JOURNAL OF PROPULSION AND POWER
Vol. 17, No. 1, January–February 2001

Thank You and Best Wishes to Dr. R. H. Woodward Waesche

READERS of the *Journal of Propulsion and Power* will remember Dr. R. H. Woodward ("Woody") Waesche as an exemplary editor. Under his distinguished leadership, the journal has matured over the past 14 years into the premier intellectual forum for the advancement of propulsion science and technology. He is greatly respected and appreciated for his important contributions to the aerospace community, but I especially wish to emphasize his sincerity, dedication, and indefatigable spirit. It was a great pleasure and privilege to work with him, personally and professionally. I would like to take this opportunity to offer him and his wife, Lucy, my warmest wishes for a pleasant and prosperous future.

With Woody's gracious support and counsel, an orderly transition of the editorship has been conducted, with all records of *JPP* submittals transferred successfully. I am deeply grateful to all the Associate Editors of *JPP* and the AIAA staff in Washington, DC, for their dedication to the journal and for their support in the transition process. The entire editorial team maintains its full commitment to providing quality services to readers and authors. A network-based paper-tracking system with routine monitoring of paper status has been implemented to expedite the review and publication process. Further efficiency will be achieved by establishing a database of authors and reviewers and utilizing internet communication. The backlog arising from the increased number of submittals in the past two years will be substantially alleviated through a one-time increase of 500 journal pages allocated for *JPP* this year. We are striving to reduce manuscript processing time between submission and publication to nine months, if not shorter.

In recognition of the Centennial of Flight, *JPP* will publish a series of feature articles throughout the year 2003 covering the histories of key technologies in the areas of aerospace propulsion and power. All subjects relevant to the scope of *JPP* will be considered, including rocket and airbreathing propulsion, as well as power generation and conversion. Much progress has been made in the past 100 years, but there remains much to be done. *JPP* is dedicated to continuing to serve as a knowledge source, streamlining the information flow, and helping to advance the state of the art. Your ongoing involvement as reader, author, and reviewer is critical to the continuing success of *JPP*. Together we can keep *JPP* at the cutting edge of aerospace propulsion and power research.

Vigor Yang
Acting Editor-in-Chief

VIGOR YANG, Professor of Mechanical Engineering at the Pennsylvania State University, received his Ph.D. in jet propulsion and mechanical engineering from the California Institute of Technology in 1984. His research interests include combustion instabilities in propulsion systems, chemically reacting flows in air-breathing and rocket engines, combustion of energetic materials, high-pressure thermodynamics and transport, and active combustion control for gas-turbine engines. He has supervised 27 Ph.D. and 14 M.S. theses. He is the author or co-author of more than 100 technical papers in the areas of propulsion and combustion, and has published five comprehensive volumes on solid and liquid rocket propulsion. He was the recipient of the Penn State Engineering Society Outstanding Teaching and Research Awards in 1989 and 1992, respectively, and the Best Paper Award from AIAA in 1995 for research on supercritical combustion. Dr. Yang also serves on the editorial advisory boards of the *AIAA Progress in Astronautics and Aeronautics* and the Russian *Journal of Combustion, Explosion, and Shock Waves.* He is a consultant to several government, industrial, and academic organizations.

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.

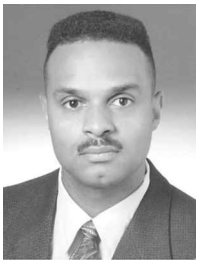
RODNEY D. W. BOWERSOX, Assistant Professor in the Department of Aerospace Engineering and Mechanics at the University of Alabama, received his Ph.D., M.S., and B.S. in Aerospace Engineering from Virginia Polytechnic Institute and State University in 1992, 1990, and 1988, respectively. Prior to joining 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 Aerospace Engineer at NASA Marshall Space Flight Center in Huntsville, Alabama. 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 the Pennsylvania State University. His current research interests include unsteady flows in turbomachinery, aerodynamics and computational fluid dynamics. Dr. Dorney has six years academic experience, including two years as an Associate Professor (with tenure) at Virginia Commonwealth University, one year as an Assistant Professor at GMI Engineering and Management Institute and three years as an Assistant Professor at Western Michigan University. Dr. Dorney has also spent six years in industry, including five years at United Technologies Research Center as an Associate Research Engineer and one year at Pratt and Whitney as a Project Engineer. Dr. Dorney's research has lead to two Best Paper Awards, a NASA Space Act Award and 45 journal articles.

JAMES J. FANG is a Technical Fellow of The Boeing Company, working at Rocketdyne Propulsion and Power Division as senior scientist in liquid propulsion systems with special interest in combustion stability, injector technology and combustion performance. He previously served as combustion device department manager at Rocketdyne, and as project engineer of research programs at Aerojet. He received his B.S., M.S. and Ph.D. in mechanical engineering from National Taiwan University in 1965, University of Mississippi in 1972, and Tennessee Technological University in 1975, respectively. Dr. Fang has been engaged in liquid rocket propulsion research and development since 1972 when he was a graduate student conducting a NASA-sponsored project on combustion stability. Over the years, he has developed analytical models for the comprehensive solution of practical combustion stability problems and devised an analytically based injector design methodology for a rapid engineering process leading to optimal design. He has worked on a wide range of liquid propulsion systems and provided his technical leadership in design and analysis for engine development programs at various phases, including design conception, hardware design and testing, problem resolution and product improvement. Dr. Fang is a member of AIAA and has published over 30 technical reports and papers. His other professional roles include teaching position at colleges, consultant to industries, and executive of an engineering and manufacturing company.

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 Hall thrusters, ion engines, arcjets, and MPD thrusters, and has implemented a variety of probe, microwave, and optical/laser plasma diagnostics. The author of more than 90 journal and conference papers on electric propulsion and plasma physics, Professor Gallimore was the recipient of the University of Michigan Faculty Career Development Award in 2000, the 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, and received the Best Paper on Electric Propulsion Award for work presented at the 1998 Joint Propulsion Conference. Professor Gallimore is a member of the AIAA Electric Propulsion Technical Committee and 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 the AIAA Deputy Director of Energy and was previously the chair of the AIAA Terrestrial Energy, and Propellants and Combustion Technical Committees. Dr. Gupta is a Fellow of AIAA, ASME, and the Institute of Energy, U.K., and a member of SAE 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 Marrieta, 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 is a 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 has been Chairman of AIAA Air Breathing Propulsion Technical Committee.

DR. LOURDES Q. MAURICE is an Air Force Deputy, Basic Research Sciences and Propulsion Science and Technology in the office of the Deputy Associate Secretary of the Air Force for science and Technology. She 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 Londons Imperial College at London, United Kingdom. She presently manages the $210 million Basic Research Sciences and $220 million Propulsion Science and Technology per annum portfolios at the office Air Force Secretariat. 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. She has authored over 60 publications and is an Associate Fellow of AIAA.

ROGER M. MYERS is the Director of Systems and Technology Development at Primex Aerospace Company, leading the development and qualification of chemical and electric propulsion thrusters and 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 70 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 a professor in the Mechanical Engineering Division at Alfred University. Previously, he was a researcher at Molten Metals Technologies, and later, on the faculty of the Diagnostic Instrumentation and Analysis Laboratory at the Mississippi State University, 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 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. Prior to joining Avco, Dr. Pian was a research engineer at NASA Lewis Research Center where he has 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 Plasmadynamics and Lasers and the Terrestrial Energy Systems Technical Committees. 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 the Virginia Polytechnic Institute 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 the 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. physics and B.S. 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. After working in industry and academia, 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 9 patents pending for advanced spacecraft thrusters, and is a member of the AIAA Electric Propulsion Technical Committee.