

## Forward into the New Millennium

Readers of the *Journal of Propulsion and Power* (*JPP*) will remember that the last issue of the 20th century was in commemoration of the life and contributions of the late Martin Summerfield, who was one of the most important figures in the field of propulsion during the past 50 years.

As we enter the 21st century and the new Millennium, I feel confident that *JPP* is in a position to continue to play an ever-increasing leadership role in Propulsion and Energy, much as did Professor Summerfield. Thanks to the tireless contributions of several Associate Editors, focused sections of *JPP* will present the status of the technology of three important disciplines. Vigor Yang, together with foreign colleagues, has assembled a truly international group of papers on solid propellants and interior ballistics that updates the material in the July–August 1995 issue of *JPP*; these papers will comprise an issue in 2000. Mike Micci, together with Andrew Ketsdever, has assembled a group of papers on the burgeoning field of microthrusters; these are needed for the small spacecraft that are assuming a growing role in the research for the next 20 years in space. A wide variety of propulsion concepts is involved in these microthrusters, and readers will have an opportunity to learn of them in another 2000 issue. Finally, Ashwani Gupta has assembled a group of papers on advanced concepts for the generation of terrestrial energy. This is a follow-on to the group of papers that was published in 1999 and will appear in yet another 2000 issue.

The several disciplines that make up the majority of the manuscripts that appear in *JPP* continue to be represented in the manuscripts submitted for publication; the number of submittals continues to hold steady, and there is a healthy backlog of manuscripts that are ready for publication.

The readers of the journal are indeed fortunate to have a strong group of Associate Editors who are capable of processing the reviews of manuscripts in order to determine their suitability for publication. This year, I felt personally blessed that Barry Butler, “Butch” Foster, Hans Immich, Roger Myers, and Vigor Yang were all willing to serve another three-year term as AE; all of them have been very professional in their service and, equally important, fun to work with! Two AEs have stepped down; George Cox has retired from Pratt & Whitney, and Jim Younghans is nearing retirement

from General Electric. It is impossible to say too much about Jim’s service to the *Journal of Propulsion and Power*; he was a member of the original Editorial Board, and has, with the help of his lovely wife Marg, contributed 15 years to *JPP*. At the same time, he has been an active member of the Air Breathing Propulsion Technical Committee, involving the members of that TC in the review process.

It is appropriate that Jim’s slot as an AE will be filled by Jim Mace, who is the Chairman of the ABP TC; Jim has over 20 years of experience as a Senior Technical Fellow with the (now) Boeing Company, with experience in several fields. George Cox’s slot will be taken by Lourdes Maurice, another member of the Propellants and Combustion Technical Committee. Lourdes has rapidly established herself as a leader in the field of fuels for hypersonic propulsion and has been an active member of the HyTasp Working Group. She has recently moved from Wright–Patterson Air Force Base to the Pentagon. I look forward to working with them, as well as with the other continuing members of the Editorial Board.

Readers will note another change on the masthead. Mary Ellen Lanham, who had been the Managing Editor of *JPP*, left for another position. Luckily, Brian Haefs, formerly a Production Specialist, was available to assume the role of Managing Editor. He rapidly moved in to complete the tasks associated with the Summerfield Issue, as well as those with the numerous manuscripts already in the production process. We are indeed fortunate to have him in this key role. Meanwhile, Norma Brennan continues her behind-the-scenes leadership role, providing her expert advice and boundless good humor.

In summary, the *Journal of Propulsion and Power* is in a strong position as a flagship journal entering the 21st century and the new Millennium. There is a strong, proactive group of Associate Editors, and excellent working relationships have been established with the Technical Committees that comprise the Propulsion and Energy Group. Many of their members are mentioned below in the list of Reviewers, a key component of the archival review process. Listing them here is one way to thank them for their assistance.

R. H. Woodward Waesche  
*Editor-in-Chief*

## Editor-in-Chief



**R. H. WOODWARD WAESCHE** is Principal Scientist at Science Applications International Corporation (SAIC) and received his B.A. in Physics from Williams College in 1952, his M.A. in 1962, and his Ph.D. in Aerospace and Mechanical Sciences from Princeton University in 1965. Before joining SAIC in 1993, he served in the U.S. Army and held senior positions at Rohm & Haas Company (1954–1966), United Technologies Research Center (1966–1981), and Atlantic Research Corporation (1981–1992). His research interests center on propulsion-related combustion, especially on unsteady combustion in solid-propellant rockets and its suppression by additives. He has also performed extensive research on combustor flowfields; his most recent publications, one of which won the Solid Rockets Best Paper Award (1990), dealt with flow in the Space Shuttle Booster. Dr. Waesche chaired the AIAA Propellants & Combustion Technical Committee (1975–1977) and was Director-Technical of the AIAA Propulsion & Energy Group. He is a long-time member (since 1978) of the Technical Activities Committee, and a member of the AIAA Finance Committee. Dr. Waesche is listed in *Who's Who in the World*. He served as Editor-in-Chief of the *Journal of Spacecraft and Rockets* from 1980 to 1986, when he assumed the post of Editor-in-Chief of this journal. Dr. Waesche is a Fellow of AIAA and has contributed an article on Spectroscopy to the *Dictionary of Science and Technology*, among numerous technical publications. He is also on the Editorial Advisory Board for the *Encyclopedia of Physical Science and Technology*, with responsibility for articles on propellants and propulsion.

## Associate Editors



**C. THOMAS AVEDISIAN** is a Professor in the Sibley School of Mechanical and Aerospace Engineering at Cornell University. His current research interests include droplet and spray combustion, particulate emissions and control during combustion of fuel droplets, impingement of droplets and fluid jets, thermal analysis of composite materials, and rapid evaporation of liquids. He was previously a member of the technical staff at AT&T Bell Laboratories (Holmdel, New Jersey), a Visiting Scientist at the National Institute of Standards and Technology (Gaithersburg, Maryland), and a Visiting Professor at Brown University. He is the recipient of three Best Paper Awards from AIAA for research on droplets and sprays, and the James Harry Potter Gold medal in 1999 from the American Society of Mechanical Engineers (ASME) for eminent scientific achievements in the thermal sciences. He received his B.S. (1972) from Tufts University, his S.M. (1974) from Massachusetts Institute of Technology, and his M.A. (1977) and Ph.D. (1980) degrees from Princeton University. He has been at Cornell since 1980. He is a fellow of ASME and was the chair of the ASME Heat Transfer Visualization Committee (1993–1997). He is a member of the Combustion Institute and is an Associate Fellow of AIAA where he is a member of the AIAA Terrestrial Energy Committee.



**RODNEY D. W. BOWERSOX**, Assistant Professor in the Department of Aerospace Engineering and Mechanics at the University of Alabama, received his Ph.D., M.S., and B.S. in Aerospace Engineering from Virginia Polytechnic Institute and State University in 1992, 1990, and 1988, respectively. Prior to joining faculty at the University of Alabama in 1997, he was on the faculty at the U.S. Air Force Institute of Technology, Department of Aeronautics and Astronautics (1992–1997). His research and teaching activities are in the areas of theoretical, experimental, and computational fluid mechanics as related to high-speed aerodynamics and propulsion. Dr. Bowersox received the USAF Col. Charles A. Stone Leadership Award (1995) and five Air Force Scientific Achievement Awards (1996–1997). Dr. Bowersox is a Senior Member of the AIAA and is currently serving a second term on the Airbreathing Propulsion Technical Committee.



**P. BARRY BUTLER**, Professor of Mechanical Engineering and Associate Dean for Academic Programs at the University of Iowa, received his B.S. and M.S. degrees in Aeronautical and Astronautical Engineering from the University of Illinois at Urbana-Champaign and his Ph.D. in Mechanical Engineering from the same university. Dr. Butler is active in a number of aerospace-related instructional and research activities at the University of Iowa, where he also serves as campus coordinator of the Iowa Space Grant Consortium. His current research interests include multi-phase reactive flows, shock initiation of energetic materials, and combustion of solid propellants and pyrotechnics. Dr. Butler has worked as a visiting research Fellow for the U.S. Navy and Sandia National Laboratories where he conducted research in the area of solid propellant and energetic materials modeling. In addition to his editorial duties with the AIAA *Journal of Propulsion and Power*, Dr. Butler is a member of the AIAA Technical Committee on Propellants and Combustion and is an Associate Fellow. In 1991 he was awarded the Society of Automotive Engineers' Ralph R. Teetor Educational Award from the Aerospace Division, and the American Society of Mechanical Engineers' Outstanding Professor Award from the student chapter at the University of Iowa.



**DANIEL J. DORNEY** is an Associate Professor of Mechanical Engineering at Virginia Commonwealth University. He received his B.S. and M.S. degrees in Aeronautical and Astronautical Engineering from the University of Illinois at Urbana-Champaign and his Ph.D. in Aerospace Engineering from Pennsylvania State University. His current research interests include unsteady flows in turbomachinery, aerodynamics, and computational fluid dynamics. Before joining the faculty at VCU in 1998, Dr. Dorney worked as an Associate Research Engineer at the United Technologies Research Center (1988–1993), as an Assistant Professor of Mechanical and Aeronautical Engineering at Western Michigan University (1993–1996), as a Project Engineer at Pratt and Whitney (1996–1997), and as an Assistant Professor at GMI Engineering & Management Institute. Dr. Dorney's research has led to two Best Paper Awards, a NASA Space Act Award, 35 journal papers, and more than 50 conference papers.



**WINFRED A. FOSTER, JR.** is a Professor in the Department of Aerospace Engineering at Auburn University. He received his B.S.A.E. (1967), M.S. (1969) and Ph.D. (1974) from Auburn University. He has been a member of the Aerospace Engineering faculty since 1974. His research has been primarily in the area of solid rocket motor performance prediction and finite element structural analysis. He has published over 60 technical documents and made numerous presentations in these and related areas. He is currently a member of the AIAA Solid Rocket Technical Committee and serves as the Chair of the History Subcommittee.



**ALEC D. GALLIMORE** is an Associate Professor of Aerospace Engineering and of Applied Physics at the University of Michigan where he directs the Plasmadynamics and Electric Propulsion Laboratory. He received his B.S. in Aeronautical Engineering from the Rensselaer Polytechnic Institute in 1986, and his M.A. and Ph.D. in Aerospace Engineering from Princeton University in 1988 and 1992, respectively. His primary research interests include electric propulsion, plasma diagnostics, space plasma simulation, and electrode physics. He has experience with a wide array of electric propulsion technologies, including MPD thrusters, arcjets, ion engines, and Hall thrusters, and has implemented a variety of probe, microwave, and optical plasma diagnostics. The author of more than 50 scientific articles on electric propulsion and plasma physics, Professor Gallimore was the recipient of the University of Michigan Class of '38E Prize for teaching, service, and research in 1996, and received teaching awards in 1994 and 1996 from Sigma Gamma Tau. In 1994 he was awarded the Crystal Image Award for Technical Achievement by the National Technical Association for science educator of the year. He has served on the Defense Science Study Group and is a member of the AIAA Electric Propulsion Technical Committee. Professor Gallimore is an Associate Fellow of AIAA.



**ASHWANI GUPTA** is a Professor of Mechanical Engineering at the University of Maryland. His academic experience includes six years as member of the research staff at MIT in the Energy Laboratory and Department of Chemical Engineering, three years as senior research associate and independent research worker at Sheffield University in the Department of Chemical Engineering and Fuel Technology, and seventeen years at the University of Maryland. He spent four months in Japan as a consultant to several companies. Presently he serves as an international consultant on a major project sponsored by the Japanese Government. He is the author of over 150 publications in the areas of combustion, swirl flows, diagnostics, fuel sprays, hazardous waste thermal destruction, pollution, and alternative fuels. He has coauthored two books and edited seven books. Presently he is co-editor of the Energy and Environmental Series of books published by CRC Press. He has been the recipient of the Propellants and Combustion Award and Energy System Award of AIAA, George Westinghouse Gold Medal of ASME, and four Best Paper Awards from AIAA and ASME. Dr. Gupta received his Ph.D. from Sheffield University in 1973. He was awarded his D.Sc. from Sheffield University in 1986 for international recognition and published high-quality original research. Dr. Gupta is Chair of the AIAA Terrestrial Energy Technical Committee and was previously Chair of the AIAA Propellant and Combustion Technical Committee. Dr. Gupta is a Fellow of AIAA and the Institute of Energy (England, UK) and a member of ASME, SAE, ASEE, and the Combustion Institute.



**HANS IMMICH** is currently manager of new rocket propulsion programs and technologies at the propulsion business unit of the Space Infrastructure Division of DaimlerChrysler Aerospace. He is responsible for new technology developments in the field of rocket propulsion. He is presently program manager of the German research and technology program for reusable, high-performance cryogenic rocket engines, which is a joint technology program with the German Aerospace Research Center DLR. Before joining Daimler-Benz Aerospace in 1985 he was with Asea Brown Boveri Company, Baden, Switzerland from 1979–1985. There he was responsible for fluid mechanical development of large steam turbines and for development of combustion chambers for large gas turbines. Dr. Immich received his Ph.D. in the area of fluid mechanics from the Technical University in Munich in 1979. In addition, he received the "habilitation" (lectureship qualification) in 1986 in fluid mechanics from the Technical University in Munich. Dr. Immich is a member of the AIAA Technical Committee of Liquid Propulsion. He is the author of 29 journal articles and conference papers.



**JAN L. LEPICOVSKY** is a Senior Project Manager and Head of the Turbomachinery Analysis Section at NYMA Inc., an on-site contractor at the NASA Lewis Research Center (LeRC) in Cleveland, Ohio. He has 30 years of experience in fluid dynamics and turbomachinery experimental research. He received his Ph.D. and M.S. degrees from the Czech Technical University in Prague, Czech Republic. He worked as a researcher and the Thermodynamic Lab leader at the Propulsion Division of the Aeronautical Research and Test Institute in Prague until 1979. He was in charge of development testing on components of a small turboprop engine. After his move to the U.S., he worked as a scientist in the Aeroacoustic group of the Lockheed-Georgia Company in Marietta, Georgia, from 1980–1988. His major involvement there was with experimental research of mixing enhancement of free jets and propeller flows. In 1988 he worked for Textron-Lycoming in Stratford, Connecticut, where he was responsible for experimental studies in turbine cooling. Since 1989 he has been associated with the Propulsion Division at NASA LeRC. His major engagement is application of nonintrusive measurement techniques to fan and turbine experimental research. His expertise involves laser velocimetry, pressure and temperature sensitive paints, and thin-film thermocouples. He has authored more than 40 technical papers. He is an Associate Fellow of AIAA and a member of the AIAA Ground Testing Technical Committee. He served as an Associate Editor of the *AIAA Journal* and on several AIAA Technical Committees. He is a member of the ASME.



**JAMES L. MACE**, Associate Technical Fellow at Phantom Works, The Boeing Company, St. Louis, Missouri. He received his B.S.A.A. and M.S.A.A. Engineering degrees from Ohio State University in 1971 and 1972, respectively and Ph.D. in Aerospace Engineering from University of Michigan in 1984. Since 1986, Dr. Mace has filled numerous technical and management positions at Boeing dealing with aircraft and propulsion system development. He has been Program Manager of a number of CRAD programs for the government and engine companies, as well as, managing propulsion IRAD programs. During 1985 and 1986, Dr. Mace was a Staff Scientist for the Lockheed Advanced Aeronautics Company supporting advanced aircraft studies. From 1972 to 1985, Dr. Mace worked at the Air Force Flight Dynamics Laboratory with the Airframe/Propulsion Integration Group and the Computational Fluid Dynamics Group. He was Program Manager for a number of propulsion integration CRAD projects and related in-house experimental and computational research activities. Dr. Mace has authored or co-authored of 21 papers. He is an Associate Fellow of AIAA and Chairman of AIAA Air Breathing Propulsion Technical Committee.



**DR. LOURDES Q. MAURICE**, Air Force Deputy, Basic Research Sciences and Dual-Use Science and Technology in the office of the Deputy Associate Secretary of the Air Force for science and Technology, received her B.S. in Chemical Engineering and M.S. in Aerospace Engineering from the University of Dayton at Dayton, Ohio and her Ph.D. in Mechanical Engineering from the University of London's Imperial College at London, United Kingdom. She presently manages the \$210 million Basic Research Sciences and \$40 million per annum portfolios at the office of the Deputy Associate Secretary of the Air Force for Science and Technology. She was previously (1983–1999) employed by the Air Force Research Laboratory's Propulsion and Power Directorate. Her areas of expertise include aviation fuels combustion kinetics, hypersonic propulsion and aviation fuels. She is serving her first term on the Propellants and Combustion Technical Committee and is the U.S. Chair for the AIAA/ICAS International Conference in Celebration of the Centennial of Flight.



**MICHAEL M. MICCI** is a Professor of Aerospace Engineering and is associated with the Propulsion Engineering Research Center at the Pennsylvania State University. He received his B.S. and M.S. in Aeronautical and Astronautical Engineering from the University of Illinois at Urbana-Champaign, and his Ph.D. in Mechanical and Aerospace Engineering from Princeton University. He joined the faculty at Penn State in 1981, where he teaches and conducts research in rocket propulsion. He spent 1987 as a Visiting Scientist at the Air Force Office of Scientific Research, the 1990–1991 academic year on sabbatical leave at ONERA, Palaiseau, France, and the 1997–1998 academic year on sabbatical leave as an NRC Senior Associate at the U.S. Air Force Research Laboratory, Edwards AFB. He is an Associate Fellow of AIAA and a member of the AIAA Liquid Propulsion Technical Committee.



**ROGER M. MYERS** is the Director of Electric Propulsion and Space Electronics at Primex Aerospace Company, leading the flight system development and production efforts in arcjet, Hall current, pulsed plasma thruster and ion thruster systems. He received his B.S. in Aerospace Engineering from the University of Michigan and his Ph.D. in Mechanical and Aerospace Engineering from Princeton University. He joined the NASA Lewis Research Center Group of Sverdrup Technology in 1988 and became supervisor of the Space Propulsion Technology Section in 1989. He continued to serve in this capacity with Nyma, Inc., becoming Deputy Director of Aerospace Technology in early 1996, and left Nyma for Primex Aerospace later that year. He has worked on a wide range of propulsion systems including solid propellant pulsed plasma thrusters, pulsed and steady-state magnetoplasmadynamic thrusters, arcjets, ion thrusters, Hall current thrusters, and small chemical rockets. The spacecraft integration assessments and mission analyses have included a wide range of spacecraft and missions, most recently focusing on small satellite applications and large commercial communications satellites. He has authored over 60 publications, is Chair of the AIAA Electric Propulsion Technical Committee, and is an Associate Fellow of the AIAA.



**CARLSON C. P. PIAN** received his B.S., M.S., and Ph.D. degrees from the University of Michigan in Aerospace Engineering. He did post-doctoral work in the field of MHD power conversion at the Eindhoven Technical University in The Netherlands. Dr. Pian is currently on the faculty of the Diagnostic Instrumentation and Analysis Laboratory at the Mississippi State University. Previously, he was on the research staff at Molten Metals Technologies, involved in research and development of plasma torches and remediation technologies for hazardous waste treatment. At Textron Defense Systems' Everett Laboratory (formerly the Avco Everett Research Laboratory), Dr. Pian was the Director of Commercial MHD Component Development. He was also the manager of the MHD Integrated Topping Cycle Program, responsible for the technical direction and administration of the program, including research and development, and the design and fabrication of MHD power generators. Dr. Pian was also involved in system design studies and analyses of MHD power conversion experiments and worked on analytical modeling of flows in gas turbine combustors. Prior to joining Avco, Dr. Pian was a research engineer at NASA Lewis Research Center where he was engaged in research and analysis relevant to MHD power generator and systems. Dr. Pian is an Associate Fellow of AIAA and previously served on both the AIAA Plasmadynamics and Lasers and the AIAA Terrestrial Energy Systems Technical Committees. He was also a member of the Board of Directors of the Symposium on the Engineering Aspects of MHD. Dr. Pian has authored or co-authored over 70 technical papers related to power conversion and space plasma.



**DAVID W. RIGGINS** received his Ph.D. in Aerospace Engineering from Virginia Polytechnic and State University in 1988. He is currently with the University of Tennessee in the Department of Mechanical and Aerospace Engineering. Previous to his work at the University of Tennessee, he was a member of the faculty of the University of Missouri-Rolla; prior to 1990 he worked for both industry and the U.S. Department of Defense. His primary research interests include scramjet propulsion, jet engine analysis, hypersonics, computational fluid dynamics, high-speed fuel-air mixing and combustion, and flow losses and irreversibilities. He is a Senior Member of AIAA and is a member of the Air-Breathing Propulsion Technical Committee. Other activities include participation in JANNAF committees and workshops. He is the author of more than 50 conference publications and 10 journal papers.



**M. FRANK ROSE** is the Director of the Science Directorate at the NASA Marshall Space Flight Center. He holds 16 patents and is the author of 140 technical papers on various aspects of advanced power systems, space environmental effects, hypervelocity impact phenomena, energy storage, advanced composites, and energy conversion technology. He received his Ph.D. in Solid State Science from Pennsylvania State University in 1966 and his B.A. in Physics from the University of Virginia in 1961. He is an Associate Fellow of AIAA, fellow of the IEEE, and a member of Sigma Xi.



**GREGORY G. SPANJERS** is Group Leader for the Electric Propulsion Laboratory at the U.S. Air Force Research Laboratory (AFRL), Edwards AFB. He received the degrees of B.S. in Physics and B.S. in Mathematics from the University of Minnesota in 1986. He received his M.S. degree in 1990 and his Ph.D. in 1992, from the University of Washington, performing plasma physics research for magnetic fusion. He became a Faculty Research Assistant at the Aeronautics and Astronautics Department of the University of Washington and initiated a program developing high-speed, free-flying plasma probes. From 1993–1995 he was with HY-Tech Research Corporation, Radford, Virginia, performing basic research on plasma radiation sources, plasma propulsion, advanced plasma diagnostics, and high-speed shutters. He joined the AFRL Electric Propulsion Laboratory as Principle Scientist in 1995, becoming Group Leader in 1998. His present research interests include pulsed plasma thrusters, Hall thrusters, micropropulsion devices, plasma diagnostics, and flight diagnostics. He is the author of over 50 journal and conference papers, has 2 patents pending for advanced electric propulsion thrusters, and is a member of the AIAA Electric Propulsion Technical Committee.



**VIGOR YANG** received his B.S.M.E. from National Tsing Hua University in Taiwan in 1976 and his Ph.D. from the California Institute of Technology in 1984. Following one year as a Research Fellow in Jet Propulsion at Caltech, he joined the faculty at the Pennsylvania State University in 1985. He is currently a Professor of Mechanical Engineering and serves as a consultant to several industrial and government laboratories. His research mainly involves combustion instabilities in propulsion systems, high-pressure droplet/spray combustion, rocket interior ballistics, and combustion of energetic materials. He has organized several international meetings and workshops devoted to various combustion aspects of liquid and solid propellants in rocket engines. He was the recipient of the Penn State Engineering Society Outstanding Teaching and Research Awards in 1989 and 1992, respectively. Professor Yang is an Associate Fellow of AIAA.