



*Seventy-Ninth
Annual Commencement
June 8, 1973*

CALIFORNIA INSTITUTE OF TECHNOLOGY

Seventy-Ninth
Annual
Commencement

FRIDAY MORNING AT TEN-THIRTY O'CLOCK
JUNE EIGHTH, NINETEEN SEVENTY-THREE

Academic Procession

Chief Marshal, Jon Mathews, Ph.D.

Assistant Marshals

Donald S. Clark, Ph.D.

William R. Cozart, Ph.D.

Marshall Hall, Jr., Ph.D.

Frederick Thompson, Ph.D.

Anthonie van Harreveld, Ph.D., M.D.

MARCHING ORDER

CANDIDATES FOR THE DEGREE OF BACHELOR OF SCIENCE

CANDIDATES FOR THE DEGREE OF MASTER OF SCIENCE

CANDIDATES FOR THE DEGREE OF ENGINEER

CANDIDATES FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

THE FACULTY

THE CHAIRMEN OF DIVISIONS

THE DEANS

THE PROVOST

THE TRUSTEES

THE COMMENCEMENT CHAPLAIN

THE PRESIDENT

THE CHAIRMAN OF THE BOARD OF TRUSTEES

Program

CALIFORNIA INSTITUTE OF TECHNOLOGY

Seventy-Ninth Annual Commencement

PRESIDING Arnold O. Beckman, Ph.D., LL.D.
Chairman of the Board of Trustees

PRELUDE AND PROCESSIONAL Chauncey Haines
Organist

INVOCATION The Reverend Charles R. Simmons
West Covina United Methodist Church

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

PRESENTATION OF CANDIDATES FOR DEGREES

For the degree of Bachelor of Science . . . James J. Morgan, Ph.D.
Dean of Students

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

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

For the degree of Doctor of Philosophy Dean Pings
and Division Chairmen

Biology, *Norman H. Horowitz, Ph.D.*

Chemistry and Chemical Engineering,

John D. Roberts, Ph.D., Dr.rer.nat., Sc.D.

Engineering and Applied Science, *Francis H. Clauser, Ph.D.*

Geological and Planetary Sciences, *Barclay Kamb, Ph.D.*

Physics, Mathematics and Astronomy, *Robert B. Leighton, Ph.D.*

CONCLUDING REMARKS President Brown

BENEDICTION Reverend Simmons

RECESSIONAL AND POSTLUDE Mr. Haines

*The audience is requested to remain standing until
the end of the Recessional*

Academic Dress

The costume of those in the academic procession has a specific symbolism which dates back to at least the 14th century. While there have been many changes in the details, the meaning of the various parts of the costume continues to be the same. Academic institutions in the United States adopted a code of academic dress in 1895 which has been revised from time to time. The dress of institutions in other countries varies considerably, but the basic elements are present in all academic costumes.

GOWNS. The bachelor's gown has long, pointed sleeves; the master's gown has an oblong sleeve open at the wrists (or some older gowns may be open near the upper part of the arm); the doctor's gown is fuller than the others with velvet panels full length on the front and three velvet crossbars on each sleeve in black or in the color distinctive of the subject to which the owner's degree pertains. The gowns are always black except for the doctor's, which in a few instances is of a color representing the institution which conferred the degree.

HOODS. The hood, draped over the shoulders and down the back, indicates the subject to which the degree pertains and the university that conferred the degree. The level of the degree is indicated by the size of the hood. The hood for the bachelor's degree is three feet long; for the master's it is three and one-half feet long; and for the doctor's it is four feet long. The binding of the hood is of colored velvet designating the subject of the degree, and it is two inches, three inches, and five inches wide for the bachelor's, master's and doctor's degrees respectively. The colors associated with some of the subjects are as follows:

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

The lining of the hood is of the color or colors of the institution conferring the degree. When two colors are used, they are usually arranged in a single chevron. The lining of the doctor's hood is revealed more than in the master's, and much less is revealed in the bachelor's hood.

CAPS. In the United States, the black mortarboard is most commonly used. The tassel fastened to the center of the cap is normally worn in the left front quadrant of the cap and is black, although it may be of the color appropriate to the subject of the degree. The tassel for a doctor's cap may be of gold thread.

Candidates for Degrees

BACHELOR OF SCIENCE

Edward Allen Adler *Baltimore, Maryland* Physics
Charles William Almquist *Wiesbaden, Germany* Engineering and Applied Science
George Oscar Alverson *North Little Rock, Arkansas* Physics-English
Bruce Allen Anderson *Longview, Washington* Engineering and Applied Science
Lary Dale Andrews *Wheat Ridge, Colorado* Biology
Dikran Antreasyan *Istanbul, Turkey* Physics
Epifanio Anzaldo *Tracy, California* Chemistry
Robert M. Bales *Fullerton, California* Biology
Dean Dayton Ballard II *Mercer Island, Washington* Engineering and Applied Science
Anthony Barcellos *Porterville, California* Mathematics
James Kelly Beatty *Madera, California* Geology
Charles Edgar Beckmann *Decatur, Georgia* Mathematics
Frederick Michael Behlen *Columbus, Nebraska* Chemistry
John Francis Belsher, III *Barstow, California* Engineering and Applied Science
Bruce William Bennett *Northridge, California* Economics
Leonard Geoffrey Benson *Pasadena, California* Engineering and Applied Science
Jacques Beser *Brussels, Belgium* Engineering and Applied Science
Stephen Maurice Beverley *Fountain Valley, California* Biology
Kenneth Alan Bickford *Lincoln, California* Chemistry
Stephen Edmund Michael Billester *El Monte, California* Chemistry
Stephen James Bisset *Canberra, Australia* Engineering and Applied Science
Mark Eric Bleck *Wichita, Kansas* Physics
James Lawrence Bonomo, Jr. *Pittsburgh, Pennsylvania* Physics
Nelson Briceño Leguizamón *Bogota, Colombia* Economics
Glen David Brin *Los Angeles, California* Astronomy
Lee Dorsey Britton *Los Angeles, California* Engineering and Applied Science
Peter P. Brooks *Los Angeles, California* Mathematics
John LeRoy Brown *Montgomery, Alabama* Biology
David Cliffrian Bryant *Palmer, Alaska* Mathematics
Fan Cheong Chan *Hong Kong* Engineering and Applied Science
Paul Kar-Sai Chan *Monterey Park, California* Biology
Stephanie Jeanne Charles *Pasadena, California* Physics
William Chia *Barrington, Illinois* Biology
Manfred Fung Chiu *Oakland, California* Engineering and Applied Science
Wilson Kar-Cheong Cho *Hong Kong* Physics
Albert Kendall Christians *Dumont, New Jersey* Economics
Deborah Duen Ling Chung *Hong Kong* Engineering and Applied Science
David Thomas Clark *Portland, Oregon* Biology
David Harris Collier *Fresno, California* Chemistry
Wayne Dale Collins, Jr. *Jacksonville, Florida* Economics
Robert Parsons Crane, III *Winnetka, Illinois* English

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

BACHELOR OF SCIENCE—Continued

William Franklin Derrick *Watsonville, California* Engineering and Applied Science
Douglas Kevin Duncan *Glendale, California* Astronomy
Stephen Radford Early *Spring Hill, Tennessee* Applied Physics
Duane Russell Edgington *San Diego, California* Biology
Eric Roy Ehlers *Del Mar, California* Biology
Bruce Scott Eisenhart *Wyckoff, New Jersey* Engineering and Applied Science
Arthur Baron Ellis *Hialeah, Florida* Chemistry
John Oakes Ellis *Salem, New Hampshire* Chemistry
David Alan Evans *Edina, Minnesota* Mathematics
Walter Bartlett Farrell *Palo Alto, California* Mathematics
Jerome Alan Feely *Visalia, California* Physics
Robert Stephen Flake *Seattle, Washington* English
Matthew Earl Fluster *Monterey Park, California* Biology
John Douglas Fraser *Kirkwood, Missouri* Applied Physics
William Robert Frensley *Wichita, Kansas* Physics
Emden Robert Gansner *Crestwood, Missouri* Mathematics
Gregory Gartrell, Jr. *Santa Barbara, California* Engineering and Applied Science
Robert James Geller *New York, New York* Geophysics
Brian Charles Gibson *Des Moines, Iowa* Physics
John Charles Gord *Tacoma, Washington* Engineering and Applied Science
Philip Michael Gschwend *Antioch, California* Biology
Daniel P. Haake *Geneva, Switzerland* Physics
Dennis Mark Heimbigner *Yakima, Washington* Mathematics
Bruce Meyer Herman *Lower Burrell, Pennsylvania* Geophysics
William Allen Hiscock *Woodland Hills, California* Physics
Ronald F. Horn *Albuquerque, New Mexico* Independent Studies Program
William Douglas Hounshell *New Orleans, Louisiana* Chemistry
Thomas David Howell *Mountain View, California* Mathematics
Kenneth Peter Jacobsen *San Bernardino, California* Astronomy
James Patrick Jakway *Palm Springs, California* Chemistry
Max Joel Kay *Kailua, Hawaii* Physics-English
Donald E. Keenan *South Sioux City, Nebraska* Mathematics
Wilfred Carl Kittler, Jr. *San Jose, California* Engineering and Applied Science
Lee Anthony Kondor *York, Pennsylvania* Engineering and Applied Science
Randall Lynn Kubena *Dallas, Texas* Physics
Stefan Kwong-Chiu Lai *Hong Kong* Applied Physics
Henry Hon-Leung Law *Los Angeles, California* Chemical Engineering
Vincent Wo-Sang Lee *Hong Kong* Mathematics
John Russell Lewis *Naperville, Illinois* Engineering and Applied Science
Richard Alan Lindsay *Odessa, Texas* Biology
Tak Sing Lo *Hong Kong* Chemical Engineering
Dennis Yung-duk Loh *Yokohama, Japan* Chemical Engineering-Biology
Sharon Long *Denver, Colorado* Independent Studies Program
Ki Bui Ma *Hong Kong* Physics
Marvin Roy Mandelbaum *Detroit, Michigan* Physics
Philip Stephen Marcus *Upper Darby, Pennsylvania* Physics
Richard B. Martin *Mission, Kansas* Engineering and Applied Science
Russell Eugene McDuff *Suisun, California* Chemistry
Harold James McGee *Elmhurst, Illinois* English

BACHELOR OF SCIENCE—Continued

Robert Patrick McNamara *Chicago, Illinois* Applied Physics
Robert John Miller, Jr. *Des Plaines, Illinois* Engineering and Applied Science
 William David Miller *Wichita, Kansas* Engineering and Applied Science
 Douglas Earl Mitchell *Irvine, California* Mathematics
Michael William Morgan *Leona Valley, California* Mathematics
 Joseph Francis Morin III *Westwood, Massachusetts* Astronomy
 James Curie Munyer *Forest Hills, New York* Mathematics
 Michael Richard Muskin, Jr. *Brandon, Florida* Engineering and Applied Science
Gerald Anton Navratil *Green Bay, Wisconsin* Physics
 William Arthur Neagle *Rochelle Park, New Jersey* Mathematics
Philip Malcolm Neches *Los Angeles, California* Engineering and Applied Science
Richard Stephen Newman *Los Angeles, California* Biology
Ting S. Ng *Hong Kong* Biology
 Lawrence Stuart Niren *West Caldwell, New Jersey* Biology
 John Trent Nogatch *West Hempstead, New York* Mathematics
 Laurence Jay November *Anaheim, California* Astronomy
Masayuki Ono *Hiratsuka, Japan* Physics
Eduardo Horacio Orces *Guayaquil, Ecuador* Engineering and Applied Science
Gordon Andrew Petersen *Fresno, California* Engineering and Applied Science
 Richard Eric Peterson *Dorchester, Massachusetts* English
Alexander D. Petruncola *Pasadena, California* Engineering and Applied Science
Robert Emil Plaa *Staten Island, New York* Physics
 Christopher James Platt *Los Angeles, California* Engineering and Applied Science
Gary Walter Pope *Chico, California* Mathematics
 Jonathan Vos Post *New York, New York* Mathematics-English
 Gary James Prohaska *Eugene, Oregon* Astronomy
 Joseph Christopher Rayhawk *New Orleans, Louisiana* Mathematics
Daniel Gregory Reichel *Hamtramck, Michigan* Physics
Bruce Arie Reznick *Los Angeles, California* Mathematics
George Clark Rinker *Portland, Oregon* Engineering and Applied Science
 John Francis Rogers *Concord, Massachusetts* Chemistry
 Gary Stephen Rubenstein *New York, New York* Engineering and Applied Science
 Bruce Rugar *Las Vegas, Nevada* Engineering and Applied Science
Paul Arthur Sand *Omaha, Nebraska* Physics
 John F. Santarius *Hazelhurst, Wisconsin* Physics
 Lorne H. Schachter *Syoset, New York* Mathematics
 William W. Schlitzkus *Roselle, Illinois* Engineering and Applied Science
Paul Scott Schluter *Sierra Madre, California* Engineering and Applied Science
 John Raymond Schroeter *Milwaukee, Wisconsin* Engineering and Applied Science-
 Economics
Bruce Robert Seaman *Aiea, Hawaii* Engineering and Applied Science-Economics
 Alex Yoichi Seita *Honolulu, Hawaii* Engineering and Applied Science
 Arthur William Selly *Encinitas, California* Mathematics
Gregory Hamilton Sharp *Squantum, Massachusetts* Independent Studies Program
Richard Alan Shaw *Spokane, Washington* Mathematics
Richard Lee Short *Strathmore, California* Biology
 Frank Steven Shuri *St. Louis, Missouri* Geology
Jay Philip Siegel *Dalton, Georgia* Biology
Stephen Karl Skedzeleski *Florissant, Missouri* Mathematics

BACHELOR OF SCIENCE—Continued

Raymond Thomas Spears *Stockton, California* English
David L. Standage *Scottsdale, Arizona* Mathematics
Robert Wesley Stecher, Jr. *Norfolk, Virginia* Engineering and Applied Science
Michael Louis Steinberger *Kennett Square, Pennsylvania* Applied Physics
Richard Frank Sunseri *San Jose, California* Mathematics
Peter Lewis Tompkins *Sierra Madre, California* Engineering and Applied Science
Platon Themistocles Tserliangos *Athens, Greece* Mathematics-Economics
Brett Alan Tucker *Lanoka Harbor, New Jersey* Physics
James Charles Vibber *Monterey Park, California* Mathematics
Price Walker, Jr. *Columbus, Georgia* Biology
Jan Waluk *North Babylon, New York* Engineering and Applied Science
Steven Spencer Watkins *Kettering, Ohio* Independent Studies Program
Andrew H. Weigel *Colorado Springs, Colorado* Biology
Ralph Harison Wells III *Newhall, California* Social Science
Robert Alan West *Sterling, Illinois* Astronomy
Stanley Ernest Whitcomb *Englewood, Colorado* Physics
Lawrence Curtis Widdoes, Jr. *Stamford, Connecticut* Engineering and
Applied Science
Randall Gary Williams *Ventura, California* Engineering and Applied Science
Kenneth James Winston *Cohasset, Massachusetts* Mathematics
Langhorne Putney Withers, Jr. *Springfield, Virginia* Mathematics
Flora Chieh Wu *Hong Kong* Chemistry
Paul Herbert Yancey *Downey, California* Biology
Charles Chung-Hoi Young *Hong Kong* Physics
Kar Woo Yung *Hong Kong* Physics
Gary Wayne Zieve *Milwaukee, Wisconsin* Biology

MASTER OF SCIENCE

- Ahmed Mansour Abdel-Ghaffar (*Civil Engineering*). B.Sc. Cairo Faculty of Engineering, 1970.
- Emilios Aleksiadis (*Civil Engineering*). B.Sc. Bosphorus University (Robert College), 1972.
- John Bruce Allingham (*Mechanical Engineering*). B.E.Sc. University of Ontario, 1972.
- Robert C. Anderson (*Biology*). A.B. Harvard College, 1971.
- William Michael Anthony (*Chemistry*). B.S. Case Institute of Technology, 1969.
- Katsuaki Asano (*Electrical Engineering*). B.E. Kyoto University, 1965; M.S.E., 1967.
- Frederick Herron Auld, Jr. (*Electrical Engineering*). B.S. West Virginia University, 1972.
- Richard Charles Barbieri (*Aeronautics*). B.S. California State Polytechnic College, Pomona, 1972.
- Frank Edward Barnes (*Physics*). B.S.E. University of Michigan, 1970.
- Bruce Warren Benjamin (*Chemical Engineering*). B.S. Columbia University, 1971.
- Jacques Beser (*Aeronautics*). B.S. California Institute of Technology, 1973.
- Russell Thomas Bock (*Aeronautics*). S.B. Massachusetts Institute of Technology, 1969.
- Waguih John Boctor (*Electrical Engineering*). B.E. Cairo University, 1970; M.Sc. American University, Cairo, 1972.
- Mark Stephen Bohn (*Mechanical Engineering*). B.M.E. Georgia Institute of Technology, 1972.
- Sanford Anthony Bolasna (*Applied Mathematics*). B.A. University of California, Riverside, 1970.
- David Franklin Bremmer (*Aeronautics*). B.S. University of California, Los Angeles, 1971.
- Lawrence James Burdick (*Geophysics*). B.S. Arizona State University, 1971.
- John Lionel Carrigan (*Biology*). B.S. Texas Agricultural and Mechanical University, 1970.
- Fan Cheong Chan (*Aeronautics*). B.S. California Institute of Technology, 1973.
- Vijay Chatoorgoon (*Aeronautics*). B.Sc. University of Manchester, 1972.
- Lenora Yee-Ling Chen (*Engineering Science*). B.A. University of California, Los Angeles, 1972.
- Martin Chen (*Applied Physics*). B.S. California Institute of Technology, 1972.
- Edmund Kai-Lien Cheng (*Electrical Engineering*). B.S. Ohio University, 1972.
- Deborah Duen Ling Chung (*Engineering Science*).
- Edward Nicholas Colonna (*Applied Physics*). A.B. Rutgers University, 1972.
- Carl Philip Constanten (*Mechanical Engineering*). B.S. California Institute of Technology, 1972.
- James Eldon Craig (*Aeronautics*). B.S. California State Polytechnic College, 1972.
- Cliff Ian Davidson (*Environmental Engineering Science*). B.S. Carnegie-Mellon University, 1972.
- Jacques Andre Delsemme (*Geophysics*). B.S. University of Toledo, 1971.

MASTER OF SCIENCE—Continued

- Deepak Dhar (*Physics*). B.Sc. University of Allahabad, 1970; M.Sc. Indian Institute of Technology, Kanpur, 1972.
- Daniel Bruce Diner (*Engineering Science*). B.A. Johns Hopkins University, 1969; M.A. 1971.
- Gordon Albert Dressler, Jr. (*Mechanical Engineering*). B.S. Florida Institute of Technology, 1972.
- Linus Antony D'Souza (*Chemical Engineering*). B. Tech. Indian Institute of Technology, Bombay, 1971.
- Dean Barton Edwards (*Mechanical Engineering*). B.S. Illinois Institute of Technology, 1972.
- Joe Patrick Elmers (*Electrical Engineering*). B.S. University of Toledo, 1968.
- Joel Earl Everson (*Geochemistry*). B.A. University of California, San Diego, 1970.
- Tomas Ganz (*Physics*). B.S. University of California, Los Angeles, 1970.
- Nathan Craig Gates (*Applied Mechanics*). B.A. Occidental College, 1972; B.S. California Institute of Technology, 1972.
- David Ross Goff (*Electrical Engineering*). B.S. West Virginia University, 1972.
- Edward Carl Graf (*Mechanical Engineering*). B.S. University of Pennsylvania, 1972.
- Robert E. Gray (*Electrical Engineering*). B.S. University of Cincinnati, 1972.
- Robert Alan Green (*Physics*). B.A. University of Chicago, 1971.
- Thomas Russell Greenlee (*Physics*). B.S. Michigan Technological University, 1970.
- Tav Frank Heistand (*Mathematics*). B.S. California Institute of Technology, 1972.
- Donald Alan Herron (*Geology*). Sc.B. Brown University, 1971.
- Glenn Hightower (*Applied Physics*). B.S. California Institute of Technology, 1972.
- David Eugene Holland (*Electrical Engineering*). B.S. San Fernando Valley State College, 1972.
- Li-Ho Raymond Hou (*Engineering Science*). B.S. National Chiao Tung University, 1970.
- James Andreas Howell (*Planetary Science*). B.S. Massachusetts Institute of Technology, 1971.
- Thomas F. Humphrey (*Physics*). B.S. University of Notre Dame, 1966.
- Christine Ann Kahr (*Environmental Engineering Science*). B.A. University of California, Berkeley, 1972.
- Robert George Kleva (*Electrical Engineering*). B.E. City College of New York, 1972.
- Malcolm Kin-Wing Ko (*Physics*). B.A. Princeton University, 1971.
- Arthur Koblasz (*Engineering Science*). B.S. University of Florida, 1970.
- Mark Kritchevsky (*Physics*). B.S. University of California, Los Angeles, 1970.
- Xavier Fernand Lagarde (*Aeronautics*). Diplome d'Ingenieurs, Ecole Nationale d'Ingenieurs de Constructions Aeronautiques, 1972.
- Ronald Elwood Land (*Electrical Engineering*). B.E. Georgia Institute of Technology, 1971.
- Vincent Wo-Sang Lee (*Mathematics*). B.S. California Institute of Technology, 1973.
- Martin Scott Leonard (*Environmental Engineering Science*). B.S. University of Rochester, 1972.

MASTER OF SCIENCE—Continued

- Elliot Charles Lepler (*Physics*). A.B. University of Pennsylvania, 1970.
- Bruce Stephen Levine (*Electrical Engineering*). B.S. University of Michigan, 1971; M.S. 1972.
- Alan Paige Lightman (*Physics*). A.B. Princeton University, 1970.
- Alexander Constantine Livanos (*Engineering Science*). B.S. California Institute of Technology, 1970.
- Mingin Philip Lo (*Environmental Engineering Science*). A.B. Dartmouth College, 1972.
- George Whitcomb Lynch (*Aeronautics*). B.S. Oklahoma State University, 1971.
- Vasilis Zissis Marmarelis (*Engineering Science*). Diploma, National Technical University of Athens, 1972.
- Michael Flynn McBride (*Environmental Engineering Science*). B.S. University of Wisconsin, 1972.
- William Walter McKeever (*Electrical Engineering*). B.S. University of Rhode Island, 1972.
- Peter Howard McMurry (*Environmental Engineering Science*). B.A. University of Pennsylvania, 1969.
- Robert Patrick McNamara (*Applied Physics*). B.S. California Institute of Technology, 1973.
- George Robert Mellman (*Geophysics*). S.B. Massachusetts Institute of Technology, 1971.
- Douglas Marion Moody, Jr. (*Aeronautics*). B.S. University of Oklahoma, 1972.
- Erik Rodney Myrmo (*Electrical Engineering*). B.S. Oregon State University, 1972.
- Ting S. Ng (*Biology*). B.S. California Institute of Technology, 1973.
- Kiam Thian Oey (*Aeronautics*). B.S. Northrop Institute of Technology, 1972.
- Robert William Offermann (*Electrical Engineering*). B.S. California Institute of Technology, 1971.
- George Alan Oliver (*Chemical Engineering*). B.S. Worcester Polytechnic Institute, 1972.
- Kendall Charles Reyzer (*Engineering Science*). B.S. Purdue University, 1972.
- Henry Maurice Roberts (*Mechanical Engineering*). B.S. California State College, Long Beach, 1959.
- Theodore Lee Rose (*Civil Engineering*). B.S. Colorado State University, 1972.
- Charles Carroll Runyan (*Chemistry*). B.S. University of Colorado, 1967.
- Stephen Lane Ryland (*Geology*). B.S. University of Missouri, 1970; M.A. 1971.
- Jean Francois Saint-Marcoux (*Mechanical Engineering*). Diplome d'Ingenieur, Ecole Centrale de Lyon, 1972.
- Norio Saito (*Aeronautics*). B.S. Tokyo University of Agriculture and Technology, 1965.
- Louis Sandler (*Engineering Science*). B.A. State University of New York, Binghamton, 1972.
- Steven Anthony Scampini (*Electrical Engineering*). B.S. Rensselaer Polytechnic Institute, 1972.

MASTER OF SCIENCE—Continued

- Brooks Nessen Schmidt (*Applied Mathematics*). B.S. University of California, Berkeley, 1971.
- Clifford Eugene Smith (*Aeronautics*). B.S. Virginia Polytechnic Institute, 1972.
- James Fredrick Stenzel (*Physics*). S.B. Massachusetts Institute of Technology, 1970.
- Michael Edward Stoll (*Applied Physics*). B.S. University of Illinois, Urbana, 1972.
- Bjorn Magnus Svennung (*Engineering Science*). Eng. Ph. Chalmers Technical Institute, 1971.
- Clement Leo Tai, Jr. (*Applied Mathematics*). B.A. (Math), B.S. (Physics), University of California, Los Angeles, 1971.
- Richard John Terrile (*Planetary Science*). B.S. State University of New York, Stony Brook, 1972.
- Joseph David Titlow (*Applied Mechanics*). A.B. Bowdoin College, 1968; B.S. California Institute of Technology, 1968.
- Gregory Boreas Van der Werff (*Mechanical Engineering*). B.S. California Institute of Technology, 1971.
- Wayne Kenneth Warzecha (*Biology*). B.A. Rockford College, 1972.
- John Mitchell Weigel (*Chemistry*). B.A. Dartmouth College, 1968.
- Richard Reid Willis (*Electrical Engineering*). B.S. California Institute of Technology, 1971.
- Rodney Keith Womer (*Aeronautics*). B.S. United States Naval Academy, 1972.
- Hung Leung Wong (*Applied Mechanics*). B.S. University of Utah, 1972.
- Ernest John Wood (*Applied Physics*). B.A. Whitman College, 1972.
- Crayton Jeffery Yapp (*Geology*). B.S. University of Wisconsin, 1971.
- Tadashi Yogi (*Applied Physics*). B.S. University of Hawaii, 1970.
- Kar Woo Yung (*Physics*). B.S. California Institute of Technology, 1973.
- Paul Solomon Zygielbaum (*Mechanical Engineering*). B.S. California Institute of Technology, 1972.

ENGINEER

- Robert Louis Ditchey (*Aeronautical Engineer*). B.S., United States Naval Academy, 1962; M.S. Naval Postgraduate School, 1969.
- Robert James Glaser (*Aeronautical Engineer*). B.S.E., University of Michigan, 1968; M.S., California Institute of Technology, 1971.
- James Joseph Kosmicki (*Aeronautical Engineer*). B.S., United States Naval Academy, 1968; M.S., California Institute of Technology, 1971.
- Narayan Krishna Mahale (*Aeronautical Engineer*). B. Tech., Indian Institute of Technology, Bombay, 1969; M.S., California Institute of Technology, 1970.
- Harry Joseph Masoni (*Aeronautical Engineer*). B.S., California State Polytechnic College, Pomona, 1970; M.S., California Institute of Technology, 1971.
- Tsung-Chow Joe Su (*Aeronautical Engineer*). B.S., National Taiwan University, 1968; M.S., California Institute of Technology, 1970.
- Yukio Stephen Tamura (*Aeronautical Engineer*). B.D., Kyoto Institute of Technology, 1968; M.E., 1970; M.S., California Institute of Technology, 1971.
- Robert Freeland Wiley (*Aeronautical Engineer*). S.B., Massachusetts Institute of Technology, 1966; M.S., California Institute of Technology, 1971.

DOCTOR OF PHILOSOPHY

DIVISION OF BIOLOGY

Larry I. Benowitz (*Psychobiology*). B.Ch.E., Cooper Union, 1966.

Thesis: Mechanisms of Information Processing in the Chick.

Moisés Eisenberg-Grünberg (*Biophysics and Chemistry*). Faculty of Sciences, University of Chile, 1967; M.S., California Institute of Technology, 1970.

Thesis: Voltage Gateable Ionic Pores Induced by Alamethicin in Black Lipid Membranes.

Jeffrey Allen Frelinger (*Immunology*). B.A., University of California, San Diego, 1969.

Thesis: Transferrin Polymorphism in Pigeons.

Stanley Charles Froehner (*Biochemistry and Neurophysiology*). B.S., University of Texas, Austin, 1968.

Thesis: The Isolation, Purification, and Characterization of Three RNA Polymerases from Novikoff Hepatoma Ascites Tumor.

Harold William Gordon (*Psychobiology*). B.S., Case Institute of Technology, 1967.

Thesis: Verbal and Non-verbal Cerebral Processing in Man for Audition.

David Salway Holmes (*Biochemistry*). B.A., Trinity College, Dublin, 1969.

Thesis: Studies on Nuclear RNA.

Algirdas Joseph Jesaitis (*Biophysics*). B.S., New York University, 1967.

Thesis: Linear Dichroism and Orientation of the Phycomyces Photopigment.

Mary Ann Monica Linseman (*Biology*). B.A., University of Toronto, 1967.

Thesis: Unit Activity in the Hypothalamus and Striatum of the Rat During Learning.

Menahem Segal (*Biology and Psychobiology*). B.A., Bar-Ilan University, 1969;

M.A., 1970.

Thesis: The Hippocampus as a Learning Machine.

Brian Storrie (*Biochemistry and Chemistry*). B.S., Cornell University, 1968.

Thesis: Studies on the Growth and Replication of Mitochondria in Hela Cells.

DIVISION OF CHEMISTRY AND CHEMICAL ENGINEERING

William Beranek, Jr. (*Chemistry*). B.S., University of Wisconsin, 1967.

Thesis: Investigation of the Catalytic Mechanism of Lysozyme Using Substrate Analogs.

Michael Dean Bertolucci (*Chemistry*). B.S., San Jose State College, 1967.

Thesis: Investigations on the Crystal and Vibrational Structures of Sym-Trifluorobenzene, Sym-Trideuterotrifluorobenzene and Hexafluorobenzene at Low Temperatures.

Michael Blumenstein (*Chemistry*). B.S., City College of New York, 1968.

Thesis: I. ^3P and ^{13}C NMR Studies of NAD and Related Compounds. II. ^{19}F NMR Studies of Rabbit Muscle Glyceraldehyde-3-Phosphate Dehydrogenase Covalently Labeled with a Trifluoromethyl Group.

Raymond Edgar Carhart (*Chemistry*). B.A., Northwestern University, 1968.

Thesis: A Detailed Theoretical Study of the Difluoromethane Molecule.

DOCTOR OF PHILOSOPHY—Continued

- Felix Alvin Carroll, Jr. (*Chemistry*). B.S., University of North Carolina, 1969.
Thesis: Studies of Photochemical and Photophysical Processes. I. The Photochemistry of 3-Methyl-1-Phenoxybut-2-Ene. II. The Role of Charge Transfer Interactions in the Quenching of 1, 4-Dimethoxybenzene Fluorescence. III. A New Method for the Determination of Intersystem Crossing Quantum Yields.
- Louis Tsi Chow (*Chemistry*). B.S., National Taiwan University, 1965.
Thesis: I. Map of the Partial Sequence Homology between Molecules of *Bacillus subtilis* Bacteriophages SPO₂ and ϕ 105. II. Electron Microscope Mapping of Phage att Sites for Bacteriophages SPO₂ and ϕ 105 and the Distribution of Ribosomal Genes on the *Bacillus subtilis* Chromosome. III. Electron Microscope Mapping λ dv DNAs.
- Kenneth Lee Gammon (*Chemistry*). B.S., University of North Carolina, Chapel Hill, 1969.
Thesis: Investigations of α -chymotrypsin by Nuclear Magnetic Resonance Spectroscopy.
- Steven Lawrence Guberman (*Chemistry*). B.A., State University of New York, 1967.
Thesis: I. Projected G₁ Wavefunctions for He₂. II. Localized Wavefunctions for H₂O, OH, and O.
- Erdogan Güleri (*Chemical Engineering and Chemistry*). B.S., Robert College, 1969.
Thesis: A Laser Light Scattering Study of Transport and Critical Phenomena.
- Esin Güleri (*Chemical Engineering and Chemistry*). B.S., Robert College, 1969; M.S., California Institute of Technology, 1970.
Thesis: A Study of Critical Phenomena in Krypton.
- Daniel Charles Harris (*Chemistry*). S.B., Massachusetts Institute of Technology, 1968.
Thesis: More Fun Than Anything.
- Thomas Arnold Hecht (*Chemistry*). B.S., Valparaiso University, 1969.
Thesis: Development of a General Kinetic Mechanism for Photochemical Smog.
- Norman Lewis Helgeson (*Chemical Engineering*). B.S., University of Idaho, 1963; M.S., University of Utah, 1964.
Thesis: I. Latent Heat of Vaporization of Propane. II. Partial and Total Heats of Vaporization for the N-Propane/N-Decane Mixture.
- David Lee Huestis (*Chemistry and Physics*). B.A., Macalester College, 1968; M.S., California Institute of Technology, 1969.
Thesis: I. The Projected GI Method and the Excited States of H₂. II. A Superposition Principle for Siegert Resonant States.
- Donald Ross Kelsey (*Chemistry*). B.S., Central Missouri State College, 1968.
Thesis: I. Studies on Cyclopropyl-stabilized Vinyl Cation Intermediates. II. Molecular Orbital Calculations on Cationic Intermediates and Displacement Reactions. III. On the Complexation of NMR Lanthanide Shift Reagents with Organic Substrates.
- Chwan Pein Kyan (*Chemical Engineering*). B.S., University of Rangoon, 1961; M.S., Illinois Institute of Technology, 1969.
Thesis: Determination of Optimal Air Pollution Control Strategies.

DOCTOR OF PHILOSOPHY—Continued

- Donald David Macmurchie (*Chemistry*). B.Sc., University of Victoria, 1967.
Thesis: Conformational Aspects of Valinomycin by Nuclear Magnetic Resonance.
- John Joseph Meister (*Chemistry and Physics*). B.S., Pennsylvania State University, 1968.
Thesis: Bifunctionate Solutions to the Schrödinger Equation for Reactive, Three-Atom, Collinear Encounters.
- Carl Frederick Melius (*Chemistry*). B. Ch., University of Minnesota, 1968; M.S., California Institute of Technology, 1970.
Thesis I. A Theoretical Investigation of the Charge Transfer Process in Alkali-Atom Alkali-Ion Collisions. II. *Ab Initio* Effective Potentials for Use in Molecular Calculations.
- Peter George Miasek (*Chemistry*). B.Sc., McGill University, 1968.
Thesis: Trapped Ion Studies of Ion-Molecule Reactions.
- Vincent Mark Miskowski (*Chemistry*). B.S., Case Institute of Technology, 1968.
Thesis: Electronic Structure of Metal-Oxygen Complexes.
- Douglas Crane Mohr (*Chemistry*). B.S., San Diego State College, 1965.
Thesis: I. Study of the Possibility of the Detection of Fluorescent Dyes by Cathodoluminescence. II. Partial Denaturation Maps of Lambda DNA Using Methylmercuric Hydroxide.
- Thomas Hellman Morton (*Chemistry*). A.B., Harvard College, 1968.
Thesis: Organic Reactions in the Gas Phase. I. The Thermal Rearrangement of 3, 3-Dimethylcyclopropene. II. Interaction of Remote Functional Groups in the Ion Chemistry of Bifunctional Ethers.
- Edward Francis O'Brien (*Chemistry*). B.Sc., St. Dunstan's University, 1967; M.S., California Institute of Technology, 1971.
Thesis: The Influence of Intermolecular Forces on Spectral Properties.
- Frank Herbert Quina (*Chemistry*). B.S., Stetson University, 1968.
Thesis: Photophysical Studies: I. Singlet Quenching in Naphthalene-Conjugated Diene Bichromophores; II. Fluorescence of Aromatic Hydrocarbon-Tertiary Amine Bichromophores; III. Intersystem Crossing in the Methyl Benzenes.
- Douglas Poll Ridge (*Chemistry*). A.B., Harvard College, 1966.
Thesis: I. Studies of Collision Broadening of Ion Cyclotron Resonance Spectra. II. Studies of the Gas Phase Ion Chemistry of Fluoroethanes.
- John Brandt Rose (*Chemistry*). B.A., Western Reserve University, 1965.
Thesis: I. Application of the Equations-of-Motion Method to the Excited States of N_2 , CO and C_2H_4 . II. Applicability of SCF Theory to Some Open-Shell States of CO, N_2 and O_2 .
- Michael Patrick Sheetz (*Chemistry and Biophysics*). B.A., Albion College, 1968.
Thesis: I. Effect of Sonication and Osmotic Pressure on the Structure of the Lecithin Bilayer. II. PMR Study of the Human Erythrocyte Membrane Upon Perturbation.
- Jack Claude Thibeault (*Chemistry*). B.S., Lowell Technological Institute, 1967.
Thesis: The Electronic Structure of Polynuclear Transition Metal Complexes.

DOCTOR OF PHILOSOPHY—Continued

David Halbert White (*Chemistry*). B.S., Michigan State University, 1967.

Thesis: I. Decomposition of 2, 3-Diazabicyclo (3.2.0)hept-2-ene. II. Vibrationally Excited Intermediates from Cyclopropyldiazomethane.

DIVISION OF ENGINEERING AND APPLIED SCIENCE

George Efstratios Apostolakis (*Engineering Science and Applied Mathematics*). Dipl., National Technical University of Athens, 1969; M.S., California Institute of Technology, 1970.

Thesis: Studies in Nuclear Reactor Dynamics. I. The Accuracy of Point Kinetics. II. The Effect of Delayed Neutrons on the Spectrum of the Group Diffusion Operator.

Vijay Hanumappa Arakeri (*Mechanical Engineering*). B.S., Utah State University, 1967; M.S., California Institute of Technology, 1968.

Thesis: Viscous Effects in Inception and Development of Cavitation on Axi-Symmetric Bodies. Part I. Cavitation Inception. Part II. A Semi-Empirical Method to Predict Cavitation Separation on Smooth Bodies.

Prem Bhatia (*Aeronautics*). B.Sch.Eng., Punjab Engineering College, 1965; M.E., Indian Institute of Science, 1968.

Thesis: Buckling of Imperfect Circular Cylindrical Shells.

Richard Henry Bigelow (*Engineering Science and Mathematics*). B.S., California Institute of Technology, 1966; M.S., 1967.

Thesis: Computer Languages for Numerical Engineering Problems.

Robert William Bower (*Applied Physics*). B.A., University of California, Berkeley, 1962; M.S., California Institute of Technology, 1963.

Thesis: Reaction Kinetics of Pd and Ti-Al Films on Si.

Thomas Glen Carne (*Applied Mechanics*). B.A., Pomona College, 1968; M.S., California Institute of Technology, 1969.

Thesis: Load-Absorption and Interaction of Two Filaments in a Fiber-Reinforced Material.

Daniel Pan Yih Chang (*Mechanical Engineering*). B.S., California Institute of Technology, 1968; M.S., 1969.

Thesis: Particle Collection from Aqueous-Suspensions by Solid and Hollow Single Fibers.

John Chester Cummings, Jr. (*Aeronautics*). B.S., California Institute of Technology, 1969; M.S., 1970.

Thesis: I. Development of a Cryogenic Shock Tube. II. Experimental Investigation of the Interaction of a Shock Wave with LHe and I and II.

Pavlos Emmanuel Dimotakis (*Applied Physics*). B.S., California Institute of Technology, 1968; M.S., 1969.

Thesis: Investigation of Supercritical Heat Flow in Helium II.

Robert Joseph D'Orazio (*Electrical Engineering and Business Economics*). B.S., Drexel Institute of Technology, 1967; M.S. California Institute of Technology, 1968.

Thesis: Detection of Mode-Locked Laser Signals.

DOCTOR OF PHILOSOPHY—Continued

- Murray Keith Hill (*Mechanical Engineering*). B.A.Sc., University of British Columbia, 1968; M.S., California Institute of Technology, 1969.
Thesis: Behavior of Spherical Particles at Low Reynolds Numbers in a Fluctuating Translational Flow.
- Hideo Ikawa (*Aeronautics*). B.S.A.E., Northrop Institute of Technology, 1962; M.S., California Institute of Technology, 1964.
Thesis: Turbulent Mixing Layer Experiment in Supersonic Flow.
- Ching-Lin Jiang (*Electrical Engineering and Physics*). B.S., National Taiwan University, 1967; M.S., California Institute of Technology, 1969.
Thesis: Electromagnetic Wave Propagation and Radiation in a Suddenly Created Plasma.
- Javier Jimenez-Sendin (*Applied Mathematics*). Ingeniero Aeronautico, Escuela Technica Superior de Ingenieros Aeronauticos, 1969; M.S., California Institute of Technology, 1970.
Thesis: I. Nonlinear Gas Oscillations in Pipes. II. Wavetrains with Small Dissipation.
- Peter Hoong-Yee Lee (*Aeronautics*). B.S., National Taiwan University, 1961; Dipl. Ing., Rheinisch-Westfälische Technische Hochschule Aachen, 1967.
Thesis: An Investigation of Collisionless Plasma Beam Interaction with a Non-homogeneous Magnetic Field.
- Tyzz-Dwo Lu (*Civil Engineering*). B.S., National Taiwan University, 1964; M.S., Duke University, 1967.
Thesis: I. Constitutive Relations for a Granular Material. II. The Distribution of Stresses and Development of Failure at the Toe of a Slope and Around the Tip of a Crack.
- Hisatoshi Maeda (*Electrical Engineering and Physics*). B.E., Tokyo University, 1967; M.E., 1969; M.S., California Institute of Technology, 1970.
Thesis: Theoretical and Experimental Investigations of Saturation Effects in a Gas Laser.
- Neville Ingersoll Marzwell (*Materials Science and Applied Physics*). B.Sc., American University, Cairo, 1966; M.S., California Institute of Technology, 1971.
Thesis: Influence of Composition of the Structure, Electric and Magnetic Properties of Amorphous Pd-Mn-P and Pd-Co-P.
- Amr Mohamed Mohsen (*Electrical Engineering and Applied Physics*). B. of Eng., Cairo University Faculty of Engineering, 1968; M.S., American University in Cairo, 1970; M.S., California Institute of Technology, 1971.
Thesis: Incomplete Charge Transfer in Charge Coupled Devices.
- Michael Aron Piliavin (*Engineering Science and Physics*). B.S., University of California, Los Angeles, 1966.
Thesis: A Theoretical Investigation of the Effect of Intermolecular Correlations Upon Properties of Simple Liquids from X-Ray Diffraction.
- Aubrey Bonner Poore, Jr. (*Applied Mathematics*). B.S., Georgia Institute of Technology, 1968; M.S., 1969.
Thesis: Stability and Bifurcation Phenomena in Chemical Reactor Theory.

DOCTOR OF PHILOSOPHY—*Continued*

Manuel Rebollo-Rebollo (*Aeronautics*). Ingeniero Aeronautico, Escuela Technica Superior de Ingenieros Aeronauticos, 1968.

Thesis: Analytical and Experimental Investigation of a Turbulent Mixing Layer of Different Gases in a Pressure Gradient.

Viviane Claude Rupert (*Aeronautics*). Ing. d'Aeronautique, Ecole Nationale Supérieure de l'Aeronautique, 1961; M.S., California Institute of Technology, 1962; Ae.E., 1963.

Thesis: Experimental Study of Shock Wave Strengthening by a Positive Density Gradient in a Cryogenic Shock Tube.

Glenn Bruce Sinclair (*Applied Mechanics*). B.Sc., B.E., University of Auckland, 1969.

Thesis: On Nonmixed Symmetric End-Load Problems in Elastic Waveguides.

Robert Donald Small (*Applied Mathematics*). B.A.Sc., University of Toronto, 1968; M.S., California Institute of Technology, 1969.

Thesis: Nonlinear Dispersive Waves in Nonlinear Optics.

Erik Storm (*Aeronautics*). B.S., California Institute of Technology, 1967; M.S., 1968.

Thesis: Investigation of Strong Shock Waves in a Conical Convergent Channel, Parts I and II.

William Noel Sullivan (*Mechanical Engineering*). B.S., State University of New York, Buffalo, 1968; M.S., California Institute of Technology, 1969.

Thesis: Heat Transfer to Flowing Granular Media.

David William Vahey (*Electrical Engineering and Physics*). S.B., Massachusetts Institute of Technology, 1966; M.S., California Institute of Technology, 1967.

Thesis: Nonlinear Absorption of Light by Solutions of Organic Dyes.

John Holm Wood (*Civil Engineering*). B.E., University of Canterbury, 1962; M.E., 1964.

Thesis: Earthquake-Induced Soil Pressures on Structures.

Thomas King Lin Yu (*Electrical Engineering*). B.S., University of California, Los Angeles, 1966; M.S., California Institute of Technology, 1967.

Thesis: Optimal Filtering for Systems Governed by Coupled Ordinary and Partial Differential Equations.

Jaiyun Min Yuh (*Electrical Engineering*). S.B., Massachusetts Institute of Technology, 1958; M.S., University of Southern California, 1970.

Thesis: Analysis and Comparative Study of Buck Regulators.

Eran Zaidel (*Engineering Science*). A.B., Columbia University, 1967; M.S., California Institute of Technology, 1968.

Thesis: Linguistic Competence and Related Functions in the Right Cerebral Hemisphere of Man Following Commissurotomy and Hemispherectomy.

John Zoltek, Jr. (*Environmental Engineering Science*). B.C.E., City College of New York, 1960; M.S., California Institute of Technology, 1961.

Thesis: Interaction of Aqueous Inorganic Orthophosphate and Phosphate Rock.

DOCTOR OF PHILOSOPHY—Continued

DIVISION OF GEOLOGICAL AND PLANETARY SCIENCES

Jeffrey Nicholas Cuzzi (*Planetary Science*). B.S., Cornell University, 1967; M.S., California Institute of Technology, 1969.

Thesis: The Subsurface Nature of Mercury and Mars from Thermal Microwave Emission.

Geoffrey Frederick Davies (*Geophysics*). B.Sc., Monash University, 1966; M.Sc., 1968.

Thesis: Elasticity of Solids at High Pressures and Temperatures: Theory, Measurement and Geophysical Application.

Edward Stowell Gaffney (*Geophysics and Planetary Science*). B.S., Yale University, 1964; M.A., Dartmouth College, 1966.

Thesis: Crystal Field Effects in Mantle Minerals.

Thomas Hillman Jordan (*Geophysics and Applied Mathematics*). B.S., California Institute of Technology, 1969; M.S., 1970.

Thesis: Estimation of the Radial Variation of Seismic Velocities and Density in the Earth.

Pierre Henri Jungels (*Geophysics and Hydraulics*). Ing., Université de Liège, 1967.

Thesis: Modeling of Tectonic Processes Associated with Earthquakes.

LeRoy Paul Knauth (*Geochemistry and Geology*). B.A., University of Chicago, 1966.

Thesis: Oxygen and Hydrogen Isotope Ratios in Cherts and Related Rocks.

Richard Lane Squires (*Geobiology*). B.S., University of New Mexico, 1966; M.S., 1968.

Thesis: Burial Environment, Diagenesis, Mineralogy, and Mg & Sr Contents of Skeletal Carbonates in the Buckhorn Asphalt of Middle Pennsylvanian Age, Arbuckle Mountains, Oklahoma.

William Roger Ward (*Planetary Science*). B.S., University of Missouri, 1968.

Thesis: I. The Formation of Planetesimals. II. Tidal Friction and Generalized Casini's Laws in the Solar System.

James Hall Whitcomb (*Geophysics*). M.S., Oregon State University, 1964; Gp. Eng., Colorado School of Mines, 1962.

Thesis: Part I: A Study of the Structure of the Earth by the use of Core Phases. Part II: The San Fernando Earthquake Series Focal Mechanisms and Tectonics.

DIVISION OF PHYSICS, MATHEMATICS AND ASTRONOMY

Charalambos Dionisios Aliprantis (*Mathematics*). B.S., University of Athens, 1969; M.S., California Institute of Technology, 1971.

Thesis: On Order and Topological Properties of Riesz Spaces.

Arturo Cisneros-Stoianowski (*Physics and Mathematics*). B.S., Instituto Politecnico Nacional de Mexico, 1967; M.S., California Institute of Technology, 1971.

Thesis: I. Baryon-Antibaryon Phase Transition at High Temperature. II. Inclusive Virtual Photon-Hadron Reactions in the Parton Model.

DOCTOR OF PHILOSOPHY—Continued

- Alan Coffman Cummings (*Physics*). B.A., Rice University, 1966.
Thesis: A Study of Cosmic-Ray Positron and Electron Spectra in Interplanetary and Interstellar Space and the Solar Modulation of Cosmic Rays.
- Peggy Lynn Dyer (*Physics*). B.S., University of Texas, 1968.
Thesis: The Reduced-Alpha-Width of the Lowest 1^- State of ^{16}O .
- John Joseph Dykla (*Physics*). B.S., Loyola University, 1966.
Thesis: Conserved Quantities and the Formation of Black Holes in the Brans-Dicke Theory of Gravitation.
- Robert Lawrence Elgin (*Physics and Economics*). B.A., Pomona College, 1966.
Thesis: The Thermodynamics of the 4He Submonolayer Film Adsorbed on Grafoil.
- Kirby William Fong (*Applied Mathematics*). B.S., University of California, Berkeley, 1967; M.S., California Institute of Technology, 1968.
Thesis: Numerical Solution of Parabolic Equations by the Box Scheme.
- Thomas Lee Garrard (*Physics*). B.A., Rice University, 1966.
Thesis: A Quantitative Investigation of the Solar Modulation of Cosmic-Ray Protons and Helium Nuclei.
- David Marshall Gordon (*Physics*). B.S., Ohio State University, 1963; M.S., 1965.
Thesis: Electromagnetic Lifetimes of Nuclear Levels by Doppler-Shift and Recoil Methods.
- Leonard Jeffrey Gray (*Mathematics*). B.S., Polytechnic Institute of Brooklyn, 1968; M.S., 1968.
Thesis: Essential Central Spectrum and Range in a W^* -Algebra.
- Eric Winslow Greisen (*Astronomy*). B.A., Cornell University, 1966.
Thesis: Aperture Synthesis of Interstellar Neutral Hydrogen in Absorption.
- Steven Kenneth Kauffmann (*Physics and Mathematics*). B.S., California Institute of Technology, 1965.
Thesis: Ortho-Positronium Annihilation: Steps Toward Computing the First Order Radiative Corrections.
- John Ying-Kuen Kwan (*Physics*). B.S., Utah State University, 1969.
Thesis: Polarization Properties of Astrophysical Masers.
- Christopher Allen Landauer (*Mathematics*). B.A., University of California, Los Angeles, 1969.
Thesis: Simple Groups with 9, 10, and 11 Conjugate Classes.
- William Carl Lyford (*Mathematics*). B.S., Clarkson College, 1966; M.S., California Institute of Technology, 1970.
Thesis: Scattering Theory for the Laplacian in Perturbed Cylindrical Domains.
- Henry Jay Melosh IV (*Physics and Geology*). A.B., Princeton University, 1969; M.S., California Institute of Technology, 1971.
Thesis: Quarks: Currents and Constituents.

DOCTOR OF PHILOSOPHY—Continued

- Charles Porter Moeller (*Physics*). B.S., University of Wisconsin, 1966.
Thesis: Damping and Saturation of a Second Order Electron Plasma Wave Echo.
- James Bryant Nation (*Mathematics*). A.B., Vanderbilt University, 1970.
Thesis: Varieties of Algebras Whose Congruence Lattices Satisfy Lattice Identities.
- Wei-Tou Ni (*Physics and Mathematics*). B.S., National Taiwan University, 1966;
M.S., California Institute of Technology, 1971.
Thesis: Metric Theories of Gravity and their Astrophysical Implications.
- Aaron James Owens (*Physics and Economics*). B.A., Williams College, 1969; M.S.,
California Institute of Technology, 1971.
Thesis: Cosmic-Ray Scintillations.
- William Henry Press (*Physics*). A.B., Harvard College, 1969; M.S., California Institute of Technology, 1971.
Thesis: Applications of Black-Hole Perturbation Techniques.
- George Harber Purcell (*Astronomy*). S.B., Massachusetts Institute of Technology, 1966; M.S., California Institute of Technology, 1968.
Thesis: The Structure of Compact Radio Sources at 606 MHz.
- Gregory Alan Shields (*Astronomy*). B.S., Stanford University, 1968; M.S., California Institute of Technology, 1969.
Thesis: The Ionization Structure and Emission Line Strengths of Seyfert Galaxy Nuclei.
- Arnold John Sierk (*Physics*). B.S., Cornell University, 1968.
Thesis: A Study of the Reactions ${}^9\text{Be}(p,\alpha)$ and ${}^9\text{Be}(p,d)$ at Low Energies.
- John Charles Stevens (*Physics*). B.S., California Institute of Technology, 1968.
Thesis: Soft X-Rays from the Cygnus Loop.
- John Randolph Stonesifer (*Mathematics*). A.B., Dartmouth College, 1969.
Thesis: Combinatorial Inequalities for Geometric Lattices.
- Alan Anderson Wray (*Physics*). B.S., University of Arkansas, 1968.
Thesis: Nonlinear Magnetohydrodynamic Phenomena.
- William Edwin Wright (*Physics and Astronomy*). B.S., Michigan State University, 1967; M.S., California Institute of Technology, 1969.
Thesis: Polarization Observations of ${}^3\text{C}$ Radio Sources and Galactic Faraday Rotation.
- Henry Che-Chuen Yuen (*Applied Mathematics*). B.S., University of Wisconsin, 1969.
Thesis: Waves on Vortex Filaments.

Prizes and Awards

GEORGE W. GREEN MEMORIAL AWARD

Awarded to the undergraduate student who, in the opinion of the Division Chairmen, has shown outstanding ability and achievement in the field of creative scholarship.

Richard Francis Lyon, junior

Michael Franz Yoder, junior

FREDERICK W. HINRICHS, JR., MEMORIAL AWARD

Awarded to the senior who, in the opinion of the Undergraduate Deans, has throughout the undergraduate years at the Institute made the greatest contribution to the welfare of the student body and whose qualities of leadership, character, and responsibility have been outstanding.

Recipient to be announced.

DON SHEPARD AWARD

Awarded to students, the basic costs of whose education have already been met but who would find it difficult, without additional help, to engage in extracurricular activities and in the cultural opportunities afforded by the community. The recipients are selected on the basis of their capacity to take advantage of and to profit from these opportunities rather than on the basis of their scholastic standing.

Alexander Chike Egwuatu, sophomore

Ioannis Nicolaos Kessides, junior

Laurie Ann Schalit, junior

DAVID JOSEPH MacPHERSON PRIZE IN ENGINEERING

Awarded annually to the graduating senior in engineering who best exemplifies excellence in scholarship. The winning student is selected by a faculty committee of three, appointed annually by the chairman of the Division of Engineering and Applied Science.

Lawrence Curtis Widdoes, Jr.

PRIZES AND AWARDS—Continued

DONALD S. CLARK ALUMNI AWARDS

May be awarded annually 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.

Gregory Lee Griffin, sophomore

Richard Louis Baker, junior

HAREN LEE FISHER MEMORIAL AWARD IN JUNIOR PHYSICS

Awarded annually to a junior physics major, to be selected by a physics faculty committee as demonstrating the greatest promise of future contributions to physics.

Edmund Charles Sutton

SIGMA XI AWARD

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

Stanley Ernest Whitcomb

THE MORGAN WARD AWARD

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

James Bergheim Shearer, freshman

MARY A. EARLE MCKINNEY PRIZE IN ENGLISH

The purpose of this prize is to cultivate proficiency in writing. The terms under which it is given are decided each year by the faculty in English. It may be awarded for essays submitted in connection with regular English classes, or awarded on the basis of a special essay contest.

Robert Stephen Flake

Harold James McGee

PRIZES AND AWARDS—*Continued*

JACK E. FROELICH MEMORIAL AWARD

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

Gregory Paul Stone

ERIC TEMPLE BELL UNDERGRADUATE MATHEMATICS RESEARCH PRIZE

Awarded annually to one or more juniors or seniors for outstanding original research in mathematics, the winners being selected by members of the mathematics faculty.

Bruce Arie Reznick, senior

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

Awarded annually 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: *Thomas David Howell*

JAMES H. SHEARER—*Special Guest* honored for his twenty-five years of distinguished and loyal service to the California Institute of Technology as organist for the commencement ceremonies.