Eighty-Seventh Annual Commencement

June 12, 1981

CALIFORNIA INSTITUTE OF TECHNOLOGY

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Eighty-Seventh Annual Commencement

FRIDAY MORNING AT TEN-THIRTY O'CLOCK
JUNE TWELFTH, NINETEEN EIGHTY-ONE

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, Robert W. Oliver, Ph.D.

Assistant Marshals

Arden L. Albee, Ph.D.
J. Kent Clark, Ph.D.
Christopher Brennen, Ph.D.
Jenijoy La Belle, Ph.D.

Faculty Officers

David L. Goodstein, Ph.D.
E. John List, 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 Convocation Wind Ensemble Brass and Organ
William Bing, M.M., Conductor

INVOCATION . . . . . Reverend Donald P. Merrifield, S.J.
President
Loyola Marymount University

COMMENCEMENT ADDRESS . . . . . .
"America's Greatest Investment Opportunity: Human Resources"
Mrs. Shirley M. Hufstedler, LL.D.
Former United States Secretary of Education
Trustee, California Institute of Technology

MUSICAL SELECTION . The Caltech Men's and Women's Glee Clubs
Monica J. Bown, M.A., Director

Laudate Dominum, by Marc Antoine Charpentier

CONFERRING OF DEGREES . . . . Marvin L. Goldberger, Ph.D.
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 . . . . . Cornelius J. Pings, Ph.D.
Dean of Graduate Studies

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

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 . . . . . Reverend Merrifield

RECESSIONAL . . The Convocation Wind Ensemble Brass and Organ

ORGAN POSTLUDE . . . . . Leslie Deutsch

Candidates for Degrees

BACHELOR OF SCIENCE

James Lyle Abbott *San Diego, California* Engineering and Applied Science
James Joseph Angel *Baden, Pennsylvania* Engineering and Applied Science and Economics
Erdal Arikan *Manisa, Turkey* Electrical Engineering
Lawrence Jeffrey Atherton *San Diego, California* Chemical Engineering
Nathaniel Jecorey Bachman *Portland, Oregon* Mathematics
Neil J. Barabas *Granada Hills, California* Engineering and Applied Science
John William Belliveau *San Mateo, California* Chemistry
Donald R. Benton *Escondido, California* Physics
David Anders Berge *Salt Lake City, Utah* Applied Physics
Stacey Marie Bilski *Goleta, California* Engineering and Applied Science
Bonnie Leigh Blamick *Altamonte Springs, Florida* Biology
Mary Agnes Bolton *Los Alamitos, California* Chemistry
David Stout Bradburn *Manhattan Beach, California* Engineering and Applied Science
Lynette Diane Brown *Yuba City, California* Biology
Robert Dean Brunkhorst *Colorado Springs, Colorado* Chemical Engineering
Mark Steven Burnett *Lompoc, California* Geophysics
Bret Steven Burns *Lancaster, California* Applied Physics
Kenneth Lawrence Campos *Fresno, California* Biology
David E. Carlan *Pasadena, California* Engineering and Applied Science
Jefferson William Chen *South Pasadena, California* Chemistry
John Te-Chung Chiang *Vancouver, British Columbia, Canada* Engineering and Applied Science
Terry Teh-I Chiang *Taipei, Taiwan, Republic of China* Physics
Kwok Wing Chow *Hong Kong* Engineering and Applied Science
Min-Kun Chung *Cerritos, California* Physics
Patrick Gene Coin *Fayetteville, North Carolina* Engineering and Applied Science
Robert Charles Colgrove *San Diego, California* Chemistry
Michael P. Connolly *Milwaukee, Wisconsin* Biology
Thomas Edward Cowan *Pasadena, California* Physics
Kent Douglas Daniel *San Juan Capistrano, California* Physics
Kris Paul Dehnel *San Angelo, Texas* Electrical Engineering
Jeffrey Jay Derby *Richfield, Minnesota* Chemical Engineering

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

David Hamilton Drum *Sudbury, Massachusetts* Chemistry
Bryan Charles Dunkeld *Portland, Oregon* Engineering and Applied Science
Eric Hansen Eichorn *Napa, California* Engineering and Applied Science
David B. Ellison *Belmont, California* Engineering and Applied Science
Joel Brian Ennis *Stuart, Florida* Physics
Anne Lana Erdmann *Fairfield, California* Biology
Richard Robert Erickson *Overland Park, Kansas* Electrical Engineering
Daniel Armstrong Erwin *Seattle, Washington* Applied Physics
Eric Pharr Etheridge *Atlanta, Georgia* Engineering and Applied Science
Peter Dean Farson *Glendale, California* Engineering and Applied Science
John Gordon Faughnan *St. Laurent, Quebec, Canada* Chemistry
John F. Fill *Glen Ellyn, Illinois* Mathematics
Christopher John Finch *Burbank, California* Geology
Davis Wallace Finley *Austin, Texas* Mathematics
William Shan-Chen Fong *Hong Kong* Chemical Engineering
Kevin P. Gambrel *Corona, California* Engineering and Applied Science
William Gee, Jr. *Amarillo, Texas* Engineering and Applied Science
Andrew John Gellman *Vancouver, British Columbia, Canada* Chemistry
Glen Arthur George *Westland, Michigan* Engineering and Applied Science
Saeid Ghamaty *Tehran, Iran* Physics
Gary Glassmoyer *Costa Mesa, California* Geophysics
Natalie Sue Gluck *Aurora, Colorado* Physics
Robert Warner Goodrich *Bettendorf, Iowa* Astronomy
Daniel Martin Gordon *Setauket, New York* Mathematics and Literature
Terry Michael Grant *Kent, Washington* Chemical Engineering
Marci Lynn Gray *Passaic Township, New Jersey* Engineering and Applied Science
Mark Russell Greenstreet *Oak Harbor, Washington* Electrical Engineering
William Tod Gross *Sherman Oaks, California* Engineering and Applied Science
Erik W. Gunderson *Appleton, Wisconsin* Biology
Thomas Lee Guthrie *Cleveland Heights, Ohio* Engineering and Applied Science
Nathan Walter Haase *La Crescenta, California* Electrical Engineering
Francis James Haggerty *San Francisco, California* Engineering and Applied Science
Shahram Hamidi *Tehran, Iran* Physics and Engineering and Applied Science
Deborah Ann Henriquez *Miramar, Florida* Engineering and Applied Science
John Edward Hershberger *Elberton, Georgia* Applied Mathematics and Literature
Ted Hesselroth *Columbia Heights, Minnesota* Physics
Richard Brooks Holmes *South Lake Tahoe, California* Physics
Eric John Holstege *San Francisco, California* Engineering and Applied Science

Pui Kwan Andy Hong *Kennedy Town, Hong Kong* Chemistry
John Thomas Hopeck *Brooklyn, New York* Geology and Literature
James D. Horn *Santa Fe, New Mexico* Engineering and Applied Science
James Joseph Host *Los Angeles, California* Biology
David N. Howard *Fontana, California* Applied Physics
Gary Chi-Hwei Hsieh *Taipei, Republic of China* Engineering and Applied Science
John Patrick Huber *Orange, California* Engineering and Applied Science
Susan Elizabeth Hunts *Cupertino, California* Engineering and Applied Science
Joseph Hurliman, Jr. *Othello, Washington* Chemical Engineering
Jill Tina Ibers *Evanston, Illinois* Chemistry
Craig Howard Jones *Woodland Hills, California* Geophysics
Michael Juda *Rochester, New York* Physics
Alan Kazuo Kamei *Anaheim, California* Chemical Engineering
Scott Allen Karns *Chetepa, Kansas* Engineering and Applied Science
Herbert Kay *Belmont, Massachusetts* Engineering and Applied Science
James Emery Kendall *Pasadena, California* Biology
Daniel John Kerns *San Francisco, California* Engineering and Applied Science
Alexander Kharev *Moscow, U.S.S.R.* Mathematics
Henry Ham Chung King *Hong Kong* Engineering and Applied Science
Christopher H. Kingsley *East Northport, New York* Engineering and Applied Science
Chesda Kiriratnikom *Bangkok, Thailand* Chemical Engineering
Clinton Neal Knott *Eugene, Oregon* Physics
Eric John Korevaar *La Jolla, California* Physics
Michael Walter Koza *Pasadena, California* Engineering and Applied Science
Hin-Wing Kui *Hong Kong* Applied Physics
Kerry Sunao Kurasaki *Los Altos, California* Engineering and Applied Science
Larry Allen Lader *Avalon, Wisconsin* Applied Mathematics
Dennis Kang-Por Lam *Hong Kong* Engineering and Applied Science
James Patrick Landon *Tacoma, Washington* Biology
Daniel Keith Lathrop *Canoga Park, California* Physics
Frederic William Cornelius Ledeboer XV *Los Angeles, California* Engineering and Applied Science
Paul Kakui Lee *San Leandro, California* Engineering and Applied Science
Dorian Liepmann *Pasadena, California* Chemical Engineering
Terry Jay Ligocki *Reeseville, Wisconsin* Mathematics and Engineering and Applied Science
Derek Scott Lillie *Greenwich, Connecticut* Engineering and Applied Science
Christopher John Lindblad *Portland, Oregon* Engineering and Applied Science

Pamela Logan *Evanston, Illinois* Engineering and Applied Science
Alan Eton Loh *Elmhurst, New York* Engineering and Applied Science
John Arthur Lovberg *San Diego, California* Physics
Michael Ernest Lucero *El Monte, California* Physics
Bonaventura Francesco Luisi *Fremont, California* Chemistry
Christopher Paul Lutz *East Orange, New Jersey* Engineering and Applied Science
Robert Blake Maffit *Sherman Oaks, California* Engineering and Applied Science
Grace Hway-Jwin Mah *Northridge, California* Engineering and Applied Science
Maqsood Mahmud *St. Louis, Missouri* Engineering and Applied Science
Aneesh Vasant Manohar *Bombay, India* Physics
William Kenneth Marshall *Downey, California* Applied Physics
Bruce David Martin *Torrance, California* Chemistry
Kreg Allen Martin *Santa Clara, California* Engineering and Applied Science
Peter John Martin *La Jolla, California* Physics
Bruce Bryce McArthur *San Diego, California* Physics
Thomas Oliver McCabe *San Francisco, California* Engineering and Applied Science
John Boyett McCluskey III *Pendleton, Oregon* Engineering and Applied Science
James Patrick McDermott *Cliffside Park, New Jersey* Engineering and Applied Science
Patrick A. McMurtry *Sunnymead, California* Engineering and Applied Science
Ronald Lee Merkord *Corpus Christi, Texas* Applied Physics
Michael Shawn Meyer *San Diego, California* Physics
Joe Louis Miller, Jr. *Costa Mesa, California* Engineering and Applied Science
David John Mills *La Mesa, California* Mathematics and Social Science
Korak Mitra *Denver, Colorado* Engineering and Applied Science
Mark Madison Morrisset *El Cajon, California* Engineering and Applied Science
Koko K. Nazerian *Pasadena, California* Engineering and Applied Science
Michael R. Nelson *Kent, Washington* Geology
Michael Orel Newton *Severna Park, Maryland* Mathematics
Charles Rudolph Nichols *Pasadena, California* Engineering and Applied Science
Leslie Thomas Niles *Whidbey Island, Washington* Physics and Engineering and Applied Science
James Malcolm Erwin Nuckols *Carpinteria, California* Engineering and Applied Science
John Vincent Cañizares Nye *Metro Manila, Philippines* Physics
Norma Jean Ofsthun *Depew, New York* Chemical Engineering
Randall Edward Okubo *White Bear Lake, Minnesota* Chemical Engineering
Todd Culver Olson *Seattle, Washington* Physics
Charles Rowley O'Neil *Alamo, California* Engineering and Applied Science

Sethu Palaniappan *Petaling Jaya, Malaysia* Engineering and Applied Science
Jay **William Parker** *Bloomington, California* Electrical Engineering
Pirooz Parvarandeh *Tehran, Iran* Electrical Engineering
Daniel J. Pernich *Rock Springs, Wyoming* Chemistry
Celia R. Peterson *Bloomington, Indiana* Chemistry
Mary Ellen Peterson *San Diego, California* Engineering and Applied Science and Chemistry
John Russell Platenak *Anaheim, California* Chemistry
John Larry Porter, Jr. *Alexander, Arkansas* Physics
Werner Hans Pyka *Redlands, California* Engineering and Applied Science
Mark W. Randolph *Pasadena, California* Physics
Said Rashedmarandy *Tehran, Iran* Engineering and Applied Science and Mathematics
Russell Lawrence Reder *Glenview, Illinois* Chemical Engineering
John W. Reeds III *Thousand Oaks, California* Engineering and Applied Science
Alison Jean Reinbold *Anchorage, Alaska* Biology
Jean Marie Richter *La Mesa, California* Geochemistry
William Manuel Rojas *Daytona Beach, Florida* Electrical Engineering
Matthew Alan Ronning *Ridgecrest, California* Engineering and Applied Science
Mark Jeffrey Rosker *La Cañada, California* Physics
Daniel M. Rovner *East Lansing, Michigan* Engineering and Applied Science
Martin Joseph Ruzek *Manitowoc, Wisconsin* Geochemistry
S. S. Sabharwal *New Delhi, India* Physics
Mark Edward Saffman *Pasadena, California* Applied Physics
Christopher David Schlueter *Seattle, Washington* Chemical Engineering
Russell Mark Schmalenberger *Santa Ana, California* Engineering and Applied Science
Steven P. Schneider *Chicago, Illinois* Engineering and Applied Science
Deepak Shantilal Shah *Santa Rosa, California* Engineering and Applied Science
Arthur Elliott Sheiman *Great Neck, New York* Electrical Engineering
Mark Scott Sheldon *Boise, Idaho* Engineering and Applied Science
Peter Williston Shor *Mill Valley, California* Mathematics
John J. Sidorowich *Whitehouse Station, New Jersey* Physics
Ira Jonathan Simon *Long Beach, California* Engineering and Applied Science
Paul Byron Smith *Dallas, Texas* Chemical Engineering
Ray Edward Snyder *Orange, California* Engineering and Applied Science
Paul N. Spathis *Athens, Greece* Physics
Brett Alverson Spivey *Houston, Texas* Physics
John Reese Stembridge *La Crescenta, California* Mathematics

Stuart Keller Stephens *Bells, Tennessee* Geophysics
Alphonse Christopher Sterling *Fresno, California* Physics
Jorgos Christos Stylianos *Ioannina, Greece* Physics
Fan-Chia Tao *Wilton, Connecticut* Electrical Engineering
Terry Blane Thomason *Decatur, Georgia* Chemical Engineering
Kerin Thompson *San Diego, California* Biology
Gary Alan Tornquist *Paso Robles, California* Engineering and Applied Science
Niklas Gerard Traub *Altadena, California* Engineering and Applied Science
Tawach Ungsuwarungsri *Bangkok, Thailand* Engineering and Applied Science
Gregory Paul Vaccaro *Newport Beach, California* Engineering and Applied Science
Frederick Richard Vachss *Hillsdale, New Jersey* Applied Mathematics
David Edward Valdez *Riverside, California* Engineering and Applied Science
Carolyn Ann Venger *Las Vegas, Nevada* Biology
Christopher Davis Vestuto *Whitehorse, Yukon Territory, Canada* Biology
Stuart Jay Vincent *Long Beach, California* Chemistry
Kelvin H. Wagner *Pullman, Washington* Applied Physics
Patrick Kevin Walp *Pasadena, California* Engineering and Applied Science
Michael Roger Walsh *Seattle, Washington* Applied Mathematics
Ralph Cecil Weeks *Houston, Texas* Engineering and Applied Science
Christopher Harold Wendt *St. Paul, Minnesota* Physics
Bradley T. Werner *Wauwatosa, Wisconsin* Physics
Laura Helen Wesson *Goleta, California* Mathematics
John Charles Whitehead *Tuxedo, New York* Biology
George Walton Williams V *Durham, North Carolina* Mathematics and Engineering and Applied Science
Richard Coale Willson *Littleton, Colorado* Chemical Engineering
David Tak-Sing Yuen *San Francisco, California* Chemistry
John Boyd Zacharias *Marietta, Georgia* Applied Mathematics
Jonas Zmuidzinas *Glendale, California* Physics

MASTER OF SCIENCE

Rajapillai Veluppillai Ahilan *(Civil Engineering)* B.Sc., University of Leeds 1980.

David Thomas Allen *(Chemical Engineering)* B.S., Cornell University 1979.

David Verge Baxter *(Applied Physics)* B.Sc., University of Alberta 1979.

James Hugh Bayless *(Physics)* B.S., California Institute of Technology 1980.

David Joseph Atwood Bliss *(Environmental Engineering Science)* B.S., California Institute of Technology 1980; B.A., Whitman College 1980.

Philippe Guy Boita *(Mechanical Engineering)* Diplôme d'Ingénieur, Ecole Nationale Supérieure de Mécanique et d'Aerotechnique 1980.

Rob Bonney *(Engineering Science)* B.S., Tulane University 1979.

Hugues Bornet dit Vorgeat *(Materials Science)* Diplôme d'Ingénieur, Ecole Centrale de Lyon 1979; D.E.A., Université Claude Bernard, Lyon 1979.

Alan Richard Breight *(Electrical Engineering)* B.S., University of Missouri, Rolla 1980.

Elliott Rowe Brown *(Applied Physics)* B.S., University of California, Los Angeles 1979.

Thomas Douglas Burton *(Electrical Engineering)* B.S., Virginia Polytechnic Institute and State University 1980.

Antonio Carreón Carpio *(Mechanical Engineering)* Ingeniero Mecánico, Instituto Politecnico Nacional 1978.

Joel Gary Chaiken *(Mechanical Engineering)* B.S., Columbia University 1980.

Albert Lee Charles *(Mechanical Engineering)* B.S., University of Missouri, Rolla 1978.

Constantine Chazapis *(Applied Mechanics)* B.Sc., The City University, London 1980.

Kasivisvanathan Chelvakumar *(Applied Mechanics)* B.Sc., University of Sri Lanka 1980.

Jefferson William Chen *(Chemistry)* B.S., California Institute of Technology 1981.

Glen John Cherepon *(Civil Engineering)* B.S., University of Virginia 1978.

Joanna Marie Chiarito *(Electrical Engineering)* B.S., University of Maryland 1980.

Arturo Ovalle Cifuentes *(Civil Engineering)* Ingeniero Civil, Universidad de Chile 1977.

Ilan Cohen *(Electrical Engineering)* Ingénieur Civil Mécanicien et Electricien, Université Libre De Bruxelles 1979, Control Systems Engineer 1980.

James Louis Conca *(Geochemistry)* Sc.B., Brown University 1979.

Philippe Michel Costes *(Civil Engineering)* Diplôme d'Ingénieur, Ecole Centrale des Arts et Manufactures 1979.

Francis Claude Couillard *(Mechanical Engineering)* Ingénieur Mécanicien-Electricien, Ecole Spéciale des Travaux Publics, du Bâtiment et de l'Industrie 1979.

Christopher Thomas Creaven *(Geophysics)* B.S., Bridgewater State College 1979.

Rodolphe Guy Cristiano *(Mechanical Engineering)* Diplôme d'Ingénieur, Ecole Nationale Supérieure des Arts et Industries de Strasbourg 1980.

Rosemarie Cubba *(Geology)* B.S., Wayne State University 1979.

Luca d'Agostino *(Mechanical Engineering)* Laurea in Ingegneria Meccanica, Università degli Studi di Pisa 1978.

Adelaide D'Ambrosio *(Mechanical Engineering)* Dottore in Ingegneria Meccanica, Università degli Studi di Genova 1972.

Antonio De Candia *(Electrical Engineering).*

Allen Mark Dewey *(Electrical Engineering)* B.S., Texas A&M University 1980.

Kathryn Leonard DeWitt *(Electrical Engineering)* B.S.E., Duke University 1980.

Russell George DeWitt, Jr. *(Electrical Engineering)* B.S.E., Duke University 1980.

Benjamin Paul Dolgopolsky *(Applied Physics)* M.S., Leningrad Electrotechnical Institute 1975.

Yves Jacques Doucet *(Civil Engineering)* Diplôme d'Ingénieur, Ecole Centrale des Arts et Manufactures 1980.

Paul Nathan Dunlap *(Chemical Engineering)* B.S.Chem.E., University of Colorado 1978.

Charles David Edwards, Jr. *(Physics)* A.B., Princeton University 1979.

Singaravelu Elangovan *(Materials Science)* B.Sc., St. Joseph's College 1977; B.E., Indian Institute of Science 1980.

Charles William Engelhardt Jr. *(Civil Engineering)* B.S., Purdue University 1980.

Gary Herbert Fischer *(Electrical Engineering)* B.S., Worcester Polytechnic Institute 1980.

Michael David Foote *(Physics)* A.B., Cornell University 1978.

Dewey Alcott Frech *(Electrical Engineering)* B.S., Northern Arizona University 1980.

Lucien Froidevaux *(Planetary Science)* B.S., University of California, Los Angeles 1976.

Susan Elizabeth Fuhs *(Mechanical Engineering)* B.S., California Institute of Technology 1980.

Michael Robert Gabrielli *(Electrical Engineering)* B.S., University of Illinois at Urbana-Champaign 1980.

Steven Leslie Gay *(Electrical Engineering)* B.S., University of Missouri, Rolla 1979.

Gary Glassmoyer *(Geophysics)* B.S., California Institute of Technology 1981.

Moshe Gray *(Computer Science)* B.Sc., Technion-Israel Institute of Technology 1976.

Michele Andree Grivillers *(Electrical Engineering)* Diplôme d'Ingénieur, Ecole Supérieure d'Ingénieurs en Electrotechnique et Electronique 1980.

Craig Warren Gustafson *(Physics)* S.B., Massachusetts Institute of Technology 1978.

Michael Lee Harmon *(Electrical Engineering)* B.S., University of Maine at Orono 1980.

Thomas Martin Hearn *(Geophysics)* B.S., University of California, Riverside 1978.

Anne M. Hofmeister *(Geology)* B.S., Harvey Mudd College 1976; M.S., University of Illinois at Urbana-Champaign 1978.

MASTER OF SCIENCE—*Continued*

Philip Alan Hookham *(Chemical Engineering)* B.S., University of Illinois at Urbana-Champaign 1979.

Russell Duane Howard *(Aeronautics)* B.S., California Institute of Technology 1977; M.A., University of California, Berkeley 1979.

Thomas R. Howard *(Chemistry)* A.B., University of California, Berkeley 1978.

Daniel Jacob *(Environmental Engineering Science).*

Nicholas Patrick Jones *(Civil Engineering)* B.E., University of Auckland 1980.

Michael Panayiotis Karyeaclis *(Mechanical Engineering)* B.S., Harvey Mudd College 1980.

Richard Paul Keller *(Geophysics)* B.A., B.S., University of California, Santa Barbara 1975.

Karyn Theresa Knoll *(Aeronautics)* S.B., Massachusetts Institute of Technology 1978.

Constantine Kravaris *(Chemical Engineering)* Diploma, National Technical University of Athens 1979.

Michael Alan Kroupa *(Planetary Science)* B.A., The University of Chicago 1979.

Luen-Hin Kwok *(Electrical Engineering)* B.Sc., University of Hong Kong 1979.

Didier Lacroix *(Electrical Engineering).*

Ronald Robert Lagnado *(Chemical Engineering)* B.S., University of Illinois at Urbana-Champaign 1979.

Louis Lamarche *(Aeronautics)* Bachelier en Ingénierie, Ecole Polytechnique de Montréal 1979.

Christopher LaMendola *(Electrical Engineering)* B.S., State University of New York at Buffalo 1980.

Koon Hang Lau *(Physics)* B.A., University of California, Berkeley 1978.

Stephen Koon-Yee Lau *(Electrical Engineering)* B.S., University of California, Berkeley 1980.

Patrick Laurieux *(Mechanical Engineering)* Ingénieur Arts et Métiers, Ecole Nationale Supérieure d'Arts et Métiers 1980.

Tuan Anh Le *(Electrical Engineering)* B.S., University of Missouri, Rolla 1979.

Ronan J. Le Bras *(Geophysics)* Ingénieur Civil, Ecole Nationale Supérieure des Mines de Paris 1979.

Ricky K. Leo *(Electrical Engineering)* B.S., University of Wyoming 1980.

Joseph Anthony Leone *(Chemical Engineering)* B.E., Youngstown State University 1979.

Pui-Tang Leung *(Physics)* B.Sc., Chinese University of Hong Kong 1979.

Robert Kenneth Lewis *(Computer Science)* B.S., California Institute of Technology 1972.

Chuen-Der Lien *(Electrical Engineering)* B.S., National Taiwan University 1978.

Jane Ming-Chin Lin *(Aeronautics)* B.S., Iowa State University of Science and Technology 1980.

Tzu-mu Lin *(Computer Science)* B.S., National Taiwan University 1978.

Fai Ma *(Engineering Science)* B.Sc., University of Hong Kong 1977.

Douglas Alan Macdonald *(Physics)* B.S., Florida State University 1975.

Emmanuel Antony Maragakis *(Civil Engineering)* Diploma, National Technical University of Athens 1980.

Daniel Margoliash *(Engineering Science)* B.S., California Institute of Technology 1975.

Catherine Claire Marshall *(Computer Science)* B.S., California Institute of Technology 1977.

Madhav Mehra *(Materials Science)* B.Tech., Indian Institute of Technology, Kanpur 1980.

Marcus Holden Mendenhall *(Physics)* B.A., Washington University 1979.

Richard Craig Mosteller *(Computer Science)* B.S., Northrop Institute of Technology 1968.

Xavier Mottet *(Civil Engineering)* Ingénieur ETP, Ecole Spéciale des Travaux Publics 1980.

Michael Steven Muha *(Applied Physics)* B.S., University of Southern California 1979.

John Anthony Murphy *(Physics)* B.Sc., University College 1977; M.Sc., 1979.

Afshin Nassiri *(Aeronautics)* B.S., Illinois Institute of Technology 1980.

Dean Paul Neikirk *(Applied Physics)* B.S., Oklahoma State University 1979.

Hai Ngoc Nguyen *(Electrical Engineering)* B.S., Oklahoma State University 1980.

Christian Michael Nielsen *(Mechanical Engineering)* B.S., California Polytechnic State University, San Luis Obispo 1980.

Nutan Kumari Pande *(Chemical Engineering)* B.S., University of California, Berkeley 1979.

Salvador Parisi *(Mechanical Engineering)* B.S., Utah State University 1980.

David Bruce Parlour *(Electrical Engineering)* B.Eng., Carleton University 1980.

Jérôme Perigne *(Aeronautics)* Ingénieure, Ecole Central de Lyon 1980.

Marianna Plastourgou *(Environmental Engineering Science)* B.Sc., The University of Newcastle upon Tyne 1980.

Ian H. Redmount *(Physics)* B.S., Michigan State University 1978.

Antonio Arevalo Reyes *(Biology)* B.S., University of the Philippines 1975.

Sally Miranda Rigden *(Geology)* B.Sc., Australian National University 1977.

Harry Francis Robey, III *(Aeronautics)* B.S.E., Duke University 1979.

Leonid Iakov Rudin *(Computer Science)* M.S., Odessa University 1976.

Raghvendra Sahai *(Astronomy)* M.Sc., Indian Institute of Technology, Kanpur 1978.

Ka-Yiu San *(Chemical Engineering)* B.S., Rice University 1978.

Bonny Laura Schumaker *(Physics).*

Richard Lawrence Ségal *(Computer Science)* B.S., University of California, Irvine 1979.

MASTER OF SCIENCE—*Continued*

Byron Bong Siu *(Physics)* B.A., Princeton University 1979.

John Stephen Smith *(Applied Physics)* B.S., California Institute of Technology 1980.

David Bruce Squires *(Electrical Engineering)* B.Eng., McMaster University 1980.

Peter Hans Stahlecker *(Applied Mechanics)* Vordiplom, Universität Stuttgart 1978.

Stuart Keller Stephens *(Geophysics)* B.S., California Institute of Technology 1981.

Alan Thomas Stone *(Environmental Engineering Science)* B.S., University of Maryland 1978.

Larry K. Temple *(Electrical Engineering)* B.S., Ohio University 1980.

Alastair James Thompson *(Computer Science)* B.Sc., Manchester University 1978.

Steve Joseph Tillman *(Electrical Engineering)* B.S., Virginia Polytechnic Institute and State University 1980.

Thomas Edward Tkacik *(Electrical Engineering)* B.S., University of Virginia 1980.

Peter Ping Tak Tong *(Electrical Engineering)* B.S., University of Hawaii 1980.

John Robert Torczynski *(Applied Physics)* B.A., Rice University 1979.

Daniel Herbert Turnbull *(Applied Mathematics)* B.Sc., Brock University 1978.

Kerry John Vahala *(Electrical Engineering)* B.S., California Institute of Technology 1980.

Timothy Edwin Van Eck *(Electrical Engineering)* B.S., California Institute of Technology 1980.

Cristo Daniel Vanevic *(Electrical Engineering)* B.S., Rutgers University 1980.

Mark Alan Voelker *(Physics)* B.S., California State University, Long Beach 1978.

Gregory Edward Vorbach *(Electrical Engineering)* B.E., State University of New York at Stony Brook 1980.

Marianne Carol Walck *(Geophysics)* A.B., Hope College 1978.

Daniel Wenkert *(Planetary Science)* B.A., Rice University 1977.

Daniel Steven Whelan *(Computer Science)* B.S., California Institute of Technology 1979.

Telle Elizabeth Whitney *(Computer Science)* B.S., University of Utah 1978.

Stephen Wilkowski *(Electrical Engineering)* B.E., The Cooper Union 1980.

David Daniel Wolfe *(Electrical Engineering)* B.S., Montana State University 1980.

Hon-Chi Yu *(Electrical Engineering)* B.S., Polytechnic Institute of New York 1980.

Jeffrey Alan Zelt *(Aeronautics)* B.Sc., University of British Columbia 1980.

Carl Kirk Ziegler *(Applied Mechanics)* B.S., University of California, Santa Barbara 1980.

ENGINEER

Phuc The Doan *(Aeronautical Engineer)* B.S., M.S., University of Minnesota 1978.

DOCTOR OF PHILOSOPHY

DIVISION OF BIOLOGY

G. Aston-Jones *(Neurobiology)* B.A., University of Virginia 1973.
Thesis: The Behavioral Physiology of Locus Coeruleus Neurons.

John Richard Bell *(Biochemistry)* S.B., Massachusetts Institute of Technology 1971.
Thesis: The Isolation and Partial Biochemical Analysis of Sindbis Virus Proteins.

Arlene Yuen-Chin Chiu *(Biology)* B.A., Stanford University 1968; M.Sc., University of Washington 1969.
Thesis: Biochemical and Immunohistochemical Studies of the Egg-Laying Hormone of *Aplysia californica:* Purification, Primary Structure, Neurosecretion and Morphological Distribution.

Mark Morris Davis *(Molecular Biology)* B.A., Johns Hopkins University 1974.
Thesis: Programmed DNA Rearrangements During Differentiation: Immunoglobulin Class Switching.

Deanna Ojala Johnson *(Molecular Biology)* B.S., Washington State University 1967; M.S., California Institute of Technology 1979.
Thesis: Transcription of the HeLa Cell Mitochondrial Genome.

Nelson Daniell Johnson *(Biochemistry)* B.S., California Institute of Technology 1974.
Thesis: An Analysis of Patterns of Diversity in Antibodies with Defined Specificity.

Elizabeth Hardy Lacy *(Biology)* B.A., University of Pennsylvania 1974.
Thesis: The Structure, Expression and Chromosomal Arrangement of Rabbit β-Globin Genes.

Joyce Ellen Lauer *(Biology)* A.B., Radcliffe College 1974.
Thesis: Molecular Cloning of the Human α-Globin Gene Family.

Charles Moen Rice, III *(Biochemistry)* B.S., University of California, Davis 1974.
Thesis: Studies on the Structural Proteins of Sindbis Virus.

Thomas Dean Sargent *(Biochemistry)* A.B., Indiana University 1975.
Thesis: The Rat Serum Albumin Gene.

James Walter Schilling, Jr. *(Molecular Biology)* A.B., Princeton University 1975.
Thesis: Antibody Diversity.

Brian Seed *(Biochemistry)* B.S., California Institute of Technology 1972.
Thesis: I. A Theoretical Study of the Representation of Genomic Sequences in Partial Digest Libraries. II. Studies of the Bacteriophage T4 Proximal Half Tail Fiber.

Wilson Chia-Siung Wu *(Biochemistry)* B.A., University of California, Los Angeles 1975.
Thesis: Functional Reconstitution of the Purified Acetylcholine Receptor from *Torpedo californica.*

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

David Andrew Agard *(Chemistry)* B.S., Yale College 1975.
Thesis: Approaches to Macromolecular and Supramolecular Structure Determination.

D. Wayne Berman *(Chemistry)* B.S., Muhlenberg College 1975.
Thesis: I. Thermochemistry and Reaction Kinetics of Disolvated Protons by Ion Cyclotron Resonance Spectroscopy. II. Thermochemical Studies of Small Fluorocarbons by Photoionization Mass Spectrometry.

David Scott Bomse *(Chemistry)* Sc.B., Brown University 1975; M.A., University of Cambridge 1976.
Thesis: Infrared Photochemistry.

Russell Leslie Bone *(Chemical Engineering)* B.S., Kansas State University 1975; M.S., California Institute of Technology 1977.
Thesis: Kinetics and Mechanism of the Co-Oxidation of Aldehydes and Model Organic Sulfur Compounds in Studies Related to the Oxo-Desulfurization of Fuel Oil and Coal.

Duncan William Brown *(Chemistry)* A.B., Princeton University 1975.
Thesis: Synthesis and Matrix Isolated Photolysis of 2,3-Dimethylbicyclo[2.2.0] hexa-2,5-diene-1,4-dicarboxylic Acid Anhydride: A Potential Precursor to 2,3-Dimethyl-1,4-dehydrobenzene.

Katherine A. Brown-Wensley *(Chemistry)* B.S., University of Rochester 1974.
Thesis: Formation of Bonds to Carbon at Transition Metal Centers.

Gary W. Brudvig *(Chemistry)* B.S., University of Minnesota 1976.
Thesis: The Nature and Distribution of the Metal Centers in Cytochrome *c* Oxidase.

Douglas Glenn Carson *(Chemical Engineering)* B.S., University of Michigan 1974.
Thesis: Solid State NMR at High Magnetic Fields Using Multiple Pulse Techniques.

Carla Jutta Casewit *(Chemistry)* B.A., University of Colorado 1976.
Thesis: I. Electrophilic Reactions of *p*-Toluenesulfonyl Azide. II. ^{15}N and ^{13}C Nuclear Magnetic Studies of Aryldiazonium Compounds. Effect of Substituent, Solvent and 18-Crown-6.

Horace Rainsford Drew III *(Chemistry)* B.S., Davidson College 1976.
Thesis: The High Resolution Structure of DNA by Single-Crystal X-Ray Methods.

Penny Kristen Eidem *(Chemistry)* B.S., San Diego State University 1974.
Thesis: An Investigation of the Photochemistry and Structures of Selected Second and Third Row Transition Metal Complexes.

Kenneth Eugene Eigenberg *(Chemistry)* B.S., Nebraska Wesleyan University 1976.
Thesis: The Interaction of Chlorophyll *a* with Lipids in Model and Natural Membrane Systems.

Jane Elizabeth Frommer *(Chemistry)* B.S., Tufts University 1976.
Thesis: Syntheses and Reactions of Polymer-Bound Molybdenum Complexes and Hydrogenolyses of an Alkynyl Cobalt Carbonyl Cluster.

Patricia M. George *(Chemistry)* B.S., B.A., California State University, Fullerton 1976.
Thesis: Electron Attachment Reactions and Photochemistry of Transition Metal Carbonyls in the Gas Phase and on Surfaces.

Richard Randolph Hardy *(Chemistry)* B.S., Illinois Institute of Technology 1974.
Thesis: Studies of the Specificity and Function of Immunoglobulins. I. Relationship Between Structure and Specificity in Dinitrophenyl-Binding Mouse Myeloma Immunoglobulins. II. Effector Function Triggering in Immunoglobulins.

Brian Herndier *(Chemistry)* B.Sc., University of British Columbia 1975.
Thesis: Activation of Cell Function; Pharmacological Agents Which Degranulate Mast Cells and Cause Skeletal Muscle to Contract.

Albert John Highe *(Chemistry)* B.S., University of Michigan 1975.
Thesis: Ionic Motion in Solid Electrolytes: A Solid State NMR Study of Sodium and Lithium in β-alumina.

John Mitchell Huggins *(Chemistry)* B.A., Amherst College 1976.
Thesis: A Study of Fundamental Reaction Pathways for Transition Metal Alkyl Complexes. I. The Reaction of a Nickel Methyl Complex with Alkynes. II. The Mechanism of Aldehyde Formation in the Reaction of a Molybdenum Hydride with Molybdenum Alkyls.

Dale Edward Ibbotson *(Chemical Engineering)* B.S., University of Illinois at Urbana-Champaign 1976.
Thesis: A Fundamental Study of NO Reduction with Hydrogen over Ir(110).

Keiko Kanamori *(Chemistry)* B.A., Tokyo University 1962; B.S., California State University, Los Angeles 1976.
Thesis: ^{15}N Nuclear Magnetic Resonance Studies of the Active Sites of Enzymes and *in vivo* Nitrogen Metabolism.

Peter M. Koelsch *(Chemistry)* B.S., Duke University 1976.
Thesis: Use of Masked Quinones in Organic Synthesis: Efforts Directed Towards the Synthesis of Tropolonoid Natural Products.

Robert Paul Kreh *(Chemistry)* B.A., Susquehanna University 1976.
Thesis: The Synthesis, Electrochemistry and Reactivity of Binuclear Copper(I) Complexes as Mimics of Protein Active Sites.

George Clark Lisensky *(Chemistry)* B.A., Earlham College 1976.
Thesis: Reactions of Multidentate-Ligand Copper(I) Complexes with Dioxygen.

Thomas Paul Lockhart *(Chemistry)* B.S., Duke University 1976.
Thesis: The Chemistry of 1,4-Dehydrobenzenes.

James Arthur Miller *(Chemistry)* B.S., University of Oregon 1975.
Thesis: Studies on Ligand Binding to the Histrionicotoxin and the Agonist Binding Sites of Membrane Bound Acetylcholine Receptor from *Torpedo californica.*

Randall Heywood Morse *(Chemistry)* B.A., Kalamazoo College 1976.
Thesis: EPR Spectroscopic Studies of the Active Sites of Some Heme- and Copper-Containing, Oxygen-Binding Proteins.

John Victor Nelson *(Chemistry)* B.S., Carnegie-Mellon University 1976.
Thesis: I. The Stereochemistry of the [3,3] Sigmatropic Rearrangement of 1,5-diene-3-alkoxides. II. Stereoselective Aldol Condensations *via* Dialkylboron Enolates.

William Lee Olbricht *(Chemical Engineering)* B.S., Stanford University 1973.
Thesis: The Motion of Macromolecules and Immiscible Drops in Creeping Flow.

Charunya Phichitkul *(Chemical Engineering)* B.S., Stanford University 1976; M.S., California Institute of Technology 1978.
Thesis: Catalytic Activity and Deactivation Mechanisms of Supported NiO in CH_4 Oxidation.

Florence Trentacosti Presti *(Chemistry)* B.A., New York University 1974.
Thesis: Cholesterol's Important Influence on Structure and Function of Membrane Lipids.

Anthony K. Rappé *(Chemistry)* B.S., University of Puget Sound 1974.
Thesis: Theoretical Studies of Homogeneous Catalysis by Transition Metal Complexes.

Jeffrey Allen Reimer *(Chemistry)* B.S., University of California, Santa Barbara 1976.
Thesis: The Development of Novel Nuclear Magnetic Resonance Techniques for the Study of Solids, Thin Films, and Surfaces with Particular Application to Amorphous Semiconducting Silicon-Hydrogen Films.

Randy Richard Robinson *(Chemistry)* B.S., Stanford University 1974.
Thesis: Sequence Analysis of a tRNA Gene Cluster: *Drosophila* Leucine-tRNA Genes Contain Intervening Sequences.

John Robert Schlup *(Chemical Engineering and Chemistry)* B.S., Kansas State University 1974; B.S., 1975.
Thesis: The Nature of Fluorinated Oxide Catalysts: A Nuclear Magnetic Resonance Investigation.

Duane Donald Smith *(Chemistry)* B.S., University of Nebraska 1975.
Thesis: The Coherence and Transport of Electronic Excitation in One- and Two-Dimensional Solids.

Clifford Lawrence Spiro *(Chemistry)* B.S., Stanford University 1976.
Thesis: Studies on the Consequences of Metal-Metal Interactions.

Amy Elizabeth Stevens *(Chemistry)* B.A., Cornell University 1976.
Thesis: Fundamental Studies of Reactive Intermediates in Organometallic Chemistry.

Tom Hall Stevens *(Chemistry and Biology)* B.A., San Francisco State University 1974; M.S., 1976.
Thesis: The Structure of the Metal Centers in Cytochrome *c* Oxidase.

Terry Ray Taber *(Chemistry)* B.S., Purdue University 1976.
Thesis: The Total Synthesis of A-23187 and Related Enantioselective Aldol Condensations.

James M. Takacs *(Chemistry)* B.A., Rutgers University 1976.
Thesis: Approaches to Asymmetric Synthesis. The Diastereoselective Alkylations of Chiral Propionamide Enolates.

DOCTOR OF PHILOSOPHY—*Continued*

Patricia Ann Thiel *(Chemistry)* B.A., Macalester College 1975.
Thesis: Adsorption, Co-Adsorption and Catalytic Reactions on Rh(111) and Ru(001) Surfaces.

Nikolaos Petrou Vasilakos *(Chemical Engineering and Chemistry)* Diploma, National Technical University of Athens 1976; M.S., California Institute of Technology 1978.
Thesis: Coal Desulfurization by Selective Chlorinolysis.

Peter Thomas Wolczanski *(Chemistry)* S.B., Massachusetts Institute of Technology 1976.
Thesis: The Reactivity and Syntheses of Mono and Bis Permethylcyclopentadienyl Zirconium Hydrides.

DIVISION OF ENGINEERING AND APPLIED SCIENCE

Luis P. Bernal *(Aeronautics)* Ingeniero Aeronáutico, Universidad Politecnica de Madrid 1971.
Thesis: The Coherent Structure of Turbulent Mixing Layers. I. Similarity of the Primary Vortex Structure. II. Secondary Streamwise Vortex Structure.

Alexander Nelson Brooks *(Civil Engineering)* B.S., University of California, Berkeley 1976; M.S., California Institute of Technology 1977.
Thesis: A Petrov-Galerkin Finite Element Formulation for Convection Dominated Flows.

Arthur Raymond Brown *(Electrical Engineering)* B.S., Stanford University 1976; M.S., California Institute of Technology 1977.
Thesis: Topics in the Analysis, Measurement, and Design of High-Performance Switching Regulators.

Martin Cohen *(Civil Engineering)* B.A., University of Notre Dame 1974; B.S., 1975; M.S., California Institute of Technology 1976.
Thesis: Silent Boundary Methods for Transient Wave Analysis.

Andrew Keith Gabriel *(Applied Physics)* Sc.B., Brown University 1975; M.S., California Institute of Technology 1978.
Thesis: Optogalvanic Spectroscopy and Cataphoretic Laser Isotope Separation.

Ari Glezer *(Aeronautics)* B.Sc., Tel-Aviv University 1974; M.S., California Institute of Technology 1975.
Thesis: An Experimental Study of a Turbulent Vortex Ring.

Shawn Anthony Hall *(Mechanical Engineering)* B.S.E., Princeton University 1975; M.S., California Institute of Technology 1976.
Thesis: Vortex-Induced Vibrations of Structures.

Ralph Boyd James *(Applied Physics)* B.S., The University of Tennessee, Knoxville 1976; M.S., Georgia Institute of Technology 1977; M.S., California Institute of Technology 1978.
Thesis: Theoretical Studies of the Nonlinear Infrared Properties of p-Type Semiconductors.

Allan Douglas Jepson *(Applied Mathematics)* B.Sc., University of British Columbia 1976.
Thesis: I. Asymptotic Boundary Conditions for Ordinary Differential Equations. II. Numerical Hopf Bifurcation.

Michael Yih-Hwa Jin *(Engineering Science)* B.S., Chiao Tung University 1974; M.S., 1976.
Thesis: Temporal-Spatial Functional Analysis of the Class-IIa1 Motion Detection Cell of the Fly *Calliphora phaenicia.*

David Lawrence Johannsen *(Computer Science)* B.S., M.S., California Institute of Technology 1978.
Thesis: Silicon Compilation.

William Lawrence Kath *(Applied Mathematics)* S.B., Massachusetts Institute of Technology 1978.
Thesis: I. Propagating and Waiting Fronts in Nonlinear Diffusion. II. Sustained Reentry Roll Resonance.

Joseph Katz *(Electrical Engineering)* B.Sc., Technion, Israel Institute of Technology 1973; M.Sc., Tel-Aviv University 1976.
Thesis: AlGaAs Optoelectronic Devices for Optical Communications.

Charles Morton Krousgrill, Jr. *(Applied Mechanics)* B.S.M.E., Purdue University 1975; M.S., California Institute of Technology 1976.
Thesis: A Linearization Technique for the Dynamic Response of Nonlinear Continua.

Thomas Francis Kuech *(Applied Physics)* B.S., Marquette University 1976; M.S., 1977; M.S., California Institute of Technology 1978.
Thesis: Investigations on Schottky Barrier Structures in Compound Semiconductors. I. HgTe on CdTe: A Latticed Matched Schottky Barrier. II. Au-Cd Barriers to CdTe. III. Au Barriers on $In_xGa_{1-x}P$.

Kam-Yin Lau *(Electrical Engineering)* B.S., M.S., California Institute of Technology 1978.
Thesis: Ultra-High Frequency Dynamics of Semiconductor Injection Lasers.

Thierry Georges Lepelletier *(Civil Engineering)* Diplôme d'Ingénieur, Ecole Nationale Supérieure d'Electrotechnique, d'Electronique, d'Informatique, et d'Hydraulique de Toulouse 1975.
Thesis: Tsunamis—Harbor Oscillations Induced by Nonlinear Transient Long Waves.

Wing Kam Liu *(Civil Engineering)* B.S., University of Illinois at Chicago Circle 1976; M.S., California Institute of Technology 1977.
Thesis: Development of Finite Element Procedures for Fluid-Structure Interaction.

Gregory John McRae *(Environmental Engineering Science)* B.E., Monash University 1973; M.S., California Institute of Technology 1975.
Thesis: Mathematical Modeling of Photochemical Air Pollution.

Ronald Benjamin Melton *(Engineering Science)* B.S.E.E., University of Washington 1977; M.S., California Institute of Technology 1978.
Thesis: A Study of Horizontal Cell—Photoreceptor Interaction in the Frog Retina Using a Randomly Modulated Stimulus.

Paul Henry Milenkovic *(Electrical Engineering)* B.S.E.E., Northwestern University 1977; M.S., California Institute of Technology 1978.
Thesis: A Systematic Assessment of the Accuracy of Vocal Tract Area Function Estimates Made from the Speech Waveform.

Gordon Stuart Mitchard *(Applied Physics)* B.Sc., University of Waterloo 1976; M.S., California Institute of Technology 1977.
Thesis: Low Temperature Photoluminescence Properties of Silicon and Silicon-Germanium Alloys.

James Richard Ouimette *(Environmental Engineering Science)* B.S., University of California, Riverside 1970; M.S., California Institute of Technology 1977.
Thesis: Aerosol Chemical Species Contributions to the Extinction Coefficient.

Edward Kenneth Ruth *(Aeronautics)* B.S., Ohio State University 1975; M.S., California Institute of Technology 1976.
Thesis: Experiments with Unconventional Cross Flow Heat Exchangers.

James Carl Schatzman *(Applied Mathematics)* B.A., California State University, Fullerton 1976; M.S., University of California, Los Angeles 1977.
Thesis: A Model for the von Kármán Vortex Street.

Joseph Emmett Shepherd *(Applied Physics)* B.S., University of South Florida 1976.
Thesis: Dynamics of Vapor Explosions: Rapid Evaporation and Instability of Butane Droplets Exploding at the Superheat Limit.

Choon-Foo Shih *(Aeronautics)* B.S., National Taiwan University 1974; M.S., California Institute of Technology 1977.
Thesis: Failure of Liquid Storage Tanks Due to Earthquake Excitation.

Rodney Alan Stephenson *(Applied Mechanics)* B.E., University of Auckland 1975.
Thesis: The Equilibrium Field near the Tip of a Crack for Finite Plane Strain of Incompressible Elastic Materials.

Windsor Sung *(Environmental Engineering Science and Social Science)* S.B., Massachusetts Institute of Technology 1975; M.S., California Institute of Technology 1976.
Thesis: Catalytic Effects of the γ-FeOOH (Lepidocrocite) Surface on the Oxygenation Removal Kinetics of Fe(II) and Mn(II).

Dean Dalton Taylor *(Mechanical Engineering)* B.A., University of Utah 1972; B.S., 1973; M.S., California Institute of Technology 1974.
Thesis: Laboratory Studies of Submicron Particle Formation in Pulverized Coal Combustion.

Michael Alan Tenhover *(Applied Physics)* B.S., University of Cincinnati 1976; M.S., California Institute of Technology 1978.
Thesis: Mössbauer Effect Studies in Yttrium Based Metallic Glasses.

Arthur Ray Williams *(Applied Physics)* B.S., Cornell University 1976.
Thesis: Atomic Structure of Transition Metal Based Metallic Glasses.

Daniel Paul Wilt *(Applied Physics)* B.A., University of Southern California 1976.
Thesis: (AlGa)As Semiconductor Lasers and Integrated Optoelectronics.

Paul Jerome Yoder *(Applied Mechanics)* B.E., McGill University 1973; M.S., California Institute of Technology 1975.
Thesis: A Strain-Space Plasticity Theory and Numerical Implementation.

Kwang-I Yu *(Computer Science)* B.S., University of Richmond 1973.
Thesis: Communicative Databases.

DIVISION OF GEOLOGICAL AND PLANETARY SCIENCES

John Joseph Cipar *(Geophysics)* B.S., State University of New York at Binghamton 1970; M.A., 1972; M.S., California Institute of Technology 1974.
Thesis: Seismic Source Processes and Tectonics: Observations of Four Intracontinental Earthquakes.

Robert Everett Criss *(Geochemistry)* B.S., Case Western Reserve University 1973; M.S., California Institute of Technology 1974.
Thesis: An $^{18}O/^{16}O$, D/H and K-Ar Study of the Southern Half of the Idaho Batholith.

John Edward Ebel *(Geophysics)* A.B., Harvard College 1975.
Thesis: Evidence for Fault Asperities from Systematic Time-Domain Modeling of Teleseismic Waveforms.

Robert T. Gregory *(Geology)* B.A., University of California, San Diego 1974.
Thesis: Geology and Isotope Geochemistry of the Samail Ophiolite Complex, Southeastern Oman Mountains.

John H. Jones *(Geochemistry)* B.G.S., University of Kentucky 1974; M.S., California Institute of Technology 1978.
Thesis: Studies of the Geochemical Similarity of Plutonium and Samarium and Their Implications for the Abundance of ^{244}Pu in the Early Solar System.

William Beall McKinnon *(Planetary Science and Geophysics)* S.B., Massachusetts Institute of Technology 1976; M.S., California Institute of Technology 1979.
Thesis: Large Impact Craters and Basins: Mechanics of Syngenetic and Postgenetic Modification.

Robert Edward Powell *(Geology and Geophysics)* A.B., Middlebury College 1969; M.S., California Institute of Technology 1970.
Thesis: Geology of the Crystalline Basement Complex, Eastern Transverse Ranges, Southern California: Constraints on Regional Tectonic Interpretation.

James Edward Quick *(Geology)* B.S., University of California, Los Angeles 1972; M.S., University of Minnesota 1974.
Thesis: I. Petrology and Petrogenesis of the Trinity Peridotite, Northern California. II. Petrogenesis of Lunar Breccia 12013.

DOCTOR OF PHILOSOPHY—*Continued*

Maritza Irene Stapanian *(Planetary Science)* B.A., University of Wisconsin, Madison 1971.
Thesis: Induced Fission Track Measurements of Carbonaceous Chondrite Th/U Ratios and Th/U Microdistributions in Allende Inclusions.

DIVISION OF THE HUMANITIES AND SOCIAL SCIENCES

Robert William Hahn *(Social Science)* A.B., A.M., Brown University 1975; M.S., California Institute of Technology 1979.
Thesis: An Assessment of the Viability of Marketable Permits.

R. Mark Isaac *(Social Science)* B.S.F.S., Georgetown University 1976; M.S., California Institute of Technology 1978.
Thesis: Essays on the Role of Information in Natural Resource Exploration and Development.

Thomas Rossman Palfrey, III *(Social Science)* B.A., University of Michigan 1975; M.A., 1976.
Thesis: Equilibrium Models of Multiple-Object Auctions.

William Paul Rogerson *(Social Science)* B.A., University of Alberta 1976.
Thesis: Legal Remedies and Reputation as Solutions to Moral Hazard in Contracting.

DIVISION OF PHYSICS, MATHEMATICS AND ASTRONOMY

Gregory John Ball *(Physics)* B.Sc., University of Melbourne 1977; M.S., California Institute of Technology 1979.
Thesis: A Proximity Formulation of Nuclear Dynamics.

Yia-Chung Chang *(Physics)* B.S., Cheng-Kung University 1974; M.S., California Institute of Technology 1978.
Thesis: Electronic Properties Associated with Donor Impurities in Multivalley Semiconductors.

Walter Richardson Cook III *(Physics)* B.S., M.S., Stevens Institute of Technology 1972.
Thesis: Elemental Composition of Solar Energetic Particles.

Murray Scott Daw *(Physics)* B.A., University of Florida 1974.
Thesis: Theory of Vacancies and Core Excitons Near Semiconductor Surfaces.

Leslie Joseph Deutsch *(Mathematics)* B.S., California Institute of Technology 1976; M.S., 1977.
Thesis: Sharp Bounds for the Operator Norm of the Mehler Kernel Operator.

Bradley A. Flanders *(Physics)* B.S., Rensselaer Polytechnic Institute 1974; M.S., California Institute of Technology 1977.
Thesis: Application of the TDHF Methods to Nuclear Physics.

George Michael Fuller *(Physics)* B.S., California Institute of Technology 1976.
Thesis: Nuclear Weak Interaction Rates During Stellar Evolution and Collapse.

Philip James Hanlon *(Mathematics)* A.B., Dartmouth College 1977.
Thesis: Applications of the Quaternions to the Study of Imaginary Quadratic Ring Class Groups.

Jeffrey Alan Harvey *(Physics)* B.S., University of Minnesota 1977.
Thesis: Baryon Number Generation and Mass Relations in SO(10) Unified Models.

Ilias George Kastanas *(Mathematics and Computer Science)* Diploma, National Technical University of Athens 1975; M.S., California Institute of Technology 1976.
Thesis: The Ramsey Property and Degrees in the Analytical Hierarchy.

Heemin Kwon *(Physics)* B.S., Seoul National University 1974.
Thesis: Experimental Investigations of Neutrino Oscillations at a Fission Reactor.

James Roy Lee *(Physics)* B.S., Iowa State University 1974.
Thesis: Measurements of νN Charged Current Cross Sections from $E_\nu = 25$ GEV to $E_\nu = 260$ GEV.

Hong-Chuan Lin *(Mathematics)* B.S., National Taiwan University 1970; M.S., 1974.
Thesis: On the Reconstruction Problem in Graph Theory.

Roger Paul Linfield *(Astronomy)* B.S., Michigan State University 1975.
Thesis: Studies of Compact Extragalactic Radio Sources.

Fai Ma *(Applied Mathematics)* B.Sc., University of Hong Kong 1977.
Thesis: Stability Theory of Linear and Nonlinear Stochastic Difference Systems.

David Uhl Martin *(Applied Mathematics)* B.S., Ohio State University 1969.
Thesis: Studies of the Nonlinear Schrödinger Equation and Its Application to Water Waves.

Kay Wyatt Brown Merritt *(Physics)* B.S., Clemson University 1973.
Thesis: Observation of Prompt Single Muon Production by 400 GeV Protons.

Daniel Nadeau *(Physics)* B.S., Laval University 1975.
Thesis: High Spectral Resolution Observations of the Molecular Hydrogen Emission in the Orion Molecular Cloud.

Douglas Mark Rabin *(Astronomy)* A.B., Harvard College 1973.
Thesis: Studies of Stellar Populations: Star Clusters in M31, the Galaxy and the Magellanic Clouds.

David Benjamin Reiss *(Physics)* B.S., State University of New York at Stony Brook 1975.
Thesis: Some Topics in Grand Unified Models and the Cosmological Baryon Asymmetry.

Anthony Emerson Terrano *(Physics)* A.B., S.M., University of Chicago 1974.
Thesis: Topics in Perturbative Field Theory.

Richard Alan Wade *(Astronomy)* B.A., University of Utah 1975.
Thesis: Spectroscopy and Spectrophotometry of Cataclysmic Variable Stars.

Jack Leach Wisdom *(Physics)* B.A., Rice University 1975.
Thesis: I. The Origin of the Kirkwood Gaps: A Mapping for Asteroidal Motion Near the 3/1 Commensurability. II. The Resonance Overlap Criterion and the Onset of Stochastic Behavior in the Restricted Three-Body Problem.

Howard Kwong Chew Yee *(Astronomy)* B.A.Sc., University of Toronto 1975; M.S., California Institute of Technology 1980.
Thesis: Optical Spectral Properties of Active Galactic Nuclei and Quasars.

James Frederick Zumberge *(Physics)* B.S., University of Michigan 1974.
Thesis: A Balloon Measurement of the Isotopic Composition of Galactic Cosmic Ray Boron, Carbon and Nitrogen.

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.

1981 Daniel M. Gordon, senior; Peter W. Shor, senior; Thiennu H. Vu, junior

*1980 John R. Stembridge**

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.

Erdal Arikan
Jefferson William Chen
Terry Teh-I Chiang
Kwok Wing Chow
Robert Charles Colgrove
Jeffrey Jay Derby
William Shan-Chen Fong
Terry Michael Grant
John Edward Hershberger
Susan Elizabeth Hunts
Jill Tina Ibers
Aneesh Vasant Manohar
Michael R. Nelson
Leslie Thomas Niles
Norma Jean Ofsthun
Todd Culver Olson
Daniel J. Pernich
John Russell Platenak
Arthur Elliott Sheiman
Peter Williston Shor
Brett Alverson Spivey
John Reese Stembridge
Fan-Chia Tao
Carolyn Ann Venger
Kelvin H. Wagner
Christopher Harold Wendt
John Charles Whitehead

**The names of students who have received prizes or awards in previous years, but who are graduating in 1981, 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.

William L. Kath

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.

1981 Charlotte B. Clark, sophomore; Michael P. Thien, junior

*1980 Grace H.-J. Mah**

*1979 Leslie T. Niles**

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.

Mark Morris Davis

HAREN LEE FISHER MEMORIAL AWARD IN JUNIOR PHYSICS

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

1981 Jens H. Jensen

*1980 Terry T. Chiang**

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.

1981 William C. Naylor, Jr., junior

*1980 Erdal Arikan**

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.

1981 Lance J. Dixon

*1980 Terry T. Chiang**

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.

Thiennu H. Vu, junior

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.

1981 Juanito S. Villanueva, junior

*1980 Andrew J. Gellman**

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.

*1980 F. William C. Ledeboer XV**

DAVID JOSEPH MACPHERSON PRIZE IN ENGINEERING

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

Daniel M. Rovner

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.

1981 John T. Hopeck, senior; Donald C.-T. Lo, sophomore; Jill T. Ibers, senior

*1980 John E. Hershberger**

*1978 Christopher D. Vestuto**

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.

1981 Susan VandeWoude, junior; Richard C. Willson, senior; Grace H.-J. Mah, senior

*1980 Charles R. O'Neil**

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.

Michael P. Connolly

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.

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.

1981 Avideh Zakhor, freshman; Bimal Wadhwa, junior; Tracy T. Furutani, freshman

1980 John V. C. Nye, Todd C. Olson**

*1979 Charles R. O'Neil**

*1978 James J. Angel**

SIGMA XI AWARD

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

Jefferson W. Chen

THE MORGAN WARD PRIZE

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

1981 Alan G. Murray, freshman

*1979 David J. Mills**

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