



*Eighty-Second  
Annual Commencement  
June 11, 1976*

CALIFORNIA INSTITUTE OF TECHNOLOGY

*Eighty-Second*  
*Annual*  
*Commencement*

FRIDAY MORNING AT TEN-THIRTY O'CLOCK  
JUNE ELEVENTH, NINETEEN SEVENTY-SIX

# *Academic Procession*

*Chief Marshal*, Jon Mathews, Ph.D.

## *Assistant Marshals*

Arden L. Albee, Ph.D.

Robert V. Langmuir, Ph.D.

Robert W. Oliver, Ph.D.

Milton S. Plesset, Ph.D.

Frank J. Sciulli, Ph.D.

## MARCHING ORDER

CANDIDATES FOR THE DEGREE OF BACHELOR OF SCIENCE

CANDIDATES FOR THE DEGREE OF MASTER OF SCIENCE

CANDIDATES FOR THE DEGREE OF ENGINEER

CANDIDATES FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

THE FACULTY

THE CHAIRMEN OF DIVISIONS

THE DEANS

THE PROVOST

THE TRUSTEES

THE COMMENCEMENT CHAPLAIN

THE PRESIDENT

THE CHAIRMAN OF THE BOARD OF TRUSTEES

# Program

PRESIDING . . . . . R. Stanton Avery, LL.D.  
*Chairman of the Board of Trustees*

ORGAN PRELUDE . . . . . Leslie J. Deutsch, Class of 1976

AN INTRODUCTION TO COMMENCEMENT

David C. Elliot, Ph.D.  
*Secretary of the Faculty*

PROCESSIONAL . . The Convocation Brass Ensemble and Organ  
*James Rötter, M.M., Conductor*

INVOCATION . . . . . Robert F. Kaufmann, Ph.D.  
*Throop Memorial Church, Unitarian Universalist*

COMMENCEMENT ADDRESS . . . . .  
"Clarity of Thought and Higher Education"  
John H. Knowles, M.D.  
*President, The Rockefeller Foundation*

MUSICAL SELECTION The Caltech Glee Club (men's section)  
*Olaf M. Frodsham, A.M., Director*  
*The Heavens Declare the Glory of God, by William Billings*

CONFERRING OF DEGREES

Harold Brown, Ph.D., D.Eng., LL.D., Sc.D.  
*President, California Institute of Technology*

PRESENTATION OF CANDIDATES FOR DEGREES

For the Degree of Bachelor of Science . . . Ray D. Owen, Ph.D.  
*Dean of Students*

For the Degree of Master of Science . . . Stirling L. Huntley, Ph.D.  
*Associate Dean of Graduate Studies*

For the Degree of Engineer . . . . . Cornelius J. Pings, Ph.D.  
*Dean of Graduate Studies*

For the Degree of Doctor of Philosophy . . . . . Dean Pings

Biology . . . . . Robert L. Sinsheimer, Ph.D.  
*Division Chairman*

Chemistry and Chemical Engineering  
John D. Baldeschwieler, Ph.D.  
*Division Chairman*

Engineering and Applied Science . . . Robert H. Cannon, Jr., Sc.D.  
*Division Chairman*

Geological and Planetary Sciences . . . Barclay Kamb, Ph.D.  
*Division Chairman*

Physics, Mathematics and Astronomy  
Maarten Schmidt, Ph.D., Sc.D.  
*Division Chairman*

CONCLUDING REMARKS . . . . . President Brown

BENEDICTION . . . . . Dr. Kaufmann

RECESSIONAL . . . The Convocation Brass Ensemble and Organ

ORGAN POSTLUDE . . . . . Leslie Deutsch

# Academic Dress

The costume of those in the academic procession has a specific symbolism which dates back to at least the 14th century. While there have been many changes in the details, the meaning of the various parts of the costume continues to be the same. Academic institutions in the United States adopted a code of academic dress in 1895 which has been revised from time to time. The dress of institutions in other countries varies considerably, but the basic elements are present in all academic costumes.

**GOWNS.** The bachelor's gown has long, pointed sleeves; the master's gown has an oblong sleeve open at the wrists (or some older gowns may be open near the upper part of the arm); the doctor's gown is fuller than the others with velvet panels full length on the front and three velvet crossbars on each sleeve in black or in the color distinctive of the subject to which the owner's degree pertains. The gowns are always black except for the doctor's, which in a few instances is of a color representing the institution which conferred the degree.

**HOODS.** The hood, draped over the shoulders and down the back, indicates the subject to which the degree pertains and the university that conferred the degree. The level of the degree is indicated by the size of the hood. The hood for the bachelor's degree is three feet long; for the master's it is three-and-one-half feet long; and for the doctor's it is four feet long. The binding of the hood is of colored velvet designating the subject of the degree, and it is two inches, three inches, and five inches wide for the bachelor's, master's, and the doctor's degrees, respectively. The colors associated with some of the subjects are as follows:

Arts, Letters, Humanities, <i>White</i>	Pharmacy, <i>Olive Green</i>
Commerce, Accountancy, Business, <i>Drab</i>	Philosophy, <i>Dark Blue</i>
Economics, <i>Copper</i>	Public Administration, including Foreign Service, <i>Peacock Blue</i>
Education, <i>Light Blue</i>	Public Health, <i>Salmon Pink</i>
Engineering, <i>Orange</i>	Science, <i>Golden Yellow</i>
Fine Arts, including Architecture, <i>Brown</i>	Theology, <i>Scarlet</i>
Law, <i>Purple</i>	
Medicine, <i>Green</i>	

The lining of the hood is of the color or colors of the institution conferring the degree. When two colors are used, they are usually arranged in a single chevron. The lining of the doctor's hood is revealed more than in the master's, and much less is revealed in the bachelor's hood.

**CAPS.** In the United States, the black mortarboard is most commonly used. The tassel fastened to the center of the cap is normally worn in the left front quadrant of the cap and is black, although it may be of the color appropriate to the subject of the degree. The tassel for a doctor's cap may be of gold thread.

# Candidates for Degrees

## BACHELOR OF SCIENCE

- Jerard Alan Adams *Portland, Oregon* Engineering and Applied Science  
**Ole I Anderson** *Corvallis, Oregon* Independent Studies Program  
Richard M. Atwater *Spokane, Washington* Applied Mathematics  
**James Enslin Backus** *Cincinnati, Ohio* Mathematics  
John Bartlett Bacon *Toronto, Ontario* Engineering and Applied Science  
Richard William Baird *Spartanburg, South Carolina* Chemistry  
John Christopher Baker *Corcoran, California* Engineering and Applied Science  
Mark Harold Bandhauer *Whittier, California* Applied Physics  
**Randall Kieth Bartman** *Milwaukee, Wisconsin* Applied Physics  
John Franklin Belew Jr. *Fremont, California* Astronomy  
Russell Arundel Bell *Physics*  
**Rebecca Electra Berg** *Woodland Hills, California* Biology  
**Robert Eugene Betz** *Torrance, California* Mathematics  
James Edward Billingsley *Willoughby, Ohio* Astronomy  
**Todd Allan Boroson** *Stamford, Connecticut* Astronomy  
Craig Richard Broskow *Overland Park, Kansas* Engineering and Applied Science  
Timothy F. Brown *Cocoa, Florida* Astronomy  
James David Bruchie *Canyon Country, California* Chemical Engineering  
**Howard Gregory Bubb** *Newport Beach, California* Engineering and Applied Science  
**Gilbert Stevens Burrus Jr.** *Hatteras, North Carolina* Engineering and Applied Science  
Science  
**Charles Ray Byler** *Sobe, Okinawa* History  
Ronald Steven Carson *Wood Dale, Illinois* Applied Physics  
**Wesley Guy Chalfant** *Montclair, California* Engineering and Applied Science-  
Mathematics  
**Hsueh-Chia Chang** *Hsin-Chu, Taiwan* Chemical Engineering  
Peter Sen-Poon Chang *Hong Kong* Engineering and Applied Science  
**Khuan Hoong Chow** *Penang, Malaysia* Engineering and Applied Science  
Marc Christopher Cimolino *Carlsbad, California* Chemistry  
**Michael Christian Wohnsen Coln** *San Rafael, California* Chemistry-Engineering  
and Applied Science  
Jeanne Marie Courval *Cardiff-by-the-Sea, California* Biology  
**Robert William Cox** *Friday Harbor, Washington* Mathematics  
Edward Arthur Cuellar *Pico Rivera, California* Chemistry

*Students whose names appear in boldface type are being graduated with honor in accordance with a vote of the faculty.*

BACHELOR OF SCIENCE—Continued

- Henry Stuart David** *Eatontown, New Jersey* Economics  
**Leslie Joseph Deutsch** *Sherman Oaks, California* Mathematics  
**Deno Pete Dialynas** *Anaheim, California* Biology  
**Wayne Alan Dickenson** *Orange, California* Chemistry  
**Daniel Mark Dobkin** *Huntington Beach, California* Applied Physics  
**Marc Daniel Donner** *New York City, New York* Engineering and Applied Science  
**James Joseph Dudziak** *North Miami Beach, Florida* Mathematics  
**Douglas Whitney Early** *Spring Hill, Tennessee* Astronomy  
**David Charles Easter** *Joshua Tree, California* Chemistry  
**David J Ekpenyong** *Mbiafun, Nigeria* Chemical Engineering  
**K. Jeffrey Eriksen** *Kent, Washington* Biology-Engineering and Applied Science  
**Margaret Mary Evans** *South Pasadena, California* Chemistry  
**Stephen Douglas Flanagan** *Missoula, Montana* Engineering and Applied Science  
**Michael David Forgac** *Euclid, Ohio* Biology-Chemistry  
**Wolfgang Franzen** *Downey, California* Mathematics  
**James Masami Fujitaki** *Altadena, California* Chemistry-Biology  
**George Michael Fuller** *Granada Hills, California* Physics  
**Paul Howe Gailus** *Chicago, Illinois* Engineering and Applied Science  
**Paul R. Gazis** *Millwood, New York* Physics  
**Nikos Elias Georgopoulos** *Athens, Greece* Physics  
**Gregory Earl Gibbons** *Picture Butte, Alberta, Canada* Mathematics  
**James Lawrence Gimlett** *Pasadena, California* Applied Physics  
**Walter John Grams** *Inyokern, California* Mathematics  
**Russell Greiner** *Costa Mesa, California* Mathematics-Engineering and Applied Science  
**Lock-Fong Han** *Labuan, Sabah, Malaysia* Engineering and Applied Science  
**Lewis Kei Hashimoto** *Pasadena, California* Engineering and Applied Science  
**Timothy John Herbst** *Phoenix, Arizona* Biology  
**Margaret Ann Higley** *Omaha, Nebraska* Biology  
**Robert Hawley Higley** *Wayland, Massachusetts* Applied Physics  
**Thomas Michael Himel** *Covina, California* Physics  
**Pauline Ho** *Sunnyvale, California* Chemistry  
**Benjamin Ralph Hoffmann** *Eden Prairie, Minnesota* Applied Physics  
**James Takfay Hong** *Los Angeles, California* Mathematics-Economics  
**John Leonard Horn Jr.** *Palmdale, California* Chemical Engineering  
**Laura Louise Horner** *Pomona, California* Mathematics  
**Andrew Bin Huang** *Altadena, California* Physics  
**Hugo Eng Huey** *Bronx, New York* Physics  
**Kiturah Humphrey** *Downey, California* Biology  
**Deanna Lynne Hunt** *Compton, California* Chemistry  
**Andrew John Jankevics** *Chicago Heights, Illinois* Astronomy

BACHELOR OF SCIENCE—Continued

- Mary Louise Johnson** *Concord, California* Geochemistry  
**Melvin Owen Jones** *Pasadena, California* Chemistry  
**Felipe Miguel Joos Gieschen** *Montevideo, Uruguay* Engineering and Applied Science  
**James Easby Kaye** *Riverside, California* Engineering and Applied Science  
**Jonathan G. Kaye** *New York City, New York* Biology  
**Stephen Alan Klein** *North Hollywood, California* Engineering and Applied Science  
**Cynthia Joyce Kojima** *Riverside, California* Chemistry  
**Robert Gabor Korody** *Rolling Hills, California* Engineering and Applied Science  
**Michael Robert Kozlowski** *Chico, California* Biology  
**Peter Wai Shek Kwok** *Honolulu, Hawaii* Engineering and Applied Science  
**Craig Stephen Lage** *Downers Grove, Illinois* Physics  
**Cary Lai** *Canoga Park, California* Biology  
**Gerald Ronald Laib** *Columbus, New Jersey* Chemistry  
**Mark Stuart Lamkin** *Framingham, Massachusetts* Chemistry  
**Daniel Bernard Lang** *Minneapolis, Minnesota* Applied Physics  
**Lang Li Lao** *Danang, Vietnam* Engineering and Applied Science  
**Richard Scott Larson** *San Diego, California* Chemical Engineering  
**Thomas James Lawler** *Linden, New Jersey* Chemical Engineering  
**Clifford Leong** *Oakland, California* Engineering and Applied Science  
**Franklin Mark Liang** *Northridge, California* Mathematics  
**Richard Gary Lizambri** *New Castle, Pennsylvania* Biology  
**Claus Dieter Makowka** *San Jose, California* Physics  
**Dennis Mallonee** *Long Beach, California* Economics  
**Paul Barton Manis** *Terra Bella, California* Biology  
**Karen Elizabeth Maples** *Berkeley, California* Biology  
**Charles Lee McKnett** *Los Angeles, California* Physics  
**Elizabeth Carol McLeod** *Pasadena, California* Biology  
**John Charles Middlebrooks** *Long Beach, California* Biology  
**David Howard Miller** *St. Louis, Missouri* Physics  
**Arthur Dearth Moore III** *Salinas, California* Engineering and Applied Science  
**Steven C. Moritsugu** *Brentwood, Missouri* Engineering and Applied Science  
**May-Chu Patricia Mu** *Hong Kong* Chemistry  
**Carl Eric Mueller** *Los Altos, California* Mathematics  
**David Herbert Munro** *Orinda, California* Physics  
**David Phillip Murdock** *Pico Rivera, California* Chemistry  
**Philip Alan Naecker** *Houston, Texas* Engineering and Applied Science  
**Keith Douglas Neerman** *New York City, New York* Engineering and Applied Science  
**David A. Neff** *San Clemente, California* Engineering and Applied Science  
**Norman Charles Nelson** *Granada Hills, California* Chemistry  
**Chiu-Yuen Jacob Ng** *Kowloon, Hong Kong* Engineering and Applied Science

BACHELOR OF SCIENCE—Continued

- Walter Dulany Niles II *Warrenton, Missouri* Biology  
**Daniel Davy O'Dowd** *Rochester, Michigan* Engineering and Applied Science  
**Tullis Cullen Onstott** *Las Vegas, Nevada* Geophysics  
Edward John O'Rourke *Midwest City, Oklahoma* Applied Physics  
**William Mann Owen, Jr.** *Winter Park, Florida* Astronomy  
Randal Bradley Page *Miamisburg, Ohio* Applied Mathematics  
Douglas Petrie *Estacada, Oregon* Engineering and Applied Science  
Robert Stanley Pfeiffer *Groton, Connecticut* Chemistry  
**Harvey Monroe Phillips** *Maryville, Tennessee* Applied Physics  
**Hallie Ann Poore** *Bakersfield, California* Literature  
William David Post *Woodland Hills, California* Mathematics  
**Thomas Theo Pressburger** *North Hollywood, California* Mathematics  
Channon Pharr Price II *Dolton, Illinois* Physics  
Lewis Stephen Proudfoot *St. Petersburg, Florida* Engineering and Applied Science  
Michael Elmer Purucker *West Bend, Wisconsin* Geophysics  
Richard Louis Rairden *Palo Alto, California* Physics  
Donald Andy Rasmussen *Cheyenne, Wyoming* Biology  
**Shelley Elizabeth Rayhawk** *Coos Bay, Oregon* Engineering and Applied Science  
**Jai-Hyon Rho** *Pasadena, California* Biology  
Douglas W. Ridder *Torrance, California* Engineering and Applied Science  
**Jodi Nancy Jo Riedinger** *La Jolla, California* Chemical Engineering  
**Stephen Reitan Roe** *Bellingham, Washington* Mathematics  
**James Arthur Roth** *Deerfield, Illinois* Engineering and Applied Science  
**Mark Geoffrey Rowan** *Alta, Utah* Biology  
**James Allely Rowson** *Glendale, California* Engineering and Applied Science  
Dayna Jean Salter *San Rafael, California* Geophysics  
**Jeffrey Ducloux Sanders** *Boise, Idaho* Mathematics  
Alan Bruce Saul *Pittsburgh, Pennsylvania* Mathematics  
Clyde L. Scandrett *Salinas, California* Mathematics  
LouAnn Rosa Schemmel *Wichita, Kansas* Economics  
**JeanClare Seagrave** *Los Alamos, New Mexico* Biology  
**Subhash Sharma** *New Delhi, India* Engineering and Applied Science  
**James Bergheim Shearer** *Livermore, California* Mathematics-Applied Mathematics  
Hubert Hsueh-Han Shen *Westfield, New Jersey* Physics  
**Alan Jeffrey Shusterman** *North Hollywood, California* Chemistry  
**Cheukwai Siu** *Hong Kong* Chemistry  
Don Jeffrey Slankard *Albuquerque, New Mexico* Biology  
Brian James Smith *San Pedro, California* Mathematics  
**Shelley Lynn Smith** *Northridge, California* Biology  
**Karl David Stephan** *Fort Worth, Texas* Engineering and Applied Science  
Matthew Stillerman *Pasadena, California* Physics  
**Thomas Bradley Stoughton** *Peoria, Illinois* Physics

BACHELOR OF SCIENCE—Continued

Richard Anthony Suchter *Milwaukee, Wisconsin* Engineering and Applied Science  
**Ellen Sung** *Huntington Beach, California* Biology  
**Patrick Mark Sutton** *Pasadena, California* Chemistry  
Steven Michael Sweeney *Columbus, Ohio* Astronomy  
**Brent Nevin Sweitzer** *Pasadena, California* Chemistry  
**Robert Wesley Tajima** *Altadena, California* Biology  
**Steve Thomas Tappel** *Davis, California* Mathematics  
**Jonathan Marc Teich** *Edison, New Jersey* Chemistry  
**Martin Teintze** *Princeton, New Jersey* Chemistry  
Kim Cheryl Thomas *Carmichael, California* Biology  
**Siri Tia** *Bangkok* Chemical Engineering  
**Tom Trinko** *La Grange, Illinois* Physics  
Paul Allen Wagner *Cincinnati, Ohio* Physics  
Gary Ryo Wakai *San Mateo, California* Mathematics  
Steven Kemp Wake *Compton, California* Biology  
**Joseph Scott Walder** *Wrightwood, California* Geophysics  
Dennis Wang *Montague, Massachusetts* Astronomy  
Gerald Allen Wedekind *Palos Verdes, California* Applied Mathematics  
Jack Gwin Welch *Stockton, California* Chemistry  
**Francine Ellen Wetter** *San Diego, California* Biology  
Lawrence Alan Wise *Mountain View, California* Engineering and Applied Science  
**Johnson Tai Wong** *San Francisco, California* Chemistry  
**Laurence Gregory Yaffe** *Los Altos, California* Chemistry  
**Michael Wai Ki Yung** *Hong Kong* Engineering and Applied Science  
Howard Allan Zebker *Ventura, California* Engineering and Applied Science  
**Fredrick John Zeigler** *Chesterton, Indiana* Applied Mathematics

## MASTER OF SCIENCE

- Iraj Aalam (*Aeronautics*) B.S., Illinois Institute of Technology 1975.
- Rohan Chandra Abeyaratne (*Applied Mechanics*) B.Sc., University of Ceylon 1975.
- Richard Lee Anderton (*Environmental Engineering Science*) B.S., University of Utah 1975.
- Peter Douglas Andriola (*Electrical Engineering*) B.S., California Institute of Technology 1975.
- Ahmet Vecdet Arslan (*Applied Mechanics*) B.S., Middle East Technical University 1974.
- Denis William Aull (*Electrical Engineering*) B.S., Purdue University 1974.
- James Enslin Backus (*Mathematics*) B.S., California Institute of Technology 1976.
- Samir Elias Barudi (*Chemical Engineering*) Iraqi Baccl., Baghdad College 1970; B.E., American University of Beirut 1975.
- Osgood Massee Bateman, Jr. (*Biology*) B.S., University of Georgia 1974.
- David Peter Graydon Beatty (*Mechanical Engineering*) B.S., California Institute of Technology 1975.
- Gary Bedrosian (*Physics*) B.S., Rensselaer Polytechnic Institute 1973.
- Gerhard Werner Befeld (*Economics*) B.S., California Institute of Technology 1975.
- Alaudin Mohamedali Bhanji (*Electrical Engineering*) B.S., California Institute of Technology 1975.
- Ronald Lee Boatright (*Applied Physics*) B.S., United States Air Force Academy 1966.
- David Nicholson Bogue (*Mechanical Engineering*) B.S., Washington State University 1975.
- Rhett Butler (*Geophysics*) S.B., Massachusetts Institute of Technology 1974.
- Ying-Chee Chung (*Chemical Engineering*) B.S., California Institute of Technology 1974.
- Martin Cohen (*Civil Engineering*) B.A., B.S., University of Notre Dame 1975.
- Michael Lee Cooper (*Biology*) B.S., Duke University 1974.
- James Emmett Curry (*Applied Mathematics*) B.A., Carroll College 1974.
- Cedric Schinzing Daksla (*Mechanical Engineering*) B.S., Mindanao State University 1974.
- Wolfgang Friedrich Johann Deeg (*Materials Science*) B.A., B.S.E., University of Connecticut 1975.
- John Hook Dilles (*Geology*) B.S., California Institute of Technology 1975.
- Daniel Paul Dolata (*Chemistry*) B.A., University of Oregon 1973.
- John Patrick Dwyer (*Chemistry*) B.A., DePauw University 1973.
- Michel Edmont (*Civil Engineering*) Diplôme d'Ingénieur, École Centrale des Arts et Manufactures 1975.
- David Eskinazi (*Environmental Engineering Science*) B.S., University of Southern California 1975.
- Tom Farr (*Geology*) B.S., California Institute of Technology 1974.

MASTER OF SCIENCE—Continued

- Richard Alan Flammang (*Physics*) B.S., California Institute of Technology 1968; A.M., Harvard University 1971.
- William Andrew Freeman (*Electrical Engineering*) B.S., Tennessee Technological University 1975.
- Thomas Anthony Gerard (*Civil Engineering*) B.S., United States Military Academy 1970.
- Jean François Haas (*Aeronautics*) B.S., Lycée Kléber (Strasbourg) 1970; Diplôme d'Ingénieur, École Nationale d'Ingénieurs de Constructions Aéronautiques 1975.
- Shawn Anthony Hall (*Mechanical Engineering*) B.S.E., Princeton University 1975.
- Mohammad Amin Hamzavi-Abedi (*Aeronautics*) B.S., Pahlavi University 1975.
- Medhat Ahmed El-Sayed Haroun (*Civil Engineering*) B.Sc., Cairo University 1973.
- Robert Stuart Hart (*Geophysics*) S.B., Massachusetts Institute of Technology 1972.
- Mark Allen Hedemann (*Applied Physics*) B.S., Michigan State University 1974.
- Morris M. Hervey, Jr. (*Electrical Engineering*) A.S., Long Beach City College 1972; B.S., California State University, Long Beach 1975.
- Jan Leslie Hillson (*Environmental Engineering Science*) B.S., Michigan State University 1973.
- Russell Roy Jensen (*Applied Physics*) B.S., Columbia University 1975.
- Nicholas Alexandrou Kaffes (*Chemical Engineering*) A.A., Bronx Community College 1972; B.E., City College of New York 1975.
- Ilias George Kastanas (*Mathematics*) Diploma, National Technical University of Athens 1975.
- Barbara Frances Keenan (*Biology*) B.A., Wells College 1974.
- Louise Kirkbride (*Electrical Engineering*) B.S., California Institute of Technology 1975.
- Yannis Kouvoopoulos (*Civil Engineering*) Diploma, National Technical University of Athens 1975.
- Steven Philip Krekeler (*Electrical Engineering*) B.S., California Polytechnic State University 1974.
- Charles Morton Krousgrill, Jr. (*Applied Mechanics*) B.S.M.E., Purdue University 1975.
- James Shigeru Kuwabara (*Environmental Engineering Science*) B.S., University of Hawaii 1975.
- Stelios Kyriakides (*Aeronautics*) B.Sc., University of Bristol 1975.
- Mark Stuart Lamkin (*Chemistry*) B.S., California Institute of Technology 1976.
- Lang Li Lao (*Mechanical Engineering*) B.S., California Institute of Technology 1976.
- Vincent Wo-Sang Lee (*Applied Mechanics*) B.S., California Institute of Technology 1973; M.S., 1974.
- Thierry Lepelletier (*Civil Engineering*) Diplôme d'Ingénieur, École Nationale Supérieure d'Électrotechnique d'Électronique d'Informatique et d'Hydraulique 1975.

MASTER OF SCIENCE—Continued

- Franklin Mark Liang (*Mathematics*) B.S., California Institute of Technology 1976.  
Anastasia Chopelas Lumsden (*Geochemistry*) B.S., University of California, Los Angeles 1974.  
Uy-Loi Ly (*Applied Mechanics*) B.S., University of California, Davis 1975.  
Anne Marie Lyne (*Planetary Science*) B.S., M.S., Polytechnic Institute of Brooklyn 1972.  
Stephen Aplin Lyon (*Applied Physics*) B.S., Cornell University 1974.  
Carol Elizabeth Lyons (*Chemical Engineering*) C.E.P.F., Université de Lyon 1970; D.U.E.S., Université des Sciences et Techniques du Languedoc 1973.  
Daniel Joseph McCormick (*Chemical Engineering*) B.S., Clarkson College 1975.  
Donald Lee Miller (*Chemistry*) B.S., California Institute of Technology 1974.  
George Michael Morris (*Electrical Engineering*) B.S., University of Oklahoma 1975.  
Richard Harrison Moyer (*Applied Physics*) B.S., Purdue University 1975.  
Tanh Van Nguyen (*Mechanical Engineering*) B.S., Iowa State University 1975.  
James B. Orlin (*Mathematics*) A.B., University of Pennsylvania 1974.  
Thomas Edward Orłowski (*Chemistry*) B.S., Rochester Institute of Technology 1973.  
Dominic Ping-Yim Orr (*Physics*) B.S., City College of New York 1973.  
Harry Lawrence Parker, II (*Electrical Engineering*) A.B., Hamilton College 1974.  
Rudolph Michael Pecoraro (*Mechanical Engineering*) B.S., Polytechnic Institute of Brooklyn 1975.  
Jack Peter (*Mechanical Engineering*) B.S., Columbia University 1974.  
Glen George Pfeiderer (*Mechanical Engineering*) B.S., Polytechnic Institute of Brooklyn 1975.  
Anton Emil Pietsch (*Chemistry*) B.S., California Institute of Technology 1975.  
Lloyd Emerson Powell (*Electrical Engineering*) B.S., George Washington University 1975.  
David Eugene Presti (*Physics*) B.S., Butler University 1974.  
Dale Austen Prouty (*Applied Physics*) B.S., University of Missouri 1974.  
Charles Lee Ramiller (*Electrical Engineering*) B.E., Vanderbilt University 1974.  
Robert Henry Reiner (*Chemistry*) B.A., DePauw University 1970.  
Loman Rensink (*Electrical Engineering*) B.S., California State University, Northridge 1974.  
Yvon Resplandy (*Mechanical Engineering*) D.U.E.S., Université de Nice 1972; Diplôme d'Ingénieur, École Nationale d'Ingénieur de Constructions Aéronautiques 1975.  
Fredrick Allan Roberts (*Aeronautics*) B.S., Illinois Institute of Technology 1975.  
David Cele Rosenblum (*Mechanical Engineering*) B.S., United States Military Academy 1970.  
Michael Elmer Purucker (*Planetary Science*) B.S., California Institute of Technology 1976.

## MASTER OF SCIENCE—Continued

- Thomas Davidson Russell (*Mechanical Engineering*) B.S., Pennsylvania State University 1975.
- Edward Kenneth Ruth (*Aeronautics*) B.S., Ohio State University 1975.
- Mohamed Abdel Moniem Sayed (*Civil Engineering*) B.Sc., Cairo University 1973.
- Subhash Sharma (*Engineering Science*) B.S., California Institute of Technology 1976.
- Jeffrey Brian Shellan (*Applied Physics*) B.S., California Institute of Technology 1975.
- Tad Decatur Simons (*Mechanical Engineering*) B.S., Stanford University 1975.
- Windsor Sung (*Environmental Engineering Science*) S.B., Massachusetts Institute of Technology 1975.
- Stephen Bart Sunshine (*Applied Mathematics*) B.A., Temple University 1973.
- Ernst Norman Tangren (*Aeronautics*) B.S., University of Washington 1975.
- Glenn Ellwood Thomas (*Chemical Engineering*) B.A., Amherst College 1974.
- John Mei-Ming Ting (*Civil Engineering*) B.Eng., McGill University 1975.
- Aharon P. Vinkler (*Aeronautics*) B.Sc., Technion—Israel Institute of Technology 1975.
- Michael Vernon Warlick (*Electrical Engineering*) S.B., Massachusetts Institute of Technology 1974.
- Chak Lang Won (*Electrical Engineering*) B.S., The Cooper Union 1974.
- James Robert Young (*Environmental Engineering Science*) B.A., St. Mary's College 1973.
- Mark Zimmermann (*Physics*) B.A., Rice University 1974.
- John Lehrer Zyskind (*Physics*) A.B., University of Chicago 1973.

## ENGINEER

- Ignatius Po-Cheung Lam (*Civil Engineer*) B.S., Ohio State University 1973;  
M.S., California Institute of Technology 1974.

## DOCTOR OF PHILOSOPHY

### DIVISION OF BIOLOGY

Wesley Monroe Brown (*Biophysics and Chemistry*) B.A., University of Colorado 1963; M.A., 1967.

*Thesis*: Animal Mitochondrial DNA. I. Interspecific Comparisons. II. The Fidelity of Replication of Mitochondrial DNA Fragments Grown as Recombinant Plasmids in *Escherichia coli*.

John William Cross Jr. (*Cell Biology and Genetics*) B.A., Vanderbilt University 1969.

*Thesis*: Protein Synthesis in *Chlamydomonas reinhardtii*: 1. Characterization of Temperature-Sensitive Mutants in Protein Synthesis. 2. Action of the Drug, Chloral Hydrate.

James William Deutsch (*Biochemistry*) A.B., Columbia College 1970.

*Thesis*: Biochemical Studies of Acetylcholine Receptors from Electric Fish.

John Robinson Duguid (*Biochemistry*) B.S., University of Illinois 1971.

*Thesis*: Specialized Membrane Fragments from the Electric Organs of *Torpedo californica* and *Electrophorus electricus* and Investigations into the Structure of the Murine Hepatocyte Gap Junction.

Glenn Allan Galau (*Developmental Biology*) B.A., Lawrence University 1971.

*Thesis*: Sequence Complexity and Synthesis of Sea Urchin Embryo Messenger RNA.

Joel M. Gottesfeld (*Biochemistry*) A.B., University of California, Berkeley 1971; M.Sc., Merton College, University of Oxford 1973.

*Thesis*: Chromatin Structure and Gene Expression.

William Anthony Harris (*Neurobiology and Literature*) A.B., University of California, Berkeley 1972.

*Thesis*: Color Vision in *Drosophila*.

Mark James Miller (*Biochemistry*) B.A., University of Colorado 1969.

*Thesis*: Investigations of the Mechanism of Cell Killing Induced by Actinomycin D.

Barry Samuel Rothman (*Biochemistry and Neurophysiology*) B.A., Haverford College 1969.

*Thesis*: Electrophysiological and Biochemical Studies on the Effects of RNA and Protein Synthesis Inhibitors on the Circadian Rhythm of the Isolated *Aplysia* Eye.

### DIVISION OF CHEMISTRY AND CHEMICAL ENGINEERING

Mark Andrew Allen (*Chemistry*) B.A., Columbia University 1971.

*Thesis*: Interstellar Space—The Astrochemist's Laboratory.

DOCTOR OF PHILOSOPHY—Continued

- Ricardo Bloch (*Chemical Engineering*) B.S., Rose Hulman Institute of Technology 1968; M.S., California Institute of Technology 1969.  
*Thesis*: Viscoelastic Behavior of Filled and Unfilled Elastomers in Moderately Large Deformations.
- Wenji V. Chang (*Chemical Engineering and Chemistry*) B.S., National Taiwan University 1966; M.S., 1968.  
*Thesis*: Theoretical and Experimental Studies of the Viscoelastic Behavior of Soft Polymers.
- Kevin Gerard Donohoe (*Chemical Engineering and Philosophy*) B.S., Newark College of Engineering 1969; M.S., California Institute of Technology 1970.  
*Thesis*: The Development and Characterization of an Atmospheric Pressure Non-equilibrium Plasma Chemical Reactor.
- Harry Osborn Finklea (*Chemistry*) B.S., Duke University 1970.  
*Thesis*: Mechanisms of Photocurrent Generation at Metal and Semiconductor Electrodes.
- Wayne Michael Flicker (*Chemistry*) B.A., Harvard College 1968.  
*Thesis*: Electronic Spectroscopy of  $\pi$ -Bonded Polyatomic Molecules by Electron Impact.
- Claude Clinton Frazier, III (*Chemistry*) B.S., Memphis State University 1970; M.S., Oregon Graduate Center 1972.  
*Thesis*: An Investigation of the Photochemical and Excited State Properties of the Solid State and of Liquid-Solid Interfaces.
- Jeffrey Wayne Hare (*Chemistry*) B.S., Arizona State University 1969.  
*Thesis*: Ligand Field Aspects of Biochemical and Geochemical Systems: The Electronic Structure of the Single Blue Copper Proteins and Iron Group Olivines.
- Shaw-Fen Sylvia Hu (*Chemistry and Biology*) B.S., National Taiwan University 1967.  
*Thesis*: I. Electron Microscope Heteroduplex Studies of the Sequence Organization in Several F-Primes. II. Mapping and Genetic Analysis of Insertion Sequence in Bacterial Plasmids. III. Structural Studies on the RNA Genomes of Type C. Oncornaviruses. IV. Heteroduplex Studies of the Sequence Relations of Several Type C RNA Tumor Viruses.
- Richard R. Jones (*Chemistry*) B.S., University of Tennessee 1969.  
*Thesis*: Progress Toward the Synthesis and Characterization of 1,4-Dehydroaromatic Systems: I. 1,4-Dehydrobenzene (para-Benzene or Butalene); II. 1,4-Dehydrotropyl Cation; Anion and the Bicyclo[3.2.0]heptatrien-3-one.
- Roger Erdman Koeppel II (*Chemistry and Biochemistry*) A.B., Haverford College 1971.  
*Thesis*: Catalysis by Trypsin.

DOCTOR OF PHILOSOPHY—*Continued*

- Monty Krieger (*Chemistry*) B.S., Tulane University 1971.  
*Thesis*: Serine Proteases: Structure, Mechanism and Role in Eucaryotic Cell Transformation.
- James Hsing-Jien Kung (*Chemistry*) B.S., National Taiwan University 1969.  
*Thesis*: Structure of RNA Tumor Virus Genome.
- Arthur Lai Yin Lau (*Chemistry*) B.S., University of Hawaii 1971.  
*Thesis*: An Investigation on the Interactions of Alamethicin with Lecithin Bilayers.
- James Vincent McArdle (*Chemistry*) B.S., Brown University 1972.  
*Thesis*: Kinetic Studies of the Oxidation of Horse Heart Cytochrome *c*(II), *Pseudomonas aeruginosa* Cytochrome *c*<sub>551</sub>(II), and *Pseudomonas aeruginosa* Azurine(I) by Tris Complexes of 1,10-Phenanthroline and Modified 1,10-Phenanthroline with Cobalt(III).
- Clyde William McCurdy, Jr. (*Chemistry*) B.S., Tulane University 1971.  
*Thesis*: The Application of Basis Set Methods and Many-Body Theory in Electron-Molecule Scattering.
- J. Wayne Miller (*Chemical Engineering*) B.S., Worcester Polytechnic Institute 1967.  
*Thesis*: I. A Study of the Effects of Dislocations in Silver on the Rate of Oxidation of Carbon Monoxide. II. A Mechanism for the Formation of Dislocations during the Oxidation of Zinc.
- Donald Mills Mintz (*Chemistry*) B.S., Yale University 1970.  
*Thesis*: Variable Angle Photoelectron Spectroscopy.
- George Chappell Schatz (*Chemistry*) B.S., Clarkson College 1971.  
*Thesis*: The Quantum Dynamics of Atom Plus Diatom Chemical Reactions.
- Winston Rei-Yun Shu (*Chemical Engineering and Environmental Engineering Science*) B.S., National Taiwan University 1967; M.S., University of Rochester 1971.  
*Thesis*: Turbulent Chemical Reactions: Application to Atmospheric Chemistry.
- Ralph Horton Staley (*Chemistry*) A.B., Dartmouth College 1967.  
*Thesis*: Studies of Acid-Base Ion-Molecule Chemistry Using Ion Cyclotron Resonance Techniques and Photoelectron Spectroscopy.
- Chaim N. Sukenik (*Chemistry*) B.A., Yeshiva University 1972.  
*Thesis*: Catalysis of Organic Reactions. I: Enhancement of a Solid State Reaction by Proper Orientation Within a Crystal. II: Micellar Effects on the Stereochemistry and Rate of Aqueous Solvolysis Reactions.
- Grover Timothy Surratt (*Chemistry*) B.S., University of Delaware 1968; M.S., California Institute of Technology 1971.  
*Thesis*: A Generalized Valence Bond Description of Vacancy and Impurity States in Diamond and Silicon.

DOCTOR OF PHILOSOPHY—Continued

Sorab Rustom Vatcha (*Chemical Engineering*) B.Tech., Indian Institute of Technology 1969.

*Thesis:* Analysis and Design of Methanation Processes in the Production of Substitute Natural Gas from Coal.

David Mark Walba (*Chemistry*) B.S., University of California, Berkeley 1971.

*Thesis:* The Total Synthesis of ( $\pm$ )-Friedelin.

David Allan Weisblat (*Chemistry and Neurophysiology*) B.A., Harvard College 1971.

*Thesis:* Electrophysiology of the Somatic Muscles in the Nematode *Ascaris lumbricoides*.

Larry Allan Wendling (*Chemistry*) B.S., Knox College 1970.

*Thesis:* I. The Synthesis, Absolute Configuration, and Stereochemistry of Thermal Decomposition of (+)-3R,5R- and (+)-3R,5S-3-Ethyl-5-methyl-1-pyrazoline. II. Mechanistic Investigations of the Thermal Decompositions of 2H-Azirines.

Alvin Keith Willard (*Chemistry*) B.S., University of Southern California 1971.

*Thesis:* The Ester Enolate Claisen Rearrangement: I. Stereochemical Control Through Stereoselective Enolate Formation; II. Construction of the Prostanoid Skeleton.

Ashley Deas Williamson (*Chemistry*) B.S., Emory University 1968; M.S., California Institute of Technology 1969.

*Thesis:* Investigation of Kinetics and Thermochemistry of Ion-Molecule Reactions Using Photoionization Mass Spectrometry.

John S. Winterle (*Chemistry*) B.S., Florida State University 1969.

*Thesis:* Excitation Transfer in Organic and Inorganic Systems.

DIVISION OF ENGINEERING AND APPLIED SCIENCE

Ahmed Mansour Abdel-Ghaffar (*Civil Engineering*) B.Sc., Cairo Faculty of Engineering 1970; M.S., California Institute of Technology 1973.

*Thesis:* Dynamic Analyses of Suspension Bridge Structures and Some Related Topics.

Kwasi Kete Bofah (*Aeronautics*) B.S., Purdue University 1969; M.S., California Institute of Technology 1970.

*Thesis:* A Study of the Trailing Vortices Behind a Ring Wing.

Mark Stephen Bohn (*Mechanical Engineering*) B.M.E., Georgia Institute of Technology 1972; M.S., California Institute of Technology 1973.

*Thesis:* Noise Produced by the Interaction of Acoustic Waves and Entropy Waves with High Speed Nozzle Flows.

DOCTOR OF PHILOSOPHY—*Continued*

- Brian Joseph Cantwell (*Aeronautics*) B.A., University of Notre Dame 1967; B.S., 1968; M.S., California Institute of Technology 1971.  
*Thesis*: A Flying Hot Wire Study of the Turbulent Near Wake of a Circular Cylinder at a Reynolds Number of 140,000.
- Raymond Yuen-Fong Chan (*Engineering Science and Neurophysiology*) B.S.A.E., B.S.M.E., California State Polytechnic College 1971; M.S., California Institute of Technology 1972.  
*Thesis*: Spatial Dynamics of Vertebrate Retinal Neurons.
- Edmund Kai-lien Cheng (*Electrical Engineering and Engineering Science*) B.S.E.E., Ohio University 1972; M.S., California Institute of Technology 1973.  
*Thesis*: I. A Single-Chip Cursive Character Generator. II. A Two's Complement Pipeline Multiplier.
- Raymond Robert Cosner (*Aeronautics and Applied Mathematics*) B.S., M.S., Purdue University 1972.  
*Thesis*: Experiments on Thin Airfoils Spanning a Transonic Shear Flow.
- Joseph Stirling Deviny (*Environmental Engineering Science*) B.S., California Institute of Technology 1969; M.S., University of Oregon 1971.  
*Thesis*: The Effects of Thermal Outfalls on Benthic Marine Algae.
- William Karl Faisst (*Environmental Engineering Science and History*) B.S., University of California, Davis 1971; M.S., California Institute of Technology 1972.  
*Thesis*: Digested Sludge: Delineation and Modeling for Ocean Disposal.
- Samuel Robert Maurice Gardiner (*Mechanical Engineering*) B.A.Sc., University of British Columbia 1971; M.S., California Institute of Technology 1972.  
*Thesis*: Heat Transfer in an Annular Gap.
- Avraham Gover (*Applied Physics and Electrical Engineering*) B.S., Tel Aviv University 1968; B.S., 1971.  
*Thesis*: Wave Interactions in Periodic Structures and Periodic Dielectric Waveguides.
- Robert Bruce Hammond (*Applied Physics*) B.S., California Institute of Technology 1971; M.S., 1972.  
*Thesis*: Some Luminescence Properties of Excited Silicon at Low Temperature.
- Joe M. Harris Jr. (*Applied Physics*) B.S., Lamar State College of Technology 1970; M.S., California Institute of Technology 1972.  
*Thesis*: I. Energy Stragglers of  $^4\text{He}$  below 2.0 MeV in Al, Ni, Au, and Pt. II. Studies of the Ti-W Metallization System on Si.
- Alfred C. Hartmann (*Engineering Science*) B.S., Carnegie-Mellon University 1969; M.S., California Institute of Technology 1971.  
*Thesis*: A Concurrent Pascal Compiler for Minicomputers.

DOCTOR OF PHILOSOPHY—*Continued*

Steven Ludvic Heisler (*Environmental Engineering Science*) B.S., California Institute of Technology 1970; M.S., 1971.

*Thesis:* Gas-to-Particle Conversion in Photochemical Smog: Growth Laws and Mechanisms for Organics.

George Anthony Jackson (*Environmental Engineering Science and Biology*) B.S., California Institute of Technology 1969; M.S., 1970.

*Thesis:* Nutrients and Productivity of the Giant Kelp, *Macrocystis pyrifera*, in the Nearshore.

Arthur R. Jensen (*Environmental Engineering Science*) B.S., University of California, Berkeley 1970; M.S., California Institute of Technology 1971.

*Thesis:* Computer Simulation of Surface Water Hydrology and Salinity with an Application to Studies of Colorado River Management.

Kei-Fung Lau (*Applied Physics*) B.S., Stetson University 1971; M.S., California Institute of Technology 1972.

*Thesis:* Pulse NMR in Solids: Chemical Shift, Lead Fluoride and Thorium Hydride.

Vasilis Zissis Marmarelis (*Engineering Science and Economics*) Diploma, National Technical University of Athens 1972; M.S., California Institute of Technology 1973.

*Thesis:* Identification of Nonlinear Systems through Quasi-White Test Signals.

Donald W. Miklovic (*Applied Mathematics*) B.S.A.E., University of Cincinnati 1970.

*Thesis:* Topics in Linear and Nonlinear Dispersive Waves.

Richard Keith Miller (*Applied Mechanics*) B.S., University of California, Davis 1971; S.M., Massachusetts Institute of Technology 1972.

*Thesis:* The Steady-State Response of Multidegree-of-Freedom Systems with a Spatially Localized Nonlinearity.

Antonmaria Minzoni Alessio (*Applied Mathematics*) B.S., Universidad Nacional de México 1971.

*Thesis:* Some Problems of Edge Waves and Standing Waves on Beaches.

Adrian Leigh Moyls (*Mechanical Engineering*) B.A.Sc., University of British Columbia 1970; M.S., California Institute of Technology 1971.

*Thesis:* Friction and Heat Transfer Reduction in Turbulent Flow of Dilute Asbestos Fiber Suspensions in Smooth and Rough Tubes.

Ehud Naheer (*Civil Engineering*) B.Sc., Israel Institute of Technology 1968; M.Sc., 1970.

*Thesis:* Stability of Bottom Armoring Under the Attack of Solitary Waves.

Sheung-Lip Ng (*Mechanical Engineering*) B.Sc., Imperial College 1968; M.S., California Institute of Technology 1969.

*Thesis:* The Dynamic Response of Cavitating Turbomachines.

DOCTOR OF PHILOSOPHY—*Continued*

- Dennis John Packard (*Electrical Engineering*) B.S.E.E., University of Michigan 1971; M.S.E.E., 1972.  
*Thesis:* Discrete Modeling and Analysis of Switching Regulators.
- James Charles Pearce (*Mechanical Engineering*) B.S., California State Polytechnic College 1971; M.S., California Institute of Technology 1972.  
*Thesis:* Mechanics of Flowing Granular Media.
- O. Glenn Ramer (*Applied Physics*) B.S.E.E., University of Oklahoma 1968; M.S.E.E., 1969.  
*Thesis:* Surface Effects on Spinwave Resonance in Thin Magnetic Films.
- Michael Joe Shantz (*Engineering Science*) B.A., Goshen College 1966; M.S., Drexel University 1971.  
*Thesis:* Description and Classification of Neuronal Structure in the Frog Retina.
- John Richard Shea, III (*Aeronautics*) B.S.E., M.S.E., Princeton University 1971.  
*Thesis:* A Chemical Reaction in a Turbulent Jet.
- Yoshitaka Suezawa (*Electrical Engineering*) B.Eng., Yokohama National University 1967; M.Eng., 1969.  
*Thesis:* Damped Free Oscillation of Magnetization in Ni-Fe Thin Films.
- Gregory Ligot Tangonan (*Applied Physics and Chemistry*) B.S., Ateneo De Manila University 1969; M.S., California State College, Long Beach 1971; M.S., California Institute of Technology 1972.  
*Thesis:* The Electrical and Magnetic Properties of Amorphous Pd-Cu-P Alloys.
- Jasenka Vuceta (*Environmental Engineering Science*) B.S., University of Zagreb 1968; M.S., California Institute of Technology 1971.  
*Thesis:* Adsorption of Pb(II) and Cu(II) on  $\alpha$ -quartz from Aqueous Solutions: Influence of pH, Ionic Strength, and Complexing Ligands.
- Fang-chou Yang (*Electrical Engineering*) B.S., National Taiwan University 1969; M.S., California Institute of Technology 1971.  
*Thesis:* An Analysis of Linear Induction Motors for Propulsion and Suspension of Magnetically Levitated Vehicles.
- Huan-wun Yen (*Electrical Engineering*) B.S., National Taiwan University 1970; M.S., California Institute of Technology 1972.  
*Thesis:* Gallium Arsenide—Gallium Aluminum Arsenide Distributed Feedback and Distributed Bragg Reflector Lasers.

DIVISION OF GEOLOGICAL AND PLANETARY SCIENCES

- Karl Richard Blasius (*Planetary Science and Philosophy*) B.S., Michigan State University 1969; M.S., California Institute of Technology 1970.  
*Thesis:* Topical Studies of the Geology of the Tharsis Region of Mars.

DOCTOR OF PHILOSOPHY—*Continued*

Clay Michael Conway (*Geology*) A.S., Dixie Junior College 1961; B.S., Brigham Young University 1966.

*Thesis:* Petrology, Structure, and Evolution of a Precambrian Volcanic and Plutonic Complex, Tonto Basin, Gila County, Arizona.

Michael Glen Foley (*Geology*) B.S., California Institute of Technology 1967; M.S., 1968.

*Thesis:* Scour and Fill in Ephemeral Streams.

Alexander John Gancarz Jr. (*Geology and Geochemistry*) A.B., Princeton University 1970.

*Thesis:* I: Isotopic Systematics in Archean Rocks, West Greenland. II: Mineralogic and Petrologic Investigations of Lunar Rock Samples.

Steven Judson Lambert (*Geochemistry and Chemistry*) B.A., University of California, Riverside 1970; M.S., California Institute of Technology 1971.

*Thesis:* Stable Isotope Studies of Some Active Hydrothermal Systems.

Charles Adam Langston (*Geophysics*) B.S., Case Western Reserve University 1972; M.S., California Institute of Technology 1974.

*Thesis:* Body Wave Synthesis for Shallow Earthquake Sources: Inversion for Source and Earth Structure Parameters.

Michael Charles Malin (*Planetary Science and Geology*) A.B., University of California, Berkeley 1971.

*Thesis:* I. Comparison of Volcanic Features of Elysium (Mars) and Tibesti (Earth). II. Age of Martian Channels. III. Nature and Origin of Intercrater Plains on Mars.

Mark Jonathan Reid (*Planetary Science and Astronomy*) B.A., University of California, San Diego 1971.

*Thesis:* The Structure of Hydroxyl Masers and Circumstellar Envelopes of Long Period Variable Stars.

Roger Stanley Uhr Smith (*Geology*) B.S., Stanford University 1966; M.S., University of Arizona 1968.

*Thesis:* Late-Quaternary Pluvial and Tectonic History of Panamint Valley, Inyo and San Bernardino Counties, California.

DIVISION OF PHYSICS, MATHEMATICS AND ASTRONOMY

William G. Bagnuolo, Jr. (*Astronomy and Electrical Engineering*) A.B., University of Chicago 1969.

*Thesis:* The Stellar Composition and Evolution of Irregular and Other Late-Type Galaxies.

DOCTOR OF PHILOSOPHY—Continued

- Nim-Kwan Cheung (*Physics*) B.Sc., University of Hong Kong 1970; M.S., California Institute of Technology 1972.  
*Thesis:* A Test of Time Reversal Invariance in Oriented Nuclei.
- Keith Howard Despain (*Physics*) B.S., Brigham Young University 1971.  
*Thesis:* Rapid Nuclear Reactions in Turbulent Convection and the Helium-Shell Flash Instability.
- Tomas Ganz (*Applied Physics*) B.S., University of California, Los Angeles 1970; M.S., California Institute of Technology 1973.  
*Thesis:* I. The Phase-Current Relation at Zero Voltage in Proximity Effect Bridges.  
II. The Interaction of Proximity Effect Bridges with Superconducting Microstrip Resonators.
- Richard Henry Goldberg (*Physics*) S.B., Massachusetts Institute of Technology 1971.  
*Thesis:* Depth-Sensitive Analysis of Fluorine on Lunar Sample Surfaces and in Carbonaceous Chondrites by a Nuclear Resonant Reaction Technique.
- Paul Hickson (*Astronomy*) B.Sc., University of Alberta 1971.  
*Thesis:* The Structure of Clusters of Galaxies and the Angular Size-Redshift Test.
- Jeffrey Alan Holmes (*Physics*) B.S.E., Princeton University 1970.  
*Thesis:* A Semi-Empirical Statistical Model for Thermonuclear Reaction Rates and Its Application to Neutron Induced Reactions.
- John Kormendy (*Astronomy*) B.Sc., University of Toronto 1970.  
*Thesis:* Brightness Distributions in Compact and Normal Galaxies.
- Knox Stedman Long, Jr. (*Physics*) B.A., Harvard College 1971.  
*Thesis:* Soft X-Rays from the Large Magellanic Cloud and the Galaxy—Implications on the Origin of the Diffuse X-Ray Background.
- William Edwin Moore (*Physics*) B.S., University of Wisconsin, Madison 1969; M.S., California Institute of Technology 1971.  
*Thesis:* Soft X-Ray Emission from the Vela Supernova Remnant.
- Don Nelson Page (*Physics and Astronomy*) A.B., William Jewell College 1971; M.S., California Institute of Technology 1972.  
*Thesis:* Accretion into and Emission from Black Holes.
- Joseph A. Parker Jr. (*Mathematics*) B.S., Stanford University 1972.  
*Thesis:* The Matrix Equation  $F(A)X - XA = 0$ .
- Jay Cee Pigg, Jr. (*Astronomy*) B.S., Loyola University, New Orleans 1966; M.S., California Institute of Technology 1968.  
*Thesis:* A Limit on the Inhomogeneity of the Cosmic Microwave Background Radiation at an Angular Scale of 1.25 Arcmin.

DOCTOR OF PHILOSOPHY—Continued

- Karl Hansell Rudnick (*Mathematics*) B.S., Harvey Mudd College 1972.  
*Thesis*: Lorentz-Zygmund Spaces and Interpolation of Weak Type Operators.
- Theodore Dean Tarbell (*Physics*) A.B., Harvard University 1971.  
*Thesis*: Semiconvection in Halo Stars and the Primordial Helium Abundance.
- Edwin Lewis Turner (*Astronomy*) S.B., Massachusetts Institute of Technology 1971.  
*Thesis*: Binary Galaxies and Groups of Galaxies.
- Barry Edmund Turnrose (*Astronomy and Physics*) B.A., Wesleyan University 1969.  
*Thesis*: The Stellar Content of the Nuclear Regions of Sc Galaxies.
- Robert Tung-Hsing Wang (*Physics*) S.B., Massachusetts Institute of Technology 1969.  
*Thesis*: A Study of Some Two-Dimensional Field Theory Models.
- Theodore Burton Williams (*Astronomy*) B.S., Purdue University 1971.  
*Thesis*: Stellar Populations and Velocity Dispersions of Ten Nearby Galaxies.
- Steven Paul Willner (*Astronomy*) A.B., Harvard College 1971.  
*Thesis*: Compact Infrared Sources: NGC 7538 and the Galactic Center.

# Prizes and Awards

## GEORGE W. GREEN MEMORIAL AWARD

Awarded to the undergraduate students who, in the opinion of the division chairmen, have shown outstanding ability and achievement in creative scholarship.

*Daniel Lang*

*Michael Purucker*

## FREDERIC W. HINRICHS, JR., MEMORIAL AWARD

Awarded to the senior who, in the opinion of the undergraduate Deans, has made the greatest undergraduate contribution to the welfare of the student body and whose qualities of leadership, character, and responsibility have been outstanding. *Recipient to be announced at Commencement.*

## DON SHEPARD AWARD

Awarded to students who would find it difficult, without additional financial help, to engage in extracurricular and cultural activities. The recipients are selected on the basis of their capacity to take advantage of and to profit from these activities rather than on the basis of their scholastic standing.

1976 *José Helu, Jr., Christian Parry, Allen Johnson*

1975 *Subhash Sharma, Ole Anderson\**

1974 *Margaret Evans, Gary Wakai\**

## DAVID JOSEPH MACPHERSON PRIZE IN ENGINEERING

Awarded to the graduating senior in engineering who best exemplifies excellence in scholarship. Limited to U.S. citizens.

*Lewis Hashimoto*

## THE HONEYWELL AWARD

Awarded annually to the outstanding junior in undergraduate engineering and science, with preference toward engineering. Limited to U.S. citizens.

*Jan Morris Martin*

*\*The names of students who have received prizes or awards in previous years, but who are graduating in 1976, are also listed.*

PRIZES AND AWARDS—*Continued*

DONALD S. CLARK AWARDS

May be awarded to a sophomore and a junior in recognition of service to the campus community and good academic performance. Preference is given to students in the Division of Engineering and Applied Science and to those in Chemical Engineering.

- 1976 *Andrew Falls, sophomore; Kevin Gromley, junior*  
1975 *Richard Larson\**  
1974 *Jonathan Teich\**

HAREN LEE FISHER MEMORIAL AWARD IN JUNIOR PHYSICS

Awarded to a junior physics major who demonstrates the greatest promise of future contributions in physics.

- 1976 *Christopher Henley*  
1975 *Thomas Himel\**

SIGMA XI AWARD

Awarded to a senior selected for an outstanding piece of original scientific research.

*Laurence Yaffe*

THE MORGAN WARD AWARD

Awarded for the best problems and solutions in mathematics submitted by a freshman or sophomore.

- 1976 *David Zelinsky, freshman; David Feinstein, freshman;*  
*Charles Schlindwein, sophomore*  
1973 *James Shearer\**

MARY A. EARLE MCKINNEY PRIZE IN ENGLISH

The purpose of this prize is to cultivate proficiency in writing. It may be awarded for essays submitted in connection with regular English classes or awarded on the basis of a special essay contest.

- 1976 *James Michael Wilson*  
1975 *James Hong, James Michael Wilson\**

PRIZES AND AWARDS—*Continued*

JACK E. FROELICH MEMORIAL AWARD

Awarded to a junior in the upper five percent of his class who shows outstanding promise for a creative professional career.

1976 *Christopher Henley*

1975 *Laurence Yaffe\**

ERIC TEMPLE BELL UNDERGRADUATE MATHEMATICS RESEARCH PRIZE

Awarded to one or more juniors or seniors for outstanding original research in mathematics.

1976 *Albert Wells, Jr., Hugh Woodin, John Gustafson*

1975 *James Shearer\**

THE ROYAL SOCIETY FOR THE ENCOURAGEMENT OF ARTS MANUFACTURES AND COMMERCE SILVER MEDAL

Awarded to students who are receiving their first degrees from the most important institutions of learning in the United States. Winners are selected on the basis of outstanding academic records and significant participation in student activities.

*Designee: Lewis Hashimoto*

*\*The names of students who have received prizes or awards in previous years, but who are graduating in 1976, are also listed.*