Eighty-Fourth Annual Commencement

June 9, 1978

CALIFORNIA INSTITUTE OF TECHNOLOGY

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Eighty-Fourth Annual Commencement

FRIDAY MORNING AT TEN-THIRTY O'CLOCK
JUNE NINTH, NINETEEN SEVENTY-EIGHT

The Commencement Ceremony

These tribal rites have a very long history. They go back to the ceremony of initiation for new university teachers in mediaeval Europe. It was then customary for students, after an appropriate apprenticeship to learning and the presentation of a thesis as their masterpiece, to be admitted to the Guild of Masters of Arts and granted the license to teach. In the ancient University of Bologna this right was granted by authority of the Pope and in the name of the Holy Trinity. We do not this day claim such high authority.

As in any other guild, whether craft or merchant, the master's status was crucial. In theory at least, it separated the men from the boys, the competent from the incompetent. On the way to his master's degree, a student might collect a bachelor's degree in recognition of the fact that he was half-trained, or partially equipped. The doctor's degree was somewhat different. Originally indistinguishable from the masters, the doctors gradually emerged by a process of escalation into a supermagisterial role—first of all in the higher faculties of theology, law, and medicine. It will come as no surprise that the lawyers had a particular and early yen for this special distinction.

These gradations and distinctions are reflected in the quaint and colorful niceties of academic dress.

Of particular interest is the cap or mortarboard. In the form of the biretta it was the peculiar sign of the master. Its use has now spread far beyond that highly select group to school boys and choir girls and even to the nursery school. *Sic transit. . . .*

The gown, of course, is the basic livery of the scholar, with its clear marks of rank and status—the pointed sleeves of the bachelor, the oblong sleeves of the master, the full sleeves and velvet trimmings of the doctor. The doctors, too, may depart from basic black and break out into many colors—Harvard crimson or Yale blue or the scarlet splash of Oxford.

Color is the very essence of the hood: color in the main body to identify the university; color perhaps in the binding to proclaim the subject of the degree—orange for engineering, gold for science, the baser copper for economics, white for arts and letters, green for medicine, purple for law, scarlet for theology, and so on. Size is a further variable, as the hoods tend to lengthen from the three feet of the bachelor to the four of the doctor. So the birds are known by their plumage.

With this color and symbolism which is mediaeval though mutated, we stage our brief moment of pageantry, paying homage to that ancient community of scholars in whose shadow we stand and acknowledging our debt to the university as one of the great institutional constructs of the middle ages. While looking back, however, we also celebrate the achievements of this present generation of students and look forward to the future of these our younger colleagues, whom we now welcome to our midst.

David C. Elliot
Secretary of the Faculty

Academic Procession

Marshals

Arden L. Albee, Ph.D.
Harry B. Gray, Ph.D.
J. Kent Clark, Ph.D.
Robert V. Langmuir, Ph.D.
Robert W. Oliver, Ph.D.

Faculty Officers

James J. Morgan, Ph.D.
David L. Goodstein, Ph.D.
David C. Elliot, 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

FACULTY OFFICERS

THE FACULTY

THE CHAIRMEN OF DIVISIONS

THE DEANS

THE TRUSTEES

THE COMMENCEMENT CHAPLAIN

THE ACTING 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, M.S.

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

INVOCATION . . . . . The Reverend Stanley W. Lewis
Friendship Baptist Church, Pasadena

COMMENCEMENT ADDRESS . . . "The Arrow of Time—
Beginning and End"
Max Delbrück, Ph.D., Sc.D., Nobel Laureate
Board of Trustees Professor of Biology, Emeritus
California Institute of Technology

MUSICAL SELECTION . . . . The Caltech Men's Glee Club
Olaf M. Frodsham, A.M., Director

Confirma Hoc Deus, by Jacob Handl

CONFERRING OF DEGREES . . . . Robert F. Christy, Ph.D.
Acting President
California Institute of Technology

PRESENTATION OF CANDIDATES FOR DEGREES

For the Degree of Bachelor of Science . . Ray D. Owen, Ph.D., Sc.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 . . . . . Norman H. Horowitz, Ph.D.
Division Chairman

Chemistry and Chemical Engineering . . John H. Seinfeld, Ph.D.
Executive Officer for Chemical Engineering

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

Geological and Planetary Sciences . . . Arden L. Albee, Ph.D.
Academic Officer for Geological and Planetary Sciences

Humanities and Social Sciences . . . Rodman W. Paul, Ph.D.
Acting Division Chairman

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

CONCLUDING REMARKS . . . . Acting President Christy

BENEDICTION . . . . . Reverend Lewis

RECESSIONAL . . . The Convocation Brass Ensemble and Organ

ORGAN POSTLUDE . . . . . Leslie Deutsch

Candidates for Degrees

BACHELOR OF SCIENCE

Richard O. Ackermann *Bern, Switzerland* Astronomy and Geophysics
Triantaphyllos R. Akylas *Athens, Greece* Physics
Joseph John Alonis *Portland, Oregon* Engineering and Applied Science
Gary Allen Anwyl *Huntington Beach, California* Engineering and Applied Science
Joseph David Arpaia *Granada Hills, California* Mathematics
Lee C. Aydelotte *Manhattan Beach, California* Mathematics
Michael John Aziz *West Boylston, Massachusetts* Applied Physics
Bruce Don Baker *Torrance, California* Applied Physics
Wayne Michael Baxter *Sunnyvale, California* Engineering and Applied Science
Jill Eleanor Bechtold *New York, New York* Astronomy
Bill Behen *Youngstown, Ohio* Engineering and Applied Science
Marc Stuart Berger *Montreal, Quebec, Canada* Chemistry and Biology
George Lawrence Best *Bellevue, Washington* Engineering and Applied Science
Edward Joseph Bielecki, Jr. *Alexandria, Virginia* Chemistry
R. Jeffrey Blair *Honolulu, Hawaii* History
Gary Raymond Bodie III *Hampton, Virginia* Engineering and Applied Science
Gregory Alan Bone *Punxsutawney, Pennsylvania* Engineering and Applied Science
Douglas Evan Brandt *Columbia Heights, Minnesota* Mathematics and Applied Physics
William Eugene Bratton II *Washington, District of Columbia* Applied Mathematics
Susan Kathleen Brazeal *Albuquerque, New Mexico* Applied Mathematics
Chris Allen Broka *Chatsworth, California* Chemistry
Steven Mitchell Brown *Canoga Park, California* Chemical Engineering
James Lee Brubaker *Delphi, Indiana* Engineering and Applied Science
Lois Freeman Brubaker *Yreka, California* Biology and Chemistry
Arthur Jun Buto *Laurel, Maryland* Astronomy
José Ignacio Cabezón *Framingham, Massachusetts* Independent Studies Program
Robert John Calvet *Altadena, California* Engineering and Applied Science
Daniel Gordon Canin *Poughkeepsie, New York* Applied Physics
Steven Samuel Chaiken *Palo Alto, California* Applied Mathematics
Johnny Kwok Bun Chan *Pasadena, California* Engineering and Applied Science
Yuk-Lun Chan *Hong Kong* Engineering and Applied Science
Yuk-sun Chan *Hong Kong* Physics

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

BACHELOR OF SCIENCE—*Continued*

Michael Paul Chandler *Lamont, California* Mathematics
Brian Kent Chaney *Long Beach, California* Engineering and Applied Science and Economics
Robert Bruce Chess *Palos Verdes Estates, California* Engineering and Applied Science
Wilbert Chew *Seattle, Washington* Applied Physics
Donald Chin *West Los Angeles, California* Engineering and Applied Science
Michael George Chong *Los Angeles, California* Engineering and Applied Science
Young-il Choo *Seoul, Korea* Mathematics
Mark Claudson *Richland, Washington* Physics
William Rex Clingan *Berkeley, Missouri* Chemical Engineering
Alan Elbert Comer *Kent, Washington* Engineering and Applied Science
Bruce Gilbert Cortez *Elmont, New York* Physics
Gary W. Cox *Palos Verdes Estates, California* History
Matt Crawford *Milwaukee, Wisconsin* Applied Mathematics and Physics
Timothy Ernald Cushing *Huntington Beach, California* Engineering and Applied Science
William Clifford Danchi *Chapel Hill, North Carolina* Physics
Jon Anderson Dart *Calimesa, California* Engineering and Applied Science
Erik Penn DeBenedictis *Newark, Ohio* Engineering and Applied Science
Marta D. deJesus *Union City, California* Chemistry
Javier del Valle *El Paso, Texas* Engineering and Applied Science
Richard Alan Dermer *Monroeville, Pennsylvania* Engineering and Applied Science
Alvin Joseph Drehman *Miami, Florida* Applied Physics
Brian Douglas Dyer *Richardson, Texas* Chemical Engineering
Kenneth Franklin Ekström *Winslow, Arizona* Engineering and Applied Science
Philip Lee Engelauf *Riverside, California* Engineering and Applied Science
Stephen Michael Eppley *Silver Spring, Maryland* Engineering and Applied Science
Robert Warren Erickson, Jr. *Pacific Palisades, California* Engineering and Applied Science
Jill Suzanne Evensizer *Long Beach, California* Geology
Andrew H. Falls *Del Rio, Texas* Chemical Engineering
James Eric Findley *Rolla, Missouri* Chemical Engineering
LeRoy James Fisher II *Longview, Washington* Engineering and Applied Science
Robert Steven Forgey *Seattle, Washington* Engineering and Applied Science
Richard John Frechen *Garden City, New York* Chemistry
Richard Brownley Gayle III *Houston, Texas* Biology
Carol Ann Geller *New York, New York* Geophysics
Martin Jeffry Goldberg *Levittown, Pennsylvania* Chemistry
Duane Robert Gray *Vale, Oregon* Engineering and Applied Science
Gary Paul Gray *Seattle, Washington* Engineering and Applied Science
Joel Brent Gunter *Weatherford, Oklahoma* Biology and Chemistry

Douglas Gene Hager *Glendora, California* Engineering and Applied Science
Burl M. Hall *Mill Run, Pennsylvania* Physics
Rebecca Lee Hartsfield *South Pasadena, California* Geology
Mathew Thomas Heffron *Los Alamitos, California* Engineering and Applied Science
Lisa Cox Heinz *Coronado, California* Biology
Marcus Hobbs Henderson *San Angelo, Texas* Engineering and Applied Science
George Stephen Hendrickson *Lake Alfred, Florida* Engineering and Applied Science
Neil David Hickey *Kennebunk, Maine* Engineering and Applied Science
Scott Howard Hochwald *Brooklyn, New York* Mathematics
Saif Mohammed Hussain *Karachi, Pakistan* Engineering and Applied Science
Frank John Jakovac *Winnipeg, Manitoba, Canada* Physics
David Lawrence Johannsen *San Gabriel, California* Engineering and Applied Science
Eric William Kaler *Alamogordo, New Mexico* Chemical Engineering
Edward Neal Keller *Beverly Hills, California* Physics and Geophysics
Stephen Edward Kellogg *Ledyard, Connecticut* Physics
Miral Eonhah Kim-E *Chatsworth, California* Chemical Engineering
Bing Ho Ko *Kowloon, Hong Kong* Chemical Engineering
Sandra Jean Koch *Victoria, Texas* Biology
Leslie Dean Kohn *San Mateo, California* Physics
Kerry Alan LaPrade *Dallas, Texas* Engineering and Applied Science
Kristen Marie Larson *Gainesville, Florida* Chemical Engineering
Kam-Yin Lau *Hong Kong* Engineering and Applied Science
Nelson Shen-Tsai Lee *Northridge, California* Applied Physics
Lawrence Lesyna *San Jose, California* Physics
Donald A. Lieberman *Torrance, California* Physics
Eric Kurt Lucha *Laguna Beach, California* Biology
Richard Charles Lye *Towson, Maryland* Physics
Moses Lin Ma *Monterey Park, California* Physics
Man-Chung Mak *Hong Kong* Physics
Margaret Ann Marshall *Omaha, Nebraska* Biology
Antonio Alfonso Martínez Marroig *Mission Viejo, California* Engineering and Applied Science
Lloyd Murat Maxson *Westlake Village, California* Physics
James Bruce McBeath *Seattle, Washington* Engineering and Applied Science
Thomas Joseph McDonnell *Buffalo, New York* Chemistry
Roy Desmond Mead *Seattle, Washington* Chemistry and Engineering and Applied Science
David Michael Moreno *Estacada, Oregon* Physics
Ray Bowen Morris *Pasadena, California* Biology
James David Morrow *Wilmette, Illinois* Mathematics
Lawrence Ira Mortin *Los Angeles, California* Biology

Francis Ken Mukai *Santa Monica, California* Engineering and Applied Science
James Hilary Mullany *Alexandria, Virginia* Geology
Harry S. Myers III *Covina, California* Engineering and Applied Science
Joel Ryuichi Okazaki *Honolulu, Hawaii* Applied Physics
Robert Khoren Ouzounian *Los Angeles, California* Engineering and Applied Science
Yuri Owechko *Greeley, Colorado* Applied Physics
Alan William Paeth *Mercer Island, Washington* Engineering and Applied Science
Ralph Henry Page *Endwell, New York* Physics
Dimitris Antony Papantoniou *Athens, Greece* Engineering and Applied Science
Leland S. Paul *Salem, Oregon* Chemistry
John Leonard Pender *Fairfield, California* Engineering and Applied Science
George Donald Penrod *Portales, New Mexico* Astronomy
Joseph Francis Pineau *Natick, Massachusetts* Engineering and Applied Science
Stephen Patrick Pope *San Francisco, California* Mathematics and Engineering and Applied Science
Mark Poyser *Los Angeles, California* Engineering and Applied Science
Daniel John Rader *Sonora, California* Engineering and Applied Science
Christopher Edward Reed *Toronto, Ontario, Canada* Physics
Daniel Steven Rimkus *Troy, Ohio* Chemistry
Gilbert Nicholas Roderman *Palos Verdes Estates, California* Physics
Diane Eileen Ross *Lincoln, California* Chemical Engineering
Joshua Elliott Rothenberg *Claremont, California* Applied Physics
Douglas Brian Rountree *Thunderbolt, Georgia* Engineering and Applied Science
Eileen Patricia Leslie Roy *Fullerton, California* Biology and Literature
Timothy Daniel Ryan *Los Angeles, California* Physics
Louise Jane Saffman *Pasadena, California* Astronomy
Steven Alan Schafer *Vacaville, California* Engineering and Applied Science
Charles William Schlindwein *Canoga Park, California* Mathematics
Michael Alan Schwartz *Ventura, California* Engineering and Applied Science
Larry Dean Seiler *Torrance, California* Engineering and Applied Science
Kenneth Paul Severin *Gainesville, Virginia* Geology
Christopher Steven Sexton *Riverside, California* Applied Physics
Michael Myungsup Shin *Union City, California* Physics
Paul D. Shubert *Burbank, Illinois* Applied Physics
Narinder Pal Singh *Pasadena, California* Engineering and Applied Science
Stephen Dean Smith *Sarasota, Florida* Engineering and Applied Science
Anthony Sneed *Saugus, California* Engineering and Applied Science
Michael Louis Steigerwald *Phoenix, Arizona* Chemistry
James Smith Swenson, Jr. *Northridge, California* Applied Physics
Constantine Emmanuel Synolakis *Athens, Greece* Engineering and Applied Science

BACHELOR OF SCIENCE—*Continued*

Kenneth Lloyd Tanaka *Seattle, Washington* Geology
Louis Charles Testa *Los Angeles, California* Engineering and Applied Science
Suwat Thaniyavarn *Bangkok, Thailand* Engineering and Applied Science
Carol Thompson *Aurora, Illinois* Engineering and Applied Science
Janet Maureen Towner *Pasadena, California* Engineering and Applied Science
Kwok Yeung Tsang *Hong Kong* Physics
David Philip Walker *Owings Mills, Maryland* Economics
John Charles Wathey *Charlotte, North Carolina* Biology
Albert Lewis Wells, Jr. *El Cajon, California* Mathematics
Chris Duane Wheeler *Sarasota, Florida* Applied Physics
Erling Henry Wold *Garden Grove, California* Engineering and Applied Science
David Shan-Hill Wong *Hong Kong* Chemical Engineering
Ella H. Wong *Skokie, Illinois* Engineering and Applied Science
Keeman Hong-Kee Wong *Kwangtung, China* Engineering and Applied Science
Diane Marie Wunderlich *Placentia, California* Chemical Engineering
James Hideto Yamamoto *Lihue, Hawaii* Engineering and Applied Science
Ronald Kenichi Yamamoto *Carson, California* Chemical Engineering
Kimo Bernard Yap *Sepulveda, California* Chemistry
King-Wah Walter Yeung *Los Angeles, California* Engineering and Applied Science
Josef Benjamin Zwass *Sherman Oaks, California* Biology

MASTER OF SCIENCE

Timothy Jon Abrott *(Environmental Engineering Science)* B.S., University of California, Berkeley 1977.

Constantine S. Ananiades *(Engineering Science)* A.B., Dartmouth College 1960; M.S., California Institute of Technology 1961; M.B.A., Pepperdine University 1977.

Lee C. Aydelotte *(Engineering Science)* B.S., California Institute of Technology 1978.

Ray Hayward Bartlett III *(Aeronautics)* B.S., United States Air Force Academy 1977.

Farhad Barzegar *(Electrical Engineering)* B.S., Arya-Mehr University of Technology 1977.

David Wayne Beaty *(Geology)* B.A., Dartmouth College 1975.

Jay Edward Bennett *(Materials Science)* B.S., Stetson University 1977.

Carl Hilmer Berdahl *(Aeronautics)* B.S., United States Air Force Academy 1977.

Clarke Berdan II *(Chemical Engineering)* B.S., University of California, Berkeley 1975.

Paul Norwood Booth *(Electrical Engineering)* B.S., University of California, Davis 1977.

Mark Bruce Boslough *(Applied Physics)* B.S., Colorado State University 1977.

Jerome Ross Breitenbach *(Electrical Engineering)* B.S., E.E.E., California State Polytechnic University, Pomona 1977.

David Bruce Bruns *(Environmental Engineering Science)* B.S., University of California, Davis 1977.

Charles Soutter Campbell *(Mechanical Engineering)* B.A., Vassar College 1977.

David Maxwell Cannon *(Chemistry)* B.S., Brigham Young University 1976.

Randall Lloyd Carlson *(Geophysics)* B.S., New Mexico Institute of Mining and Technology 1975.

Christopher Jeyaparan Catherasoo *(Aeronautics)* B.A., University of Cambridge 1971.

Louis Pierre Cazaubon *(Electrical Engineering)* Diplôme d'Ingénieur, Ecole Nationale Supérieure des Techniques Avancées 1977.

Steven Samuel Chaiken *(Electrical Engineering)* B.S., California Institute of Technology 1978.

Dimitri S. Chamieh *(Mechanical Engineering)* S.B., Northwestern University 1977.

Yuk-Lun Chan *(Mechanical Engineering)* B.S., California Institute of Technology 1978.

Yia-chung Chang *(Physics)* B.S., Cheng-Kung University 1974.

Reazuddin Ahmed Chaudhuri *(Applied Mechanics)* B.E., University of Calcutta 1969; M.S., Indian Institute of Technology, Madras 1974.

David Arthur Chin *(Civil Engineering)* B.Sc., University of the West Indies 1977.

Josephine Beatrice Cimino *(Planetary Science)* B.S., University of California, Berkeley 1976.

Wyman David Clark *(Environmental Engineering Science)* B.Sc., University of Tennessee, Knoxville 1975.

Steward J. Cline *(Aeronautics)* B.S.A.E., Tri-State University 1976.

Stephen Norfleet Cohn *(Geophysics)* A.B., Harvard College 1975.

Nicholas Albert Copping *(Physics)* B.S., California State University, Los Angeles 1976.

Jean-Luc Cornet *(Engineering Science)* Diplôme d'Ingénieur, Ecole Spéciale de Mécanique et d'Electricité 1977.

Mohammad Davarpanah-Jazi *(Engineering Science)* B.S., School of Planning and Computer Applications 1977.

Nicki Lee Davis *(Chemistry)* B.S., Point Park College 1974.

Daniel Richard Dawson *(Chemistry)* B.S., University of California, Santa Barbara 1975.

Jack David Dodd *(Aeronautics)* B.S., United States Naval Academy 1970.

Mark B. Dolson *(Electrical Engineering)* B.S., Carnegie-Mellon University 1976.

Marc Daniel Donner *(Electrical Engineering)* B.S., California Institute of Technology 1976.

John Joseph Dvorak *(Planetary Science)* B.S., University of Washington 1974.

Fred M. Dycus, Jr. *(Mechanical Engineering)* B.S.M.E., Memphis State University 1976.

James Conrad Eisenach *(Chemistry)* B.A., University of Nebraska 1976.

Edward William Fall *(Geology)* B.S., University of California, Los Angeles 1976.

David Faulkner *(Mechanical Engineering)* B.A., Whitman College 1977; B.S., California Institute of Technology 1977.

Frank Paul Festini *(Electrical Engineering)* B.S., Harvey Mudd College 1977.

Carol Leslie Frand *(Mechancial Engineering)* B.S.M.E., University of Miami 1977.

Christopher Lee Frenzen *(Applied Physics)* B.A., The University of Chicago 1976.

Andrew Keith Gabriel *(Applied Physics)* Sc.B., Brown University 1975.

Michael David Greig *(Physics)* B.A., University of Cambridge 1977.

Samy Maurice Hanna *(Electrical Engineering)* B.Sc., Alexandria University 1971; M.Sc., 1975.

Jeffrey Arthur Hiltner *(Electrical Engineering)* B.S., University of California, Los Angeles 1977.

Wiley Don Holcombe, Jr. *(Applied Mechanics)* B.S., Georgia Institute of Technology 1977.

Arturo M. Homs *(Electrical Engineering)* B.S., University of Florida 1976.

Stuart Thomas Hopkins *(Applied Physics)* B.Sc., Queen's University at Kingston 1977.

James Evan Houseworth *(Environmental Engineering Science)* B.S., California Institute of Technology 1977.

Behnam Hushmand *(Civil Engineering)* B.S., Arya-Mehr University of Technology 1977.

James Drew Hussin *(Civil Engineering)* B.S., Columbia University 1977.

Douglas Kerry Ikemi *(Mechanical Engineering)* B.S., Harvey Mudd College 1976.

Robert Mark Isaac *(Social Science)* B.S.F.S., Georgetown University 1976.

Ralph Boyd James *(Applied Physics)* B.S., University of Tennessee, Knoxville 1976; M.S., Georgia Institute of Technology 1977.

David Lawrence Johannsen *(Engineering Science)* B.S., California Institute of Technology 1978.

John Hume Jones *(Geochemistry)* B.G.S., University of Kentucky 1974.

Janet Roberta Kallo *(Biology)* B.A., University of California, Berkeley 1975.

Joseph Katz *(Mechanical Engineering)* B.Sc., Tel-Aviv University 1977.

Richard Morris Katz *(Engineering Science)* S.B., Massachusetts Institute of Technology 1972; S.B., 1974.

Arieh Königl *(Physics)* A.B., University of California, Berkeley 1975.

Thomas Francis Kuech *(Applied Physics)* B.S., Marquette University 1976; M.S., 1977.

Mark Robert Laessig *(Aeronautics)* B.S., Case Western Reserve University 1977.

Kam-Yin Lau *(Electrical Engineering)* B.S., California Institute of Technology 1978.

David Anthony Leighton *(Applied Mathematics)* S.B., Massachusetts Institute of Technology 1976.

Jesus Leyva Ramos *(Electrical Engineering)* B.S., Universidad Autónoma de San Luis Potosí 1975.

John Kevin Markey *(Physics)* B.S., California State University, San Diego 1975.

Antonio Alfonso Martínez Marroig *(Electrical Engineering)* B.S., California Institute of Technology 1978.

Amelia Marie Maxted *(Electrical Engineering)* B.S., Michigan State University 1976.

William McCown *(Electrical Engineering)* B.S., California Institute of Technology 1977.

MASTER OF SCIENCE—*Continued*

Kevin John Meaney *(Mechanical Engineering)* B.S., University of Pennsylvania 1977.

Barry Bruce Megdal *(Engineering Science)* B.S., California Institute of Technology 1977.

Kristian Erik Meisling *(Geology)* B.S., University of California, Los Angeles 1977.

Ronald Benjamin Melton *(Engineering Science)* B.S.E.E., University of Washington 1977.

Arthur Ira Metz *(Applied Mathematics)* B.A., University of California, Los Angeles 1973.

Paul Henry Milenkovic *(Electrical Engineering)* B.S., Northwestern University 1976.

Donald Evans Miser *(Geology)* B.S., Indiana University, Ft. Wayne 1976.

Manoochehr Mohseni-Koochesfahani *(Aeronautics)* B.S., Rensselaer Polytechnic Institute 1977.

Michael Charles Murphy *(Aeronautics)* B.S.M.E., Cornell University 1977.

Frank Joseph Nagy *(Physics)* B.S., Carnegie-Mellon University 1971.

Duc Gia Nguyen *(Mechanical Engineering)* B.S., Carnegie-Mellon University 1977.

Louis Alexander Ortiz *(Civil Engineering)* B.S., University of Colorado 1977.

Tor Endre Ostbo *(Aeronautics)* B.Sc., University of Salford 1977.

Siranush Papazian *(Engineering Science)* B.A., Queens College of the City University of New York 1977.

Dan Laurence Peterka *(Mechanical Engineering)* B.A., University of California, San Diego 1977.

Charunya Phichitkul *(Chemical Engineering)* B.S., Stanford University 1976.

Richard Ian Pineles *(Civil Engineering)* B.S., B.C.E., Tufts University 1977.

Jonell Polansky *(Electrical Engineering)* B.F.A., Carnegie-Mellon University 1971.

Jim David Povlis *(Physics)* B.S., M.A., Kent State University 1976.

Jack Powell *(Electrical Engineering)* Baccalauréat C., Lycée J. B. Say 1968; Maîtrise, Université de Paris VI 1973; D.E.A., 1976.

Florence Prevosteau *(Electrical Engineering)* Diplôme d'Ingénieur, Ecole Supérieure d' Ingénieurs en Electrotechnique et Electronique 1977.

Per Gustaf Reinhall *(Applied Mechanics)* B.S.M.E., University of Washington 1977.

Mark Alan Richards *(Applied Physics)* B.S., The University of Texas, Austin 1977.

Joshua Elliott Rothenberg *(Electrical Engineering)* B.S., California Institute of Technology 1978.

John Edward Ruark *(Chemistry)* B.A., University of Redlands 1973.

Dean Lawrence Sanzo *(Mechanical Engineering)* B.S., California Institute of Technology 1977.

Conrad Nobushige Sato *(Physics)* B.S., University of California, Los Angeles 1969; M.S., California State University, Los Angeles 1976.

Helene R. Schember *(Engineering Science)* B.S.E., The Catholic University of America 1976.

John Patrick Schmitz *(Social Science)* B.A., Georgetown University 1976.

Edgard R. Schweig *(Electrical Engineering)* B.S., Brussels University 1977.

Henry Francis Shaw III *(Geology)* B.A., Amherst College 1977.

Kenji Shintani *(Applied Physics)* B.S., Osaka University 1973.

Kuniaki Shiraki *(Applied Mechanics)* B.S., Kyushu Institute of Technology 1969.

Virgil Simon Speriosu *(Applied Physics)* B.S., Case Western Reserve University 1976.

Brian L. Steelman *(Environmental Engineering Science)* B.S., Lafayette College 1977.

Tom Peter Sterk *(Electrical Engineering)* B.S., Cornell University 1976.

John Cary Stevenson *(Mechanical Engineering)* B.S., University of Illinois, Chicago Circle 1977.

Maureen Celinda Stone *(Engineering Science)* B.S., University of Illinois, Urbana 1973; M.S., 1976.

David Michael Strand *(Chemical Engineering)* B.S., University of Minnesota, Minneapolis 1977.

Eugene Szedenits, Jr. *(Physics)* B.S., Case Western Reserve University 1975.

Kenneth Lloyd Tanaka *(Geology)* B.S., California Institute of Technology 1978.

Michael A. Tenhover *(Applied Physics)* B.S., University of Cincinnati 1976.

Tayfun Ersin Tezduyar *(Mechanical Engineering)* B.S., Middle East Technical University 1977.

Suwat Thaniyavarn *(Electrical Engineering)* B.S., California Institute of Technology 1978.

Paul Arthur Thomas *(Social Science)* B.S., California Institute of Technology 1974.

David Walker Thompson *(Aeronautics)* S.B., Massachusetts Institute of Technology 1976.

Judy Carol Thompson *(Aeronautics)* S.B., Massachusetts Institute of Technology 1977.

William James Tiffany *(Electrical Engineering)* B.S., The University of Texas, Austin 1977.

Yuenkeung Albert Tong *(Mechanical Engineering)* B.Sc., University of Hawaii, Manoa 1977.

Lloyd Richard Townley *(Environmental Engineering Science)* B.E., University of Sydney 1976.

George Triantafyllou *(Civil Engineering)* Diploma of Civil Engineer, National Technical University of Athens 1977.

MASTER OF SCIENCE—*Continued*

Bor-Yeu Tsaur *(Electrical Engineering)* B.S., National Taiwan University 1977.

Yau Kwong Tsui *(Civil Engineering)* B.Sc., Columbia University 1977.

Paul William Tuinenga *(Electrical Engineering)* B.S., California Institute of Technology 1977.

Jean Uwate *(Electrical Engineering)* B.S., California Institute of Technology 1977.

Nikolaos Petrou Vasilakos *(Chemical Engineering)* Diploma, National Technical University of Athens 1976.

Laurance Allin Weber *(Electrical Engineering)* B.S., Cornell University 1977.

Michael Ben Weimer *(Physics)* S.B., Massachusetts Institute of Technology 1976.

Robert Kenneth Welch *(Mechanical Engineering)* B.S., California State Polytechnic University, Pomona 1977.

Albert Lewis Wells, Jr. *(Mathematics)* B.S., California Institute of Technology 1978.

James Michael Winget *(Applied Mechanics)* B.S., University of Cincinnati 1977.

Ella H. Wong *(Environmental Engineering Science)* B.S., California Institute of Technology 1978.

Stephen Gregory Wurst *(Aeronautics)* B.S., United States Air Force Academy 1977.

Jeffrey Chung-Lau Yuen *(Applied Physics)* B.A., Cornell University 1977.

Michael Anthony Zampaglione *(Electrical Engineering)* B.S., Trinity College 1977.

Barton Zwiebach *(Electrical Engineering)* B.S., Universidad Nacional de Ingeniería 1977.

ENGINEER

Uy-Loi Ly *(Aeronautical Engineer)* B.S., University of California, Davis 1975; M.S., California Institute of Technology 1976.

Rodney Tak Masumoto *(Electrical Engineer)* B.S., California Institute of Technology 1972; M.S., 1974.

Stephen Taylor Neely *(Electrical Engineer)* B.S., Ottawa University 1974; M.S., California Institute of Technology 1975.

Ernst Norman Tangren *(Aeronautical Engineer)* B.S., University of Washington 1975; M.S., California Institute of Technology 1976.

DOCTOR OF PHILOSOPHY

DIVISION OF BIOLOGY

Antony Clifford Bakke *(Biochemistry)* B.S., Washington State University 1971.
Thesis: Studies on the Chromatin of the Cellular Slime Mold, *Dictyostelium discoideum.*

Welcome Bender *(Biology)* A.B., Harvard College 1971.
Thesis: Electron Microscopic Studies of Sequence Arrangement: Poly (A) Mapping, RNA Tumor Viruses, and Slime Mold Actin Genes.

Sheila Gillard Crewther *(Biology)* B.Sc., University of Melbourne 1969; M.Sc., 1971.
Thesis: Plasticity in the Cat Visual System.

Jay Barry Edelman *(Biophysics)* S.M., Massachusetts Institute of Technology 1973.
Thesis: Statistical Mechanics of Biological Membranes: Protein Aggregation and Lipid Ordering.

Teryl Kenneth Frey *(Biochemistry and Genetics)* B.S., Iowa State University 1971; M.S., 1972.
Thesis: Biochemical and Biophysical Studies on the RNA Species of Sindbis Virus.

Karen Faye Greif *(Psychobiology and Biochemistry)* A.B., Brown University 1973.
Thesis: Memory Processing in Chickens and Goldfish.

Stanley Hoffman *(Cell Biology)* S.B., Massachusetts Institute of Technology 1972.
Thesis: The Role of the Plasma Membrane in the Development of the Cellular Slime Mold, *Dictyostelium discoideum.*

Henry Vincent Huang *(Biochemistry)* A.B., Occidental College 1972.
Thesis: I. The Ontogenetic Expression of Antibody Variable-Region Genes in the Chicken. II. Methods for Fractionation of Plasma Membranes and Membrane Proteins.

Robert Edward Sheridan, Jr. *(Neurophysiology and Biochemistry)* B.S., Colorado State University 1972.
Thesis: Kinetics and Equilibria at Nicotinic Receptor in *Electrophorus electricus* and *Raia erinacea* Electroplaques.

Barbara Landale Stitt *(Biochemistry and Genetics)* B.A., Reed College 1971.
Thesis: Role of the Host Cell in Bacteriophage T4 Development.

Duncan Knight Stuart *(Neurophysiology and Genetics)* B.S., Yale University 1968.
Thesis: The Neurosecretion of the Polypeptide Egg-laying Hormone (ELH) from the Bag Cells, Neuronal Sites of Action of ELH, and Circadian Release of Polypeptides from the Eye of *Aplysia californica.*

David Tang *(Biophysics)* A.B., University of California, Berkeley 1969.
Thesis: A DNA Nicking-Closing Enzyme from Mouse L Cells.

When more than one field of study is indicated, the first is the major and the second and others are minors.

DOCTOR OF PHILOSOPHY — *Continued*

Christopher Mark West *(Cell Biology)* B.S., University of Florida 1973.
Thesis: I. Glycoproteins and Development in the Cellular Slime Mold *Dictyostelium discoideum*. II. Separation of Cells Using Isopycnic Centrifugation in Linear Density Gradients of Colloidal Silica.

Barbara J. Wold *(Developmental Biology)* B.S., Arizona State University 1973.
Thesis: Studies of Structural Gene Transcripts in Sea Urchin Embryos and Adult Tissues.

DIVISION OF CHEMISTRY AND CHEMICAL ENGINEERING

Robert James Almassy *(Chemistry)* B.S., University of Redlands 1971.
Thesis: Structure Determination and Refinement of *Pseudomonas aeruginosa* Cytochrome c_{551} at 2.0 A Resolution.

Catherine Louise Coyle *(Chemistry)* B.A., Hunter College 1974.
Thesis: Mechanism of Electron Transfer in Cytochromes and Blue Copper Proteins.

John Patrick Dwyer *(Chemistry)* B.A., DePauw University 1973; M.S., California Institute of Technology 1976.
Thesis: Quantum Mechanical Studies of Molecular Scattering.

James Brian Flanagan *(Chemistry)* B.S., Texas Tech University 1972; M.S., 1974.
Thesis: Some Investigations in Theoretical and Experimental Electrochemistry.

Robert Paul Frueholz *(Chemistry)* B.S., Harvey Mudd College 1973.
Thesis: Electronic Spectroscopy of Various Molecular Systems by Low-Energy, Variable Angle, Electron Impact.

Andrew Michael Goetze *(Chemistry)* B.Sc., The University of British Columbia 1973.
Thesis: Nuclear Magnetic Resonance Studies of Immunoglobulins. I. Structure-Function Relationships in Phosphorylcholine-Binding Mouse Myeloma Antibodies. II. ^{19}F NMR Studies of Trifluoroacetonylated Immunoglobulins as a PProbe of Antibody Conformation.

Ronald Vernon Hodges *(Chemistry)* B.S., Bethany Nazarene College 1973.
Thesis: Gas Phase Ion-Molecule Chemistry. I. Ion Cyclotron Resonance Investigations of Organophosphorus Compounds. II. Reactions of Aluminum Ions with Alkyl Halides.

Valerie Wailin Hu *(Chemistry and Biology)* B.S., University of Hawaii, Honolulu 1972.
Thesis: Structure-Function Studies on Cytochrome *c* Oxidase. I. An Investigation into the Nature of the Metal Sites in Cytochrome *c* Oxidase Using X-Ray Absorption Spectroscopy. II. An Investigation into the Lipid Factors Affecting Protein Activity and Respiratory Control in Reconstituted Cytochrome *c* Oxidase Membranes.

Mark Keil *(Chemistry)* B.A., Colgate University 1973.
Thesis: Interaction Potentials of Helium with Atoms and Molecules from Crossed Beam Experiments.

Robert James Kinney *(Chemistry)* B.S., Iowa State University 1971; M.S., California Institute of Technology 1972.
Thesis: I. Synthesis and Characterization of the New Cyclopentadienyl Vanadium Tricarbonyl Hydride and Methyl Anions and Their Reactions with Organic Substrates. II. Monomeric Organometallic Dianions.

Dale Alvin Kooistra *(Chemistry)* B.A., Hope College 1972.
Thesis: Magnetic Resonance Studies of the Binding Site Interactions between ^{19}F Labelled Nitrophenyl Haptens and Specific Mouse Myeloma Immunoglobulin MOPC-315.

Sudarshan Kumar *(Chemical Engineering)* B. Tech., Indian Institute of Technology, Kanpur 1972; M.S., California Institute of Technology 1974.
Thesis: Optimal Design of Distributed Parameter Measurement Systems.

Brian Kent Lamb *(Chemistry)* B.S., Idaho State University 1973.
Thesis: Development and Application of Dual Atmospheric Tracer Techniques for the Characterization of Pollutant Transport and Dispersion.

Donald Robert McAlister *(Chemistry)* B.S., University of Oregon 1971; M.S., 1973.
Thesis: Organometallic Reaction Mechanisms: Catalytic Cyclotrimerization of Alkynes, Reduction of Carbon Monoxide and Reductive Elimination from an Alkylhydride Complex.

Terry William Moody *(Chemistry)* B.S., University of California, Berkeley 1972.
Thesis: Biochemical Studies of the Nicotinic Acetylcholine Receptor from *Torpedo californica* Electroplax.

Marco Antonio Chaer do Nascimento *(Chemistry)* B.Sc., Escola de Quimica, Universidade Federal do Rio de Janeiro 1968; M. Sc., Instituto de Quimica 1973; M.S., California Institute of Technology 1977.
Thesis: I. Theoretical Studies of Photoionization. II. The Electronic Structure of Linear Polyenes.

Bruce Alan Parkinson *(Chemistry)* B.S., Iowa State University 1972.
Thesis: Experimental Studies of Interfacial Electrochemistry.

Pamela J. Peerce *(Chemistry)* B.S., Rensselaer Polytechnic Institute 1973.
Thesis: The Coordination Chemistry and Electrochemistry of Chromium (III) Complexes of Thiobis (Ethylenenitrilo) Tetraacetic Acid.

Nils Overgaard Petersen *(Chemistry and Biology)* B.Sc., University of Western Ontario 1972.
Thesis: Studies of Lipid-Lipid Interactions in Phospholipid Bilayer Membranes.

Thomas William Peterson *(Chemical Engineering)* B.S., Tufts University 1972; M.S., University of Arizona 1973.
Thesis: Aerosol Dynamics in an Urban Atmosphere.

DOCTOR OF PHILOSOPHY — *Continued*

Robert D. Sanner *(Chemistry)* B.S., Miami University, Ohio 1973.
Thesis: Synthetic and Structural Investigations of Dinitrogen, Carbonyl, Olefin, Dichloride, and Hydride Derivatives of Bis(Pentamethylcyclopentadienyl)Titanium and Zirconium.

Michael Allen Shippey *(Chemistry)* B.A., Rice University 1973.
Thesis: Trimethylsilyl Anions: Stereospecific Deoxygenation of Epoxides and Trimethylsilyldehalogenation of Aryl Halides.

Steven Andrew Spencer *(Chemistry)* B.A., Wesleyan University 1971.
Thesis: Studies on a Neurotoxic Protein: The 5 A Structure of α-Bungarotoxin.

Sally Anne Sullivan *(Chemistry)* B.A., Hunter College 1973.
Thesis: Ion Cyclotron Resonance Investigations of Negative Ion-Molecule Reactions.

Wayne Julius Thompson *(Chemistry)* B.S., Illinois Institute of Technology 1974.
Thesis: The Total Synthesis of Chlorotricolide; The Top Half.

Jerry Tobler *(Chemistry)* B.S., Cornell University 1973.
Thesis: Studies on Interaction of Plasminogen with Balb/c 3T3 and SV3T3 Cells in Culture.

William Charles Trogler *(Chemistry)* B.A., M.A., The Johns Hopkins University 1974.
Thesis: Electronic Spectroscopy and the Photochemistry of Compounds which Contain Quadruple Metal-Metal Bonds.

Philip Eric Wood *(Chemical Engineering)* B.A.Sc., University of Waterloo 1973.
Thesis: Studies of Mean Reynolds Stress Models of Turbulent Flow.

Ajit Prithiviraj Yoganathan *(Chemical Engineering)* B.Sc., University College, University of London 1973.
Thesis: Cardiovascular Fluid Mechanics. I. Fluid Dynamics of Prosthetic Aortic Valves. II. Use of the Fast Fourier Transform in the Analysis of Cardiovascular Sounds.

DIVISION OF ENGINEERING AND APPLIED SCIENCE

Glen Rowan Cass *(Environmental Engineering Science and Economics)* B.S., University of Southern California 1969; M.S., Stanford University 1970.
Thesis: Methods for Sulfate Air Quality Management with Applications to Los Angeles.

Gene Alan Clough *(Applied Physics)* B.S., California Institute of Technology 1969; M.S., 1971.
Thesis: I. A Recirculating Charge-Coupled Device. II. The Mercury Selenide on N-Silicon Schottky Barrier.

Dwight William Decker *(Applied Mathematics)* B.Sc., McGill University 1972.
Thesis: Topics in Bifurcation Theory.

Walter K. De Logi *(Electrical Engineering and Physics)* Kandidaat, Ryksuniversiteit, Belgium 1970; Burgerlyk Ingenieur 1973; M.S., California Institute of Technology 1974.
Thesis: Electromagnetic Wave Generation and Propagation in Gravitational Fields.

Daniel Bruce Diner *(Engineering Science and Neurophysiology and Business Economics and Management)* B.A., The Johns Hopkins University 1969; M.A., 1971; M.S., California Institute of Technology 1973.
Thesis: Hysteresis in Human Binocular Fusion: A Second Look.

Crockett Lane Grabbe *(Applied Physics)* B.S., The University of Texas, Austin 1972; M.S., 1973.
Thesis: Resonance Cones and Mode Conversion in a Warm Magnetized Bounded Plasma.

Gregory Prince Hamill *(Applied Physics and Astronomy)* A.B., Boston University 1971; M.S., California Institute of Technology 1972.
Thesis: Analysis of Defect Structures in High Purity Copper Single Crystals Using X-Ray Topographic Techniques.

Thomas Russell Holm *(Environmental Engineering Science and Chemistry)* B.S., Portland State University 1971; M.S., California Institute of Technology 1972.
Thesis: Trace Metals in Fresh Water Plankton.

Li-ho Raymond Hou *(Engineering Science and Neurobiology)* B.S., National Chiao Tung University 1970; M.S., California Institute of Technology 1973.
Thesis: The Programming Strategy of the Saccadic Eye Movement Control System.

Kochan Ju *(Electrical Engineering)* B.S.E., Cheng Kung University 1969; M.S., Taiwan University 1972; M.S., State University of New York, Stony Brook 1973.
Thesis: Magnetic Bubble Domain and Domain Wall Dynamics in Gradient Translation.

Peter D. Kirkwood *(Environmental Engineering Science and Biology)* S.B., Massachusetts Institute of Technology 1966; M.S., California Institute of Technology 1972.
Thesis: Seasonal Patterns in the Growth of the Giant Kelp, *Macrocystis pyrifera.*

Keith Koenig *(Aeronautics)* B.S., Mississippi State University 1973; M.S., California Institute of Technology 1974.
Thesis: Interference Effects on the Drag of Bluff Bodies in Tandem.

Randall L. Kubena *(Applied Physics)* B.S., California Institute of Technology 1973; M.S., 1974.
Thesis: Fluctuations in a Tokamak Plasma.

James Laurens Latimer *(Electrical Engineering and Applied Physics)* B.S., Rice University 1973; M.S., California Institute of Technology 1974.
Thesis: Cost and Traffic Analysis of Demand Access Satellite Networks.

Chien-Ping Lee *(Applied Physics)* B.S., National Taiwan University 1971.
Thesis: New Optoelectronic Devices Using GaAs - GaAlAs Epitaxy.

Marianela Lentini Gil *(Applied Mathematics)* Licenciado, Universidad Central de Venezuela 1973.
Thesis: Boundary Value Problems on Semi Infinite Intervals.

Kiran Ramanlal Magiawala *(Aeronautics)* B.E., St. Xavier's College 1971; M. Tech., Indian Institute of Technology, Kanpur 1973; M.S., California Institute of Technology 1974.
Thesis: Measurements of Energy Exchange between Acoustic Fields and non-Uniform Steady Flow Fields.

Derek John McKay *(Environmental Engineering Science and Social Science)* B.Sc., University of Auckland 1969; B.E., 1971; M.S., California Institute of Technology 1972.
Thesis: Two Essays on the Economics of Electricity Supply: I. Has the Averch-Johnson Effect Been Empirically Verified? II. Electricity Pricing.

Luis Manuel Medina-Vaillard *(Engineering Science)* B.S.E.E., National University of Mexico 1973.
Thesis: An Engineering Formalization of Computer Systems.

Alan Rolf Mickelson *(Electrical Engineering and Physics)* B.S., The University of Texas, El Paso 1973; M.S., California Institute of Technology 1974.
Thesis: Electromagnetic Wave Propagation in Almost Periodic Media.

Siu Joe Poon *(Applied Physics)* B.S., California Institute of Technology 1974.
Thesis: Superconductivity, Spin-Glass Properties, and Ferromagnetism in Amorphous La-Gd-Au Alloys.

Scott Darrell Roth *(Engineering Science)* B.A., California State College, Long Beach 1970.
Thesis: Stereo 3-D Perception for a Robot.

Robert A. Scranton *(Applied Physics)* B.S., California Institute of Technology 1974; M.S., University of California, Berkeley 1975.
Thesis: Investigations of the Conductor-Semiconductor Interface.

David Sheby *(Engineering Science)* B.S., Pratt Institute 1972; M.S., California Institute of Technology 1974.
Thesis: Wiener Kernel Analyses of the Functional Microstructure of a Crustacean Visual Field.

Jeffrey B. Shellan *(Applied Physics)* B.S., California Institute of Technology 1975; M.S., 1976.
Thesis: Aperiodic Structures in Optics and Integrated Optics and the Transverse Bragg Reflector Laser.

William Allan Symington *(Mechanical Engineering)* B.E., Cooper Union 1974; M.S., California Institute of Technology 1975.
Thesis: Analytical Studies of Steady and Non-Steady Motions of a Bubbly Liquid.

Joseph David Titlow *(Applied Mechanics)* A.B., Bowdoin College 1968; B.S., California Institute of Technology 1968; M.S., 1973.
Thesis: Sailing Vessel Dynamics.

Alan James Wadcock *(Aeronautics)* B.Sc., Imperial College, London University 1968; M.Sc., 1970.
Thesis: Flying-Hot-Wire Study of Two-Dimensional Turbulent Separation on an NACA 4412 Airfoil at Maximum Lift.

Bruce Donald Westermo *(Applied Mechanics and Geophysics)* B.S., Illinois Institute of Technology 1974; M.S., California Institute of Technology 1975.
Thesis: The Solutions of a Non Linear Difference Equation Found in Numerical Analysis.

Randall Gary Williams *(Applied Mathematics)* B.S., California Institute of Technology 1973.
Thesis: The Stochastic Exit Problem for Dynamical Systems.

Rick Alan Williams *(Engineering Science and Neurophysiology)* B.S., Northwestern University 1972; M.S., California Institute of Technology 1974.
Thesis: The Processing of Velocity Information by the Pursuit Oculomotor System.

DIVISION OF GEOLOGICAL AND PLANETARY SCIENCES

Bruce Gordon Bills *(Planetary Science and Geophysics)* B.S., Brigham Young University 1973.
Thesis: A Harmonic and Statistical Analysis of the Topography of the Earth, Moon, and Mars.

Donald James DePaolo *(Geology and Chemistry)* B.S., State University of New York, Binghamton 1973.
Thesis: Study of Magma Sources, Mantle Structure and the Differentiation of the Earth Using Variations of $^{143}Nd/^{144}Nd$ in Igneous Rocks.

David Joseph Diner *(Planetary Science and Geology)* B.S., State University of New York, Stony Brook 1973; M.S., California Institute of Technology 1977.
Thesis: I. Silicon Vidicon Imaging of Jupiter 4100-8300 Angstroms: Spectral Reflectivity, Limb-Darkening, and Atmospheric Structure. II. Simultaneous Ultraviolet (0.36 Micron) and Infrared (8-20 Micron) Imaging of Venus: Properties of Clouds in the Upper Atmosphere.

David Milton Hadley *(Geophysics)* B.A., University of California, Riverside 1971; M.S., 1973.
Thesis: Geophysical Investigations of the Structure and Tectonics of Southern California.

James Alan Hileman *(Geophysics)* Gp.E., Colorado School of Mines 1960; M.S., California Institute of Technology 1971.
Thesis: I. A Contribution to the Study of the Seismicity of Southern California. II. Inversion of Phase Times for Hypocenters and Shallow Crustal Velocities.

DOCTOR OF PHILOSOPHY — *Continued*

Tai-Lin Hong *(Geophysics)* B.S., National Tsing-Hua University 1970; M.S., 1972.
Thesis: Elastic Wave Propagation in Irregular Structures.

Dan Douglas Kosloff *(Geophysics)* B.A., Hebrew University 1971.
Thesis: Numerical Models of Crustal Deformation.

Theodore Charles Labotka *(Geology and Geochemistry)* B.S., University of Illinois, Urbana 1971.
Thesis: Geology of the Telescope Peak Quadrangle, California, and Late Mesozoic Regional Metamorphism, Death Valley Area, California.

Jay Dennis Murray *(Geology)* B.A., Hamilton College 1966.
Thesis: The Structure and Petrology of the San José Pluton, Northern Baja California, Mexico.

Emile André Okal *(Geophysics)* D.E.A., University of Paris 1971; M.S., 1972.
Thesis: I. Application of Normal Mode Theory to Seismic Source and Structure Problems. II. Seismic Investigations of Upper Mantle Lateral Heterogeneity.

Susan Ann Raikes *(Geophysics)* B.A., Newnham College 1973.
Thesis: I. Regional Variations in Upper Mantle Compressional Velocities beneath Southern California. II. Post-Shock Temperatures: Their Experimental Determination, Calculation, and Implications.

Frederic Peter Schloerb *(Planetary Science and Geophysics)* A.B., Hamilton College 1973.
Thesis: Radio Interferometric Investigations of Saturn's Rings at 3.71- and 1.30-cm Wavelengths.

Seth Avram Stein *(Geophysics)* S.B., Massachusetts Institute of Technology 1975.
Thesis: I. Seismological Study of the Ninetyeast and Chagos-Laccadive Ridges, Indian Ocean. II. Models for Asymmetric and Oblique Spreading at Midocean Ridges. III. Attenuation Measurements Using Split Normal Modes.

Richard John Terrile *(Planetary Science and Geophysics)* B.S., State University of New York, Stony Brook 1972; M.S., California Institute of Technology 1973.
Thesis: High Spatial Resolution Infrared Imaging of Jupiter: Implications for the Vertical Cloud Structure from Five-Micron Measurements.

DIVISION OF HUMANITIES AND SOCIAL SCIENCE

Naim Hassan Al-Adhadh *(Social Science)* G.CE., Northwest Kent College of Technology 1963; B. Sc., University College of North Wales 1966; M. Sc., 1967.
Thesis: Essays on Economic and Political Choice.

Steven A. Matthews *(Social Science)* B.S., California Institute of Technology 1974.
Thesis: Directional and Static Equilibrium in Social Decision Processes.

Barry Robert Weingast *(Social Science)* B.S., University of California, Santa Cruz 1973.
Thesis: A Representative Legislature and Regulatory Agency Capture.

DIVISION OF PHYSICS, MATHEMATICS AND ASTRONOMY

Victor R. Akylas *(Physics)* B.S., M.S., The University of Chicago 1973; M.S., California Institute of Technology 1975.
Thesis: Cascade of Negative Muons in Atoms.

Charles Alcock *(Astronomy)* B.Sc., Auckland University 1973.
Thesis: I. Small Angle Scattering of Radiation. II. Molecular Emission Lines around Evolved Stars.

Steven Van Walter Beckwith *(Physics)* B.S., Cornell University 1973.
Thesis: Observations of Interstellar Molecular Hydrogen Emission.

Edward J. Bissett *(Applied Mathematics)* S.B., Massachusetts Institute of Technology 1974.
Thesis: Bifurcation in a Reaction Diffusion System.

David Philip Crewther *(Physics)* B.Sc., University of Melbourne 1972; M.Sc., 1974.
Thesis: The Infrared Behaviour of Quantum Chromodynamics.

Jean Roger Delayen *(Applied Physics)* Engineer, Ecole Nationale Supérieure d'Arts et Métiers 1970; M.S., California Institute of Technology 1971.
Thesis: Phase and Amplitude Stabilization of Superconducting Resonators.

Deepak Dhar *(Physics)* B.Sc., University of Allahabad 1970; M.Sc., Indian Institute of Technology, Kanpur 1972; M.S., California Institute of Technology 1973.
Thesis: Renormalization Techniques in the Study of Phase Transitions. I. Lattices of Effectively Nonintegral Dimensionality. II. A Model of the Melting Transition.

Jonathan H. Elias *(Astronomy)* S.B., S.M., Massachusetts Institute of Technology 1972.
Thesis: Infrared Studies of Two Dark Clouds.

Ian Gatley *(Physics)* B.Sc., London University 1972.
Thesis: Far Infrared Observations of the Galactic Center.

Thomas Russell Greenlee *(Physics)* B.S., Michigan Technological University 1970; M.S., California Institute of Technology 1973.
Thesis: Measurement of Transition Probabilities for Mn I Lines and the Manganese Solar Abundance.

Alan Andrew Hahn *(Physics)* B.S., University of Florida 1972.
Thesis: Experimental Investigations of Muonic X-Ray Transitions in Mercury Isotopes.

Robert Patrick McNamara *(Applied Physics)* B.S., M.S., California Institute of Technology 1973.
Thesis: Comparative Studies of the Steady State and R.F. Properties of Proximity Effect Bridges.

John Charles Neu *(Applied Mathematics)* B.A., University of California, San Diego 1974.
Thesis: Nonlinear Oscillations in Discrete and Continuous Systems.

Dee-Son Pan *(Physics)* B.S., National Tsing-Hua University 1971.
Thesis: Some Theoretical Problems in Low Temperature Optical Properties of Semiconductors.

William Charles Priedhorsky *(Physics)* B.A., Whitman College 1973.
Thesis: Observations of Three Binary X-Ray Sources: CYG X-1, CYG X-2, and 4U1813+50 (AM HER).

Arthur Leonard Rubin *(Mathematics)*
Thesis: Free Algebras in von Neumann-Bernays-Gödel Set Theory and Positive Inductions in Reasonable Structures.

Anneila Isabel Sargent *(Astronomy)* B.Sc., University of Edinburgh 1963; M.S., California Institute of Technology 1967.
Thesis: Molecular Clouds and Star Formation.

John Steven Sheffield *(Applied Mathematics)* B.S., California Institute of Technology 1972; S.M., Harvard University 1973.
Thesis: Topics in Vortex Motion.

Roque Kwok-Hung Szeto *(Applied Mathematics)* B.S., New York University 1972.
Thesis: The Flow between Rotating Coaxial Disks.

Eric Paul Verheiden, Jr. *(Mathematics)* B.A., Portland State University 1974.
Thesis: Arithmetical Properties of Combinatorial Matrices.

Robert Allen Weller, Jr. *(Physics)* B.S., University of Tennessee, Knoxville 1971.
Thesis: The Energy Spectra of Uranium Atoms Sputtered from Uranium Metal and Uranium Dioxide Targets.

Mark Edward Wiedenbeck *(Physics)* B.S., The University of Michigan 1971.
Thesis: An Investigation of Techniques for the Measurement and Interpretation of Cosmic Ray Isotopic Abundances.

Shiu-Chin Wu *(Physics)* B.S., National Tsing-Hua University 1974.
Thesis: Fusion Cross Section Measurements for the Reactions $^{14}N+^{10}B$ and $^{16}O+^{16}O$.

Pochi Albert Yeh *(Physics and Applied Physics)* B.S., National Taiwan University 1971; M.S., California Institute of Technology 1975.
Thesis: Stark-Induced Optical Nonlinearity in Gaseous NH_2D and Optical Waves in Layered Media.

Michael Franz Yoder *(Mathematics)* B.S., M.S., California Institute of Technology 1974.
Thesis: Replicative Functions.

Prizes and Awards

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.*

ERIC TEMPLE BELL UNDERGRADUATE MATHEMATICS RESEARCH PRIZE

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

*1976 Albert L. Wells, Jr.**

DONALD S. CLARK MEMORIAL 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.

1978 Isabella T. Lewis, sophomore
Leslie A. Paxton, junior
*1977 Eric W. Kaler**
*1976 Andrew H. Falls**

HAREN LEE FISHER MEMORIAL AWARD IN JUNIOR PHYSICS

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

Liew C. Chieu

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.

1978 Thongchai Kengmana, Sangtae Kim
*1977 Kam-Yin Lau**

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.

David L. Johannsen

**The names of students who have received prizes or awards in previous years, but who are graduating in 1978, are also listed.*

ARIE J. HAAGEN-SMIT MEMORIAL AWARD

Awarded to a sophomore or junior in biology or chemistry who has shown academic promise and who has made recognized contributions to Caltech.

1978 Robert M. Hanson
*1977 Thomas J. McDonnell**

DAVID JOSEPH MACPHERSON PRIZE IN ENGINEERING

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

Wayne M. Baxter

MARY A. EARL 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.

Jeffrey M. Hicks, Cecelia B. Rodriguez,
Christopher D. Vestuto

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: Eric W. Kaler

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.

1978 James J. Angel, Colleen R. Ruby, Janet A. Rice
*1977 Bruce D. Baker**
*1975 José I. Cabezón**

SIGMA XI AWARD

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

Michael L. Steigerwald

THE MORGAN WARD AWARD

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

*1976 Charles W. Schlindwein**
*1975 Albert L. Wells, Jr.**