Eightieth Annual Commencement
June 14, 1974
Academic Procession

Chief Marshal, William R. Cozart, Ph.D.

Assistant Marshals

Marshall Hall, Jr., Ph.D.  Jon Mathews, Ph.D.
Robert V. Langmuir, Ph.D.  Vito A. Vanoni, 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

PRELUDE . . . Caltech Convocation Brass and Percussion Choir
William Nicholls, M.M., Director

Three pieces by Giovanni Gabrieli: 1) Canzon Primi Toni. 2) Sonata pian’e forte. 3) Canzona per Sonare No. 1 “La Spiritata.”

AN INTRODUCTION TO COMMENCEMENT
David C. Elliot, Ph.D.
Secretary of the Faculty

PROCESSIONAL . . . Leslie J. Deutsch, Class of 1976, Organ and The Brass and Percussion Choir

INVOCATION . . . . . . . Rabbi Edgar F. Magnin, D.D.
Wilshire Boulevard Temple, Los Angeles

COMMENCEMENT ADDRESS “Unscientific Evidence”
Richard P. Feynman, Ph.D., Nobel Laureate
Richard Chace Tolman Professor of Theoretical Physics, Caltech

MUSICAL SELECTIONS . . . . . . The Caltech Glee Club
Olaf M. Frodsham, A.M., Director

CONFERRING OF DEGREES Harold Brown, Ph.D., D. Eng., LL.D.
President, California Institute of Technology

PRESENTATION OF CANDIDATES FOR DEGREES
For the Degree of Bachelor of Science . . . James J. Morgan, 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 . . . Francis H. Clauser, Ph.D.
Division Chairman

Geological and Planetary Sciences . . . Bruce Murray, Ph.D.
Professor of Planetary Science

Physics, Mathematics and Astronomy . . . Jon Mathews, Ph.D.
Executive Officer for Physics

CONCLUDING REMARKS . . . . . President Brown

BENEDICTION . . . . . . . . . Rabbi Magnin

RECESSIONAL . . . The Brass and Percussion Choir and Organ
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 doctor's degrees respectively. The colors associated with some of the subjects are as follows:

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

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.
About the Music

GIOVANNI GABRIELI (c. 1557-1612)

Canzon Primi Toni appeared in the Sacrae Symphoniae, a collection of some forty ecclesiastical compositions for voice and/or instruments, published in Venice in 1597. “Primi Toni” refers to the first, or Dorian, church mode; the Italian instrumental canzona was based on the earlier Flemish or French chanson. Written for two separate choirs (cori spezzati; Gabrieli wrote for as many as five spatially separated vocal or instrumental choirs and organs in St. Mark’s), Primi Toni offers a glimpse of baroque elaboration and ornamentation in the long trumpet themes. Sonata pian’e forte, also from Sacrae Symphoniae, is an instrumental Venetian motet for a high and low choir; it illustrates the typical modal polyphony—dissonance followed by resolution. Pian’e forte is historically significant: it is the first piece in which the composer specified the instrumentation—one choir consisting of a cornetto and three trombones, the other a viola and three trombones; it is also the first time dynamics were specified—hence the name. In 1608 Alessandro Raverij published Canzoni per sonare con ogni sorte di strumenti, containing 36 canzonas by a dozen Italian composers. Of the six by Gabrieli, La Spiritata is considered the most interesting and innovative of its time. It was probably composed long before the publication date, perhaps in the late 1580’s. It is written for four instrumental voices: canto, alto, tenore and basso, and features quickly repeating themes; in this arrangement, the organ is added in the 3/2 section for contrast.

THE CALTECH CONVOCATION BRASS AND PERCUSSION CHOIR is composed of members of the Caltech Wind Ensemble and the Caltech staff, plus members of the San Marino Dads’ Band. The Processional features compositions by Melchior Franck, Jeremiah Clarke, Henry Purcell, Dietrich Buxtehude, Aurelio Bonelli, and Edward Elgar. The Recessional pieces are by Sergei Prokofieff and Louis Lewandowski.

GLEE CLUB SELECTIONS

1) Hodie Apparuit ........................................... Orlando di Lasso
2) Miserere Mei .............................................. Antonio Lotti
3) Behold Man ............................................... Ron Nelson
Candidates for Degrees

BACHELOR OF SCIENCE

John Steele Abbott III  Bow Mar, Colorado  Mathematics
Ervin Adler  Los Angeles, California  Engineering and Applied Science
Lisa Michelle Anderson  Manhattan Beach, California  Independent Studies Program
Phyllis Jean Anwyl  Huntington Beach, California  Biology
Phillip John Arnold  Downey, California  Engineering and Applied Science
Ronald Frederick Ayres  Los Angeles, California  Mathematics
James Francis Battye, Jr.  Los Altos, California  Independent Studies Program
Peter Wayne Beckman  Stockton, California  Economics
Thomas W. Bell  San Gabriel, California  Chemistry
Trudy Lynn Bergen  Valencia, California  Mathematics
Neil Scott Berkey  Cincinnati, Ohio  Geology
Stephen A. Bitondo  Lakeside, California  Chemistry
Kim Christian Border  Sunnymead, California  Economics
Dale Eric Bredesen  Fort Lauderdale, Florida  Biology-English
Robert Bernard Bresler  South San Francisco, California  Engineering and Applied Science
Robert Bruce Brewington  Seabrook, Texas  Chemistry
Gregory K. Brock  Chehalis, Washington  Chemistry
Clifford Lawrence Brown  Skokie, Illinois  Chemical Engineering
Mark Adrian Bruni  Salinas, California  Applied Mathematics
Leslie M. Brusseau  Phoenix, Arizona  Engineering and Applied Science
John Alden Reimer Caldwell  Astronomy
John Patrick Cannady  Lakewood, California  Chemistry
Joseph A. Carlsen  Biology
Donald R. Carrigan  Garland, Texas  Biology
Valerian Anthony Catanzarite  Rancho Palos Verdes, California  Independent Studies Program
Robert Joseph Chansler, Jr.  San Jose, California  Mathematics
Wai Kong Cheng  Hong Kong  Engineering and Applied Science
Ying-Chee Chung  Hong Kong  Engineering and Applied Science-Biology
Barry Arthur Cipra  Overland Park, Kansas  Independent Studies Program
William Edward Cleverger  Rocky Ford, Colorado  Chemical Engineering
Andrew Fort Cockburn  Cave Creek, Arizona  Biology
Richard Eric Cofield IV  Livermore, California  Applied Physics
Robert Moorhouse Coleman, Jr.  Nisqually, Washington  Engineering and Applied Science
Mark Wayne Coles  Yorba Linda, California  Physics
Alan James Coltri  Granada Hills, California  Engineering and Applied Science

Students whose names appear in boldface type are being graduated with honor in accordance with a vote of the faculty.
BACHELOR OF SCIENCE—Continued

Dennis B. Creamer Tulsa, Oklahoma Physics
Kirby Grant Dahman Glendale, Missouri Mathematics
Dale Brian Dalrymple Toledo, Ohio Engineering and Applied Science
Debra Valorie Dixon San Jose, California Biology
Jay D. Doty Brewster, Washington Engineering and Applied Science
Andrew Philip Dowsett Pacifica, California Independent Studies Program
David Anderson Drake Ridgewood, New Jersey Engineering and Applied Science
Robert William Durst Salem, Oregon Chemistry
Charles William Eason Redmond, Oregon Chemical Engineering
Karen Sue Eaton Salina, Kansas Biology
Mary E. Eichbauer Floral Park, New York English
Mark W. Eltgroth Tujunga, California Physics
Keith Alan Ex Sarasota, Florida Engineering and Applied Science
Tom G. Farr Hawthorne, California Geology
Louis D. Fielder Atherton, California Engineering and Applied Science
Robert Burns Fisher III Stockton, California Mathematics
Gary Alan Frankel Waco, Texas Biology
Donald Gibson Franks Little Rock, Arkansas Mathematics
Howard Bradley French Plainview, New York Astronomy
René Charles Gandolfi Bayside, New York Biology
John Marland Garth Poway, California Applied Physics
Gene Robert Gindi New Orleans, Louisiana Applied Physics
David Langdon Glackin St. Petersburg Beach, Florida Astronomy
Christopher Allan Goldstein Los Angeles, California Mathematics
Mark Andrew Grunwald St. Louis, Missouri Biology
Eric Keith Gustafson Sacramento, California Physics
Bruce Scott Hantover Engineering and Applied Science
Christina Anne-Marie Harrington Los Angeles, California Biology
Jeffrey John Harrow Houston, Texas Engineering and Applied Science
Edward Monroe Hedgecock Pasadena, California Biology
John G. Helm, Jr. New Orleans, Louisiana Applied Physics
Thomas Herman Torrance, California Engineering and Applied Science
David Da-i Ho Los Angeles, California Biology
Frank Worden Hobbs, Jr. Salinas, California Chemistry
Erik Royal Horsley La Canada, California Engineering and Applied Science
Ron L. Hospelhorn Glendale, Arizona Physics
Joyce Shih-chiao Hsiao Silver Spring, Maryland Chemistry
James William Hugg, Jr. Oklahoma City, Oklahoma Physics-Social Science
Glenn Reginald Ierley Florham Park, New Jersey Applied Physics
Carl Frank Imparato Stanton, California Engineering and Applied Science
Bryan Creed Jack Tyler, Texas Economics
Patrick Henry Jenkins Arlington Heights, Illinois Chemical Engineering
John Hallock Jerman Malibu, California Applied Physics
Gregory Allan Jirak Yuma, Arizona Mathematics
Mark Richard Johnson Potomac, Maryland Mathematics
Nelson Daniell Johnson Corona del Mar, California Biology
Keith Richard Karasek Villa Park, Illinois Physics
BACHELOR OF SCIENCE—Continued

John Karl Kastner  
Fresno, California  
Engineering and Applied Science

David Louis Kazan  
Mathematics-Biology

Ioannis Nicolaos Kessides  
Prohoma, Thessaloniki, Greece  
Physics

Robert Mariner Kieckhefer  
Barrington, Illinois  
Geophysics

Alan Willis Kleinsasser  
Azusa, California  
Applied Physics

Casimir C. Klimasauskas  
Altadena, California  
Mathematics

Hon Hong Kwai  
Hong Kong  
Mathematics

Betty Pui-fun Kwan  
Los Angeles, California  
Physics

David Jeffrey Larwood  
Bakersfield, California  
Chemistry

Kar-Shing Simon Lee  
Hong Kong  
Engineering and Applied Science

James Robert Leger  
San Diego, California  
Applied Physics

John Lehmann  
Kitchener, Ontario, Canada  
Biology

Raymond H. Lem  
Torrance, California  
Mathematics-Chemistry

Lawrence Stuart Lichtmann  
Sepulveda, California  
Physics-English

Anita Crafts Lighty  
Fullerton, California  
Biology

Gloria Won Liu  
Longview, Washington  
Engineering and Applied Science

Baruch Livneh  
Kibbutz Hatzor, Israel  
Engineering and Applied Science

Kevin Kwok-Kam Lo  
Hong Kong  
Engineering and Applied Science

James Matthew Loddenaard  
Kabul, Afghanistan  
Biology

Thanh Luu  
Saigon, South Vietnam  
Engineering and Applied Science

Richard Francis Lyon  
El Paso, Texas  
Engineering and Applied Science

Rhonda Lynne MacDonald  
New Bedford, Massachusetts  
Engineering and Applied Science

Daniel George Marks  
South Gate, California  
Mathematics

Michael John Mariani  
San Jose, California  
Biology

Richard B. Martin  
Shawnee Mission, Kansas  
Engineering and Applied Science

Steven Allen Matthews  
Carthiael, California  
Mathematics

Patrick John McCrea  
San Leandro, California  
Physics

Douglas Boyden McElroy  
Palos Verdes Peninsula, California  
Astronomy

John Thomas Meador  
Oklahoma City, Oklahoma  
Engineering and Applied Science

Donald Lee Miller  
Key Biscayne, Florida  
Biology

Kenneth Alan Mills  
Chemistry-History

William Richard Molzon  
Vineland, New Jersey  
Physics

Bruce Gilbert Montgomery  
Minnetonka, Minnesota  
Engineering and Applied Science

Steven Ray Moosman  
Walla Walla, Washington  
Chemical Engineering

John Adrian Morgan  
Downey, California  
Physics

John Lewis Morton, Jr.  
Palo Alto, California  
Engineering and Applied Science

Marion Louise Movius  
Porterville, California  
Mathematics

Robert Warren Murphy  
Chemistry

David I. Musgrave  
Chemistry

Stanley Kazuo Nakamoto  
Los Angeles, California  
Biology

Gregory Alan Nelson  
Minnetonka, Minnesota  
Chemistry-Biology

Mark James Nelson  
Downey, California  
Chemistry

Albert Tung-Yiu Ng  
Hong Kong  
Physics

Patrick Lee Nolan  
Grass Valley, California  
Physics

Carol Nottenburg  
Biology

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BACHELOR OF SCIENCE—Continued

John Robert Odden  Ann Arbor, Michigan  Mathematics
John Thomas O'Donnell  Lexington, Kentucky  Astronomy
Robert Bruce Olshan  Sepulveda, California  Geology
Daniel Packman  Los Angeles, California  Astronomy
David Balfour Peisner  Huntington Woods, Michigan  Engineering and Applied Science
Patrick Perkins  Redondo Beach, California  Chemistry
Darrell Lee Peterson  Chico, California  Physics
Gary Scott Peterson  Oklahoma City, Oklahoma  Chemistry
James Graham Peterson  Clarendon Hills, Illinois  Applied Physics
Robert Milton Pleva  Indianapolis, Indiana  Applied Physics
Edward Burner Pontius  Scottsdale, Arizona  Biology
Siu Joe Poon  Hong Kong  Engineering and Applied Science
Stephen R. Poon  Bacolod City, Philippines  Engineering and Applied Science
James William Posakony  Ventura, California  Biology
James Edward Price  Thousand Oaks, California  Engineering and Applied Science
Mark Keith Puryear  Denver, Colorado  Mathematics
Gary Alan Rabins  Monterey Park, California  Engineering and Applied Science
Ram Rao  Bangalore, India  Engineering and Applied Science
Celia Patricia Rivera-Zárate  Compton, California  English
D. Wilmer Rivers, Jr.  Alexandria, Virginia  Geophysics
Karen Verna Roberts  Claremont, California  Biology
Haywood James Robinson  Los Angeles, California  Biology
Charles Joseph Romeo, Jr.  Augusta, Georgia  Biology
Thomas Peter St. John  Honolulu, Hawaii  Biology
Laurie Ann Schalit  Chatsworth, California  English
Louis Kossuth Scheffer  Rochester, New York  Engineering and Applied Science
Stephen Richard Schnetzer  Lawrenceburg, Indiana  Physics
Michael Edward Schroeder  Claremont, California  Physics
Robert Alan Scranton  Huntington, New York  Applied Physics
Mei-Ling Shek  Hong Kong  Chemistry
Virgil Bernard Shields  Carson, California  Physics
Jacqueline Siegel  Detroit, Michigan  Biology
Frederick John Sigworth  Orinda, California  Applied Physics
Vanessa Roberta Skedzeleski  Bartlesville, Oklahoma  Biology
John Carl Smith  Brewster, New York  Geophysics
Hon Hing So  Hong Kong  Engineering and Applied Science
Bruce Calvin Spalding  Seattle, Washington  Chemistry
Robert Wendell Standley  Lake Forest, Illinois  Physics
Douglas Anthony Stauber  Redding, California  Geology
Paul Joseph Steinhardt  Coral Gables, Florida  Physics
Richard Leroy Stephens  Hanley Hills, Missouri  Chemistry
Gregory P. Stone  Glennville, California  Chemical Engineering
Kenneth Sanders Suslick  Glencoe, Illinois  Chemistry
Edmund Charles Sutton  Baltimore, Maryland  Physics
Paul Arthur Thomas  Miami, Florida  Biology
W. Scott Thompson  Scottsdale, Arizona  Biology
BACHELOR OF SCIENCE—Continued

Patricia Ellen Tressel  Los Angeles, California  Physics
William Douglas Trotter  Bainbridge Island, Washington  Biology
Sheila Marie Young  Rancho Palos Verdes, California  Mathematics
James Charles Vibber  Monterey Park, California  Biology
Lee Weigle Vibber  Downey, California  English
Janet Christine Wainwright  Anaheim, California  Biology
Kenneth Lee Walker  Lakewood, Colorado  Chemical Engineering
Frederick Abbott Ware  Omaha, Nebraska  Applied Physics
Steven James Warling  Canoga Park, California  Engineering and Applied Science
Thomas Van Weaver  New Orleans, Louisiana  Mathematics
Richard Evan Weinberger  Shorewood, Wisconsin  English
David Charles Wellman  Olympia, Washington  Independent Studies Program
Robert Dean Wieting  Downey, California  Chemistry
Frederick Douglas Williams, Jr.  Los Angeles, California  Economics
Alexander Jonathan Wilson  Kansas City, Missouri  Mathematics-Engineering and Applied Science
Michael U. Wimbrow  Chappaqua, New York  Engineering and Applied Science
Durwin Wright  Compton, California  Engineering and Applied Science
Brian Stuart Yandell  Orinda, California  Mathematics
Thomas Wai Yee  Gardena, California  Biology
Michael Franz Yoder  Albuquerque, New Mexico  Mathematics
John Gregory Zima  Phoenix, Arizona  Physics
MASTER OF SCIENCE

Christopher Scott Amenson (Biology) B.S., Michigan State University 1971.
James Harold Atherton (Electrical Engineering) B.S., University of Illinois 1972.
Gene Allan Aydinian (Geochemistry) B.S., University of Notre Dame 1972.
Timothy Miller Benjamin (Geology) B.S., University of California, Davis 1973.
Meletios Spyridon Berdelis (Aeronautics) B.S., California Polytechnic State University, San Luis Obispo 1973.
Larry Arthur Bergman (Electrical Engineering) B.S., California Polytechnic State University, San Luis Obispo 1973.
Scott Branda (Geology) B.S., University of Rochester 1972.
Robert Everett Criss (Geology) B.S., Case Western Reserve University 1973.
Gertrude Hill Fila (Aeronautics) B.S., Oklahoma A & M College 1940.
Charles Aubrey Foley (Electrical Engineering) B.S., University of Maryland 1972.
James Albert Fontana (Mathematics) B.S., Emory University 1970.
David Lee Fox (Physics) B.A., University of Colorado 1972.
Lawrence Jerome Grubka (Mechanical Engineering) B.S., Michigan State University 1972.
Stanton Francis Gunderson (Mechanical Engineering) B.S., California Polytechnic State University, Pomona 1972.
MAster of SCience—Continued

Ernest Dwight Gustafson, Jr.  (Geophysics and Geology)  B.S., University of Minnesota 1972.


Jerry Michael Harris  (Electrical Engineering)  B.S., University of Mississippi 1973.

Joel Norval Harrison  (Mechanical Engineering)  B.S., California Polytechnic State University, Pomona 1973.

Eddy Walter Hartenstein  (Applied Mechanics)  B.S., California Polytechnic State University, Pomona 1972.

Philip David Hattis  (Aeronautics)  B.S., Northwestern University 1973.


David Li-Shui Quek Hwang  (Electrical Engineering)  B.S., Rensselaer Polytechnic Institute 1973.

Robert Murray Jaffe  (Electrical Engineering)  B.S., University of California, Berkeley 1972.


Terrell Harvey Johnson  (Physics)  B.S., Purdue University 1970.

Kenneth Lee Jones  (Electrical Engineering)  B.S., Oklahoma State University 1972.


David Alan King  (Geology)  B.S., Wisconsin State University, River Falls 1972.

Peter James Knox  (Chemical Engineering)  B.S., California State University, Long Beach 1973.

Keith Koenig  (Aeronautics)  B.S., Mississippi State University 1973.


Sudarshan Kumar  (Chemical Engineering)  B.Tech., Indian Institute of Technology 1972.

Daniel Fung Lam  (Physics)  B.S., University of Maryland 1972.

Ignatius Po-Cheung Lam  (Civil Engineering)  B.S., Ohio State University 1973.

Charles Adam Langston  (Geophysics)  B.S., Case Western Reserve University 1972.


David Yee-Chan Leung  (Engineering Science)  B.S., University of California, Davis 1973.
Kevin Kwok-Kam Lo  (Applied Mechanics)  B.S., California Institute of Technology 1974.
Rodney Tak Masumoto  (Electrical Engineering)  B.S., California Institute of Technology 1972.
Douglas Colbourne Mason  (Chemistry)  B.S., California Institute of Technology 1970.
Alan Rolf Mickelson  (Electrical Engineering)  B.S., University of Texas 1973.
Subir Kumar Mitra  (Physics)  B.S., St. Xavier's College, Calcutta 1969; M.S. 1972.
Lawrence Henry Mohr  (Chemistry)  B.S., University of California, Berkeley 1967.
Galina Dmitriyevna Moller  (Biology)  M.S., University of Moscow 1968.
Wesley Elwood Munsil  (Engineering Science)  B.S., California Institute of Technology 1971.
Willie Wing Lau Ng  (Electrical Engineering)  B.S., Case Western Reserve University 1973.
Eduardo Horacio Orces  (Mechanical Engineering)  B.S., California Institute of Technology 1973.
Daniel B. Pearson III  (Geochemistry)  B.A., Rice University 1971; M.S. 1972.
Gordon Andrew Petersen  (Mechanical Engineering)  B.S., California Institute of Technology 1973.
Judy Hope Pollack  (Physics)  B.S., Miami University 1972.
Ernest Edward Ross  (Mechanical Engineering)  B.S., California Polytechnic State University, Pomona 1972.
Sedigheh Salim  (Chemical Engineering)  B.S., Brigham Young University 1973.
MASTER OF SCIENCE—Continued

David Sheby (Engineering Science) B.S., Pratt Institute 1972.
David Andrew Smith (Engineering Science) B.S., California Institute of Technology 1972.
Polihronis-Thomas Dimitrios Spanos (Civil Engineering) Diploma, National Technical University, Athens 1973.
Gregory Paul Stone (Chemical Engineering) B.S., California Institute of Technology 1974.
Kenneth Charles Underwood (Mathematics) B.S., Furman University 1972.
Rick Alan Williams (Engineering Science) B.S., Northwestern University 1972.
Alfred Po-hung Wu (Geophysics) B.S., Colorado School of Mines 1972.
Michael Franz Yoder (Mathematics) B.S., California Institute of Technology 1974.
Yanis Christos Yortsos (Chemical Engineering) Diploma, University of Athens 1973.

ENGINEER

Hendrik Willem Marie Hoeijmakers (Aeronautical Engineer) M.S., Technological University of Delft 1971.
Hilary Max Irvine (Civil Engineer) B.E., University of Canterbury 1970; M.E. 1971.
Laurent Bernard Sidor (Aeronautical Engineer) B.E., Johns Hopkins University 1969; M.S., California Institute of Technology 1970.
DOCTOR OF PHILOSOPHY

DIVISION OF BIOLOGY

Charles Ray Birdwell (Biochemistry) B.S., University of Chicago 1969.

Ming Ta Chong (Biochemistry) M.B., Medical College of National Taiwan University 1968.
*Thesis:* Investigation of Chromatin Bound Enzymes.

Tommy Charles Douglas (Immunology) A.B., Princeton University 1969; M.S., California Institute of Technology 1970.
*Thesis:* The Theta Antigen of Mice and Its Analog in Rats.

William Jack Driskell (Biology) B.S., University of Georgia 1967; M.S., California Institute of Technology 1968.
*Thesis:* The Role of Tyrosine in the Sclerotization and Tanning of the Puparium of Drosophila Melanogaster.

John Edward Geltosky (Biology) B.S., Memphis State University 1967.
*Thesis:* Studies on Some of the Enzymes Involved in the Synthesis and Use of Tyrosine in Drosophila.

Lily Kung-Chung Yeh Jan (Biophysics and Physics) B.S., National Taiwan University 1968; M.S., California Institute of Technology 1970.
*Thesis:* Investigations on Rhodopsin and Bacteriorhodopsin. I. Ultrastructural Localization of Rhodopsin in Vertebrate Retina. II. The Isomeric Configuration of the Bacteriorhodopsin Chromophore.

Susan Leah Melvin (Immunology and Cell Biology) B.A., State University of New York, Buffalo 1968.
*Thesis:* Studies in Cellular Immunology.

Ronald Leo Meyer (Biology) B.A., Don Bosco College 1967.

William Ignatius Murphy III (Biochemistry and Chemistry) B.S., Fordham University 1967.
*Thesis:* Studies on the Mechanism and Products of Transcription of the Nuclear Genome in Animal Cells.

Jeffrey Lewis Ram (Biochemistry and Neurophysiology) A.B., University of Pennsylvania 1967; M.S., California Institute of Technology 1971.
*Thesis:* Effects of High K⁺ Media on Leucine Incorporation into Aplysia Nervous Tissue.

Daniel Tawil Simmons (Biochemistry) B.S., Colorado College 1969.
*Thesis:* The Function and Replication of Sindbis Virus-Specific RNA's in Infected Cells.

Jessica Tuchman (Biochemistry) B.A., Radcliffe College 1967.
*Thesis:* The Developmental Role of Membrane in the Cellular Slime Mold, Dictyostelium discoideum.

Anthony Joseph Zucarelli (Biophysics and Genetics) B.S., Cornell University 1966; M.S., Loma Linda University 1968.
DOCTOR OF PHILOSOPHY—Continued

DIVISION OF CHEMISTRY AND CHEMICAL ENGINEERING

Karl Ammon Bell  *(Chemical Engineering and Environmental Engineering Science)*  
B.S., Lehigh University 1969; M.S., California Institute of Technology 1970.  
*Thesis:* Aerosol Deposition in Models of a Human Lung Bifurcation.

Theodore I. Benzer  *(Chemistry and Biology)*  

Frank Wilhelm Bobrowicz  *(Chemistry)*  
B.S., Seton Hall University 1969.  

Wen Hsiung Chen  *(Chemical Engineering)*  
B.S., Tunghai University 1963; M.S., Illinois Institute of Technology 1968.  
*Thesis:* Estimation of Parameters in Partial Differential Equations, with Applications to Petroleum Reservoir Description.

Thomas Carl Clarke  *(Chemistry)*  
B.A., Rice University 1969.  
*Thesis:* I. Investigations on the Mechanism of Thermal Decomposition of 1-Pyrazolines. II. The Stereochemistry of Solvolytic Displacement and Intramolecular Nucleophilic Substitution by a Double Bond at a Vinyl Center.

Charles Dane Cowman, Jr.  *(Chemistry)*  
B.S., Case Western Reserve University 1969.  

Robert Gouldman Eagar, Jr.  *(Chemistry)*  
B.S., Virginia Polytechnic Institute 1969.  
*Thesis:* I. Mechanism of Action of Coenzyme B_{12}. Hydrogen Transfer in the Isomerization of $\beta$-Methylaspartate to Glutamate. II. Kinetic Studies of 3-Fluoro-1,2-propanediol, a New Substance for Dioldehydrase. III. Reaction of 5'-deoxyinosylcobalamene with Propanediol Dehydrase. IV. Adenosine Deaminase.

James Bernard Ellern  *(Chemistry and Economics)*  
B.S., University of Illinois 1962.  

Gerald W. Feigenson  *(Chemistry and French)*  
B.S., Rensselaer Polytechnic Institute 1968; M.S. 1969.  
*Thesis:* Nuclear Magnetic Relaxation Studies of Lecithin Bilayers.

Steven Neil Frank  *(Chemistry)*  
B.S., Colorado State University 1969.  
*Thesis:* Investigations of the Binding of Some Azido-, Isocyano-, and Isothiocyanato-chromium (III) and Azidocobalt (III) Complexes with Heavy Metal Ions and Mercury Electrodes.

Gregory Lynn Geoffroy  *(Chemistry)*  
B.S., University of Louisville 1968.  
*Thesis:* An Investigation of the Photochemical and Excited State Properties of Selected Second and Third Row Transition Metal Complexes.

Frank John Grunthaner  *(Chemistry)*  
B.S., King's College 1966.  
*Thesis:* Electronic Structure, Surface Reactivity and Site Analysis of Transition Metal Complexes and Metalloproteins by X-Ray Photoelectron Spectroscopy.
Amitava Gupta (Chemistry) B.Sc., Institute of Science 1967; M.Sc., Indian Institute of Technology 1969.  
*Thesis:* I. The Role of Exciplexes in Singlet and Triplet Quenching Processes. II. Cage Recombination of Radical Pairs from ABN and ACC. III. Magnetic Field Effects on Cis-Trans Isomerisations of Dienes.

Robert Alan Holwerda (Chemistry) B.S., Stanford University 1969.  

Ming-Ta Hsu (Chemistry) B.S., National Taiwan University 1966; M.S. 1968.  

Michael W. Hunkapiller (Chemistry) B.S., Oklahoma Baptist University 1970.  

Joseph Francis Karnicky (Chemistry) B.S., Villanova University 1965.  

Conrad John Kowalski (Chemistry) B.S., Massachusetts Institute of Technology 1968; M.S., California Institute of Technology 1971.  

Charles Anderson Langhoff (Chemistry) B.S., Tulane University 1969.  

George Benjamin Levin (Chemistry and Physics) B.S., University of Michigan 1963; M.S., George Washington University 1968.  
*Thesis:* The Generalized Valence Bond Description of the Pi Electron States of Conjugated Molecules.

David Harris Live (Chemistry) B.A., University of Pennsylvania 1967.  
*Thesis:* The Interaction of Cations with Cyclic Polyethers.

Terrance Brian McMahon (Chemistry) B.Sc., University of Alberta 1969.  

James Gregory Nourse (Chemistry) B.S., Columbia University 1969.  

Steven Diggs Reynolds (Chemical Engineering) B.S., University of California, Davis 1969.  

*Thesis:* Spectral and Magnetic Studies of Metallocarboxypeptidase A’s.

Guston Price Russ III (Chemistry) B.A., University of the South 1968.  

Charles Frederick Schmidt, Jr. (Chemistry) B.S., Rensselaer Polytechnic Institute 1967.  
DOCTOR OF PHILOSOPHY—Continued

Albert Edward Schweizer, Jr.  (Chemistry)  B.S., West Chester State College 1964; M.S., Rutgers University 1968.


Satish Chander Sharda  (Chemical Engineering)  B.S., Panjab University 1967; M.S., Montana State University 1968.

James Stanley Sherfinski  (Chemistry)  B.A., University of Wisconsin 1969.
Thesis: A Structural Analysis of Three Arabinosylpyrimidines.

Lois Elaine Hodgson Smith  (Chemistry)  B.Sc., University of British Columbia 1968.

Ronald Irving Trust  (Chemistry)  B.S., Drexel Institute of Technology 1969.

DIVISION OF ENGINEERING AND APPLIED SCIENCE


Norval Lagier Broome  (Electrical Engineering)  B.S., M.S., Purdue University 1966.
Thesis: Transient Radiation from Coaxial Waveguide and Cylindrical Monopole Antennas.

Charles Brian Crouse  (Civil Engineering)  B.S., Case Institute of Technology 1968; M.S., California Institute of Technology 1969.
Thesis: Engineering Studies of the San Fernando Earthquake.


Donnie Carlton Fletcher  (Engineering Science)  B.Sc., Massachusetts Institute of Technology 1965.

Blair Allen Folsom  (Mechanical Engineering and Business Economics)  B.S., California State College, Long Beach 1967; M.S., California Institute of Technology 1968.
DOCTOR OF PHILOSOPHY—Continued

Jerry Howard Griffin (Applied Mechanics) B.S., M.S., University of South Florida 1969.

Atul Jain (Electrical Engineering) B.S., California Institute of Technology 1969; M.S. 1970.

Doyle Dana Knight (Aeronautics and Applied Mathematics) B.A., Occidental College 1971; B.S., California Institute of Technology 1971; M.S. 1972.

Eriabu Lugujjo (Electrical Engineering) B.Sc., Makarere University College 1969; M.S., California Institute of Technology 1971.

Momtaz Nosshi Mansour (Engineering Science) B.Ae.E., Cairo University 1962; M.S., California Institute of Technology 1965.

Horacio Augusto Méndez (Electrical Engineering) Ensign, Argentine Naval Academy 1953; M.S., California Institute of Technology 1964; Engineer, Stanford University 1969.
Thesis: Shielding Theory of Enclosures with Apertures.


Edward Payson Myers (Environmental Engineering Science) B.S., Oregon State University 1965; M.S., California Institute of Technology 1969.
Thesis: The Concentration and Isotopic Composition of Carbon in Marine Sediments Affected by a Sewage Discharge.


Andrea Prosperetti (Engineering Science) Laurea in Fisica, University of Milano 1968; M.S., California Institute of Technology 1972.
Thesis: Viscous and Nonlinear Effects in the Oscillations of Drops and Bubbles.


Sasson Roger Somekh (Electrical Engineering) B.S., University of Tel-Aviv 1969; M.S., California Institute of Technology 1970.
Harold McDowell Stoll (Electrical Engineering) B.S., Stanford University 1968; M.S., California Institute of Technology 1969.

Sachio Uehara (Aeronautics) B.S., University of Tokyo 1956; M.S., California Institute of Technology 1965.

Christopher George Whipple (Engineering Science) B.S., Purdue University 1970; M.S., California Institute of Technology 1971.

Ralph Wilson Alewine III (Geophysics) B.S., Mississippi State University 1968; Sc.M., Brown University 1970.
Thesis: Application of Linear Inversion Theory Toward the Estimation of Seismic Source Parameters.


Rex Vincent Gibbons (Geology) B.A., Memorial University of Newfoundland 1967; M.Sc. 1969.

Raymond Leonard Joosten (Geology) B.S., San Jose State College 1966.
Thesis: Metasomatism and Magmatic Assimilation at a Gabbro-Limestone Contact, Christmas Mountains, Big Bend Region, Texas.

Thesis: The Equations of State of Hydrogen and Argon; Applications to the Jovian Interior.


Kenneth Raymond Ludwig (Geology and Geochemistry) B.S., California Institute of Technology 1965; M.S. 1967.
Thesis: I. Precambrian Geology of the Central Mazatzal Mountains, Arizona; II. Lead Isotope Heterogeneity in Precambrian Igneous Feldspars.

Thesis: Elastodynamics of Failure in a Continuum.
DOCTOR OF PHILOSOPHY—Continued

DIVISION OF PHYSICS, MATHEMATICS AND ASTRONOMY


*Thesis:* A Model Biochemical Reaction.

Donald Campbell Brabston, Jr. (Applied Mathematics and Engineering Science) B.S., Georgia Institute of Technology 1967; M.S., California Institute of Technology 1968.

James William Brown (Physics) B.S., Villanova University 1968.
*Thesis:* A Satellite Measurement of Cosmic-Ray Abundances and Spectra in the Charge Range $2 \leq Z \leq 10$.

Keith Howard Burrell (Physics, Applied Mathematics, and History) B.S., Stanford University 1968; M.S., California Institute of Technology 1970.

Philip Sidney Callahan (Physics and Astronomy) B.S., Cornell University 1969; M.S., California Institute of Technology 1971.

Paul Charles Clapham (Mathematics) B.Sc., University of British Columbia 1970.
*Thesis:* Steiner Triple Systems with Block-Transitive Automorphism Groups.

Jack Clifton Comly, Jr. (Physics) B.S., California Institute of Technology 1966.
*Thesis:* Optical Pulse Propagation in Media Exhibiting a Third Order Nonlinear Polarization.

Daniel Edwin Erickson (Mathematics and Economics) B.S., California Institute of Technology 1967; M.S., Stanford University 1968.

Lawrence Charles Ford (Mathematics) B.S., Portland State University 1968; M.S. 1970.

Paul Michael Harvey (Physics) B.A., Wesleyan University 1968.
*Thesis:* Infrared and Microwave Variability of OH/IR Stars, and a One Millimeter Wavelength Detecting System for the 200-Inch Telescope.

William Cary Huffman (Mathematics) B.S., University of New Mexico 1970.
*Thesis:* Eigenvalue Structure in Primitive Linear Groups.

Robert Vernon Kline (Physics) S.B., Massachusetts Institute of Technology 1967.
*Thesis:* A Measurement of the Process $p+d \rightarrow$ He$^0$ + Photon at Intermediate Energies.

Clement Wing Hong Lam (Mathematics and Engineering Science) B.S., California Institute of Technology 1971.
*Thesis:* Rational g-Circulants Satisfying the Matrix Equation $A^2 = dI + \lambda J$. 

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DOCTOR OF PHILOSOPHY—Continued

David Li Lee (Physics and Economics) B.Sc., McGill University 1970.

Douglas Albert Leich (Physics) B.A., Colgate University 1968.


Jonathan David Melvin (Physics and Biology) B.A., M.A., Yale University 1968.

William James Metcalf (Physics) B.S., University of California, Los Angeles 1967.
Thesis: The Recoil Proton Polarization in π photoproduction From Deuterium Between 450 and 950 MeV and a Partial Wave Analysis of γn→πp in the Resonance Region.

Howard Cary Morris (Mathematics) B.S., Louisiana Polytechnic Institute 1969.
Thesis: Two Pigeon Hole Principles and Unions of Convexly Disjoint Sets.


Bruce Kent Richard (Mathematics) B.S., Georgia Institute of Technology 1969.

Rafael Sorkin (Physics) A.B., Harvard University 1966.

Saul Arno Teukolsky (Physics) B.S., University of Witwatersrand, Johannesburg 1970.

Glenn John Veeder, Jr. (Astronomy) S.B., Massachusetts Institute of Technology 1968.
Thesis: Temperatures and Luminosities of M Type Dwarfs from Infrared Photometry.

Andrew Benjamin White, Jr. (Applied Mathematics) B.A., University of Texas 1969.

Ming Lun Yu (Physics) B.Sc., University of Hong Kong 1966; M.Sc. 1969; M.S., California Institute of Technology 1971.
Thesis: An Experimental Study of Nonequilibrium Superconductivity.
Prizes and Awards

GEORGE W. GREEN MEMORIAL AWARD
Awarded to the undergraduate student who, in the opinion of the division chairmen, has shown outstanding ability and achievement in creative scholarship.
Kenneth Stephen Jancaitis

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.

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.
Claude Anderson
José Cabezon
Margaret Evans
Kathleen Kong
Gary Wakai

DAVID JOSEPH MacPHerson PRIZE IN ENGINEERING
Awarded to the graduating senior in engineering who best exemplifies excellence in scholarship.
Siu Joe Poon

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.
Jonathan Marc Teich, sophomore
Richard Steven Gruner, junior

HAREN LEE FISHER MEMORIAL AWARD IN JUNIOR PHYSICS
Awarded to a junior physics major who demonstrates the greatest promise of future contributions in physics.
Joseph G. Polchinski
PRIZES AND AWARDS—Continued

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

David Langdon Glackin

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

Christopher Henley, freshman

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.

Dale Eric Bredesen
Barry Arthur Cipra

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

Roland Robert Lee

ERIC TEMPLE BELL UNDERGRADUATE MATHEMATICS RESEARCH PRIZE
Awarded to one or more juniors or seniors for outstanding original research in mathematics.

David Dummit, junior

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: Kenneth Sanders Suslick