Eighty-Sixth Annual Commencement

June 13, 1980

CALIFORNIA INSTITUTE OF TECHNOLOGY

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Eighty-Sixth Annual Commencement

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

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.
Christopher Brennen, Ph.D.
J. Kent Clark, Ph.D.
Robert V. Langmuir, 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 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, M.S.

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

INVOCATION . . . . . Rabbi Leonard I. Beerman
Leo Baeck Temple

COMMENCEMENT ADDRESS . The Honorable Dixy Lee Ray, Ph.D.
Governor of the
State of Washington

MUSICAL SELECTION . . . . . The Caltech Combined Glee Clubs
Olaf M. Frodsham, A.M., Director

Dance, Dance, My Heart, by Emma Lou Diemer

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 . . Ray D. Owen, Ph.D., Sc.D.
Dean of Students

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

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

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

Biology . . . . . Norman H. Horowitz, Ph.D.
Division Chairman

Chemistry and Chemical Engineering . . . 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 . . . . . Rabbi Beerman

RECESSIONAL . . . . The Convocation Brass Ensemble and Organ

ORGAN POSTLUDE . . . . . Leslie Deutsch

Candidates for Degrees

BACHELOR OF SCIENCE

David Laurence Adams *Granada Hills, California* Physics
Rayhaneh Akhavan-Alizadeh *Tehran, Iran* Engineering and Applied Science
Robert Dennis Arendt *San Diego, California* Applied Physics
Timothy N. Ayres *Los Altos Hills, California* Engineering and Applied Science
Ralph Gallegos Baca *Phoenix, Arizona* Engineering and Applied Science
Donald George Bacon *Fridley, Minnesota* Engineering and Applied Science
Bruce Matathias Baskir *Houston, Texas* Biology and Chemistry
James Hugh Bayless *Santa Maria, California* Physics
Raymond G. Beausoleil, Jr. *Phoenix, Arizona* Physics
Paul D. Belmont *Minneapolis, Minnesota* Engineering and Applied Science
Kevin Andrew Berasley *Reseda, California* Engineering and Applied Science
Allan Ira Berger *Castro Valley, California* Mathematics
Frank Lovett Bernstein *Washington, District of Columbia* Applied Mathematics
Gregory Allan Blaisdell *Camarillo, California* Applied Mathematics
Alan-Philippe Blanchard *East Hampton, New York* Mathematics
David Joseph Atwood Bliss *Danville, Kentucky* Engineering and Applied Science
Cristine Rae Bockenstette *Cincinnati, Ohio* Chemical Engineering
Thomas Alan Boldt *Menasha, Wisconsin* Engineering and Applied Science
Alan Howard Boyar *Whittier, California* Biology
Dean Carter Brackett *Cumberland, Rhode Island* Engineering and Applied Science
Christopher Stephen Bretherton *Boulder, Colorado* Applied Mathematics
Forrest Duane Brewer *Arvada, Colorado* Physics
Kenneth Hale Britten *Newport Beach, California* Biology
Donald Jeffery Brotemarkle *Valley Center, California* Applied Physics
Nicholas Gregg Brown *Chesham, Buckinghamshire, United Kingdom* Engineering and Applied Science
Richard O'Reilly Brown *Vienna, Virginia* Biology
Robert Lester Butler *Harbor City, California* Engineering and Applied Science
John Nathaniel Campbell *Los Angeles, California* Engineering and Applied Science
Jeffrey D. Carpenter *Yakima, Washington* Engineering and Applied Science
Edward Ming Chan *Wauwatosa, Wisconsin* Chemical Engineering
Robert Timothy Chang *New York, New York* Engineering and Applied Science and Economics

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

Shepperd Chao *Tainan, Taiwan* Engineering and Applied Science
Alan G. Cocconi *Geneva, Switzerland* Engineering and Applied Science
Johanan Leal Codona *Crestline, California* Applied Physics
Sean William John Colgan *Carnelian Bay, California* Astronomy
Margaret Elizabeth Cox *Ridgecrest, California* Mathematics
Carrie Anne Cummings *Sunnyvale, California* Engineering and Applied Science
Russell Lane Dailey *Minden, Louisiana* Engineering and Applied Science
John Ricardo DeAguiar *Chino, California* Chemical Engineering
Paul Raymond de la Houssaye *San Diego, California* Applied Physics
Stefan Gabriel Demetrescu *Irvine, California* Applied Physics
Scott Lawrence DeVore Applied Physics
Joseph Brun DiGiorgio *Sacramento, California* Engineering and Applied Science
Brian Patrick Doyle *Pasadena, California* Geophysics
Peter Ward Drapes *Great Falls, Montana* Electrical Engineering
Steven Glen Eaton *Salina, Kansas* Engineering and Applied Science
Peter Albert Edwards *Compton, California* Chemical Engineering
Victoria A. Edwards *Los Angeles, California* Chemical Engineering
Michael Dean Ellis *Petaluma, California* Engineering and Applied Science
Erik Eriksen *Montague, California* Biology
Henri Hayim Farhi *Richmond, Virginia* Biology
Shal Wayne Farley *Kailua, Hawaii* Engineering and Applied Science
M.G. Finn *Mahwah, New Jersey* Chemistry
Mark Steven Fischer *Northridge, California* Engineering and Applied Science
Cynthia Ann Flanagan *Miami, Florida* Chemistry
Thomas Havird Fly *Spartanburg, South Carolina* Engineering and Applied Science
Jon Fong *Los Angeles, California* Chemistry
Courtenay Peter Footman *San Francisco, California* Physics
Mark Patrick Fortunato *Williamsville, New York* Electrical Engineering
Ali Fotowat-Ahmady *Tehran, Iran* Engineering and Applied Science
James Robert Fruchterman, Jr. *Arlington Heights, Illinois* Engineering and Applied Science
Susan Elizabeth Fuhs *Carmel, California* Chemical Engineering
Susan Akiko Fujimoto *Honolulu, Hawaii* Engineering and Applied Science
Deane A. Gardner *Granada Hills, California* Engineering and Applied Science
Susan Shevaun Gilley *Denver, Colorado* Biology and Literature
Charles Edward Goodhart, Jr. *Leonardo, New Jersey* Applied Mathematics
Peter Marvin Goodwin *Bangkok, Thailand* Physics
John Arlin Goree *Odessa, Texas* Applied Physics
William Wallace Gould *Las Vegas, Nevada* Geology

Kenneth Gray *Dallas, Texas* Biology
Jay Aaron Hellinger *Van Nuys, California* Chemical Engineering
Laurel Jean Henderson *Littleton, Colorado* Geochemistry
William Edwin Henslin, Jr. *San Marino, California* Engineering and Applied Science
Glen Alan Herrmannsfeldt *Los Altos, California* Applied Physics
Lynn Mary Hildemann *Los Angeles, California* Biology and Engineering and Applied Science
Thomas Adam Howell *St. Paul, Minnesota* Engineering and Applied Science
Gregory Jude Hungerford *Santee, California* Mathematics
James Neal Jensen II *Bellevue, Washington* Engineering and Applied Science
David Mark Joseph *Los Angeles, California* Chemical Engineering
Dennis Koichi Kato *Huntington Beach, California* Chemical Engineering
John William Killea *San Diego, California* Applied Physics
Eric William Klumpe *La Cañada, California* Engineering and Applied Science
Chung-Tung Augustine Kong *Hong Kong* Mathematics
Scott Michael Konishi *Gardena, California* Physics
William Stuart Lawson *Pleasant Hill, California* Physics
Norman Tai Ming Lee *Pasadena, California* Electrical Engineering
Pik-Chun Beatrice Lee *Hong Kong* Engineering and Applied Science
Gabriel Anthony Lengua *Miramar, Florida* Physics
Isabella Talley Lewis *Redding, California* Chemical Engineering
Kenneth George Libbrecht *Fargo, North Dakota* Physics
Wen Liu *Singapore* Engineering and Applied Science
Edmond Yatman Lo *Singapore* Engineering and Applied Science
Eugene Ying Loh *Malibu, California* Physics
Robert J Luoma *New York, New York* Astronomy
Steven John Margaretic *Merced, California* Engineering and Applied Science
Rono James Mathieson *Denver, Colorado* Applied Physics
David Ross Mathog *San Jose, California* Applied Physics
Robert Dennis McAnelly *Austin, Texas* Applied Physics
Robert Edwin McCarthy III *Bakersfield, California* Engineering and Applied Science
Mark Allen McHenry *Orange, California* Engineering and Applied Science
Kevin Shane McLoughlin *Santa Barbara, California* Physics
James Chester Meador *Oklahoma City, Oklahoma* Engineering and Applied Science
Gary Harris Memovich *Tigard, Oregon* Mathematics
Bruce Allen Miller *Manhattan Beach, California* Applied Physics
David James Morris *Olympia, Washington* Applied Physics
Edward Ernest Musgrave *Berkeley, California* Physics

Charles Kwame Nartey *Big Ada, Ghana* Engineering and Applied Science
Bill A. Newman *Thousand Oaks, California* Engineering and Applied Science
Kim Man Ng *Seattle, Washington* Engineering and Applied Science
Albert Loyd Nichols III *Westwood, California* Chemistry and Applied Mathematics
Eric Stephen Nickell *Bainbridge Island, Washington* Engineering and Applied Science
Eric Nygren *Zumbrota, Minnesota* Applied Physics
Randall Edward Okubo *White Bear Lake, Minnesota* Engineering and Applied Science
Barry Anthony O'Mahony *Union City, New Jersey* Physics
Dale Koji Ota *Los Altos Hills, California* Engineering and Applied Science
Charles Changsik Park *Seoul, Korea* Engineering and Applied Science
Bruce Bennett Pedersen *El Cajon, California* Applied Physics
Chris Lee Peterson *Belmont, California* Applied Physics
Eric Thomas Peterson *Manhattan Beach, California* Geophysics
E. Sterl Phinney III *Leverett, Massachusetts* Astronomy
Alexis Porras *San José, Costa Rica* Engineering and Applied Science
William Laurence Power *San Rafael, California* Geology
Brian Mathew Punsly *Palos Verdes Estates, California* Physics
Ralph Edward Pursifull, Jr. *Midwest City, Oklahoma* Engineering and Applied Science
James Frederick Quilliam *McMinnville, Oregon* Engineering and Applied Science
Bill Hamilton Ray *Fort Collins, Colorado* Engineering and Applied Science
Michael Keith Reach *Oxnard, California* Physics and Mathematics
John Bertram Reinitz *Colorado Springs, Colorado* Biology
Charles Scott Reynolds *Little Rock, Arkansas* Engineering and Applied Science
Janet Ann Rice *Chicago, Illinois* Chemistry
David Brian Ritchie *Los Angeles, California* Economics
Alexander Francisco Rivera *Bremerton, Washington* Engineering and Applied Science
Kelly Roach *Spokane, Washington* Mathematics and Engineering and Applied Science
Jeffrey Arthur Ronne *Portland, Oregon* Chemistry
Mitchell Benedict Rotter *Alamo, California* Chemical Engineering
Constance Slavens Royden *Los Altos Hills, California* Engineering and Applied Science and Biology
Colleen Roseanna Ruby *Roseville, Michigan* Engineering and Applied Science
David E. Rumph *Orinda, California* Engineering and Applied Science
Kurt William Runge *San Diego, California* Biology and Chemistry
Leslie Ann Rusch *Schaumburg, Illinois* Electrical Engineering

Eric Saund *Los Angeles, California* Engineering and Applied Science
William B. Schmidke, Jr. *Lombard, Illinois* Physics
Mark Diedrich Seidler *El Cajon, California* Chemistry
Paul Fredrich Seidler *El Cajon, California* Chemistry
David Christopher Shafer *Oak Park, Illinois* Physics
K T Shum *Hong Kong* Engineering and Applied Science
Paul Alan Shupak *Dresher, Pennsylvania* Biology
Sandra Kay Sigmund *Wadsworth, Ohio* Chemistry
Conrad Lorenzo Silvestre *Seattle, Washington* Applied Physics
Michael Perry Simon *Pasadena, California* Applied Mathematics
Dave William Sivertsen *Des Moines, Iowa* Engineering and Applied Science
John Stephen Smith *Phoenix, Arizona* Applied Physics
Kenneth Scott Smith *Pasadena, California* Applied Mathematics
Michael Joseph Spreitzer *Westminster, California* Engineering and Applied Science
John Richard Stabler *Jacksonville, Florida* Engineering and Applied Science
David Zhao-Yo Ting *Taipei, Taiwan* Physics
Kerry John Vahala *Flint, Michigan* Applied Physics
Timothy Edwin Van Eck *Waldwick, New Jersey* Applied Physics
Jimmy Kwok-Yu Wang *Hong Kong* Chemical Engineering
David John Warling *Northridge, California* Engineering and Applied Science
Robert Wooddell Weaver *San Diego, California* Mathematics
Matthew Jonah Weinstein *Palm Beach, Florida* Engineering and Applied Science
Douglas Lee Whiting *Richmond, Virginia* Applied Physics
Mladen Victor Wickerhauser *Bethesda, Maryland* Mathematics
Michael Richard Woolley *Salt Lake City, Utah* Engineering and Applied Science
Mary Alice Wuerz *Belleville, Illinois* Chemistry
Robert R. Yamashita *Pearl City, Hawaii* Engineering and Applied Science
Joseph Anthony Zasadzinski *Riverside, California* Chemical Engineering
Jonathan Alan Zingman *Louisville, Kentucky* Physics
Lawrence M. Zwick *Livermore, California* Engineering and Applied Science

MASTER OF SCIENCE

Kim Maynard Aaron *(Aeronautics)* B.Eng., McGill University 1979.

Paul Mihran Agbabian *(Mechanical Engineering)* B.S., University of California, Los Angeles 1979.

Abdul-Rahman Abdul-Mohsen Al-Bassam *(Electrical Engineering)* B.Sc., University of Riyadh 1972.

Jean-Luc Raphael Aschard *(Mechanical Engineering)* Diplôme d'Ingénieur, D.E.A., Ecole Nationale Supérieure des Arts et Métiers 1979.

Richard Bartlett Ashman *(Mechanical Engineering)* B.S., University of Miami 1979.

Pamela Rae Auburn *(Chemistry)* B.A., Goucher College 1975.

Elias Awad *(Mechanical Engineering)* Diplôme d'Ingénieur, Ecole Centrale des Arts & Manufactures 1979.

Thomas Clyde Banwell *(Electrical Engineering)* B.S., Harvey Mudd College 1978.

N. Walden Barcus *(Electrical Engineering)* B.A., University of Washington, Seattle 1972; B.S., 1979.

Katherine Hamilton Barhydt *(Mechanical Engineering)* B.S., University of California, Los Angeles 1979.

Meir Bartur *(Electrical Engineering)* B.Sc., Technion, Israel Institute of Technology 1975.

Samir Elias Barudi *(Social Science)* B.E., American University of Beirut 1975; M.S., California Institute of Technology 1976.

Michael Stanley Becker *(Social Science)* B.A., University of California, San Diego 1978.

Robert Jacques Bensoussan *(Electrical Engineering)*

Barry Jerome Bentley *(Chemical Engineering)* B.Ch.E., University of Delaware 1978.

Beckie E. Berg *(Chemistry)* B.S., California Institute of Technology 1976.

Donna Hope Berry *(Social Science)* B.A., Pomona College 1978.

Stuart Lynch Blackburn *(Mathematics)* B.S., University of the Pacific 1976.

Michael Anthony Blessinger *(Applied Physics)* B.S., Purdue University 1978.

Norman Bobroff *(Physics)* B.S., University of Chicago 1977.

Kirk Daniel Borne *(Astronomy)* B.S., Louisiana State University 1975.

Roland Louis Bouchard *(Mechanical Engineering)* Diplôme d'Ingénieur, Ecole Nationale Supérieure d'Arts et Métiers de Paris 1979.

Richard Carl Bozzuto, Jr. *(Electrical Engineering)* B.S., United States Air Force Academy 1976.

Eugene David Brooks III *(Physics)* B.S., University of Maryland 1977.

Cynthia Rae Carlson *(Social Science)* B.A., St. Lawrence University 1977.

Samuel Kwang Yeh Chang *(Aeronautics)* B.Sc., National Taiwan Normal University 1976.

Marina Chien-Mei Chen *(Computer Science)* B.S., National Taiwan University 1978.

Michael Jiu-Wei Chen *(Electrical Engineering)* B.S., National Taiwan University 1975.

Wen-Wei Chiang *(Mechanical Engineering)* B.S., National Taiwan University 1977.

Liew-Chuang Chiu *(Applied Physics)* B.S., California Institute of Technology 1979.

Bo Hyung Cho *(Electrical Engineering)* B.S., California Institute of Technology 1979.

John Michael Cimbala *(Aeronautics)* B.S., The Pennsylvania State University 1979.

Joseph Stephens Clapp *(Physics)* B.S., Carnegie-Mellon University 1978.

Reuben Theodore Collins *(Applied Physics)* B.A., University of Northern Iowa 1979.

Martha Harriet Conklin *(Environmental Engineering Science)* B.A., Mount Holyoke College 1976.

Joseph James Connery, Jr. *(Electrical Engineering)* B.S., United States Air Force Academy 1977.

Christopher William Coyle *(Electrical Engineering)* S.B., Massachusetts Institute of Technology 1978.

Henry Marie Defalque *(Electrical Engineering)* Ingénieur Civil Electricien, Université Catholique de Louvain 1979.

Alain Delsupexhe *(Electrical Engineering)*

Stefan Gabriel Demetrescu *(Computer Science)* B.S., California Institute of Technology 1980.

Steven Duran *(Electrical Engineering)* B.S., University of New Mexico 1979.

Kenneth Eagle *(Chemical Engineering)* B.S., State University of New York at Buffalo 1979.

Steven Glen Eaton *(Electrical Engineering)* B.S., California Institute of Technology 1980.

Peter Kent Edberg *(Engineering Science)* B.S., California Institute of Technology 1977.

Gregory Humphreys Efland *(Computer Science)* B.S., Rensselaer Polytechnic Institute 1978.

Reda Abdu el-hay Mohamed Ali El-Damak *(Civil Engineering)* B.Sc., Cairo University 1975; M.Sc., 1978.

James Richard Ellison *(Electrical Engineering)* B.S., University of Texas at Austin 1978.

MASTER OF SCIENCE—*Continued*

Jay William Ellison *(Biology)* B.S., University of Illinois at Urbana-Champaign 1977.

Robert Warren Erickson, Jr. *(Electrical Engineering)* B.S., California Institute of Technology 1978.

Randall Meindert Feenstra *(Applied Physics)* B.Sc., University of British Columbia 1978.

Jeffrey Lee Fordon *(Mathematics)* B.S., Clarkson College of Technology 1977.

Lynn Forester *(Chemical Engineering)* B.A., University of California, Santa Cruz 1978.

Patrick Michael Frantz *(Physics)* B.S., Rochester Institute of Technology 1978.

James Robert Fruchterman, Jr. *(Applied Physics)* B.S., California Institute of Technology 1980.

Sai-Wai Fu *(Electrical Engineering)* B.S., California Institute of Technology 1979.

Celestino John Gaeta *(Electrical Engineering)* B.S., California State University, Fresno 1979.

Dhrumil Jayantilal Gandhi *(Electrical Engineering)* B.Tech., Indian Institute of Technology, Bombay 1979.

Marius Gerber *(Civil Engineering)* B.Sc., University of Stellenbosch 1974; M.Sc., University of Cape Town 1978.

Alexander Sherwin Gerwer *(Chemistry)* B.S., University of Michigan 1976.

George Randall Gladstone *(Planetary Science)* B.Sc., University of British Columbia 1978.

Patrick William Goalwin *(Applied Physics)* S.B., Massachusetts Institute of Technology 1979.

Harry Andrew Gray *(Environmental Engineering Science)* B.S., Carnegie-Mellon University 1979.

Paula Jean Grunthaner *(Chemistry)* B.S., California Institute of Technology 1975.

Mark E. Gurney *(Biology)* B.A., University of California, San Diego 1975.

Douglas Gene Hager *(Electrical Engineering)* B.S., California Institute of Technology 1978.

Christoph Stephan Harder *(Electrical Engineering)* Diploma, Swiss Federal Institute of Technology Zurich 1978.

Paul Baxter Harwood *(Materials Science)* B.Sc., Clarkson College of Technology 1978.

Steven Wayne Hashimoto *(Social Science)* A.B., University of California, Berkeley 1976.

Mohammed Fawzy Farrage Helwa *(Civil Engineering)* B.Sc., Cairo University 1975; M.Sc., 1979.

Jean-Marc Claude Henry *(Mechanical Engineering)* Diplôme d'Ingénieur, Ecole Nationale Supérieure des Arts et Industries de Strasbourg 1979.

Mark Hereld *(Physics)* B.S., University of California, Berkeley 1978.

James Carl Hermanson *(Aeronautics)* B.S., University of Washington 1977.

Bruce Kuo Ting Ho *(Electrical Engineering)* S.B., Massachusetts Institute of Technology 1978.

Kwok Kee Ho *(Electrical Engineering)* B.S., University of Texas at Austin 1979.

Tai-Ping Ho *(Computer Science)* B.S., National Chung-Hsing University 1971; M.S., The University of Tennessee, Knoxville 1978.

Gregory Scott Hoffman *(Mechanical Engineering)* B.A., Whitman College 1979; B.S., California Institute of Technology 1979.

Ulrich Manfred Huener *(Applied Mathematics)* Vordiplom, Universität Bielefeld 1977.

Dominic Izzo *(Civil Engineering)* B.S., United States Military Academy 1974.

Sudhir Kumar Jain *(Civil Engineering)* B.E., University of Roorkee 1979.

Bruce Martin Jakosky *(Planetary Science)* B.S., University of California, Los Angeles 1977.

Belgacem Jery *(Mechanical Engineering)* Diplôme d'Ingénieur, Ecole Nationale Supérieure d'Arts et Métiers de Paris 1979.

David Clifford Jewitt *(Planetary Science)* B.Sc., University College London 1979.

Jeffrey Bowman Johnson *(Social Science)* B.A., University of Kansas 1978.

Steven Wayne Johnston *(Environmental Engineering Science)* B.S., Louisiana State University and Agricultural and Mechanical College 1973; M.S., 1976; M.S., 1978.

Prakash Kasiraj *(Applied Physics)* B.S., Texas A&M University 1978.

Alan Stewart Katz *(Engineering Science)* B.A., Brandeis University 1978.

William Gerard Kerschen *(Mechanical Engineering)* B.S., New Mexico State University 1979.

Isabella Brigitte Kierkowska *(Applied Physics)* B.S., California Institute of Technology 1979.

Douglas Harold Klein *(Mechanical Engineering)* B.S.M.E., University of Cincinnati 1978.

Tony Siu Pong Kong *(Environmental Engineering Science)* B.S., University of Wisconsin, Madison 1979.

David Alan Krider *(Applied Physics)* B.A., University of California, Irvine 1978.

Charles Richard Lang, Jr. *(Computer Science)* B.S., University of Texas at Austin 1974; M.S., 1975.

Billy Ying Bui Lau *(Electrical Engineering)* B.E., State University of New York at Stony Brook 1979.

Thorne Lay *(Geophysics)* B.S., University of Rochester 1978.

François Le Clerc de Bussy *(Mechanical Engineering)* Diplôme d'Ingénieur, Ecole Nationale Supérieure des Mines de Paris 1979.

Katherine Dai-Li Lee *(Biology)* B.S., Fu Jen Catholic University 1977.

Bosco Hok-Chung Leung *(Electrical Engineering)* B.S., Rensselaer Polytechnic Institute 1979.

Herman Sui Ning Li *(Computer Science)* B.A., St. John's University 1978.

Wen Liu *(Aeronautics)* B.S., California Institute of Technology 1980.

Edmond Yatman Lo *(Mechanical Engineering)* B.S., California Institute of Technology 1980.

Shawn Michael Logan *(Electrical Engineering)* B.S., Brown University 1979.

Mark Allen Ludwig *(Physics)*

Hiroshi Maekawa *(Aeronautics)* B.E., University of Tokyo 1972.

Robert Sullivan Maier *(Physics)*

Christian Mailhiot *(Applied Physics)* B.Ing., Université de Montréal, Ecole Polytechnique 1978.

Eric Francois Matthys *(Mechanical Engineering)* Mechanical & Electrical Engineer, Brussels University 1978.

Mathew McCubbins *(Social Science)* B.A., University of California, Irvine 1978.

Paul Vincent Neilson *(Chemistry)* B.S., California Polytechnic State University, San Luis Obispo 1977.

Phyllis Roberta Nelson *(Electrical Engineering)* B.S., California State Polytechnic University, Pomona 1977.

Khai Doan The Ngo *(Electrical Engineering)* B.S., California State Polytechnic University, Pomona 1979.

Donald Wallace Northfelt *(Geochemistry)* B.S., University of Minnesota 1978.

Jaime Jose Olaechea *(Civil Engineering)* B.S., Texas A&M University 1978.

Clifford Alvin Oostman, Jr. *(Mechanical Engineering)* B.S., Illinois Institute of Technology 1978.

Michael John Otto *(Mechanical Engineering)* B.S., University of Wisconsin, Milwaukee 1976.

Ronald Yu Sang Pak *(Civil Engineering)* B.Eng., McMaster University 1979.

Alexandros Christos Papachristidis *(Computer Science)* Diploma of Mechanical and Electrical Engineering, National Technical University of Athens 1979.

James Scott Patton *(Mechanical Engineering)* B.M.E., Georgia Institute of Technology 1979.

Thomas James Pence *(Applied Mechanics)* B.S., Michigan State University 1979.

Marc Jean-François Peran *(Mechanical Engineering)* Diplôme d'Ingénieur, L'Ecole Polytechnique 1979.

Frank Allen Perez *(Mechanical Engineering)* B.S., Columbia University 1979.

Robert Charles Pike *(Physics)* B.Sc., University of Toronto 1978.

Elliot Martin Pines *(Electrical Engineering)* B.A., Brandeis University 1978.

Alexis Porras *(Mechanical Engineering)* B.S., California Institute of Technology 1980.

James Neal Potechin *(Mechanical Engineering)* B.S., Rensselaer Polytechnic Institute 1979.

Arati Prabhakar *(Electrical Engineering)* B.S., Texas Tech University 1979.

Paul Michael Rapacz *(Aeronautics)* B.S., Illinois Institute of Technology 1979.

Wayne Harvey Richardson *(Electrical Engineering)* B.S., University of Southern California 1979.

Rory Alberto Rivera *(Electrical Engineering)* B.S., University of Puerto Rico at Mayaguez 1979.

Kelly Roach *(Computer Science)* B.S., California Institute of Technology 1980.

Karen Irene Robinson *(Geology)* B.S., University of California, Los Angeles 1978.

Kenneth Vincent Rousseau *(Applied Physics)* B.S., California Institute of Technology 1979.

Nicolas Alexis Roy *(Applied Mechanics)* B.S., The Pennsylvania State University 1979.

Olivier Roy *(Aeronautics)* Diplôme d'Ingénieur, Ecole Centrale des Arts & Manufactures 1979; Licence es Sciences Economiques, Université Paris I 1979.

Armistead Goode Russell *(Mechanical Engineering)* B.S., Washington State University 1979.

Todd Spencer Rust *(Aeronautics)* A.B., Occidental College 1979; B.S., California Institute of Technology 1979.

Venkatraman Sadanand *(Social Science)* B.Tech., Indian Institute of Technology, Madras 1978.

William Allen Salter *(Electrical Engineering)* B.S., Carnegie-Mellon University 1978.

David Bruce Sams *(Geochemistry)* B.S., University of California, Irvine 1977.

Martine Marie-Françoise Savalle *(Electrical Engineering)* Diplôme d'Ingénieur, Ecole Supérieure d'Ingénieurs en Electrotechnique et Electronique 1979.

Pierre Schnoeller *(Electrical Engineering)* Diploma of Electrical Engineering, Ecole Nationale Supérieure des Arts et Industries de Strasbourg 1979.

Robert Schulz *(Applied Physics)* B.Ing., Université de Montréal, Ecole Polytechnique 1978; D.E.A., Université Paul Sabatier de Toulouse 1979.

Patricia Frances Scott *(Geophysics)* B.A., Princeton University 1976.

Karl A. Seibert *(Chemical Engineering)* B.S., University of Illinois at Urbana-Champaign 1978.

Larry Dean Seiler *(Computer Science)* B.S., California Institute of Technology 1978.

Linda A. Seltzer *(Electrical Engineering)* A.B., University of Pennsylvania 1971; B.S., University of Colorado 1978.

Kevin John Sene *(Aeronautics)* B.Sc., Southampton University 1979.

John George Sherstobitoff *(Civil Engineering)* B.A.Sc., University of British Columbia 1978.

Lorenz Willard Sigurdson *(Aeronautics)* B.A.Sc., University of Toronto 1978.

Robert Thomas Skelton *(Physics)* B.S., Auburn University 1971; M.S., 1977.

James Eric Skjelbreia *(Civil Engineering)* B.S., University of Washington 1979.

Charles Seymour Slater *(Social Science)* A.B., Duke University 1978.

Duane Andre Smith *(Mechanical Engineering)* B.S., Purdue University 1978.

Tracy Marie Stigers *(Environmental Engineering Science)* B.S., Clarkson College of Technology 1979.

Mark Edward Stover *(Social Science)* B.A., University of Kentucky 1977.

Ralph Eric Strong *(Electrical Engineering)* B.S., United States Air Force Academy 1977.

Lawrence H. Sverdrup *(Applied Physics)* B.A., Reed College 1978.

Eric John Swanson *(Electrical Engineering)* B.S., Michigan State University 1977.

John Edward Tanner *(Electrical Engineering)* B.A., Wartburg College 1979.

Elizabeth Anne Horton Thomas *(Geology)* B.S., University of California, Los Angeles 1978.

Allen Eric Tracht *(Electrical Engineering)* S.B., Massachusetts Institute of Technology 1979.

Jed Michael Waldman *(Environmental Engineering Science)* B.S., University of Florida 1978.

Terry Charles Wallace, Jr. *(Geophysics)* B.S., New Mexico Institute of Mining and Technology 1978.

Jimmy Kwok Yu Wang *(Chemical Engineering)* B.S., California Institute of Technology 1980.

MASTER OF SCIENCE—*Continued*

Thierry Lucien Watteyne *(Electrical Engineering)* Ingénieur Civil Electricien, Université Catholique de Louvain 1979.

Frank Michael Weyer *(Mechanical Engineering)* B.E., Stevens Institute of Technology 1979.

Jeffrey Owen White *(Applied Physics)* Sc.B., Brown University 1977.

Leighton Gee Mung Wong *(Environmental Engineering Science)* B.S., University of Michigan 1979.

Howard Kwong Chew Yee *(Astronomy)* B.A., University of Toronto 1975.

ENGINEER

Douglas Kerry Ikemi *(Mechanical Engineer)* B.S., Harvey Mudd College 1976; M.S., California Institute of Technology 1978.

M. Mullainathan *(Aeronautical Engineer)* B.Sc., Loyola College (University of Madras) 1966; D.M.I.T., Madras Institute of Technology 1970; M. Tech., Indian Institute of Technology, Madras 1977.

Hideki Nomoto *(Aeronautical Engineer)* B.E., University of Tokyo 1972; M.E., 1974.

DOCTOR OF PHILOSOPHY

DIVISION OF BIOLOGY

David John Asai *(Biology)* B.S., M.S., Stanford University 1975.
Thesis: Immunological Approaches to Flagellar Movement.

John Lovell Bixby *(Neurobiology)* B.A., Cornell University 1975.
Thesis: The Formation and Loss of Supernumerary Synapses in Mammalian Skeletal Muscle.

Andrew Duncan Byers *(Biology)* B.A., Carleton College 1970.
Thesis: Studies on Learning and Cyclic AMP Phosphodiesterase of the *dunce* Mutant of *Drosophila melanogaster.*

Edwin Paul Ching *(Biochemistry and Neurobiology)* A.B., University of California, Berkeley 1974.
Thesis: Biochemical and Functional Characterization of the Products of Mitochondrial Protein Synthesis in HeLa Cells.

David Paul Corey *(Neurobiology)* B.A., Amherst College 1974.
Thesis: A Biophysical Approach to Sensory Transduction by Vertebrate Hair Cells.

Franklin David Costantini *(Developmental Biology)* B.S., Yale College 1974.
Thesis: Studies of Repetitive Sequence Transcripts in the Sea Urchin.

Philip Warren Early *(Biochemistry)* B.S., Yale University 1974.
Thesis: Mouse Immunoglobulin Heavy Chain Gene Organization and Rearrangement: Genetic Bases for Antibody Diversity and Regulated Expression.

John Gregory Frelinger *(Biochemistry)* B.S., Stanford University 1975.
Thesis: Studies on the Major Histocompatibility Complex of the Mouse and Rat.

Karen Elizabeth Gaston *(Psychobiology)* B.A., Stanford University 1965; M.A., California State University, Los Angeles 1975.
Thesis: Behavioral Studies on Learning and Interocular Transfer in the Domestic Chick.

Robert Allen Gelfand *(Biochemistry)* S.B., Massachusetts Institute of Technology 1970; M.A., University of California, Santa Barbara 1973.
Thesis: Studies on RNA Metabolism in HeLa Mitochondria.

Mark E. Gurney *(Biology)* B.A., University of California, San Diego 1975; M.S., California Institute of Technology 1980.
Thesis: Sexual Differentiation of Brain and Behavior in the Zebra Finch (*Poephila guttata*): A Cellular Analysis.

Larry E. Johnson *(Psychobiology)* B.S., University of Washington 1971; M.D., University of Chicago 1975.
Thesis: Interhemispheric Visual Communication in Human Commissurotomy Subjects.

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

Marilyn Rose Kehry *(Biochemistry)* B.A., University of California, San Diego 1975.
Thesis: Structure and Function of Murine Immunoglobulin M from Serum and Cell Membrane.

Michael William Klymkowsky *(Biophysics)* B.S., Pennsylvania State University 1974.
Thesis: On the Structure of the Acetylcholine Receptor from *Torpedo californica* Electroplaques.

Kenneth Lawrence Marton *(Neurobiology)* B.S., Yale College 1973.
Thesis: Binocular Facilitation and Inhibition in the Lateral Geniculate Nucleus of the Cat.

Galina Dmitrieyvna Moller *(Biochemistry)* M.S., University of Moscow 1961; M.S., California Institute of Technology 1974.
Thesis: Development and Protein Synthesis in *Drosophila.*

Robert Francis Murphy *(Biochemistry)* B.A., Columbia College 1974.
Thesis: Chromosomal Protein-DNA Interactions.

William Thomas Newsome III *(Biology)* B.S., Stetson University 1974.
Thesis: Studies on Primate Extrastriate Visual Cortex. I. The Interhemispheric Connections of Visual Cortex in the Owl Monkey, *Aotus trivirgatus,* and the Bushbaby, *Galago senegalensis.* II. A Functional Localization of Neuronal Response Properties in Extrastriate Cortex of the Owl Monkey, *Aotus trivirgatus.*

Betty Anne Vermeire *(Psychobiology)* B.S., Allegheny College 1974.
Thesis: Laterality and Visual Perception in Monkeys.

DIVISION OF CHEMISTRY AND CHEMICAL ENGINEERING

George Adler *(Chemistry)* B.A., Hunter College (City University of New York) 1974.
Thesis: NMR Studies of Cooperativity in Hemoglobin.

Peter Bruce Armentrout *(Chemistry)* B.S., Case Western Reserve University 1975.
Thesis: Mechanistic and Thermochemical Studies of the Reactions of Transition Metal Ions and Uranium Ions with Small Molecules in the Gas Phase.

Steven Gerard Blanchard *(Chemistry)* B.S., Loyola University, New Orleans 1975.
Thesis: Interactions of Local Anesthetics and Cholinergic Ligands with Membrane-Bound Acetylcholine Receptor from *Torpedo californica.*

William Matthew Bowser *(Applied Physics)* B.S., Case Western Reserve University 1973; M.S., California Institute of Technology 1975.
Thesis: The Development and Utilization of Inelastic Electron Tunneling Spectroscopy as a Surface Vibrational Probe with an Emphasis on the Study of Chemisorption and Heterogeneous Catalysis.

Frank Ripley Brown, Jr. *(Chemistry)* B.S., Duke University 1975.
Thesis: Macrocyclic Lactone Formation Through Sulfide Contraction: Synthesis of (±)-Diplodialide A.

Paul Chun-Ho Chan *(Chemical Engineering)* B.Ch.E., University of Minnesota 1973.
Thesis: Non-Newtonian Migration of a Deformable Drop in Shearing Flows.

Richard Eugene Cherpeck *(Chemistry)* B.A., Rice University 1975.
Thesis: Studies Directed toward the Total Synthesis of Histrionicotoxin.

Ernest Ying-Chee Chung *(Chemical Engineering)* B.S., California Institute of Technology 1974; M.S., 1976.
Thesis: Experimental Investigations of the Transport Properties of Flow Suspensions. I. Measurement of Velocity Distributions of Suspension Flows in a Rectangular Channel. II. Experimental Study of the Effective Thermal Conductivity in Shear Flow of a Suspension. III. The Use of Fluorescence Correlation Spectroscopy to Measure Molecular Diffusion and Velocity Distributions.

William Robert Croasmun *(Chemistry)* B.A., Case Western Reserve University 1975.
Thesis: The Physical State of Hydrocarbons and Chlorophyll *a* Incorporated in Phospholipid Bilayers as Determined by Nuclear Magnetic Resonance Spectroscopy.

Thomas Michael Duncan *(Chemical Engineering and Chemistry)* B.S.E., University of Michigan 1975; M.S., California Institute of Technology 1977.
Thesis: The Nature of Molecules Adsorbed on Catalytic Surfaces: Pulsed Nuclear Magnetic Resonance and Infrared Absorbance Studies.

Janet Ruth Elliott *(Chemistry)* B.S., University of Michigan 1973.
Thesis: Interactions of Perhydrohistrionicotoxin with Acetylcholine Receptors from *Torpedo californica* Electroplax.

Howard Edwin Evans *(Chemical Engineering)* B.S., Brigham Young University 1974.
Thesis: The Development and Utilization of Inelastic Electron Tunneling Spectroscopy as a Tool for Investigating Fundamental Catalytic Processes.

Eric Robert Evitt *(Chemistry)* B.S., University of Rochester 1975.
Thesis: Insertion and Thermal Decomposition Reactions of Cyclopentadienylcobalt(III) Dialkyl Complexes.

Gerald Gendall Fuller *(Chemical Engineering)* B.Sc., University of Calgary 1975; M.S., California Institute of Technology 1977.
Thesis: I. Dynamics of Flowing Polymer Solutions. II. The Measurement of Velocity Gradients by Homodyne Light Scattering Spectroscopy.

Paula Jean Grunthaner *(Chemistry)* B.S., California Institute of Technology 1975; M.S., 1980.
Thesis: The Chemical Structure of Metal/Semiconductor Interfaces as Determined by X-Ray Photoelectron Spectroscopy.

William Dinan Hinsberg III *(Chemistry)* B.S., University of Michigan 1975.
Thesis: The Synthesis, Spectroscopic Observation and Chemical Reactivity of N-(2,2,6,6-Tetramethylpiperidyl)Nitrene.

David Michael Ingle *(Chemistry)* A.B., Pasadena College 1973.
Thesis: Investigations of Four-Coordinate and Five-Coordinate Nickel(I) Macrocyclic Ligand Complexes.

Ravi Jain *(Chemical Engineering)* B.Tech., Indian Institute of Technology, Kharagpur 1974; M.S., California Institute of Technology 1975.
Thesis: Mathematical Modeling and Experimental Studies of Thermal Reactions of Coal.

Seong Hee Lee *(Chemical Engineering)* B.S., Seoul National University 1970; M.S., 1972.
Thesis: I. Motion of a Sphere in the Presence of a Plane Interface. II. Modeling of Non-Isothermal Turbulent Flows.

Charlotte K. Lowe Ma *(Chemistry)* B.S., California State University, Los Angeles 1973.
Thesis: Crystallographic Studies of Iodide-Containing Quasi-One-Dimensional Conductors.

Hsiao-ping Hsu Moore *(Chemistry)* B.S., National Taiwan University 1975.
Thesis: Correlation of Structure and Function of the Acetylcholine Receptor from *Torpedo californica.*

Clifford E. Sacks *(Chemistry)* B.S., Purdue University 1975.
Thesis: Synthesis of A-23187 and Related Model Compounds.

Don S. Santilli *(Chemistry)* B.S., University of Rochester 1975.
Thesis: Synthesis and Thermal Decomposition of *cis*-3,4,5,6-Tetrahydropyridazine-3,4-d_2.

Richard Henry Scheller *(Chemistry)* B.S., University of Wisconsin, Madison 1975.
Thesis: Studies of Cloned Repetitive DNA Sequences in the Sea Urchin Genome.

Napapon Sailasuta Scott *(Chemistry)* B.Sc., Chulalongkorn University 1971; M.Sc., 1973.
Thesis: Spectroelectrochemical Studies of Metalloenzymes and Polymer-Coated Graphite Transparent Electrodes.

Robert Allen Scott *(Chemistry)* B.S., University of Illinois at Urbana 1975.
Thesis: Metalloprotein Electron Transfer. Cytochrome aa_3 Reduction Kinetics and Theoretical Formulation of Distance Dependence.

Catherine Boxley Devine Strader *(Chemistry)* B.S., University of Virginia 1975.
Thesis: Investigations of the Structural Properties of the Acetylcholine Receptor and Its Polypeptide Subunits from *Torpedo californica.*

Suvit Thaisrivongs *(Chemistry)* A.B., Harvard College 1976.
Thesis: The Total Synthesis of Lasalocid A.

Richard S. Threlkel *(Chemistry)* B.A., University of California, San Diego 1975.
Thesis: Early Transition Metal Organometallic Reactivity. Catalytic Acetylene Hydrogenation and Dimerization, Carbene Migratory Insertion Reactions.

Grant Fred Tiefenbruck *(Chemical Engineering)* B.S., Northwestern University 1973.
Thesis: The Translational Motion of Particles in a Viscoelastic Liquid.

Thomas Hallworth Upton *(Chemistry)* B.S., Stanford University 1974.
Thesis: Theoretical Studies of Chemisorption Processes on Nickel Surfaces.

DOCTOR OF PHILOSOPHY—*Continued*

Albert Theodore Watson, Jr. *(Chemical Engineering)* B.S., University of Texas at Austin 1975.
Thesis: Estimation of Two-Phase Petroleum Reservoir Properties.

Mary Ann White *(Chemistry)* B.S., Miami University 1975.
Thesis: The Formation of Carbon-Carbon and Carbon-Nitrogen Bonds Mediated by Organometallic Cobalt Complexes.

DIVISION OF ENGINEERING AND APPLIED SCIENCE

Pinchas Agmon *(Applied Physics)* B.Sc., The Hebrew University of Jerusalem 1972; M.S., California Institute of Technology 1974.
Thesis: I. Design, Control, and Characterization of the Passively Mode Locked CW Dye Laser. II. Photoconductive Impulse Response and Excess Carrier Lifetime of Cr-Doped GaAs.

Anthony Francis Barton *(Computer Science)* B.Sc., St. Andrews University 1976; M.S., California Institute of Technology 1977.
Thesis: A Fault Tolerant Integrated Circuit Memory.

David Miner Braisted *(Mechanical Engineering)* B.S., Michigan State University 1974; M.S., California Institute of Technology 1975.
Thesis: Cavitation Induced Instabilities Associated with Turbomachines.

Sally Anne Browning *(Computer Science)* B.S., University of Oregon 1974; M.S., California Institute of Technology 1977.
Thesis: The Tree Machine: A Highly Concurrent Computing Environment.

Jing-Chang Chen *(Civil Engineering)* B.S., National Taiwan University 1972; M.S., California Institute of Technology 1975.
Thesis: Studies on Gravitational Spreading Currents.

Woontong Nathan Cheung *(Applied Physics)* S.B., Massachusetts Institute of Technology 1971.
Thesis: I. Channeling Studies of Silicon Interfaces. II. Diffusion Barrier Properties of Titanium Nitride.

Evangelos Athanassios Coutsias *(Applied Mathematics)* B.S., California Institute of Technology 1975.
Thesis: Some Effects of Spatial Nonuniformities in Chemically Reacting Mixtures.

Kenneth R. Elliott *(Applied Physics)* B.S., Purdue University 1973.
Thesis: Optical Determination of the Properties of Excitons Bound to Impurities in Semiconductors.

Timothy Joseph Gallagher *(Applied Physics)* B.S., Rose-Hulman Institute of Technology 1975; M.S., California Institute of Technology 1977.
Thesis: Domain Wall Dynamics in Ion-Implanted Magnetic Bubble Materials.

Medhat Ahmed Haroun *(Civil Engineering)* B.S., Cairo University 1973; M.S., California Institute of Technology 1976.
Thesis: Dynamic Analyses of Liquid Storage Tanks.

Jerry Michael Harris *(Electrical Engineering)* B.S.E.E., University of Mississippi 1973; M.S., California Institute of Technology 1974.
Thesis: The Influence of Random Media on the Propagation and Depolarization of Electromagnetic Waves.

Gideon David Hess *(Computer Science)* B.Sc., Technion, Israel Institute of Technology 1968; M.Sc., 1975; M.S., California Institute of Technology 1977.
Thesis: A Software Design System.

Shi-Ping Hsu *(Electrical Engineering)* B.S., National Taiwan University 1973; M.S., California Institute of Technology 1977.
Thesis: Problems in Analysis and Design of Switching Regulators. I. Pole Placement Technique for DC-to-DC Switching Regulators. II. Transformer Modelling. III. Cross-Regulation of the Two-Output Cuk Converter.

James Robert Hunt *(Environmental Engineering Science and Economics)* B.S., University of California, Irvine 1972; M.S., Stanford University 1973.
Thesis: Coagulation in Continuous Particle Size Distributions; Theory and Experimental Verification.

Larry Douglas Koffman *(Engineering Science)* B.S., University of Tennessee 1972; M.S., 1975.
Thesis: I. Experimental Observations of the Microlayer in Vapor Bubble Growth on a Heated Solid. II. An Investigation of the Theory of Evaporation and Condensation.

Vijaya Narayan Korwar *(Electrical Engineering and Applied Physics)* B.Tech., Indian Institute of Technology, Bombay 1976; M.S., California Institute of Technology 1977.
Thesis: Degradation of Picture Quality by Speckle in Coherent Mapping Systems.

James Shigeru Kuwabara *(Environmental Engineering Science and Social Science)* B.S., University of Hawaii 1975; M.S., California Institute of Technology 1976.
Thesis: Micronutrient Requirements for *Macrocystis pyrifera* (L.) C. A. Agardh (Giant Kelp) Gametophytes Determined by Means of a Chemically Defined Medium, Aquil.

Stelios Kyriakides *(Aeronautics)* B.Sc., University of Bristol 1975; M.S., California Institute of Technology 1976.
Thesis: On the Propagating Buckle and Its Arrest.

Bruce Stephen Levine *(Electrical Engineering and Applied Physics)* B.S.E., University of Michigan 1971; M.S., 1972; M.S., California Institute of Technology 1973.
Thesis: Particle Confinement and Magnetic Fluctuations in Tokamak Discharges with Gas Puffing.

Kenneth Macdougall Liechti *(Aeronautics)* B.Sc., University of Glasgow 1973; M.S., California Institute of Technology 1974.
Thesis: The Application of Optical Interferometry to Time Dependent Unbonding.

Howard Michael Liljestrand *(Environmental Engineering Science and Chemistry)* B.A., Rice University 1974.
Thesis: Atmospheric Transport of Acidity in Southern California by Wet and Dry Mechanisms.

Bartholomew Nicholas Locanthi III *(Computer Science)* B.S., California Institute of Technology 1975; M.S., 1977.
Thesis: The Homogeneous Machine.

Graeme Haynes McVerry *(Applied Mechanics)* B.E., University of Auckland 1973; M.E., 1975.
Thesis: Frequency Domain Identification of Structural Models from Earthquake Records.

Richard Harrison Moyer *(Applied Physics)* B.S., Purdue University 1974; M.S., California Institute of Technology 1976.
Thesis: I. The Mode Locked Dye Laser. II. Picosecond Photoconductivity of Semi-Insulating Gallium Arsenide.

Tanh Van Nguyen *(Mechanical Engineering)* B.S., Iowa State University 1975; M.S., California Institute of Technology 1976.
Thesis: Studies in the Flow of Granular Materials.

David M. Pepper *(Applied Physics)* B.S., University of California, Los Angeles 1971; M.S., California Institute of Technology 1974.
Thesis: Phase Conjugate Optics: On the Theory, Observation, and Utilization of Temporally-Reversed Wavefronts as Generated Via Nonlinear Optical Parametric Interactions.

Loman Rensink *(Electrical Engineering)* B.S., California State University, Northridge 1974; M.S., California Institute of Technology 1976.
Thesis: Switching Regulator Configurations and Circuit Realizations.

James A. Rowson *(Computer Science)* B.S., California Institute of Technology 1976; M.S., 1977.
Thesis: Understanding Hierarchical Design.

Stanley Paul Sander *(Environmental Engineering Science and Chemistry)* B.A., Pomona College 1974; M.S., California Institute of Technology 1975.
Thesis: Kinetics Studies of Bromine Monoxide and Methylperoxy Free Radicals by Flash Photolysis.

David Carl Sherman *(Mechanical Engineering)* B.S., University of California, Santa Barbara 1974; M.S., California Institute of Technology 1975.
Thesis: Natural Convection Film Boiling on a Vertical Surface.

Malladi Venkata Subbaiah *(Mechanical Engineering)* B.Sc., New Science College, Osmania University 1966; B.E., College of Engineering, Osmania University 1970; M.Tech., Indian Institute of Technology, Kanpur 1972.
Thesis: Non-Steady Behavior of a Flame Spreading from a Point in a Two-Dimensional Duct.

Bor-Yeu Tsaur *(Electrical Engineering)* B.S., National Taiwan University 1977; M.S., California Institute of Technology 1978.
Thesis: Ion-Beam-Induced Modifications of Thin Film Structures and Formation of Metastable Phases.

Timothy Neal Turner *(Aeronautics)* A.B., Occidental College 1974; M.S., California Institute of Technology 1975.
Thesis: Second Sound Shock Waves and Critical Velocities in Liquid Helium II.

Israel Ury *(Applied Physics)* B.S., University of California, Los Angeles 1975; M.S., 1976.
Thesis: Monolithic Integration of Gallium Arsenide Optoelectronic Devices.

Kadri Lütfi Vural *(Electrical Engineering)* B.S., Middle East Technical University 1973; M.S., California Institute of Technology 1975.
Thesis: Magnetic Domain Wall Dynamics in the Presence of an In-Plane Field.

DIVISION OF GEOLOGICAL AND PLANETARY SCIENCES

David Wayne Beaty *(Geology)* A.B., Dartmouth College 1975; M.S., California Institute of Technology 1978.
Thesis: I. Comparative Petrology of the Apollo 11 Mare Basalts. II. The Oxygen Isotope Geochemistry of the Abitibi Greenstone Belt.

Timothy Miller Benjamin *(Geochemistry)* B.S., University of California, Davis 1973; M.S., California Institute of Technology 1974.
Thesis: Experimental Actinide Element Partitioning Between Whitlockite, Apatite, Diopsidic Clinopyroxene, and Anhydrous Melt at One Bar and 20 Kilobars Pressure.

Michael Welch Burnett *(Geochemistry)* B.S., Boston College 1968; M.S., 1970; M.S., California Institute of Technology 1972.
Thesis: The Occurrence and Distribution of Lead and Related Alkaline Earth Metals in Marine Ecosystems.

Bruce Alan Carter *(Geology)* B.S., California Institute of Technology 1968; M.S., 1965.
Thesis: Structure and Petrology of the San Gabriel Anorthosite-Syenite Body, Los Angeles County, California.

Duane Edwin Champion *(Geology)* B.A., State University of New York at Buffalo 1971; M.A., 1973.
Thesis: Holocene Geomagnetic Secular Variation in the Western United States: Implications for the Global Geomagnetic Field.

David Martin Cole *(Geophysics)* B.S., Indiana University 1972.
Thesis: A Numerical Boundary Integral Equation Method for Transient Motions.

Stein Bjørnar Jacobsen *(Geochemistry and Geology)* Cand. Mag., University of Oslo 1974; Cand. Real., 1975.
Thesis: Study of Crust and Mantle Differentiation Processes from Variations in Nd, Sr, and Pb Isotopes.

DOCTOR OF PHILOSOPHY—*Continued*

Raymond Jeanloz *(Geology and Geophysics)* B.A., Amherst College 1974.
Thesis: Physics of Mantle and Core Minerals.

Gregory Allen Lyzenga *(Applied Physics)* B.S., Harvey Mudd College 1975; M.S., California Institute of Technology 1977.
Thesis: Shock Temperatures of Materials: Experiments and Applications to the High Pressure Equation of State.

Malcolm Thomas McCulloch *(Geology)* B.Sc., Western Australian Institute of Technology 1973; M.Sc., 1975.
Thesis: I. Sm-Nd and Rb-Sr Chronology of Crustal Formation. II. Ba, Nd and Sm Isotopic Anomalies in the Allende Meteorite.

Crayton Jeffery Yapp *(Geochemistry)* B.S., University of Wisconsin, Madison 1971; M.S., California Institute of Technology 1973.
Thesis: The Variations and Climatic Significance of D/H Ratios in the Carbon-Bound Hydrogen of Cellulose in Trees.

DIVISION OF THE HUMANITIES AND SOCIAL SCIENCES

Randall Lee Calvert *(Social Science)* B.S., University of Kentucky 1975.
Thesis: On the Role of Imperfect Information in Electoral Politics.

Lee Ira Sparling *(Social Science)* B.S., California Institute of Technology 1971; M.A., Stanford University 1972.
Thesis: Regulatory Distortions in Transportation and Telecommunications.

DIVISION OF PHYSICS, MATHEMATICS AND ASTRONOMY

Richard Paul Anstee *(Mathematics)* B.Math., University of Waterloo 1976.
Thesis: I. Moore Type Graphs. II. Properties of $(\phi,1)$-Matrices with Forbidden Configurations. III. Properties of $(\phi,1)$-Matrices with Prescribed Row and Column Sums.

Alan Voltz Barnes *(Physics)* B.S., Indiana University 1971.
Thesis: Measurements of Pion Charge Exchange and Other Things at Fermilab Energies.

Arthur Robert Calderbank *(Mathematics)* B.Sc., University of Warwick 1975; M.Sc., University of Oxford 1977.
Thesis: Algebraic Coding Theory.

Menachem Cimerman *(Astronomy)* B.Sc., Tel-Aviv University 1971.
Thesis: A Study of Hydroxyl Masers in the Circumstellar Envelopes of Long Period Variable Stars.

Brian R. Davis *(Physics and Social Science)* A.B., Harvard College 1976.
Thesis: Studies of Antineutrinos at Nuclear Reactors and Atomic Final State Effects in Tests of T-Violation.

James Lawrence Gimlett *(Physics)* B.S., California Institute of Technology 1976.
Thesis: Experimental Study of Time Reversal Invariance and Atomic Final State Effects in Nuclear Transitions.

Robert Lee Hatch *(Physics)* B.S., Utah State University 1975.
Thesis: Single- and Multiple-Scattering Mechanisms in High-Energy Nuclear Collisions.

John Greg Hoessel *(Astronomy)* B.A., University of Wisconsin, Madison 1972; M.S., California Institute of Technology 1975.
Thesis: The Photometric Properties of Brightest Cluster Galaxies.

Michael David Huffman *(Mathematics)* B.S., University of New Mexico 1975; M.S., California Institute of Technology 1977.
Thesis: Efficient Approximate Solutions to the Kiefer-Weiss Problem.

Rosemary Gillian Kennett *(Physics)* B.Sc., University of Nottingham 1972; M.S., California Institute of Technology 1977; M.S., 1979.
Thesis: Experimental Tests of Triple Regge Theory.

Stephen Matthew Kent *(Astronomy)* S.B., Massachusetts Institute of Technology 1974.
Thesis: Interactions Between Galaxies and a Hot Medium in Rich Clusters.

Arieh Königl *(Physics)* A.B., University of California, Berkeley 1975; M.S., California Institute of Technology 1978.
Thesis: Relativistic Effects in Extragalactic Radio Sources.

Warren Yiu-Cho Lai *(Physics)* B.S., University of California, Berkeley 1970; M.S., California Institute of Technology 1972.
Thesis: Influence of Josephson Effect on Proximity Coupled Superconductors.

Max Marshall *(Physics)* B.A., University of California, San Diego 1971.
Thesis: A Study of Electron Pair Production in 16 GeV/c Pi-Minus Proton Collisions.

John Weidman McLean *(Applied Mathematics)* B.S., University of Arizona 1975.
Thesis: I. The Fingering Problem in Flow Through Porous Media. II. The Kinetic Equation for Hamiltonian Systems.

Frank Joseph Nagy *(Physics)* B.S., Carnegie-Mellon University 1971; M.S., California Institute of Technology 1978.
Thesis: A Study of the Reactions $\pi^{\pm}p \rightarrow \pi^{\pm}\pi^{+}\pi^{-}\pi^{o}p$ and $\pi^{\pm}p \rightarrow \pi^{\pm}\pi^{+}\pi^{+}\pi^{-}n$ at $p_{lab} = 14$ GeV/c Using a Triggered Hybrid Bubble Chamber.

David J. Perozzi *(Applied Mathematics)* B.S., Clarkson College of Technology 1976.
Thesis: I. Seismic Ray-Tracing in Piecewise Homogeneous Media. II. Analysis of Optimal Step Size Selection in Homotopy and Continuation Methods.

James William Rohlf *(Physics)* B.S., University of Minnesota, Duluth 1973; M.S., University of California, Los Angeles 1975.
Thesis: Jet Production in High Energy Hadron-Proton Collisions.

Lucy Elizabeth Seiberling *(Physics)* B.S., California State University, Los Angeles 1975.
Thesis: A Thermalized Ion Explosion Model for High Energy Sputtering and Track Registration.

Chun-Ching Shih *(Physics)* B.S., National Taiwan University 1972.
Thesis: I. Theory of the Longitudinal Free Electron Laser. II. A Theoretical Model of the Linear Electrooptic Effect.

Peter Taborek *(Physics)* B.S., Harvey Mudd College 1974.
Thesis: Phonon Reflection from Crystal Interfaces and the Kapitza Problem.

Harold Stevenson Wilson *(Physics)* B.Sc., Queen's University 1974.
Thesis: Gamow-Teller Beta Decays in 1s-ϕd Shell Nuclei.

Stephen Wolfram *(Physics)*
Thesis: Some Topics in Theoretical High-Energy Physics.

Kar Woo Yung *(Physics)* B.S., M.S., California Institute of Technology 1973.
Thesis: Study of Hadronic Jets Produced by Charged Pion and Proton Beams Incident on Hydrogen and Aluminum Targets.

Mark Edward Zimmermann *(Physics)* B.A., Rice University 1974; M.S., California Institute of Technology 1976.
Thesis: Studies on Gravitational Waves and Stars with Neutron Cores.

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.

Eugene Y. Loh, senior; John R. Stembridge, junior;
Robert W. Weaver, senior

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.

1980 Grace H.-J. Mah, junior; Michael P. Thien, sophomore
*1979 Joseph A. Zasadzinski**
*1978 Isabella T. Lewis**

HAREN LEE FISHER MEMORIAL AWARD IN JUNIOR PHYSICS

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

1980 Terry T. Chiang
*1979 Kenneth G. Libbrecht**

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.

1980 Erdal Arikan, junior
*1979 Pik-Chun Beatrice Lee**

**The names of students who have received prizes or awards in previous years, but who are graduating in 1980, are also listed.*

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.

1980 Terry T. Chiang
*1979 E. Sterl Phinney III**

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.

1980 Douglas L. Whiting, senior
*1979 Kenneth G. Libbrecht**

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.

1980 Andrew J. Gellman, junior
*1979 Lynn M. Hildemann**

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, etc.

William C. Ledeboer, junior

DAVID JOSEPH MACPHERSON PRIZE IN ENGINEERING

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

Steven Glen Eaton

MARY A. EARL McKINNEY PRIZE IN ENGLISH

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

Luke J. Will, sophomore; John E. Hershberger, junior

ROBERT L. NOLAND LEADERSHIP SCHOLARSHIP

Awarded to a junior or sophomore who exhibits 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.

Larry B. Friedrich, junior; Charles R. O'Neil, junior

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

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

Designee: Isabella T. Lewis

SCHUSTER-MARLAR MEMORIAL AWARD

A memorial award in honor of Richard P. Schuster, presented to a deserving aeronautics student completing the Doctor of Philosophy degree in June 1980.

Kenneth M. Liechti

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.

1980 David C. Johnson, John V. C. Nye, Todd C. Olson
*1979 Kenneth M. Gray**
*1978 Janet A. Rice,** *Colleen R. Ruby**
*1977 John B. Reinitz**

SIGMA XI AWARD

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

Mark D. Seidler, Paul F. Seidler

THE MORGAN WARD PRIZE

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

Forrest C. Quinn, sophomore; Scott Michael, sophomore