JOURNAL OF THERMOPHYSICS AND HEAT TRANSFER
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A Sixth Successful Year for JTHT

SUPPORT from the thermophysics and heat transfer community for the *Journal of Thermophysics and Heat Transfer* (*JTHT*) continues to be strong. Between October 31, 1991 and November 1, 1992, 155 papers were submitted to *JTHT* with 48% originating from technical meetings. During this same time period, over 380 reviews were completed by volunteers to ensure the quality of *JTHT*. The average time between the receipt of a manuscript and the Associate Editor's decision to accept or revise was 3.1 months for the articles appearing in 1992.

In 1992, *JTHT* was on schedule and the number of pages increased from 640 to 768. Still more pages are planned in 1993 to help reduce our backlog. The use of an outside vendor (Easton Publishing Services, Inc.) made the increase in pages possible. The patience of our authors is greatly appreciated.

A Full-Spectrum Publication

It should be re-emphasized that *JTHT* is a full-spectrum publication in the field of thermophysics and heat transfer, a breadth illustrated by the following list of pertinent topics:

Aerothermodynamics
- Re-entry
- Thermal protection
- Low density
- Laser interaction
- Ablation
- Plumes
- Computational

Radiative Heat Transfer
- Surface interchange
- Absorbing-emitting media
- Multiple scattering
- Nongray analysis
- Multidimensional
- Coupled with conduction
- Coupled with convection

Thermal Control
- Heat pipes
- Thermal modeling
- Electronics cooling
- Large space structures
- Contamination
- Cryogenics
- Insulation

Conduction/Phase Change
- Contact conductance
- Composite materials
- Inverse problems
- Conjugate problems
- Nonlinear problems
- Analytical techniques
- Melting/soldification

Nonintrusive Diagnostics
- IR signatures
- Remote sensing
- Laser techniques
- Particle sizing
- Scattering techniques

Convective Heat Transfer
- Forced convection
- Natural convection
- Mixed convection
- Internal/external flows
- Boiling/condensation

Thermophysical Properties
- Thermodynamic
- Transport
- Optical/radiative

Numerical Heat Transfer
- Finite difference
- Finite element
- Parallel processing

A discipline oriented publication, *JTHT* presents both original contributions of a fundamental nature and application-type papers. Analytical, numerical, and experimental approaches are all encouraged. Papers on the topics of aerothermodynamics, thermal control, and numerical heat transfer are especially encouraged. Although *JTHT* is published by AIAA, papers are not restricted to aerospace topics. Authors from the international thermophysics and heat transfer community are invited to submit papers.

Accuracy and Ethics

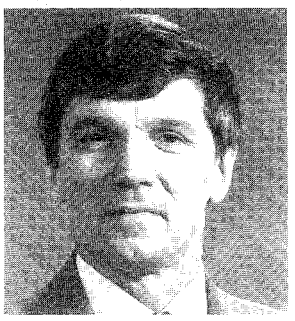
The AIAA Publications Committee has approved the following: "The AIAA journals will not accept for publication any paper reporting (1) numerical solutions of an engineering problem that fails to adequately address accuracy of the computed results or (2) experimental results unless the accuracy of the data is adequately presented." The purpose of this statement is to reiterate the desire to have high-quality investigations with properly documented results published in the AIAA journals, and to clarify acceptable standards for presentation of numerical and experimental results. The editors and reviewers will remain the final judges. An ethical standards document was also approved by the Publications Committee and is reproduced in its entirety elsewhere in this issue. Prospective authors and reviewers are encouraged to study it carefully.

Manuscript Disks

Authors are encouraged to prepare their manuscripts electronically to reduce publication delays. AIAA now has equipment that can convert virtually any disk (3½-, 5¼-, or 8-in.) directly to type, thus avoiding rekeyboarding and subsequent introduction of errors. Examples of easily converted software include TeX and LATEX. If your manuscript was prepared with a word-processing program, inclusion of the disk is now mandatory. Please retain the disk until the review process has been completed and final revisions have been incorporated in your paper. If you have any questions or need further information, please telephone Richard Gaskin, AIAA Production R&D Manager, at (202) 646-7496.

1992 AIAA Thermophysics Award Recipient

Dr. Leroy S. "Skip" Fletcher, Professor of Mechanical Engineering at Texas A&M University, was selected as the 1992 recipient of the AIAA Thermophysics Award. Dr. Fletcher was chosen for his outstanding contributions to the field of thermophysics, especially through innovative experimental research in thermal contact conductance, aerothermodynamics, and heat transfer in separated flows. The AIAA Thermophysics Award is presented for an outstanding technical or scientific contribution by an individual in thermophysics, specifically as related to the properties and mechanisms involved in thermal energy transport by conduction, convection, and radiation. This award was presented to him at the 27th AIAA Thermophysics Conference in July at Nashville, Tennessee.



1993 Editorial Team

The editorial team includes Associate Editors and members of the Editorial Advisory Board. The Associate Editors are responsible for the technical evaluation of manuscripts, and the burden of maintaining quality rests predominantly with them. Photographs and biographies of the 1993 team are included in this issue. Jack Howell decided to retire as Associate Editor and has been replaced by Ted Smith. I encourage you to discuss your views of *JTHT* with members of the editorial team.

Appreciation

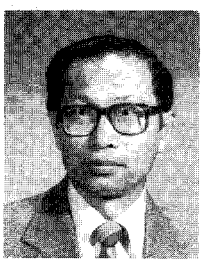
I would like to express my personal thanks to the authors who have chosen *JTHT* as the vehicle for their research work. I also want to thank the reviewers who have contributed their time to ensure the success of *JTHT*. Their names are listed in this issue. Finally, I would like to express my appreciation to Heather Brennan (Managing Editor), Chris Williams (Production Editor), Bob Elliott (Easton Publishing Services, Inc.) and Norma Brennan (Director of Journals) for their help in getting *JTHT* back on schedule.

Alfred L. Crosbie
Editor-in-Chief

Editor-in-Chief

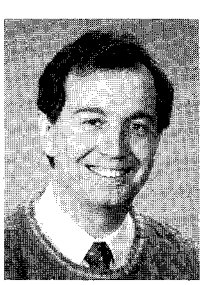
ALFRED L. CROSBIE, Curators' Professor of Mechanical Engineering at the University of Missouri-Rolla, received his B.S. from the University of Oklahoma in 1964, his M.S. in 1966, and his Ph.D. in 1969 from Purdue University, all in mechanical engineering. He joined the faculty of the University of Missouri-Rolla in 1968, where he was promoted to Professor in 1975. He has been an active researcher in the field of radiative heat transfer since 1964. His current research interests include multidimensional radiative heat transfer, multiple scattering, numerical heat transfer, and laser interaction. Dr. Crosbie has served as a member of the AIAA Thermophysics Technical Committee (1976-78), Technical Program Chairman for the AIAA 15th Thermophysics Conference (1980), Editor of two thermophysics volumes in the AIAA *Progress in Astronautics and Aeronautics* book series (1981), Associate Editor for the *AIAA Journal* (1981-83), and Chairman of the AIAA Thermophysics Technical Committee (1984-86). He is a Fellow of AIAA, a Fellow of ASME, a recipient of the AIAA Thermophysics Award (1987) and the ASME Heat Transfer Memorial Award (1990), and an Associate Editor for the *Journal of Quantitative Spectroscopy and Radiative Transfer* (1979-93). Dr. Crosbie is the author or coauthor of over 70 papers in archival journals.

Associate Editors

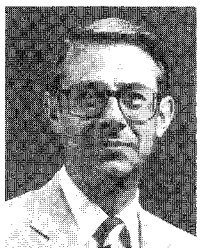


TA-SHEN CHEN, Curators' Professor of Mechanical Engineering at the University of Missouri-Rolla, received his B.S. from National Taiwan University in 1954, his M.S. from Kansas State University in 1961, and his Ph.D. from the University of Minnesota in 1966, all in mechanical engineering. He joined the faculty of the University of Missouri-Rolla in 1967, where he was promoted to Professor in 1973. His recent research centers on convective heat and mass transfer, natural convection, mixed convection, heat transfer in separated flows, and wave and thermal instability of convective flows. Dr. Chen was a member of the AIAA Thermophysics Technical Committee (1986-88) and is a Fellow of ASME. He is the author or coauthor of over 110 journal articles and 50 technical papers. He has also contributed a chapter each to the *Handbook of Single-Phase Convective Heat Transfer* and the *Handbook of Numerical Heat Transfer.*

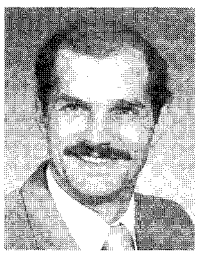
PING CHENG, Professor and Chairman of Mechanical Engineering at the University of Hawaii at Manoa, received his B.S. in mechanical engineering from Oklahoma State University in 1958, his M.S. in mechanical engineering from Massachusetts Institute of Technology in 1960, and his Ph.D. in aeronautics and astronautics from Stanford University in 1965. Before joining the University of Hawaii in 1970, he held positions at New York University (1965-67), NASA Ames Research Center (1967-68), and National Taiwan University (1968-70). His recent research centers on convection, boiling and condensation in porous media, and geothermal systems. Dr. Cheng was a member of the AIAA Thermophysics Technical Committee (1988-89) and is a Fellow of ASME. He is the author or coauthor of over 100 publications. He has also contributed chapters on heat transfer in geothermal systems and porous media to *Advances in Heat Transfer,* the *Handbook of Heat Transfer Applications,* and *Natural Convection: Fundamentals and Applications.*



PETER A. GNOFFO, Research Engineer at NASA Langley Research Center, received his B.S. in aerospace engineering in 1974 from Polytechnic Institute of Brooklyn, his M.S. in mechanical engineering in 1977 from George Washington University, and his Ph.D. in mechanical and aerospace engineering from Princeton University in 1983. He joined NASA in 1974, and his research has been primarily concerned with the development of computational fluid dynamic methods for the prediction of aerodynamic and aerothermal loads on planetary probes and Earth entry vehicles. His most recent interests have been concerned with the physical modeling and numerical simulation of hypersonic flows in thermal and chemical nonequilibrium, for which he received the NASA Medal for Exceptional Scientific Achievement (1990) and the AIAA Thermophysics Award (1991). He was a member of the AIAA Fluid Dynamics Technical Committee (1986-88). Dr. Gnoffo is the author or coauthor of more than 30 technical papers.



DARRELL W. PEPPER, Co-founder and Chairman of Advanced Projects Research, Inc. (APRI), of Moorpark, California, received his B.S. in mechanical engineering in 1968, his M.S. in aerospace engineering in 1970, and his Ph.D. in mechanical engineering in 1973, all from the University of Missouri-Rolla. He is also a faculty member at the University of Nevada, Las Vegas, and conducts the home study courses on the finite element method for AIAA. Before starting APRI, he was Chief Scientist at the Marquardt Company (1987-90) and he worked for E.I. DuPont de Nemours at the Savannah River Laboratory in Aiken, South Carolina (1974–87). His research interests include numerical heat transfer, finite element methods, and computational fluid mechanics. Dr. Pepper is a Fellow of ASME and is Chairman of ASME Heat Transfer Division's committee on Aerospace Heat Transfer (1992–95). He is the author or coauthor of numerous technical publications, including two books. He has also contributed two chapters to the *Handbook of Numerical Heat Transfer.*



GERALD E. SCHNEIDER, Professor and Associate Dean of Mechanical Engineering at the University of Waterloo, Ontario, Canada, received his B.A.Sc. in 1973, M.A.Sc. in 1974, and Ph.D. in 1977 from the University of Waterloo, in mechanical engineering. He joined the University of Waterloo in 1977 and was promoted to Professor in 1985. Most of his research work revolves around conduction heat transfer, computational fluid dynamics, numerical heat transfer, and solid/liquid phase change. He was a member of the AIAA Thermophysics Technical Committee (1977-79, 1982-84) and of the AIAA Publications Committee (1979-86). Dr. Schneider is the author or coauthor of more than 80 publications. He was guest editor for the July-August 1986 *Journal of Spacecraft and Rockets* special issue on thermophysics. He is an editor of the *Handbook of Numerical Heat Transfer,* and is a member of the Editorial Advisory Board for *Numerical Heat Transfer.*

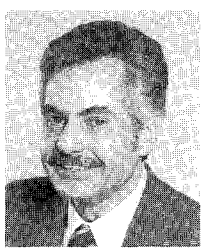
ROBERT SIEGEL, Senior Research Scientist at NASA Lewis Research Center, received his B.S. in 1950 and M.S. in 1951 from the Case Institute of Technology, in mechanical engineering, and his Sc.D. in mechanical engineering from the Massachusetts Institute of Technology in 1953. Before joining NASA in 1955, he worked for General Electric as a heat transfer engineer and analyst. He has been an active researcher in heat transfer since 1950. The majority of his research revolves around convective heat transfer, radiative heat transfer, and solidification heat transfer. He is a recipient of the ASME Heat Transfer Division's Memorial Award (1970). He served as an Associate Technical Editor for the *Journal of Heat Transfer* (1973-83) and received the NASA Exceptional Scientific Achievement Medal (1986). Dr. Siegel is a Fellow of AIAA and ASME and is the author or coauthor of 140 publications, including a textbook on thermal radiation heat transfer now in its 3rd edition.

ALLIE M. SMITH, Dean of Engineering and Professor of Mechanical Engineering at the University of Mississippi, received his B.S. in mechanical engineering from North Carolina State University in 1956, and his M.S. in 1961 and his Ph.D. in 1966 from North Carolina State University, in mechanical and aerospace engineering. Before joining the University of Mississippi in 1979, he worked for ARO for 14 years as a thermal physics supervisor and as a research manager. His research work has been in the area of radiative heat transfer, particularly the experimental and theoretical understanding of cryodeposits. Dr. Smith has been active in the AIAA thermophysics community: member of the AIAA Thermophysics Technical Committee (1973-75, 1985-88), Chairman of the AIAA Thermophysics Technical Committee (1976-77), and General Chairman of the l0th AIAA Thermophysics Conference (1975). He served as an Associate Editor of the *AIAA Journal* (1975-77), Editor for two thermophysics volumes in the AIAA *Progress in Astronautics and Aeronautics* book series (1976, 1977), General Chairman of the 17th Aerospace Sciences Meeting (1977), and Chairman of the AIAA Terrestrial Energy Systems Committee (1981-82). Dr. Smith is a Fellow of AIAA and ASME, and recipient of the AIAA Thermophysics Award (1978) and the AIAA Hermann Oberth Award (1985). He is the author or coauthor of over 75 publications.

THEODORE F. SMITH, Professor of Mechanical Engineering at the University of Iowa, received his B.S. in 1963, M.S. in 1965, and Ph.D. in 1972 from the University of Illinois, all in mechanical engineering. He joined the faculty of the University of Iowa in 1971 and was promoted to Professor in 1981. He has been an active researcher in the field of radiative heat transfer since 1964. His current research interests include radiant interchange between surfaces and multidimensional radiative transfer in participating media. Dr. Smith was a member of the AIAA Thermophysics Technical Committee (1972–75) and has been a member of ASME Heat Transfer Division's committee on Aerospace Heat Transfer since 1975. He has organized and chaired eleven technical sessions on radiation heat transfer at National Heat Transfer Conferences. He is the author of coauthor of over 50 publications.

Editorial Advisory Board

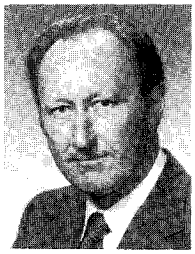
GRAEME A. BIRD, Professor Emeritus of Aeronautical Engineering at the University of Sydney and Managing Dircetor of GAB Consulting Pty Ltd., received his B.Sc. in 1951, his B.E. in 1953, his M.E. in 1959, and his Ph.D. in 1963, all from the University of Sydney. Before joining the University of Sydney in 1960, he served as scientific officer for the Australian Defence Scientific Service. He has held temporary appointments at the College of Aeronautics in Cranfield (1955), at the Royal Aircraft Establishment in Farnborough (1956), at the University of Manchester (1964), and at the California Institute of Technology (1969). He has made many significant contributions to the development of the direct simulation Monte Carlo method for simulating real gas flows for re-entry and space applications. He is a Fellow of AIAA and of the Australian Academy of Technological Sciences and Engineering, the Australian Institution of Engineers, and the Royal Aeronautical Society. Dr. Bird is a recipient of the AIAA Thermophysics Best Paper Award (1987), the AIAA Thermophysics Award (1988), and the NASA Exceptional Scientific Achievement Medal (1988).



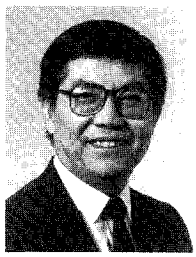
DONALD K. EDWARDS, Professor Emeritus of Mechanical Engineering at the University of California, Irvine, received his B.S. in 1954, M.S. in 1956, and Ph.D. in 1959 from the University of California, Berkeley, all in mechanical engineering. In 1959 he joined the faculty of the University of California, Los Angeles, where he was promoted to Professor in 1968 and served as Chairman of Chemical, Nuclear, and Thermal Engineering (1975-78). He received the ASME Heat Transfer Division's Memorial Award (1973) and was the first recipient of the AIAA Thermophysics Award (1976). He was a Technical Editor for the *Journal of Heat Transfer* (1975-81) and an Associate Editor for the *International Journal of Solar Energy* (1983-85). He is a Fellow of AIAA, a Fellow of ASME, and a member of the Editorial Advisory Board for the *International Journal of Heat and Mass Transfer.*

JOHN T. HOWE, Chief Scientist at NASA Ames Research Center, received his B.S. from the University of Michigan in 1950 and his M.S. in 1956 and the degree of Engineer in 1958 from Stanford University, all in engineering mechanics. He teaches Hypervelocity Atmospheric Flight and Real Gas Phenomena at Stanford University. After a brief period with Stanford Research Institute, he joined the Ames Laboratory of NACA. During his 35 years with NASA, he has served as Senior Staff Scientist, Head of Aerothermodynamics, Assistant Chief for the Physics Branch, and Branch Chief for Fluid Dynamics. He is known for his pioneering research contributions to the aerothermodynamics of atmospheric entry, including radiative energy transfer, reactive gas flows, and innovative thermal protection systems. He was a member of the AIAA Thermophysics Technical Committee (1982-84) and an Associate Editor for the *Journal of Spacecraft and Rockets* (1982-84). He is a recipient of the AIAA Thermophysics Award (1986) and a Fellow of AIAA.

TOM J. LOVE, George Lynn Cross Professor Emeritus of Aerospace, Mechanical, and Nuclear Engineering, and Halliburton Professor of Engineering at the University of Oklahoma, received his B.S. from the University of Oklahoma in 1948, his M.S. from the University of Kansas in 1956, and his Ph.D. from Purdue University in 1963, all in mechanical engineering. In 1956 he joined the faculty of the University of Oklahoma, where he was promoted to Professor (1965) and served as Director of the School of Aerospace, Mechanical, and Nuclear Engineering (1963-72). He was a member of the AIAA Thermophysics Technical Committee (1970-72), an Associate Editor for the *AIAA Journal* (1972-75), and an Associate Editor for the *ASME Journal of Bioengineering* (1976-79). He is a Fellow of AIAA and a Fellow of ASME. Dr. Love is a recipient of the AIAA Thermophysics Award (1984) and of the ASME Memorial Heat Transfer Award (1989).



WALTER B. OLSTAD, Director of Planning and Research Development for R&D Division, Lockheed Missiles and Space Company, received his B.S. in mechanical engineering from Brown University in 1954, his M.S. in aeronautical engineering from Virginia Polytechnic Institute and State University in 1958, and his Ph.D. in applied mathematics from Harvard University in 1967. Before joining Lockheed in 1983, he worked 29 years for NASA where he held many important leadership positions including Associate Administrator for Management and Acting Associate Administrator for Aeronautics and Space Technology. He is known for his pioneering research and outstanding leadership in the analysis of planetary atmospheric entry aerothermophysics. He was a member of the following AIAA technical committees: Thermophysics, Fluid Dynamics, Space Systems, and Space Transportation. He has served as Technical Program Chairman for the AIAA 12th Thermophysics Conference (1977), Associate Editor of the *Journal of Spacecraft and Rockets* (1977-79), General Chairman of the AIAA 14th Thermophysics Conference (1979), and Editor of two volumes in the AIAA *Progress in Astronautics and Aeronautics* book series (1980). He is a recipient of the AIAA Thermophysics Award (1981) and a Fellow of AIAA. Currently, he serves on the AIAA Honors and Awards Committee and the Standards Executive Council.



CHANG-LIN TIEN, A. Martin Berlin Professor and Chancellor at the University of California, Berkeley, received his B.S. from National Taiwan University in 1955, his M.M.E. from the University of Louisville in 1957, and his M.A. and Ph.D. in 1959 from Princeton University. He joined the University of California, Berkeley, in 1959, where he was promoted to Professor in 1968 and was appointed A. Martin Berlin Chair Professor in 1987. He served as Chairman of Mechanical Engineering (1974-81) and as Vice Chancellor—Research (1983-85). Dr. Tien moved to the Irvine campus in 1988 and returned to the Berkeley campus in 1990. He was a member of the AIAA Thermophysics Technical Committee (1970-72), General Chairman of the 7th Thermophysics Conference (1972), General Chairman of the AIAA 12th Aerospace Sciences Meeting (1974), and Editor of a volume in the AIAA *Progress in Astronautics and Aeronautics* book series (1973). He is a recipient of the ASME Heat Transfer Division's Memorial Award (1974), the AIAA Thermophysics Award (1977), and the ASME/AIChE Max Jakob Memorial Award (1981). He is an AIAA Fellow, an ASME Fellow, and a member of the National Academy of Engineering. He is an Editor for the *International Journal of Heat and Mass Transfer* and for *Experimental Heat Transfer,* and an Associate Editor for the *Journal of Quantitative Spectroscopy and Radiative Transfer*.

RAYMOND VISKANTA, W.F.M. Goss Distinguished Professor of Engineering at Purdue University, received his B.S. from the University of Illinois in 1955, and his M.S. in 1956 and Ph.D. in 1960 from Purdue University, all in mechanical engineering. After a brief period with Argonne National Laboratory he joined the faculty of Purdue University, where he was promoted to Professor in 1966. He was a member of the AIAA Thermophysics Technical Committee (1972-75), General Chairman of the 2nd AIAA/ASME Thermophysics and Heat Transfer Conference (1978), and Editor of two volumes in the AIAA *Progress in Astronautics and Aeronautics* book series (1979). He is a recipient of the ASME Heat Transfer Division's Memorial Award (1976), the AIAA Thermophysics Award (1979), the ASEE Senior Research Award (1984), the ASME/AIChE Max Jakob Memorial Award (1986), the ASME Melville Medal (1988), and 1991 Nusselt-Reynolds Prize of the Assembly of World Conferences on Experimental Heat Transfer, Fluid Mechanics and Thermodynamics. Dr. Viskanta is a Fellow of ASME and AIAA, and a member of the National Academy of Engineering. He was an Associate Editor for the *Journal of Quantitative Spectroscopy and Radiative Transfer* (1969-72) and a Technical Editor for the *Journal of Heat Transfer* (1981-87) and *Experimental Heat Transfer* (1987-90). He is the Technical Editor of the ASME *Journal of Heat Transfer* and is a member of the Editorial Advisory Boards of the *International Journal of Heat and Mass Transfer, International Journal of Heat and Fluid Flow,* and *Numerical Heat Transfer.*