Eighty-Eighth Annual Commencement

June 11, 1982

CALIFORNIA INSTITUTE OF TECHNOLOGY

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Eighty-Eighth Annual Commencement

FRIDAY MORNING AT TEN-THIRTY O'CLOCK
JUNE ELEVENTH, NINETEEN EIGHTY-TWO

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

Chief Marshal, Christopher E. Brennen, Ph.D.

Assistant Marshals

Arden L. Albee, Ph.D.
Jenijoy La Belle, Ph.D.
J. Kent Clark, Ph.D.
Robert W. Oliver, Ph.D.
Ray D. Owen, Ph.D., Sc.D.

Faculty Officers

Fred C. Anson, Ph.D.
Donald S. Cohen, 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 PROVOST

THE TRUSTEES

THE COMMENCEMENT CHAPLAIN

THE COMMENCEMENT SPEAKER

THE PRESIDENT

THE CHAIRMAN OF THE BOARD OF TRUSTEES

Program

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

ORGAN PRELUDE . . . . . Leslie J. Deutsch, Ph.D.

PROCESSIONAL . . . The Caltech Wind Ensemble Brass and Organ
William Bing, M.M., Conductor

INVOCATION . . . . . The Reverend Huston Horn
Director
The Caltech Y

COMMENCEMENT ADDRESS . . "To Know, To Understand, To Do"
Hans W. Liepmann, Ph.D.
Charles Lee Powell Professor of
Fluid Mechanics and Thermodynamics
and Director of the Graduate
Aeronautical Laboratories,
California Institute of Technology

MUSICAL SELECTION . The Caltech Men's and Women's Glee Clubs
Olaf M. Frodsham, A.M., Director

Alleluia, Amen, by George F. Handel
From "Sing Unto the Lord"
Joseph Fuchs, Tenor Soloist

CONFERRING OF DEGREES . . Marvin L. Goldberger, Ph.D., D.H.L.
President
California Institute of Technology

PRESENTATION OF CANDIDATES FOR DEGREES

For the Degree of Bachelor of Science . . . David B. Wales, 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 . . . . . James J. Morgan, Ph.D.
Acting Dean of Graduate Studies

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

Biology . . . . . Leroy E. Hood, M.D., Ph.D.
Division Chairman

Chemistry and Chemical Engineering . . . Harry B. Gray, Ph.D.
Division Chairman

Engineering and Applied Science . . . . Roy W. Gould, Ph.D.
Division Chairman

Geological and Planetary Sciences . . . . Arden L. Albee, Ph.D.
Professor of Geology and
Chief Scientist, Jet Propulsion Laboratory

Humanities and Social Sciences . . . . . Roger G. Noll, Ph.D.
Division Chairman

Physics, Mathematics and Astronomy . . Rochus E. Vogt, Ph.D.
Division Chairman

CONCLUDING REMARKS . . . . . President Goldberger

BENEDICTION . . . . . Mr. Horn

RECESSIONAL . . . The Caltech Wind Ensemble Brass and Organ

ORGAN POSTLUDE . . . . . Leslie Deutsch

Candidates for Degrees

BACHELOR OF SCIENCE

Steven Lee Allen *North Orange County, California* Astronomy

Nicomedes Alonso *Astoria, New York* Mathematics

Mark Richard Altobelli *St. Louis, Missouri* Mathematics and Engineering and Applied Science

B. Arlen Anderson *Seattle, Washington* Physics

Robert Gilman Andre *Cincinnati, Ohio* Mathematics

Mung-Ling Ang *Singapore* Physics

Joseph Paul Arpaia *Fairport, New York* Chemistry

Kurt Thomas Bachmann *New Albany, Indiana* Physics

Russell Hanlon Barnes *Covington, Louisiana* Engineering and Applied Science

Cynthia Juyne Beegle *Wilmington, North Carolina* Biology

Paul Ray Belvoir *Modesto, California* Engineering and Applied Science

John Robert Bennett *Auburn, Alabama* Engineering and Applied Science

Marc Jeffrey Berman *Walla Walla, Washington* Engineering and Applied Science

John Theodore Bongiovanni *Miami, Florida* Physics

Bennett H. Bonham *Fairfax, Virginia* Electrical Engineering

Roberta Jane Brandenburg *Diamond Bar, California* Biology and Literature

Duke P. Briscoe *Athens, Georgia* Biology

Rita Brown *Sacramento, California* Electrical Engineering

Robert James Buck *Stockton, California* Electrical Engineering

Jonathan F. Buss *Atlanta, Georgia* Mathematics

Glen Edward Campbell *Olympia, Washington* Engineering and Applied Science

Loudon Lee Campbell *Mequon, Wisconsin* Chemistry

George Diomedes Caravias *Mercer Island, Washington* Engineering and Applied Science

Randel Ross Castleberry *Klamath Falls, Oregon* Engineering and Applied Science

Paul Chir-Fan Chan *Hong Kong* Chemical Engineering

Sammy Way Keung Chan *Wauwatosa, Wisconsin* Engineering and Applied Science

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*

Eric Ying Chang *Altadena, California* Mathematics

Ina Chang *Sao Paulo, Brazil* Physics

Kar Man Chang *Hong Kong* Physics

Yang Tse Cheng *Beijing, China* Physics and Mathematics

Michael V. Chobotov *Palos Verdes Estates, California* Engineering and Applied Science

Nelson William Clayton *Granite, Utah* Geophysics

Ernest Samuel Cohen *Pittsburgh, Pennsylvania* Engineering and Applied Science

Evan George Colgan *Carnelian Bay, California* Applied Physics

Robert Lewis Collins *Arcadia, California* Engineering and Applied Science

Douglas Glenn Conley *Milwaukee, Wisconsin* Engineering and Applied Science

William E. Crowe *Salem, Massachusetts* Chemistry

Howard Vincent Derby *Boulder, Colorado* Engineering and Applied Science

Lance Jenkins Dixon *Manhattan Beach, California* Physics and Applied Mathematics

Kathryn Luz Doughty *Bakersfield, California* Physics

David Russel Dowling *Rancho Palos Verdes, California* Applied Physics

Paul Burdette Eskridge *Amherst, New York* Astronomy

Malcolm Webster Ewell, Jr. *Towson, Maryland* Physics

Randall Perkins Field *Nashua, New Hampshire* Chemical Engineering

Mark Douglas Foster *Reston, Virginia* Physics and Engineering and Applied Science

Ronald John Franz *Costa Mesa, California* Engineering and Applied Science

Clifford Eugene Frieler *Greeley, Colorado* Engineering and Applied Science

Ari Fuad *Prior Lake, Minnesota* Geochemistry

Joseph Anthony Garcia, Jr. *Wethersfield, Connecticut* Biology

Susan Virginia Gardner *Los Angeles, California* Physics and Chemistry

Gregory Thomas Gaudet *Fitchburg, Massachusetts* Chemical Engineering

Donald Paul Gaver III *Carmel, California* Applied Physics

Glen Arthur George *Westland, Michigan* Electrical Engineering

Natalie Ruth Gruia *Lake Bluff, Illinois* Chemical Engineering

Lisa Marie Hamilton *Redondo Beach, California* Chemical Engineering

James Robert Heckman *Bakersfield, California* Physics

Roger Jonathan Helkey *North Bend, Oregon* Engineering and Applied Science

Karen Ann Hellgren *Ft. Lauderdale, Florida* Engineering and Applied Science

BACHELOR OF SCIENCE—*Continued*

Edith Jeanette Henderson *Albuquerque, New Mexico* Applied Mathematics

Karl William Heuer *Moorhead, Minnesota* Mathematics

Jonathan Eric Holman *San Diego, California* Chemical Engineering

David Ambrose Hsu *Ridgewood, New Jersey* Chemistry

Stephen Charles Hsu *Charleston, Illinois* Electrical Engineering

Lawrence Allen Humm *Tacoma, Washington* Electrical Engineering

Nak-Hui Hwang *Culver City, California* Biology

Frank Janeczek *Leesburg, Florida* Engineering and Applied Science

Robert John Januska, Jr. *Huntington Beach, California* Engineering and Applied Science

Jens Hesselberg Jensen *Del Mar, California* Physics

David Stone Kamins *Pacific Palisades, California* Biology and Mathematics

Romney Rajeev Katti *Columbia, Missouri* Engineering and Applied Science

David T. Khoe *Santa Monica, California* Applied Physics

John Anthony King *Osaka, Japan* Engineering and Applied Science

Catherine Ann Kirschvink *Phoenix, Arizona* Biology

Karen A. Kiselewski *Palm Beach Gardens, Florida* Mathematics

Donald George Korycansky *Upper Marlboro, Maryland* Astronomy

Randal Dean Koster *Arroyo Grande, California* Engineering and Applied Science

Chengi Jimmy Kuo *South Brunswick, New Jersey* Engineering and Applied Science

Vitaly Kupisk *Los Angeles, California* Mathematics

Jimmy Kwok-Ching Lam *Hong Kong* Engineering and Applied Science

Edward Moore Lambert *Fairbanks, Alaska* Chemical Engineering

Robert James Lang *Atlanta, Georgia* Electrical Engineering

Leonardo Adlao Laroco, Jr. *Aurora, Colorado* Mathematics

Shawn Christian Larsen *Denver, Colorado* Geophysics

Cheng-Chie Lee *Rancho Palos Verdes, California* Engineering and Applied Science

Johnny Leung *Dublin, California* Engineering and Applied Science

Joakim Fredrik Lindblom *Los Altos, California* Physics

Douglas Y. MacKenzie *Eagle Rock, California* Chemistry

Duncan Gregory Mahoney *Montrose, Pennsylvania* Engineering and Applied Science

Robert McIntyre Manning *Burlington, Washington* Engineering and Applied Science

Linda Beth McAllister *Palm Beach Gardens, Florida* Biology

Joseph McIntyre *Bellingham, Washington* Engineering and Applied Science

John Paul McNally *Valencia, California* Chemistry

Wen Jin Meng *Beijing, China* Physics

Stuart Jeffrey Meyer *Northridge, California* Engineering and Applied Science

Ronald Lindsay Miller *Manhattan Beach, California* Geophysics

John Ormsby Mitchel *San Diego, California* Electrical Engineering

Samin Amirali Mithani *Karachi, Pakistan* Engineering and Applied Science and Economics

Clark Matthew Mobarry *Edina, Minnesota* Physics

Ronald William Moore *La Mirada, California* Mathematics

Roger David Moulton *Santa Monica, California* Chemistry

Richard Leonard Nadler *Stamford, Connecticut* Physics

William Clark Naylor, Jr. *Rochester, Minnesota* Engineering and Applied Science

Charles Hok-Bun Ng *Hong Kong* Engineering and Applied Science

John Yee-Keung Ngai *Lafayette, California* Engineering and Applied Science

Hisup Park *Laguna Hills, California* Engineering and Applied Science

Joel Stephen Paslaski *Needham, Massachusetts* Applied Physics

Phillip Andrew Patten *Seattle, Washington* Biology

Armando Pauker *Elmhurst, New York* Engineering and Applied Science

Michael Lee Pearson *Fresno, California* Physics

Lisa Ann Penninger *Irvington, Kentucky* Engineering and Applied Science

Catherine M. Petroff *Fullerton, California* Engineering and Applied Science

Pamela J. Phillips *Santee, California* Geology

Leslie Anthony Poltrack *Stamford, Connecticut* Economics

Scott Alan Prahl *Redding, California* Applied Physics

Bruce Lee Prickett *Leesburg, Virginia* Applied Physics

Guillermo Pablo Pulos Cárdenas *Los Mochis, Sinaloa, Mexico* Applied Physics

Forrest Christopher Quinn *Huntington Beach, California* Mathematics

Eric Brice Rasmussen *Tujunga, California* Chemical Engineering

Michael Andrew Ravine *Everett, Washington* Physics

Cecilia Berta Rodriguez *Berkeley, California* Mathematics and Literature

Bruce David Rogers *Los Gatos, California* Engineering and Applied Science

Lawrence David Rotter *Chicago, Illinois* Physics

Geoffrey David Rubin *Sherman Oaks, California* Chemistry and Biology

James Stevenson Ryan *Owensboro, Kentucky* Engineering and Applied Science
Philip A. Sackinger *College, Alaska* Chemical Engineering
Sharron Christine Sarchet *Longmont, Colorado* Engineering and Applied Science
Robert Michael Shore *Norristown, Pennsylvania* Mathematics
Margaret B. Short *Burnsville, Minnesota* Applied Mathematics
Kenneth Rodgers Sieck *Santa Barbara, California* Engineering and Applied Science
Jesse Fred Slater *Natick, Massachusetts* Literature
Mark Slater *Fullerton, California* Engineering and Applied Science
Tim W. Smith *Merced, California* Mathematics
Frederick D. Snider *Oakland, California* Physics
William Clark Snyder *Rochester, New York* Engineering and Applied Science
Maurisa Sommerfield *Lincolnwood, Illinois* Chemical Engineering
Kevin Stinson *Sacramento, California* Mathematics
Patricia Jo Stoddard *Burbank, California* Engineering and Applied Science
Brett Conley Stutz *Peoria, Illinois* Engineering and Applied Science
Dale Sumida *Altadena, California* Applied Physics
Yun-Chen Sung *Denver, Colorado* Engineering and Applied Science
Glen Howard Swindle *Glendale, Arizona* Engineering and Applied Science
Michael Paul Thien *Fremont, California* Chemical Engineering
Paul David Thomas *Tucson, Arizona* Chemical Engineering
Anuchit Tiranuchit *Suratthani, Thailand* Electrical Engineering
Carl Warren Townsend *Seattle, Washington* Chemical Engineering
Liem T. Tran *Los Angeles, California* Applied Physics
Jim C. Trask *Everett, Washington* Applied Physics
Susan Joan VandeWoude *Berryville, Virginia* Chemistry
Juanito Serrano Villanueva *Cerritos, California* Biology
Peterpaul Lugtu Vita *Pasadena, California* Electrical Engineering
Jeffrey Lance Vollin *Billings, Montana* Engineering and Applied Science
Thiennu Huy Vu *Los Angeles, California* Biology and Mathematics
Bimal Wadhwa *New Delhi, India* Engineering and Applied Science
Linda Ann Wald *Houston, Texas* Mathematics
Perry George Walker *Hephzibah, Georgia* Chemical Engineering
Richard Clayton Walker *Claremont, California* Engineering and Applied Science

BACHELOR OF SCIENCE—*Continued*

Wallace Francis Walter *Thousand Oaks, California* Engineering and Applied Science
Amy Eileen Wendt *St. Paul, Minnesota* Engineering and Applied Science
Matthew Reimut Wette *Clayton, Missouri* Chemical Engineering
Joseph Lawrence White *Huntington Beach, California* Applied Physics
John Charles Whitehead *Tuxedo, New York* Engineering and Applied Science
Luke Joseph Will *Oak Park, Illinois* Literature
Barry Allen Wilson *Bellflower, California* Geology
Yiwan Wong *Hong Kong* Electrical Engineering
Xian-Li Yeh *Shanghai, China* Applied Physics
David Christopher Younge *California* Mathematics
Chris Shu-Wing Yu *Monterey Park, California* Engineering and Applied Science

MASTER OF SCIENCE

Muneo Abe *(Electrical Engineering)* B.E., Tokyo University 1976; M.E., 1978.

Cathryn Clement Allen *(Geology)* B.A., Williams College 1980.

William James Anker *(Electrical Engineering)* B.S., Drexel University 1981.

Alan Brad Anton *(Chemical Engineering)* B.S., Virginia Polytechnic Institute and State University 1979.

Luciana Astiz *(Geophysics)* B.S., Universidad Nacional Autonoma de Mexico 1980.

Michael Atzmon *(Applied Physics)* B.Sc., Hebrew University of Jerusalem 1980.

Vincent Bach *(Electrical Engineering).*

Stewart William Baillie *(Aeronautics)* B.S., University of Washington 1981.

Mark Robert Bell *(Electrical Engineering)* B.S., California State University, Long Beach 1981.

James Joseph Berken *(Electrical Engineering)* B.S.E.E., University of Wisconsin-Milwaukee 1980.

Gregory Allan Blaisdell *(Applied Mathematics)* B.S., California Institute of Technology 1980.

Rolf Brandt *(Mechanical Engineering)* Diplom-Ingenieur, Technische Universität Carolo-Wilhelmina zu Braunschweig 1980.

Marcus Ivan Bursik *(Geophysics)* B.A., California State University, Fresno 1981.

James Robert Carluccio *(Aeronautics)* B.M.E., Villanova University 1981.

Kwokming James Cheng *(Applied Physics)* B.S.E., Duke University 1981.

Pascal Olivier Correc *(Applied Physics)* Diplôme d'Ingénieur, Ecole Polytechnique 1980.

Abraham Arnold Dauhajre *(Electrical Engineering)* B.S.E.E., University of Puerto Rico, Mayaguez 1980.

Jean Marc Delteil *(Electrical Engineering)* Diplôme d'Ingénieur, Ecole Spéciale de Mécanique et d'Electricité 1981.

Richard Henderson Dickinson *(Electrical Engineering)* B.E., Vanderbilt University 1981.

Pauline Mavis Doran *(Chemical Engineering)* B.E., University of Queensland 1978.

Anthony Gerard Dunne *(Electrical Engineering)* B.E., University College, Dublin 1981.

Holly K. Eissler *(Geophysics)* B.S., University of Illinois at Urbana-Champaign 1979.

Sayed-Amr Ahmes El-Hamamsy *(Electrical Engineering)* B.Sc., Cairo University 1979; B.Sc., Ain Shams University 1981.

Timothy L. Ellena *(Electrical Engineering)* B.S., California State University, Fresno 1981.

Ilknur Erbas *(Environmental Engineering Science)* B.Sc., Bosphorus University 1981.

James Louis Fanson *(Applied Mechanics)* B.S., University of Wisconsin-Madison 1981.

Jean-Marc Luc Favennec *(Electrical Engineering)* Licence d'Economie, Université de Paris 1981; Diplôme d'Ingénieur, Ecole Spéciale des Travaux Publics, du Batiment et de l'Industrie 1981.

David Lawrence Frost *(Aeronautics)* B.A.Sc., The University of British Columbia 1981.

Panagiotis Gerasimou Georgopoulos *(Chemical Engineering)* Diploma, National Technical University of Athens 1980.

Jaime Rogelio Gonzalez-Ruiz *(Geophysics)* B.S., Universidad Nacional Autonoma de Mexico 1979.

Morgan Gopnik *(Environmental Engineering Science)* B.Sc., McGill University 1981.

Thomas Anthony Gresik *(Social Science)* B.A., Northwestern University 1981.

Gothard Carson Grey *(Physics)* B.S., University of Utah 1980.

Lov Kumar Grover *(Electrical Engineering)* B. Tech., Indian Institute of Technology, Delhi 1981.

Jay Hauser *(Physics)* B.S., University of Michigan 1978.

Lawrence Michael Henling *(Chemistry)* B.S., Tulane University 1977.

Daniel Christopher Herlihy *(Electrical Engineering)* B.E., Manhattan College 1981.

Steven Robert Hetzler *(Applied Physics)* B.A., Carleton College 1980.

Pui Kwan Andy Hong *(Environmental Engineering Science)* B.S., California Institute of Technology 1981.

Jean-Pierre Huot *(Aeronautics)* B.Eng., Ecole Polytechnique de Montréal 1981.

Belgacem Jery *(Social Science)* Diplôme d'Ingénieur, Ecole Nationale Supérieure d'Arts et Métiers 1979; M.S., California Institute of Technology 1980.

Melvin O. Jones *(Chemistry)* B.S., California Institute of Technology 1976.

Abdo George Kadifa *(Electrical Engineering)* B.E., American University of Beirut 1981.

Sotirios Spyridon Karpouzis *(Mechanical Engineering)* Diploma, National Technical University of Athens 1981.

Dayalan Prajith Kasilingam *(Electrical Engineering)* B.A., Trinity College, University of Cambridge 1981.

Theologos Michael Kelessoglou *(Electrical Engineering)* Diploma, Aristotelean University of Thessaloniki 1981.

Elizabeth Ann Kendall *(Mechanical Engineering)* S.B., Massachusetts Institute of Technology 1978.

MASTER OF SCIENCE—*Continued*

Christopher Hayden Kingsley *(Computer Science)* B.S., California Institute of Technology 1981.

Catherine Ann Kirschvink *(Environmental Engineering Science)* B.S., California Institute of Technology 1982.

Walter German Kortschak *(Civil Engineering)* B.S., Oregon State University 1981.

Joseph Ludwig Koszarek *(Electrical Engineering)* B.S., Washington State University 1981.

J. Paul Kozak *(Electrical Engineering)* B.S.E.E., Purdue University 1981.

Predrag Felix Krstanovic *(Civil Engineering)* B.S., The University of Zagreb 1980.

Harri Kaarlo Kytömaa *(Mechanical Engineering)* B.Sc., Durham University 1979.

Caroline Ann Lambert *(Geophysics)* B.Sc., The University of Alberta 1980.

Susan M. Larson *(Environmental Engineering Science)* A.B., Washington University 1981.

Catherine Helene Marie Le Blanche *(Electrical Engineering)* Diplôme d'Ingénieur, Ecole Supérieure d'Ingénieurs en Electronique et Electrotechnique 1981.

Hyuk Lee *(Applied Physics)* B.S., Seoul National University 1978.

Marie-Bernard Paule Levine *(Civil Engineering)* Ingénieur du Batiment, Ecole Spéciale des Travaux Publics, du Batiment et de l'Industrie 1981.

Sheue-Ling Chang Lien *(Computer Science)* B.S., National Taiwan University 1979.

Christopher Sy Lim *(Aeronautics)* B.S., Rensselaer Polytechnic Institute 1981.

Christopher Paul Lindsey *(Applied Physics)* B.S., Harvey Mudd College 1975.

Thomas Glenn Lockhart *(Astronomy)* A.B., Occidental College, 1978.

Pamela Logan *(Mechanical Engineering)* B.S., California Institute of Technology 1981.

Gerasimos Kosmas Lyberatos *(Chemical Engineering)* S.B., Massachusetts Institute of Technology 1980.

Edward Douglas Lynch *(Chemical Engineering)* B.S.E., Princeton University 1979.

Ramaswamy Mahadevan *(Electrical Engineering)* B.Tech., Indian Institute of Technology, Madras 1981.

Juan Luis Mañes *(Physics)* Ingeniero Industrial (Eléctrico), E.T.S.I.I., Bilbao 1978; Licenciado en C. Fisicas, Universidad de Bilbao 1980; Doctor Ingeniero Industrial, E.T.S.I.I., Bilbao 1980.

John Mardirosian *(Electrical Engineering)* B.S., University of Massachusetts-Amherst 1981.

Philippe Marie *(Electrical Engineering).*

Oliver Martin *(Physics)* DEUG, Lycée Janson de Sailly 1978.

Peter John Martin *(Aeronautics)* B.S., California Institute of Technology 1981.

Edita Lipas Mattis *(Civil Engineering)* B.S., California State University, Los Angeles 1981.

James McArdle *(Electrical Engineering)* B.E., Stevens Institute of Technology 1981.

Brian James McGinley *(Electrical Engineering)* B.S.E.E., University of Pennsylvania 1981.

Christopher G. McHarg *(Electrical Engineering)* B.S., Kansas State University 1981.

Robert Carl McMurray *(Aeronautics)* B.S., State University of New York at Buffalo 1981.

Kevin Mark McNab *(Electrical Engineering)* B.S.E., University of Central Florida 1980.

Milan Bratívoj Mijić *(Physics)* B.S., Belgrade University 1979.

Fai Ho Mok *(Electrical Engineering)* B.S., The City College of the City University of New York 1981.

Brian Kenneth Muirhead *(Aeronautics)* B.S.M.E., University of New Mexico 1977.

Lawrence Paul Muirhead *(Physics)* B.S., B.A., University of California, Santa Barbara 1980.

Maureen Elizabeth Murphy *(Electrical Engineering)* B.S.E.E., State University of New York at Stony Brook 1981.

David Alan Myers *(Biology)* B.A., University of Colorado 1980.

Patricia Lai Ling Ngan *(Environmental Engineering Science)* B.A.Sc., The University of British Columbia 1981.

James Malcolm Erwin Nuckols *(Electrical Engineering)* B.S., California Institute of Technology 1981.

Timothy John O'Hern *(Mechanical Engineering)* B.S., University of California, Santa Barbara 1981.

Claire Josephine O'Keefe *(Mathematics)* A.B., Smith College 1980.

Dimitri Papamoschou *(Aeronautics)* B.S., Syracuse University 1981.

Julie Marie Paque *(Geochemistry)* B.A., University of Tennessee, Knoxville 1979.

Pirooz Parvarandeh *(Electrical Engineering)* B.S., California Institute of Technology 1981.

Richard David Pfaff *(Aeronautics)* B.S., University of Washington 1979.

Puvin Pichaichanarong *(Chemical Engineering)* A.B., Harvard College 1979.

Frederick Martin Randall *(Applied Mechanics)* B.S., University of Maine at Orono 1981.

Mohit Randeria *(Physics)* B.Tech., Indian Institute of Technology, New Delhi 1980.

Janice Regan *(Geophysics)* B.Sc., University of Victoria 1979.

Jeffrey David Richman *(Physics)* B.S., Yale University 1979.

Donald Fletcher Rogers *(Chemical Engineering)* B.S., University of Illinois at Urbana-Champaign 1979.

Ann Judith Rosenthal *(Physics)* A.B., Princeton University 1979.

Remy Daniel Sanouillet *(Electrical Engineering)* Diplôme d'Ingénieur, Ecole Nationale Supérieure des Arts et Métiers 1981.

Edward Schepps *(Electrical Engineering)* B.E.E., Georgia Institute of Technology 1981.

Tuviah Ehud Schlesinger *(Applied Physics)* B.Sc., University of Toronto 1980.

Michael H. Sekera *(Chemistry)* B.S., University of California, Los Angeles 1969.

Richard Sfeir *(Electrical Engineering)* Diplôme d'Ingénieur, Ecole Nationale Supérieure des Telecommunications 1981.

Yin Lung Shih *(Electrical Engineering)* B.S., California Institute of Technology 1979.

Kenneth Scott Smith *(Applied Mechanics)* B.S., California Institute of Technology 1980.

James Lawrence Snyder *(Applied Mathematics)* B.S., Columbia University 1980.

Thomas Henry Sobota *(Mechanical Engineering)* B.S., Polytechnic Institute of New York 1981.

Tonny Soesanto *(Chemical Engineering)* B.S., University of California, Berkeley 1980.

Michael Edward Stibila *(Electrical Engineering)* B.S., Illinois Benedictine College 1980.

Robert Frederik Svendsen Jr. *(Geophysics)* B.S., Bradley University 1980.

Kumar Swaminathan *(Electrical Engineering)* B.Tech., Indian Institute of Technology, Madras 1981.

Thiam-Soon Tan *(Civil Engineering)* B.E., University of Canterbury 1979.

Saleh Ahmed Tanveer *(Civil Engineering)* B.A., Pomona College 1979; M.A., Claremont Graduate School 1979.

Howard Alan Tarre *(Social Science)* B.A., University of California, Santa Barbara 1978.

Koji Toyoda *(Chemical Engineering)* B.Eng., Kyoto University 1973; M.Eng., 1975.

Steve Tritchew *(Applied Physics)* B.Eng., McMaster University 1981.

Tawach Ungsuwarungsri *(Mechanical Engineering)* B.S., California Institute of Technology 1981.

Santosh Subramanyam Venkatesh *(Electrical Engineering)* B.Tech., Indian Institute of Technology, Bombay 1981.

MASTER OF SCIENCE—*Continued*

Kelvin H. Wagner *(Electrical Engineering)* B.S., California Institute of Technology 1981.

Jason Masao Wakugawa *(Applied Mechanics)* B.S.E., Princeton University 1981.

Russell Edward Walker *(Applied Physics)* B.S., Murray State University 1980.

Nam Sun Wang *(Chemical Engineering)* B.S., University of California, Berkeley 1979.

Rueen-Fang Wang *(Environmental Engineering Science)* B.S., National Taiwan University 1980.

David Lee Wark *(Physics)* B.S., Indiana University at Bloomington 1980.

Bradley T. Werner *(Physics)* B.S., California Institute of Technology 1981.

Douglas Lee Whiting *(Computer Science)* B.S., California Institute of Technology 1980.

Richard Coale Willson III *(Chemical Engineering)* B.S., California Institute of Technology 1981.

Chung-en Zah *(Electrical Engineering)* B.S., National Taiwan University 1977; M.S., 1979.

David Nicholas Zichichi *(Mechanical Engineering)* B.S., Rice University 1980.

ENGINEER

John Eric Christenson *(Civil Engineer)* A.B., Dartmouth College 1972; B.S., M.S., University of Minnesota 1978.

Jan Karel Spelt *(Mechanical Engineer)* B.A.Sc., University of Toronto 1979; M.A.Sc., 1980.

Tak-Yiu Wong *(Mechanical Engineer)* B.S., Loyola Marymount University 1978; M.S., California Institute of Technology 1979.

DOCTOR OF PHILOSOPHY

DIVISION OF BIOLOGY

David Lynn Gard *(Cell Biology)* B.S., California Institute of Technology 1977.
Thesis: Intermediate Filaments and Myogenesis *in vitro*.

Bruce Leslie Granger *(Cell Biology)* B.A., University of Colorado 1977.
Thesis: Composition and Function of Intermediate Filaments in Avian Muscle Cells and Erythrocytes.

Steven Haym Green *(Biology)* B.S., University of Wisconsin-Madison 1975.
Thesis: Genetic Studies of Neuronal Development in *Drosophila melanogaster*.

Kent Richard Jennings *(Biology)* B.Sc., Carleton University 1977.
Thesis: Studies of Excitability in a Model Peptidergic System: The Roles of Cyclic AMP, Protein Phosphorylation and Serotonin During Afterdischarge in the Bag Cell Neurons of *Aplysia californica*.

John Henry Richard Maunsell *(Biology)* B.S., Duke University 1977.
Thesis: Functional Organization and Connections of the Middle Temporal Visual Area in the Macaque Monkey.

Dominic Ping-Yim Orr *(Biology)* B.S., The City College of the City University of New York 1973; M.S., California Institute of Technology 1976.
Thesis: Behavioral Neurogenetic Studies of a Circadian Clock in *Drosophila melanogaster*.

Jing-hsiung James Ou *(Biology)* B.S., National Taiwan University 1976.
Thesis: Structure and Replication of Alphavirus RNAs.

Steven Elery Petersen *(Biology)* B.A., University of Montana 1974; M.A., 1976.
Thesis: Visual Response Properties of Neurons in Extrastriate Cortex of the Owl Monkey.

James William Posakony *(Developmental Biology)* B.S., California Institute of Technology 1974.
Thesis: Studies of the Organization and Expression of Individual Repetitive Sequence Families of the Sea Urchin Genome.

Antonio Arevalo Reyes *(Biology)* B.S., University of the Philippines 1975; M.S., California Institute of Technology 1981.
Thesis: Application of Synthetic Oligonucleotides in the Isolation of Murine Transplantation Antigen cDNA Clones.

Loveriza A. Sarmiento *(Molecular Biology)* B.S., University of Santo Tomas 1966.
Thesis: Developmental Regulation in *Drosophila melanogaster*.

Sandra Lee Shotwell *(Biology)* A.B., Princeton University 1976.
Thesis: A Biochemical and Genetic Analysis of the Cyclic AMP Phosphodiesterase Defect in *dunce*, a Memory Mutant of *Drosophila*.

Randall Forrest Smith *(Genetics)* B.S., University of California, Irvine 1974.
Thesis: Genetic Analysis of the Circadian Clock System of *Drosophila melanogaster*.

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

DIVISION OF CHEMISTRY AND CHEMICAL ENGINEERING

Raymond A. Bair *(Chemistry)* B.S., Westminster College 1974.
Thesis: I. Theoretical Studies of the X-Ray Absorption Edge in Copper Complexes. II. Electron Correlation Consistent Calculation of Bond Dissociation Energies.

John Samuel Batchelder *(Applied Physics)* B.S., Yale University 1977.
Thesis: The Luminescent Solar Concentrator.

Michael McClellan Becker *(Chemistry)* B.A., University of South Florida 1973; M.A., 1975.
Thesis: I. Molecular Recognition of Nucleic Acid by BMSP. II. Sequence Specific B ➔ H ➔ A Allosteric Transitions in DNA.

Clarke Berdan II *(Chemical Engineering)* B.S., University of California, Berkeley 1975; M.S., California Institute of Technology 1978.
Thesis: Study of the Creeping Motion of a Sphere in the Presence of a Deformable Fluid/Fluid Interface.

Scott Adams Biller *(Chemistry)* S.B., Massachusetts Institute of Technology 1976.
Thesis: An Approach to the Total Synthesis of (±)-Naphthyridinomycin A.

William Joseph Brittain *(Chemistry)* B.A., University of Northern Colorado 1977.
Thesis: I. Rearrangement of Cyclopropyldiphenylmethyllithium and 4,4-Diphenyl-3-Buten-1-Yllithium. II. Deuterium Isotopic Perturbation of the Cyclopropylmethyl-Cyclobutyl Carbocation.

Steven Alan Cohen *(Chemistry)* B.A., M.S., Northwestern University 1977.
Thesis: Organotitanium and Niobium Chemistry: I. Structure and Reactivity of a Titanium Ethylene Complex. II. Reactivity of Decamethyl Niobocene Derivatives.

Benjamin Norman Conner *(Chemistry)* B.A., Rice University 1976.
Thesis: Iodo-CCGG: A Single Crystal Structure of A-DNA.

William Clinton Dow *(Chemistry)* B.S., M.S., Stanford University 1977.
Thesis: Total Synthesis of β-Chamigrene.

James William Gleeson *(Chemistry)* B.A., University of Delaware 1976.
Thesis: I. A Nuclear Magnetic Resonance Study of Metal Carbonyls in the Solid State. II. Studies of the Surface Chemistry of Rhodium Supported on Alumina.

Nicholas Alexandrou Kaffes *(Chemical Engineering)* B.E., The City College of The City University of New York 1975; M.S., California Institute of Technology 1976.
Thesis: Steam Reforming of Methane on a Ni Catalyst Suspended in Molten Sodium Phosphates.

Jack Alan Kaye *(Chemistry)* B.A., Adelphi University 1976.
Thesis: Theoretical Studies of Chemical Reaction Dynamics.

James Gregory Kralik *(Chemical Engineering and Chemistry)* B.S., University of California, Davis 1976; M.S., California Institute of Technology 1977.
Thesis: An Investigation of the Applied Chemistry of the Reactions of Coal and Nitrogen Dioxide with a Particular Emphasis on Oxidative Desulfurization.

Robert Ross Lucchese *(Chemistry)* B.S., University of California, Berkeley 1977.
Thesis: The Iterative Schwinger Variational Method Applied to Electron-Molecule Continuum Processes.

David Neil Marks *(Chemistry)* B.S., Trinity College 1977.
Thesis: Transition Metal Complexes of 1,3-bis(2'-pyridylimino)Isoindolines and Their Use as Alcohol Oxidation Catalysts.

Andrew William Maverick *(Chemistry)* B.A., Carleton College 1975.
Thesis: Spectroscopy and Photochemistry of Polynuclear Metal Complexes.

Lawrence Ray McGee *(Chemistry)* B.A., University of Utah 1974.
Thesis: Diastereoselective and Enantioselective Aldol Condensations with *Bis*-Cyclopentadienyl Zirconium Enolates.

David Philip Millar *(Chemistry)* B.S., University of Melbourne 1977.
Thesis: Picosecond Studies of Molecular Energy Transfer, Reorientation, and Internal Motion Dynamics.

Charles Howard Mitch *(Chemistry)* B.S., Carnegie-Mellon University 1977.
Thesis: The Application of Metallated Enamines to the Synthesis of Morphine Alkaloids.

Jan Stanley Najdzionek *(Chemistry)* B.S., State University of New York College at Geneseo 1977.
Thesis: Electrochemistry of Some Rhodium(I) Complexes.

Michael Wei-Kuo Nee *(Chemistry and Biology)* B.S., University of Santa Clara 1977.
Thesis: I. Reactions of Bicyclo[3.3.0]octenyl Tosylates. II. Nitrogen-15 Nuclear Magnetic Resonance Investigations of Organic Reactions.

Byron Lance O'Steen *(Chemical Engineering)* B.S., Clemson University 1975.
Thesis: I. Depolarized Light Scattering Studies of Rotational-Translational Coupling in Liquids Composed of Small Anisotropic Molecules. II. Investigation of the Coupling Between Reorientation and Longitudinal Modes in the Brillouin Spectra of Liquids Composed of Anisotropic Molecules.

Thomas Gardner Perkins *(Chemistry)* B.S., University of California, Riverside 1977.
Thesis: Nuclear Magnetic Resonance Investigations: Structure, Function, and Dynamics.

Danny David Reible *(Chemical Engineering)* B.S., Lamar University 1977; M.S., California Institute of Technology 1979.
Thesis: Investigations of Transport in Complex Atmospheric Flow Systems. I. Small Scale Studies of Diffusion Through Porous Media, Impact of Fumehood Exhaust Reentry on Indoor Air Quality, and Pollutant Transport Near an Isolated Island. II. Pollutant Transport in Mountain-Valley and Coastal Regions of California.

Ronald Rianda *(Chemistry)* B.S., University of California, Berkeley 1974.
Thesis: Electronic Transitions of Molecules by Electron Impact and Multiphoton Ionization Spectroscopy.

Steven Frederick Rice *(Chemistry)* S.B., Massachusetts Institute of Technology 1978.
Thesis: Optical Spectroscopic Studies of Square Planar d^8 Dimers.

Irving D. Sand *(Chemistry)* B.S., Duke University 1977.
Thesis: Investigation of the Mechanism of Complement Activation by Immunoglobulin G.

Mark Alan Siddoway *(Chemical Engineering)* B.S., Stanford University 1976.
Thesis: The Gasification of Carbonaceous Materials in Molten Sodium Phosphate.

Terrance P. Smith *(Chemistry)* B.S., University of Minnesota 1977.
Thesis: Syntheses and Characterization of a Series of Binuclear Iridium Complexes.

Arthur Wesley Stelson *(Chemical Engineering)* B.Ch.E., Georgia Institute of Technology 1975; M.S.Ch.E., 1976.
Thesis: Thermodynamics of Aqueous Atmospheric Aerosols.

Gary Eugene Whatley *(Chemical Engineering)* B.S., Colorado School of Mines 1971; M.S., 1972.
Thesis: An Experimental Study of Eddy Diffusivities and Eddy Viscosities for Cases of Anisotropic and Non-Homogeneous Turbulence in Suspension Flow.

Charles Albert Wight *(Chemistry)* B.S., University of Virginia 1977.
Thesis: Chemical Applications of Infrared Laser Photochemistry.

Ellen D. Williams *(Chemistry)* B.S., Michigan State University 1976.
Thesis: Studies of Chemical Adsorption Using Low-Energy Electron Diffraction.

Thomas Stephen Wittrig *(Chemical Engineering)* B.S., University of Illinois at Urbana-Champaign 1977.
Thesis: An Investigation of the Interaction of Water and of Saturated Hydrocarbons with the (110) Surface of Iridium.

Kathryn Mary Yocom *(Chemistry)* B.S., Bucknell University 1976.
Thesis: The Synthesis and Characterization of Inorganic Redox Reagent-Modified Cytochromes *c*.

DIVISION OF ENGINEERING AND APPLIED SCIENCE

Lisa Anderson *(Environmental Engineering Science and Economics)* B.S., California Institute of Technology 1974; M.S., Stanford University 1976.
Thesis: Iron Reduction and Micronutrient Nutrition of Juvenile *Macrocystis pyrifera* (L.) C. A. Agardh (Giant Kelp) Determined by a Chemically Defined Medium, Aquil.

John Wilson Barker *(Applied Mathematics)* B.A., King's College, University of Cambridge 1978.
Thesis: I. Interactions of Fast and Slow Waves in Problems with Two Time Scales. II. A Numerical Experiment on the Structure of Two-Dimensional Turbulent Flow.

Thomas Patrick Bauer *(Aeronautics and Planetary Science)* B.S.E., University of Michigan 1976; M.S.E., 1977.
Thesis: Low-Thrust Perturbation Guidance.

Robert J. N. Bernier *(Mechanical Engineering)* B.Sc.A., Université de Sherbrooke 1975; M.A.Sc., The University of British Columbia 1977.
Thesis: Unsteady Two-Phase Flow Instrumentation and Measurement.

William Robert Brownlie *(Civil Engineering)* B.S., State University of New York at Buffalo 1975; M.S., 1976.
Thesis: Prediction of Flow Depth and Sediment Discharge in Open Channels.

Charles Soutter Campbell *(Mechanical Engineering)* B.A., Vassar College 1977; M.S., California Institute of Technology 1978.
Thesis: Shear Flows of Granular Materials.

Christopher Ralph Carroll *(Computer Science)* B.S., Georgia Institute of Technology 1975; M.S., California Institute of Technology 1977.
Thesis: Hybrid Processing.

Christopher Jeyaparan Catherasoo *(Aeronautics)* B.A., Christ's College, University of Cambridge 1971; M.A., 1975; M.S., California Institute of Technology 1978.
Thesis: Shock Dynamics in Non-Uniform Media.

Baki Mehmet Cetegen *(Mechanical Engineering)* B.S., Bogazici University 1978; M.S., University of California, Berkeley 1979.
Thesis: Entrainment and Flame Geometry of Fire Plumes.

Herzl Chai *(Aeronautics)* B.Sc., Tel-Aviv University 1975; M.Sc., 1976.
Thesis: The Growth of Impact Damage in Compressively Loaded Laminates.

Carl Leei Chen *(Applied Mechanics)* B.S., National Taiwan University 1967; M.S.E., West Virginia University 1969; M.S., University of California, Los Angeles 1974.
Thesis: Direct Output Feedback Control of Large Flexible Spacecraft.

Michael Jiu-Wei Chen *(Engineering Science/Bioinformation Systems and Computer Science)* B.S., National Taiwan University 1975; M.S., California Institute of Technology 1980.
Thesis: A Spatiotemporal Probe of the Human Visual System by Application of Nonlinear Systems Identification Theory.

Chen Pei-Chuang *(Applied Physics)* B.S., State University of New York at Stony Brook 1975; M.S., California Institute of Technology 1977.
Thesis: Long Wavelength GaInAsP/InP Semiconductor Lasers for Optical Communications.

Nader Engheta *(Electrical Engineering and Physics)* B.S., Tehran University 1978; M.S., California Institute of Technology 1979.
Thesis: On the Radiation Patterns of Interfacial Antennas.

Randall Meindert Feenstra *(Applied Physics)* B.Sc., The University of British Columbia 1978; M.S., California Institute of Technology 1980.
Thesis: Electronic and Vibrational States of Point Defects in Semiconductors.

Graham Christopher Fleming *(Applied Mechanics)* B.E., University of Auckland 1977.
Thesis: Structure and Stability of Buoyant Diffusion Flames.

Graeme Francis Fowler *(Applied Mechanics)* B.E., University of Auckland 1976; M.E., 1977.
Thesis: Finite Plane and Anti-Plane Elastostatic Fields with Discontinuous Deformation Gradients Near the Tip of a Crack.

Mark Allen Hedemann *(Applied Physics)* B.S., Michigan State University 1974; M.S., California Institute of Technology 1976.
Thesis: Measurements of Magnetic Field Fluctuations in the Caltech Research Tokamak.

Ann Renee Karagozian *(Mechanical Engineering)* B.S., University of California, Los Angeles 1978; M.S., California Institute of Technology 1979.
Thesis: An Analytical Study of Diffusion Flames in Vortex Structures.

Joseph Katz *(Mechanical Engineering)* B.Sc., Tel-Aviv University 1977; M.S., California Institute of Technology 1978.
Thesis: Cavitation Inception in Separated Flows.

Michael Joseph Kavaya *(Electrical Engineering)* B.S., Purdue University 1974; M.S., California Institute of Technology 1975.
Thesis: Optoacoustic Detection Employing Stark Voltage Modulation and Stark Polarization Modulation.

Thomas Lawson Koch *(Applied Physics)* A.B., Princeton University 1977.
Thesis: Gigawatt Picosecond Dye Lasers and Ultrafast Processes in Semiconductor Lasers.

Charles Richard Lang, Jr. *(Computer Science)* B.S., University of Texas at Austin 1974; M.S., 1975; M.S., California Institute of Technology 1980.
Thesis: The Extension of Object-Oriented Languages to a Homogeneous, Concurrent Architecture.

Albert Niu Lin *(Civil Engineering and Environmental Engineering Science)* B.S., University of Missouri-Columbia 1978; M.S., California Institute of Technology 1979.
Thesis: Experimental Observations of the Effect of Foundation Embedment on Structural Response.

James Robert Mueller *(Applied Mathematics)* B.S., University of Wisconsin-Milwaukee 1975.
Thesis: I. The Analysis of the Rewetting of a Vertical Slab Using a Wiener-Hopf Technique. II. Asymptotic Expansions of Integrals with Three Coalescing Saddle Points.

Daniel Mark Nosenchuck *(Aeronautics)* B.S., Syracuse University 1976; M.S., California Institute of Technology 1977.
Thesis: Passive and Active Control of Boundary Layer Transition.

Kean Khoon Ooi *(Mechanical Engineering)* B.Sc., Queen Mary College, University of London 1977.
Thesis: Scale Effects on Cavitation Inception in Submerged Jets.

Louis Alexander Ortiz *(Civil Engineering)* B.S., University of Colorado 1977; M.S., California Institute of Technology 1978.
Thesis: Dynamic Centrifuge Testing of Cantilever Retaining Walls.

Dale Austen Prouty *(Applied Physics)* B.S., University of Missouri-Columbia 1974; M.S., California Institute of Technology 1976.
Thesis: Investigations of Near-Zone Doppler Effects.

Ioannis N. Psycharis *(Civil Engineering)* Diploma, National Technical University of Athens 1976; M.S., California Institute of Technology 1977.
Thesis: Dynamic Behavior of Rocking Structures Allowed to Uplift.

K. Ravi Chandar *(Aeronautics)* B.S., St. Joseph's College 1973; M.S., California Institute of Technology 1977.
Thesis: An Experimental Investigation into the Mechanics of Dynamic Fracture.

Per Gustaf Reinhall *(Applied Mechanics)* B.S.M.E., University of Washington 1977; M.S., California Institute of Technology 1978.
Thesis: The Analysis of a Nonlinear Difference Equation Occurring in Dynamical Systems.

Louis Anthony Romero *(Applied Mathematics)* B.S., California Institute of Technology 1975; Sc.M., Brown University 1977.
Thesis: I. Similarity Solutions of the Equations of Three Phase Flow Through Porous Media. II. The Fingering Problem in a Hele-Shaw Cell.

Robert E. Scheid, Jr. *(Applied Mathematics)* B.S., Carnegie-Mellon University 1977.
Thesis: The Accurate Numerical Solution of Highly Oscillatory Ordinary Differential Equations.

Helene R. Schember *(Engineering Science/General)* B.S.E., The Catholic University of America 1976; M.S., California Institute of Technology 1978.
Thesis: A New Model for Three-Dimensional Nonlinear Dispersive Long Waves.

Edgard Schweig *(Electrical Engineering)* Ingénieur Civil, Université Libré de Bruxelles 1977; M.S., California Institute of Technology 1978.
Thesis: Dielectric Waveguides for Millimeter Waves.

David Martin Scott *(Applied Physics)* B.S., California State University, Los Angeles 1974; M.S., 1976.
Thesis: The Effects of Oxygen on the Formation of Ni, Pd and Pt Silicides.

An Huh Shieh *(Aeronautics)* B.A., National Chiao Tung University 1935; M.Sc., University of Toronto 1941.
Thesis: Non-Stationary Lattice Theory.

John Cary Stevenson *(Mechanical Engineering)* B.S., University of Illinois at Chicago Circle 1977; M.S., California Institute of Technology 1978.
Thesis: The Rheology of a Bituminous Coal.

Tayfun Ersin Tezduyar *(Mechanical Engineering)* B.S., Middle East Technical University 1977; M.S., California Institute of Technology 1978.
Thesis: Finite Element Formulations for Hyperbolic Systems with Particular Emphasis on the Compressible Euler Equations.

DOCTOR OF PHILOSOPHY—*Continued*

Bernd Otto Trebitz *(Aeronautics)* Diplom-Ingenieurs, Technische Hochschule Darmstadt 1975.
Thesis: Acoustic Transmission Imaging for Flow Diagnostics.

Catharine van Ingen *(Civil Engineering)* B.S., University of California, Irvine 1973; M.S., University of California, Berkeley 1974.
Thesis: Observations in a Sediment-Laden Flow by Use of Laser-Doppler Velocimetry.

James Robert Young *(Environmental Engineering Science and Chemistry)* B.S., St. Mary's College 1973; M.S., California Institute of Technology 1976.
Thesis: A Study of the Adsorption of Ni(II) onto an Amorphous Silica Surface by Chemical and NMR Methods.

DIVISION OF GEOLOGICAL AND PLANETARY SCIENCES

Josephine Beatrice Cimino *(Planetary Science and Chemical Engineering)* B.S., University of California, Berkeley 1976; M.S., California Institute of Technology 1978.
Thesis: The Composition, Vertical Structure and Global Variability of the Lower Cloud Deck on Venus as Determined by Radio Occultation Techniques.

Alan Reed Gillespie *(Geology)* B.S., Stanford University 1969; M.S., California Institute of Technology 1977.
Thesis: Quaternary Glaciation and Tectonism in the Southeastern Sierra Nevada, Inyo County, California.

Chihang Amy Ng *(Geochemistry)* S.B., Massachusetts Institute of Technology 1974; S.M., 1975.
Thesis: I. Ancient Arctic Ice Does Not Contain Large Excesses of Natural Lead. II. Chronological Variations in Lead and Barium Concentrations and Lead Isotopic Compositions in Sediments of Four Southern California Off-Shore Basins.

Quinn R. Passey *(Planetary Science and Geology)* B.S., Brigham Young University 1978; M.S., California Institute of Technology 1979.
Thesis: Viscosity Structure of the Lithospheres of Ganymede, Callisto, and Enceladus, and of the Earth's Upper Mantle.

Larry John Ruff *(Geophysics)* B.S., University of California, Riverside 1975; M.S., California Institute of Technology 1977.
Thesis: I. Great Earthquakes and Seismic Coupling at Subduction Zones. II. The Structure of the Lowermost Mantle Determined by Short Period P-Wave Amplitudes.

Gordon Selbie Stewart *(Geophysics)* B.Sc., University of Edinburgh 1971; D.I.C., Imperial College of Science and Technology 1972; M.Sc., University of London 1972.
Thesis: Complexity of Rupture Propagation in Large Earthquakes in Relation to Tectonic Environment.

Joana Marija Vizgirda *(Geology)* B.A., University of Chicago 1975.
Thesis: Dynamic Properties of Carbonates and Applications to Cratering Processes.

DOCTOR OF PHILOSOPHY—*Continued*

DIVISION OF THE HUMANITIES AND SOCIAL SCIENCES

Joel Abe Balbien *(Social Science)* B.A., University of California, San Diego 1977; M.S., California Institute of Technology 1979.
Thesis: Essays on the Economics of Sponsored Research.

DIVISION OF PHYSICS, MATHEMATICS AND ASTRONOMY

Hideaki Aoyama *(Physics)* B.S., Kyoto University 1976; M.S., 1978.
Thesis: Pair Creation by Dynamic Field Configurations.

Robert Eugene Blair *(Physics)* B.S., Carnegie-Mellon University 1971; A.M., Boston University 1976.
Thesis: A Total Cross Section and Y Distribution Measurement for Muon Type Neutrinos and Antineutrinos on Iron.

David Leslie Brown *(Applied Mathematics)* B.S., M.S., Stanford University 1977.
Thesis: Solution Adaptive Mesh Procedures for the Numerical Solution of Singular Perturbation Problems.

Barbara Hope Cooper *(Physics)* A.B., Cornell University 1976.
Thesis: Erosion of Ice Films by Energetic Ions.

Mark Frederick Dumke *(Physics)* B.A., University of Colorado 1975.
Thesis: Sputtering of the Gallium-Indium Eutectic Alloy in the Liquid Phase.

David James Ennis *(Physics)* B.S., Purdue University 1975.
Thesis: One Millimeter Continuum Observations of Quasars.

Richard Alan Flammang *(Physics)* B.S., California Institute of Technology 1968; M.S., 1976; A.M., Harvard University 1971.
Thesis: Stationary Spherical Optically Thick Accretion into Black Holes.

Cornelis A. Gehrels *(Physics)* B.S., B.M., University of Arizona 1976.
Thesis: Energetic Oxygen and Sulfur Ions in the Jovian Magnetosphere.

Jeffrey Mark Greif *(Physics)* A.B., Princeton University 1970.
Thesis: Do Helium Monolayer Films Melt by Unbinding of Dislocations?

Rajan Gupta *(Physics)* B.Sc., Delhi University 1974; M.Sc., 1976.
Thesis: Mass-Gaps in Lattice Field Theories.

Ralph Elwood Howard *(Mathematics)* B.A., California State University, Northridge 1973; M.A., 1974.
Thesis: The Volume of Tubes in Homogeneous Spaces.

Andrew Thompson Hunter *(Physics)* B.S., Colorado School of Mines 1976.
Thesis: Low Temperature Photoluminescence Studies of Shallow Electronic States in Semiconductors.

Jai Sam Kim *(Physics)* B.S., Seoul National University 1970.
Thesis: General Methods for Analyzing Higgs Potentials.

Charles Kenneth Meins, Jr. *(Physics)* S.B., Massachusetts Institute of Technology 1975; M.S., California Institute of Technology 1977.
Thesis: Investigations into Electronic Stopping Regime Sputtering of Uranium Tetrafluoride.

Joseph Michael Nilsen *(Physics)* B.S., Cornell University 1977; M.S., California Institute of Technology 1979.
Thesis: Phase Conjugation via Four-Wave Mixing in a Resonant Medium.

Bruce Michael Ian Rands *(Mathematics)* B.Sc., Merton College, Oxford University 1979.
Thesis: Maximal Cliques in Graphs Associated with Combinatorial Systems.

Russell Ormond Redman *(Astronomy)* B.Sc., University of Victoria 1974.
Thesis: The Orientation and Sizes of Molecular Clouds in the Galaxy.

Donald P. Schneider *(Astronomy)* B.S., University of Nebraska 1976.
Thesis: CCD Observations of Clusters of Galaxies.

William Lawrence Sebok *(Astronomy)* B.S., University of Akron 1973.
Thesis: Use of an Automated Photographic Object Detection System to Analyse the Effect of Magnitude on the Angular Correlation Function of Galaxies.

Stuart Reh Stampke *(Physics)* B.S., California State University, Northridge 1973.
Thesis: Pion-Pion Decay Distributions for $\pi^- p \rightarrow \pi^+ \pi^- n$ at 100 and 175 GeV/c.

Frans Gerhardus J. Wiid *(Mathematics)* B.Sc., Rand Afrikaans University 1976; B.Sc. Hons., 1977.
Thesis: Aspects of the Theory of Normed Spaces.

John Charles Wolfskill *(Mathematics)* A.B., B.S., University of California, Berkeley 1977.
Thesis: On a Special Class of Reduced Algebraic Numbers.

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.

THE MILTON AND FRANCIS CLAUSER DOCTORAL PRIZE

Awarded to the Ph.D. candidate whose research is judged to exhibit the greatest degree of originality as evidenced by its potential for opening up new avenues of human thought and endeavor as well as by the ingenuity with which it has been carried out.

Recipient to be announced at Commencement.

THE WILLIAM F. BALLHAUS PRIZE

Awarded to an aeronautics student for an outstanding doctoral dissertation.

1982 Daniel M. Nosenchuck

ERIC TEMPLE BELL UNDERGRADUATE MATHEMATICS RESEARCH PRIZE

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

1982 Forrest C. Quinn, senior

*1981 Thiennu H. Vu**

CALTECH PRIZE SCHOLARSHIPS AND CARNATION SCHOLARSHIPS

Each year Caltech awards these prizes for academic excellence. They are based solely on merit (selection is made on the basis of grades, faculty recommendations, and demonstrated research productivity) with no consideration given to need or any other nonacademic criteria. Listed below are graduating seniors who have been recipients of these prizes.

B. Arlen Anderson
Kurt T. Bachmann
Paul C.-F. Chan
Eric Y. Chang
Kar Man Chang
Lance J. Dixon
Randall P. Field
James R. Heckman
Stephen C. Hsu
Jens H. Jensen
Robert J. Lang
Linda B. McAllister
Ronald L. Miller
Ronald W. Moore
William C. Naylor, Jr.
Forrest C. Quinn
Bruce D. Rogers
Philip A. Sackinger
Sharron C. Sarchet
Michael P. Thien
Anuchit Tiranuchit
Jeffrey L. Vollin
Thiennu H. Vu
Amy E. Wendt

**The names of students who have received prizes or awards in previous years, but who are graduating in 1982, are also listed.*

THE W. P. CAREY & CO., INC. PRIZE IN APPLIED MATHEMATICS

Awarded to the student receiving a Doctor of Philosophy degree for an outstanding doctoral dissertation in applied mathematics.

John W. Barker

RICHARD BRUCE CHAPMAN MEMORIAL AWARD

Awarded to a graduate student in hydrodynamics who has distinguished himself or herself in research in the Division of Engineering and Applied Science.

Helene R. Schember

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.

1982 Jerry R. Burch, sophomore; Russell B. Schweickart, junior

*1981 Michael P. Thien**

*1980 Michael P. Thien**

HAREN LEE FISHER MEMORIAL AWARD IN JUNIOR PHYSICS

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

1982 Arthur C. Thompson

*1981 Jens H. Jensen**

HENRY FORD II SCHOLAR AWARD

Awarded either to the engineering student with the best academic record at the end of the third year of undergraduate study, or to the engineering student with the best first-year record in the graduate program.

1982 Kenneth Ting-Yuan Kung, junior

*1981 William C. Naylor, Jr.**

JACK E. FROEHLICH MEMORIAL AWARD

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

1982 Kenneth Shun-Kei Chow, Roman Movshovich

*1981 Lance J. Dixon**

GEORGE W. GREEN MEMORIAL PRIZE

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

1982 Jens H. Jensen, senior; David J. LePoire, junior

*1981 Thiennu H. Vu**

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.

1982 Julia A. Kornfield, junior

*1981 Juanito S. Villanueva**

INSTITUTE FOR THE ADVANCEMENT OF ENGINEERING AWARD

Awarded to a student who exhibits a professional attitude toward engineering by a leadership role in the student chapter of a professional organization, such as the IEEE, ASCE, ASME.

George D. Caravias, senior

DAVID JOSEPH MACPHERSON PRIZE IN ENGINEERING

Awarded to the graduating senior in engineering who best exemplifies excellence in scholarship.

Anuchit Tiranuchit

MARY A. EARL McKINNEY PRIZE IN LITERATURE

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

1982 Michael Turyn, junior

*1980 Luke J. Will**

*1978 Cecilia B. Rodriguez**

ROBERT L. NOLAND LEADERSHIP SCHOLARSHIP

Awarded to students who exhibit qualities of outstanding leadership, which is most often expressed as personal actions that have helped other people and that have inspired others to fulfill their capabilities.

1982 R. Sekhar Chivukula, junior; Edward M. Lambert, senior

*1981 Susan J. VandeWoude**

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.

Patricia J. Stoddard

THE ERNEST E. SECHLER MEMORIAL AWARD IN AERONAUTICS

Awarded to an aeronautics student who has made the most significant contribution to the teaching and research efforts of GALCIT (Graduate Aeronautical Laboratories of the California Institute of Technology). Preference is given to students working in structural mechanics.

1982 Mark G. Mungal

*1981 K. Ravi Chandar**

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.

1982 Paul K. Kienker, junior; Sandra T. Loh, junior; David P. Watkins, freshman

*1981 Bimal Wadhwa**

*1979 Samin A. Mithani**

SIGMA XI AWARD

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

Kar Man Chang

THE MORGAN WARD PRIZE

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

1982 Alan G. Murray, sophomore

*1980 Forrest C. Quinn**

The Castle Press, Pasadena