engineering 423. One semester. Undergraduate and graduate credit. *Mr. Paslay*

Mechanical Engineering 590. Heat Transfer (3-0-3).

A general course of lectures and recitations from text covering a basic study of the laws of heat transfer by conduction, convection, and radiation. Prerequisites: Mechanical Engineering 403 and 423. One semester. *Mr. Chapman*

Mechanical Engineering 593. Mechanical Engineering Problems.

If conditions are favorable, mechanical engineering students may elect at least nine hours a week in approved investigations or designs under the direction of a member of the staff.

Mechanical Engineering 605. Graduate Seminar (1-0-2). *Staff*

Mechanical Engineering 615. Advanced Dynamics (3-0-3).

Dynamics of a particle, dynamics of a system of particles, Hamilton's principle, and Lagrange's equations. Applications to advanced engineering problems including gyroscopic motion and the vibration of elastic bodies. One semester. *Mr. Wilhoit*

Mechanical Engineering 623. Advanced Engineering Analysis I (3-0-3).

An introduction to the theory of the complex variable and a review of vector analysis with particular emphasis on engineering applications in the fields of fluid dynamics, heat conduction, and elasticity. One semester. *Mr. Plapp*

Mechanical Engineering 625. Advanced Engineering Analysis II (3-0-3).

Advanced topics in engineering analysis. The subject matter may vary from year to year depending on the background of those enrolled. Among topics which may be considered are the calculus of variations, integral equations, matrix methods, tensor analysis, partial differential equations, statistics and probability, numerical methods, and their engineering applications. One semester. *Staff*

Mechanical Engineering 631. Constitutive Equations of Applied Mechanics (3-0-3).

A study of the formulation of the constitutive equations for isotropic continuous materials. Rigid body motion, nonorthogonal coordinate systems, stress, strain. Isotropic relations of elastic and fluid materials. Linear superposition theories. Plasticity. Thixotropic materials. Variational principles. One semester. *Mr. Paslay*

Mechanical Engineering 632. Rheology (3-0-3).

Applications of the results obtained in Mechanical Engineering 631 with emphasis on plastic, viscoelastic, and thixotropic materials. One semester. *Mr. Paslay*

Mechanical Engineering 634. Thermodynamics of Alloys (3-0-3).

Discussion of equilibrium conditions in liquid and solid metallic solutions. Analysis of thermodynamic quantities from the classical and statistical points of view. Specific heat, thermal expansion coefficient, and compressibility of metallic systems are studied. One semester. *Mr. Asimow*

Mechanical Engineering 635. Transformations in Alloys (3-0-3).

The mechanism and kinetics of diffusion-controlled and of shear transformations are studied. Topics taken up include theory of diffusion, precipitation reactions, order-disorder transformations, and allotropic transformations. One semester. *Mr. Asimow*

Mechanical Engineering 636. X-ray Diffraction (3-3-4).

A study of the diffraction of X rays by crystals. The theory of diffraction by crystal lattices is developed and applications to precision parameter measurements, stress analysis, phase-diagram determination. Particle size measurement and crystalline imperfection studies are discussed. Laboratory work allows student to gain facility with various experimental techniques. One semester. *Mr. Asimow*

Mechanical Engineering 644. Lattice-Imperfection Theory (3-0-3).

Dislocations in otherwise perfect media: the geometry of dislocations in a continuum, their stress fields, and interactions. Dislocations in real crystals (dislocation reactions, dislocation interaction with other crystal imperfections) and theories concerning the origin of dislocations. The presence and behavior of lattice vacancies and interstitials in solids. Production of these defects by different methods including irradiation. One semester. *Mr. Roberts*

Mechanical Engineering 645. Mechanical Metallurgy (3-0-3).

Elastic, plastic, and viscous behavior of metallic solids. The interpretation of mechanical behavior in terms of lattice-imperfection theory. Discussion of fracture, fatigue, creep, and damping in metals. One semester. Prerequisite: Mechanical Engineering 644. *Mr. Roberts*

Mechanical Engineering 646. Theory of Metallic Structures (3-0-3).

Electron theory of metals, starting with the free-electron model and leading to Brillouin zones and band theory. Metallic structures and solid solubilities are interpreted in the light of these theories. One semester. *Mr. Brotzen*

Mechanical Engineering 647. Physical Properties of Solids (3-0-3).

Based on the electron theory of metals, the electrical and thermal conductivities of metals are studied. The origin and behavior of diamagnetic, paramagnetic, and ferromagnetic materials are considered. A discussion of semiconductors will be included. Prerequisite: Mechanical Engineering 646 or equivalent. One semester. *Mr. Brotzen*

Mechanical Engineering 653. Research and Thesis.

A report on an engineering investigation carried out by the individual student under the direction of a member of the staff in mechanical engineering. Nine hours of research weekly. Three copies of the accepted report will be required, two for deposit in the University Library and one for the Mechanical Engineering Department.

Mechanical Engineering 661. Theory of Elasticity (3-0-3).

State of stress at a point, state of strain at a point, and stress-strain relations. The general equations of three-dimensional theory of elasticity are considered. A treatment of the two-dimensional theory, including plane stress and plane strain is

included. Also discussed are the states of stress in rectangular, circular, and ring-shaped plates, and torsion of uniforms bars of any cross section. One semester.
Mr. Wilhoit

Mechanical Engineering 662. Additional Topics in the Theory of Elasticity (3-0-3).

The use of complex variables is applied to two-dimensional elastostatic problems. Three-dimensional problems in the theory of elasticity are considered. One semester. *Mr. Wilhoit*

Mechanical Engineering 663. Special Topics in Applied Mechanics.

A collection of several topics not currently included in other courses. The topics include engineering applications of variational calculus methods, thermodynamic conditions imposed on the formulation of stress-strain equations, stress-wave propagation, nonlinear elasticity, vibrational problems, and astrodynamics. One semester.
Messrs. Wilhoit and Paslay

Mechanical Engineering 665. Theory of Plates and Shells (3-0-3).

The bending of rectangular and circular flat plates with various edge conditions is discussed. An introduction to plate-buckling vibration is given. The membrane theory of shells and the general theory of cylindrical shells is treated. One semester.
Mr. Paslay

Mechanical Engineering 670. Advanced Thermodynamics (3-0-3).

A continuation of the study of the principles of thermodynamics, including a thorough review of the fundamental concepts and laws, a detailed consideration of energy and its transformations and of equilibrium, and introductions to chemical thermodynamics and statistical mechanics. One semester. *Mr. Plapp*

Mechanical Engineering 673. Advanced Fluid Dynamics I (3-0-3).

A course emphasizing topics in classical fluid dynamics. The material consists of the fundamentals of frictionless flow, airfoil theory, ducted flow, and open-channel flow. One semester. *Mr. Beckmann*

Mechanical Engineering 674. Advanced Fluid Dynamics II (3-0-3).

This course emphasizes flow of viscous fluids. Primary attention is given to boundary-layer flow and to turbulent flow. One semester. *Mr. Beckmann*

Mechanical Engineering 675. Special Applications of Fluid Dynamics I (3-0-3).

Special topics of greater interest are emphasized comprising the flow of nonmixing liquids of different densities, transport of solid particles in flowing fluids, and the fluid dynamics of meteorology. One semester. *Mr. Beckmann*

Mechanical Engineering 676. Special Applications of Fluid Dynamics II (3-0-3).

A graduate course introducing the theory of lubrication, flow through porous materials, flow with free surfaces, cavitation, and others. One semester.
Mr. Beckmann

Mechanical Engineering 682. Theory of Convective Heat Transfer (3-0-3).

A thorough investigation of the processes of forced and free convection in laminar and turbulent flow, including a development of the basic equations describing these processes and a presentation of the principal cases for which they have been solved. One semester. *Mr. Plapp*

Mechanical Engineering 693. Advanced Gas Dynamics (3-0-6).

Analysis of the general equations of fluid flow. Properties of compressible fluids. Subsonic and supersonic flow in the steady and nonsteady states and in one, two, and three dimensions. Shock waves and other phenomena connected with high-velocity flow. Two semesters. *Mr. Chapman*

Mechanical Engineering 695. Special Research Topics in Mechanical Engineering.

Individual laboratory or library research investigations under the direction of a member of the mechanical engineering staff.

Military Science

Professor Wilby, *Chairman*
Assistant Professors Sellers and Spacek

Military Science 101a. Orientation and Individual Weapons and Marksmanship (1-1-1).

Military organization. Introduction to weapons to include marksmanship. History 110 (American History) must be taken concurrently unless previously completed.

Military Science 102b. U.S. Army and National Security (1-1-1).

History 110 must be taken concurrently unless previously taken.

Military Science 201a. Military Tactics (2-2-2).

Map and aerial photo interpretation. Small-unit leadership and tactics.

Military Science 202b. Military Tactics (2-2-2).

Principles of land warfare.

Military Science 301a. Military Leadership (1-1-1).

Principles of military leadership.

Military Science 302b. Military Engineering (4-1-4).

Military structures and field construction procedures.

Military Science 401a. Military Operations (4-1-4).

Engineer operations, management, administration, and logistics.

Military Science 402b. Military Law (1-1-1).

Uniform code of military justice.

Music

The Shepherd School of Music

Music 300. Orientation and Historical Survey (3-0-6).

An investigation into the technical, psychological, and social aspects of music. Prerequisite: Junior standing. *Mr. Hall*

Music 315. Harmony and Sight-Singing (3-0-6).

Instruction in the theory and practice of traditional harmony and sight-singing and dictation. The translation of notation into rhythm and sound, and sound into notation. Includes inversions of the dominant 7th and the higher dominants, plus all major and minor triads and nonchords. *Mr. Hall*

Naval Science

Professor Dean, *Chairman*
Associate Professor Knocke
Assistant Professors Griffin, Mahon, Schloer, and Tangeman

Naval Science courses as described will be taken in succession as listed.

Naval Science 100. Sea Power and Orientation (1-2-2).

This course consists of a one-hour weekly classroom period plus a two-hour weekly laboratory in which fundamental concepts of sea power, traditions, customs, organization, seamanship, and missions of the Navy are presented. In addition, History 110 (American History—taught by the History Department) is a course requirement for all Freshmen N.R.O.T.C. students.

Naval Science 201 (first semester). Naval Weapons (3-2-3).

Introduction to naval weapons and space technology. Fire-control system. Principles of sonar and radar. Guided missiles. Nuclear weapons and radiological defense. Antisubmarine warfare. Amphibious warfare.

Naval Science 202 (second semester). Naval Leadership (3-2-3).

This course consists of a study of the principles and practice of leadership. In pursuance of these principles, the course examines human relations in the naval environment and their effect on the application of leadership.

Naval Science 301 (first semester). Naval Engineering (3-2-3).

Basic principles of and problems in thermodynamics are employed in the study of various power cycles of both main propulsion and auxiliary plants. Steam, internal combustion, and nuclear plants are studied and their energy transformations analyzed. With the emphasis on fundamental principles employed, the student is familiarized with the entire shipboard engineering plant, including electrical systems, refrigeration, compressed-air, and hydraulic systems. Principles of ship stability are studied, including evaluations of transverse and longitudinal stability after damage and weight change.

Naval Science 302 (second semester). Navigation (3-2-3).

Terrestrial and celestial navigation. Piloting problems, utilizing electronic and visual navigation aids, are studied. Motions of celestial bodies are determined. The celestial sphere concept is utilized in determining position by the employment of spherical trigonometry.

Naval Science 401 (first semester). Naval Operations (3-2-3).

The elements of shipboard operations, including the Rules of the Nautical Road, problems in relative motion, maneuvering ships in formation, and employment of the Striking Force. Fleet communications, with an introduction to electronics countermeasures. The effects of weather on naval operations.

Naval Science 402 (second semester). Principles and Problems of Leadership (3-2-3).

Application of the principles of naval management, naval administration, and leadership.

N.R.O.T.C. students who desire to be commissioned as second lieutenants in the U. S. Marine Corps or Marine Corps Reserve, and whose applications for transfer are accepted, will substitute the following courses during the final two years.

Naval Science 301M (first semester). Evolution of the Art of War (3-2-3).

Significance of military power. Classic principles of war, analyzed as a foundation for further understanding of military operations by a study of famous battles.

Naval Science 302M (second semester). Modern Basic Strategy and Tactics (3-2-3).

Basic strategic concepts and principles of offensive and defensive tactics through the battalion level.

Naval Science 401M (first semester). Amphibious Warfare (3-2-3).

History of amphibious warfare. Development of amphibious tactics. Gunfire support. Planning. Logistics. Administration.

Naval Science 402M (second semester). Marine Corps Leadership and the Uniform Code of Military Justice (3-2-3).

Development of leadership techniques through a study of the basic psychology of leadership. Uniform Code of Military Justice.

Philosophy, Psychology, and Education

Professors Fulton, *Chairman*, Hudson, and Nielsen
Associate Professors Black, Kolenda, L. Mackey, and Wann
Assistant Professors Robinson, and Wood
Instructor Sanders

PHILOSOPHY

Undergraduate Majors. Philosophy majors will normally be expected to take Philosophy 220, or its equivalent, and eight semesters of upper-division courses, of which four shall be Philosophy 301, 302, 303, and 304. In addition, qualified majors may elect Philosophy 400. At the end of the Senior year, departmental majors write comprehensive examinations instead of course examinations in philosophy.

Graduate Study. College graduates who have shown ability in their undergraduate study of philosophy may be admitted to candidacy for the degrees of Master of Arts and Doctor of Philosophy. The beginning of advanced study presupposes the completion of undergraduate courses approximately equivalent to an undergraduate major in philosophy. The fulfillment of the requirements for the degree of Master of Arts ordinarily takes two years; for the degree of Doctor of Philosophy, three or more.

Requirements for the Master of Arts degree include:

(a) The completion with high standing of at least eight advanced semester courses approved by the Department.
(b) Satisfactory evidence, conforming to the requirements printed on pages 45, of the student's ability to use French or German in his studies.
(c) The completion of a written thesis on a subject approved by the Department.
(d) The passing of satisfactory written and oral examinations in philosophy, not limited to the student's special field of study.

Requirements for the degree of Doctor of Philosophy include:

(a) The completion with high standing of courses approved by the Department.
(b) Satisfactory evidence, conforming to the requirements printed on page 45, of the student's ability to use French and German in his studies.
(c) The passing of qualifying examinations in history of philosophy, metaphysics, value theory, and logic and epistemology.
(d) The completion of a written thesis on a subject approved by the Department. At least one year of thesis research must be spent in residence.
(e) The passing of a final oral examination, not limited to the student's field of study.

COURSES

Philosophy 220. Introduction to Philosophy (3-0-6). *Staff*

Philosophy 301. Thales to Plotinus (3-0-3). *Mr. Fulton*

Philosophy 302. Augustine to Bruno (3-0-3). *Mr. Mackey*

Philosophy 303. Galileo to Hume (3-0-3). *Mr. Fulton*

Philosophy 304. Kant and the Nineteenth Century (3-0-3). *Mr. Kolenda*

Philosophy 310. History of Religion (3-0-6). *Mr. Nielsen*

Philosophy 321a. Logic (3-0-3). *Mr. Robinson*

Philosophy 322b. Advanced Logic (3-0-3). *Mr. Robinson*

Philosophy 323. Philosophy of Science (3-0-3). *Mr. Robinson*

Philosophy 324. Problems in the Philosophy of Science (3-0-3). *Mr. Robinson*

Philosophy 331a. Approaches to Ethics: Historical (3-0-3). (Given Fall, 1963) *Mr. Kolenda*

Philosophy 332b. Approaches to Ethics: Contemporary (3-0-3).
(Given Spring, 1964) *Mr. Kolenda*

Philosophy 350. Philosophical Ideas in Literature (3-0-6). *Mr. Kolenda*

Philosophy 361a. Aesthetics (3-0-3).
(Given Fall, 1963) *Mr. Mackey*

Philosophy 362b. Theory of Literature and Music (3-0-3).
(Given Spring, 1964) *Mr. Mackey*

Philosophy 400. Independent Study and Senior Thesis (3-0-6). *Staff*

Philosophy 411a. Philosophy of Religion (3-0-3). *Mr. Nielsen*

Philosophy 414. The Christian Faith in the Modern World (3-0-3).
Mr. Nielsen

Philosophy 442b. Bradley to Whitehead (3-0-3).
(Given Spring, 1964) *Mr. Fulton*

Philosophy 451a. Philosophy of Symbolism (3-0-3). *Mr. Mackey*

Philosophy 461a. Social and Political Philosophy (3-0-3).
(Given Fall, 1963) *Mr. Nielsen*

Philosophy 500. Research and Thesis (3-0-6). *Staff*

Philosophy 511a. Wittgenstein and His Influence (3-0-3).
(Given Fall, 1963) *Mr. Kolenda*

Philosophy 513. Peirce and Pragmatism (3-0-3). *Mr. Kolenda*

Philosophy 521a. Readings in Non-Christian Religious Philosophy (3-0-3). *Mr. Nielsen*

Philosophy 522b. Protestant Philosophy since the Reformation (3-0-3).
Mr. Nielsen

Philosophy 524. Hellenism and Christianity (3-0-3). *Mr. Nielsen*

Philosophy 541a. Existentialism (3-0-3).
(Given Fall, 1963) *Mr. Mackey*

Philosophy 543a. Hegel (3-0-3).
(Given Fall, 1963) *Mr. Mackey*

Philosophy 544. Metaphysics (3-0-3). *Mr. Mackey*

Philosophy 545. Kant (3-0-3). *Mr. Mackey*

Philosophy 552b. Husserl (3-0-3).
(Given Spring, 1964) *Mr. Fulton*

Philosophy 554. Whitehead (3-0-3). *Mr. Fulton*

Philosophy 556. The Problem of Time *Mr. Fulton*

PSYCHOLOGY

The student planning to major in psychology should take Psychology 210 in the Sophomore year and the 300 and 400 series of courses in the Junior and Senior years respectively. A student who has delayed in choosing psychology as his major field until the Junior year should consult with members of the Department in planning his schedule. Majors who plan to participate in practice teaching during their Senior year should also consult with members of the Department regarding their third- and fourth-year course schedules.

Students are encouraged to select Biology 100 as one of their laboratory courses in their Freshman or Sophomore year. Anthropology 200 and 300 are recommended as B electives in their Sophomore and Junior years.

Independent Study. Qualified majors in psychology are encouraged to undertake a research problem under the supervision of members of the staff, substituting this (Psychology 404) for two semester courses in their Senior year. Emphasis is placed upon a broad survey of literature pertaining to the area in which the research is to be undertaken as well as upon the research itself. The student's work would be focused upon extending his knowledge and experience in the field of experimental psychology and research methodology *per se,* or in conjunction with the latter, expanding upon one of the other subject areas in psychology taken during the Junior year.

COURSES

Psychology 210a. General Psychology (3-0-3).

An introduction to the subject matter of the several fields of psychology, its relationship to other disciplines, and some of its contemporary applications. *Mr. Hudson*

Psychology 210b. Elementary Statistics (3-0-3).

An introduction to the theories and techniques of the statistical method as applied to problems in psychological research. The course will be concerned with means of describing distribution of scores and measures, the normal curve and probabilities, sampling and statistical inference, and correlation. *Mr. Wann*

Psychology 300. General Psychology (3-0-6).

A survey of the subject matter of the several fields of psychology to include consideration of some of its applications to contemporary problems. *Mr. Hudson*

Psychology 310a. Advanced Statistics (3-0-3).

More advanced correlational techniques, frequency comparisons, small-sample methods, analysis of variance, and further consideration of sampling and statistical inference. Prerequisite: Psychology 210a and 210b. *Mr. Wann*

Psychology 310b. History and Systems (3-0-3).

This course reviews the history of Western scientific psychology and the development of systems in psychological theory. Prerequisite: Psychology 210a and 210b. *Mr. Hudson*

Psychology 330a. Differential Psychology (3-0-3).

This course is designed to familiarize the student with the techniques for measuring individual differences. Critical reviews will be made of various theories of individual differences in intelligence and personality. *Mr. Wann*

Psychology 330b. Personality (3-0-3).

Selections from the literature on personality are analyzed and compared. Prerequisite: Psychology 210a and 210b. *Mr. Wann*

Psychology 340. Experimental Psychology (2-4-6).

This course is an introduction to experimental methods in psychological research, presented in the context of its historical antecedents and interpreted in terms of modern psychological theory. In lectures and in laboratory experiments and demonstrations, psychological concepts and methods will be developed and examined experimentally. Prerequisite: Psychology 210a and 210b. *Mr. Hudson*

Psychology 404. Independent Study (0-0-6). *Staff*

Psychology 410a. Developmental Psychology (3-0-3).

The course presents three major topics: adolescence, comparative social psychology, and theories and problems of social psychology. The first semester is designed to acquaint the student, from the point of view of adolescence, with the physical, social, and emotional processes that go into the making of an adult. *Mr. Wann*

Psychology 410b. Social Psychology (3-0-3).

The second semester is a continuation of the above topics, giving greater emphasis to social processes. These are viewed from the vantage point of comparative social psychology and the wide varieties of behaviors possible for human beings, and from the points of view provided by alternative theories. Prerequisite: Psychology 210a and 210b or 300 and 410a. *Mr. Wann*

EDUCATION

Education 310. The Historical, Philosophical, and Comparative Study of Education (3-0-6).

Educational problems of our society are studied in the context of the history of education (ancient, medieval, and modern periods), the philosophy of education, and comparative education. Prerequisite: filing of teacher-certification program with instructor.

Education 410. Professional Education (3-0-6).

An intensive study of these topics in professional education: locating educational information and data; methods; tests and measurements and elementary statistics; teaching as a profession; the organization, administration, and supervision of schools; educational psychology; the curriculum; and current trends.

Education 420. Methods, Observation, and Student Teaching, Grades 7-12 (Credit: 9 semester hours).

Required of students who plan to teach in the secondary schools. Meets three hours per week on the campus during the instruction period in methods of teaching and in preparation for the actual teaching. Observation and supervised student teaching off the campus in the schools for half-day placement for a period of sixteen weeks. Open only to Senior students and Class III graduate students who have the approval of the instructor, as an additional course not to be counted in the degree program. *Mr. Sanders and Mr. Wood*

In planning his courses, the student who wishes to receive a recommendation for a teacher's certificate should consult with the Dean of Humanities.

Physical Education

(*See* pages 133-135)

Physics

PROFESSORS HOUSTON, PHILLIPS, *Chairman,* RISSER, RORSCHACH, AND WILSON (*Emeritus*)
ASSOCIATE PROFESSOR CLASS
ASSISTANT PROFESSORS BARNARD, DONOHO, AND JOSEPHSON
LECTURER BRYAN

A minimum of one year of graduate study is required for the degree of Master of Arts and at least two years for the degree of Doctor of Philosophy. To be recommended for the degree of Doctor of Philosophy, a student must present an original thesis describing the results of experimental or theoretical research in a form suitable for publication. He must also attend a sufficient number of courses to acquire a broad fundamental knowledge of physics in addition to his research specialization. His mastery in the field of physics will be tested by an oral examination given by the faculty.

Research done recently in the Department has included work on the following subjects among others:

(1) Nuclear disintegrations produced by high-energy protons, deuterons, alpha particles, and helium 3 ions.
(2) Energies of beta and gamma rays.
(3) Scattering of neutrons and disintegrations produced by neutrons.
(4) Theory of nuclear reactions.
(5) Nuclear resonance.
(6) Hall effect in metals and gases.
(7) Magnetic properties of iron and other materials.
(8) Physics of the solid state.
(9) Low-temperature physics.
(10) Superconductivity.

The physics laboratories are well equipped for modern research in the above areas, with ample auxiliary equipment available. A new building housing a 6 mev Van de Graaff accelerator was completed in 1953 and a 12 mev Van de Graaff accelerator was installed in 1961.

COURSES

Physics 100. Mechanics, Heat, and Sound (3-3-8).

An introductory course consisting of two lecture hours, one problem hour, and three hours of laboratory work per week. This course is the first of the introductory physics courses required of all science-engineering students. In addition, this course satisfies one of the laboratory-science requirements for humanities (academic)

students. Topics of study include kinematics; statics and dynamics of solids and liquids based on Newton's three laws of motion; thermal properties of materials and introductory thermodynamics based on the first and second laws of thermodynamics; wave motion and sound. Students taking Physics 100 must have or be enrolled in Mathematics 100. Laboratory fee required.

Messrs. Bryan, Josephson, and Rorschach

Physics 200. Electricity, Magnetism, and Atomic Physics (3-3-8).

A course of three lectures and three hours of laboratory work per week. This course with Physics 100 makes up a complete course on the principles of physics which is required of science-engineering students. In this second course the fundamental principles of electrical theory are explained and illustrated, including the elementary theory of direct and alternating currents, electronics, and electrical theory of matter. In the laboratory the students make measurements of all the important electrical quantities such as current, resistance, potential, capacity, inductance, magnetic properties of iron and steel, electrochemical equivalents, and characteristics of triodes; other experiments include measurements of radiations from radioactive elements. Students taking Physics 200 must have completed Mathematics 100 and must take Mathematics 200 or 210 at the same time as Physics 200. Laboratory fee required.

Physics 210. Electricity, Magnetism, and Atomic Physics (3-3-8).

This course covers the material of Physics 200 in both lecture and laboratory but gives a more complete and rigorous treatment, emphasizing mathematical methods. It is open to students who have passed Physics 100 and Mathematics 100 with high standing.

Mr. Class

Physics 310. Atomic and Nuclear Physics (3-3-8).

Outline of the principal experiments upon which the quantum theory is based. Particle-like properties of light and other electromagnetic radiation. Wave-like and particle-like properties of the electron. Optical spectra and energy levels. X rays, radioactivity. Properties and spectra of alpha, beta, and gamma rays. Elementary facts of nuclear structure. Three hours of laboratory weekly. Laboratory fee required.

Mr. Risser

Physics 400. Introduction to Mathematical Physics (3-2-7).

A systematic review of the principal subjects in mechanics and electrodynamics. Mathematical methods, including differential equations and vector analysis, will be applied to the solution of problems in particle dynamics, vibrating systems, dynamics of rigid bodies, electrostatics, magnetostatics, and the electromagnet field. Three class hours and two problem hours per week.

Messrs. Rorschach and Donoho

Physics 415. Electron Physics (3-0-6).

Introduction to the behavior of electrons in solids and in vacuum. Classical dynamics of electrons, including an introduction to the special theory of relativity. Applications to electron vacuum tubes. Fundamentals of quantum mechanics. Applications to systems of electrons in solids. Physical principles of solid-state electron devices. Introduction to quantum electronics.

Mr. Donoho

Physics 425. Thermodynamics and Statistical Physics. (3-0-6).

An introduction to the behavior and properties of macroscopic systems. Topics included are the postulates of thermodynamics; equilibrium; Legendre transformations and the thermodynamic potentials; stability of equilibrium states and phase transitions; statistical basis of thermodynamics; microcanonical, canonical, and grand canonical ensembles; classical and quantum statistics; irreversible processes and transport phenomena.

Mr. Josephson

Physics 430. Senior Physics Laboratory (0-3-2).

Required of all Seniors majoring in physics. Laboratory fee required.

(a) Fall semester: Physical optics; polarization; diffraction; interference; optical properties of selected materials.

(b) Spring semester: Electronics. Properties of electron devices and basic electronic circuits. Applications to nuclear physics and solid-state physics.
Messrs. Donoho and Josephson

Physics 500. Introduction to Solid-State Physics

This course gives an introductory treatment of the thermal, electrical, and magnetic properties of solid bodies. Included is a discussion of crystal structure, lattice vibrations, electron theory of metals, binding forces, dia- and paramagnetism, and ferromagnetism. Prerequisite: Physics 425 or equivalent. Students enrolled in Physics 500 should take Physics 520 concurrently. *Mr. Rorschach*

Physics 510. Advanced Dynamics (3-0-6).

The general principles of analytical dynamics. Orbit theory and the central force problem. The kinematics of rigid bodies, treated from the standpoint of matrix transformations, canonical transformations. Hamilton-Jacobi theory. *Mr. Class*

Physics 520. Principles of Quantum Mechanics (3-0-6).

A deductive presentation of the principles of quantum mechanics with applications to various problems in spectroscopy, collisions of atomic particles, molecular binding, etc. *Mr. Phillips*

Physics 530. Electromagnetic Theory (3-0-6).

Electrostatics, magnetostatics, boundary-value problems, stress-energy relations; electromagnetic wave equations, Lienard-Wiechert potentials, multiple fields, radiation; special relativity, radiation from accelerated charges.

Physics 540. Nuclear Physics (3-0-6).

Radiation detectors; interaction of alpha particles, electrons, neutrons, and gamma radiation with matter; properties of nuclei; theory of nuclear structure; nuclear shell model, nuclear magnetic moments and spins; beta disintegrations; artificial disintegration of nuclei; nuclear scattering; mesons; fission; cosmic rays.
Mr. Phillips

Physics 560. Structure of Solids (3-0-6).

A review of the structure and vibration of crystals and the motions of electrons in them, based on quantum mechanics. *Mr. Houston*

Physics 580. Physics Colloquium (1-0-2).

One meeting a week at which results of researches in physics will be discussed.
Staff

Physics 590. Research Work. *Staff*

Physics 600. Special Topics in Solid-State Physics (2-0-4). *Staff*

Physics 610. Neutron and Reactor Physics (3-0-6).

Fundamental properties of the neutron: mass, magnetic moment, interaction with the proton, etc. Interaction with nuclei. Sources and detectors. Interaction with matter in bulk; slowing down and diffusion. Nuclear chain reactions. Magnetic scattering and polarization. Neutron diffraction. *Mr. Risser*

Physics 620. Theoretical Nuclear Physics (3-0-6).

General nuclear properties, two-body problems, scattering, nuclear spectroscopy, nuclear reactions, interaction of nuclei with electromagnetic and electron-neutrino fields, nuclear shell theory. *Mr. Trammell*

Physics 630. Advanced Quantum Mechanics (3-0-6).

Relativistic quantum mechanics of the electron; field quantization for the electron-positron and electromagnetic fields; quantum electrodynamics; scattering matrix theory; radiative corrections.

Physics 640. Applications of Group Theory to Quantum Mechanics (3-0-6).

An introductory treatment of abstract group theory and the general theory of group representations for finite and compact groups with application to the symmetric, orthogonal, and symplectic groups. Particular emphasis is given to the three-dimensional rotation group, including the application of the Wigner and Racah coefficients.

Physics 700. Summer Graduate Research.

Open only to students already admitted as candidates for an advanced degree. At least forty hours of laboratory work per week.

Political Science

(*See* page 140)

Psychology

(*See* pages 157-158)

Russian

(*See* page 127)

Sociology

(*See* page 80)

Spanish

(*See* page 127)

Index