THE

2017 NUSSELT- REYNOLDS PRIZE

BESTOWED TO

JOHN R. THOME

AT THE

NINTH WORLD CONFERENCE ON EXPERIMENTAL HEAT TRANSFER, FLUID MECHANICS AND THERMODYNAMICS

Sponsored by
Assembly of World Conferences on Experimental Heat Transfer, Fluid Mechanics and Thermodynamics

JOHN R. THOME

After earning his doctoral degree at Oxford University, John Thome joined the faculty at Michigan State University in 1979 as an Assistant Professor and then was promoted to Associate Professor in 1984 (having received 5 NSF research and equipment grants). Taking leave of academics, he founded his own consulting company (John Thome Inc.) and continued with his business of developing and starting up new thermal technologies until taking the position of Professor at the Ecole Polytechnique Fédérale de Lausanne (EPFL) in 1998, where he established the Laboratory of Heat and Mass Transfer (LTCM). He has been active at the EPFL for 18 years, including work on falling film condensation on enhanced surfaces, echoing the pioneering work of Nusselt on plain surfaces one century ago. He is the director of the EPFL Doctoral Programme in Energy (EDEY) and is the founder and chair of the Virtual International Research Institute of Two-Phase Flow and Heat Transfer (http://2phaseflow.org) since its launch in 2014 with now 19 participating labs from around the world. He is the Swiss delegate to the Assembly of the International Heat Transfer Conference, which organizes the International Heat Transfer Conference every four years. He was the Director of the ERCOFTAC European Coordination Centre (*E*uropean *R*esearch *C*ommunity *O*n *F*low, *T*urbulence *A*nd *C*ombustion) with about 180 affiliated universities, research centers and industrial companies (2005-2011). John has organized numerous one-week summer schools at the EPFL on microchannel flow/heat transfer and more recently on advanced numerical modelling of two-phase flows, and he has hosted the 8th ECI Boiling and Condensation Heat Transfer Conference in Lausanne in 2012, and the 7th European-Japanese Two-Phase Flow Group Meeting in Zermatt in 2015.

John has authored more than 215 journal papers since joining the EPFL in 1998 and has more than 15600 Google Scolar citations. He is the author of five books: *Enhanced Boiling Heat Transfer* (1990), *Convective Boiling and Condensation, 3rd Edition* (1994) with J.G. Collier, *Wolverine Engineering Databook III* (2004 plus updates), *Nucleate Boiling on Micro-Structured Surfaces* (2008) with M.E. Poniewski and recently *Flow Boiling in Macro and Microchannels* (2015) with A. Cioncolini as part of the new 8-volumes of the "Encyclopedia of Two-Phase Heat Transfer and Flow" published by World Scientific Publishers in 2015 for which he is editor-in-chief. He received the ASME Heat Transfer Division's Best Paper Award in 1998 for his 3-part paper on flow pattern based flow boiling modelling published in the *Journal of Heat Transfer*, the Very Highly Commended Paper Award from the *International Journal of Refrigeration* for 2011-2012, the UK Institute of Refrigeration's J.E. Hall Gold Medal in 2008 for his work on microscale refrigeration heat transfer, the 2010 ASME Heat Transfer Memorial Award, an ASME 75th Anniversary Medal from the Heat Transfer Division, the ICEPT-HDP 2012 Conference Best Outstanding Paper Award, the 2013 InterPack Best Paper Award, and more recently received the ASME *Journal of Electronic Packaging* 2015 Best Paper Award.

John has contributed extensively to the field of two-phase flow and heat transfer: the first flow pattern based modelling of flow boiling, convective condensation and two-phase pressure drops; the development of diabatic flow pattern maps and maps for microscale two-phase flows; boiling of multicomponent mixtures; boiling and condensation on enhanced surfaces; boiling and condensation on the inside of enhanced tubes (especially the so-called microfinned tubes); boiling of ammonia and CO_2; modelling of oil effects on two-phase heat transfer; critical heat flux; post-dry out heat transfer; an annular flow suite of methods for evaporating and condensing flows; the 1st computerized image processing algorithm for growing bubbles in 1978; the time-strip analysis technique for microchannel flows; the micro-particle-shadow-velocimetry measurement technique; etc. He has been one of the main proponents of novel micro-two-phase cooling systems for electronics, already with successful industrial applications.

Citation

The Nusselt-Reynolds Prize is conferred on John R. Thome for outstanding contributions to the experimentation, visualisation and modelling of macro- and micro-scale two-phase flow and two-phase heat transfer, application of this science to the development of new thermal technologies of industrial importance, and for the broad dissemination of this work to the engineering community in five authored books.

THE NUSSELT-REYNOLDS PRIZE

The prize is bestowed for outstanding scientific and engineering contributions and eminent achievements in the fields of heat transfer, fluid mechanics and thermodynamics through
(1) experimental studies and analytical numerical extension of the measurements,
(2) development of experimental techniques, visualization techniques and/or instrumentation, and/or
(3) development of design theory (that needs experimental data) and/or theory based experimental correlations.

These contributions should yield a deeper insight into physical phenomena involved or should yield significant technological advances. In addition to research, the awardees should have made outstanding contributions to the field through teaching, design or a combination of such activities. The prize is based on achievement through publication in any areas of heat transfer, fluid mechanics and thermodynamics, or through the application of the science or art of heat transfer, fluid mechanics and thermodynamics.

The prize has been established beginning in 1991 by the Assembly of World Conferences on Experimental Heat Transfer, Fluid Mechanics and Thermodynamics to honour and commemorate the outstanding contributions of Wilhelm Nusselt and Osborne Reynolds as experimentalists, researchers, educators and authors. As many as three prizes may be bestowed at every World Conference (about three-four year interval), one in each of the areas of heat transfer , fluid mechanics, thermodynamics, or any combination of these. Prizes are given without regard to nationality or society affiliation. The prize consists of a plaque, an honorarium and a certificate.

PREVIOUS RECIPIENTS

1991 – R. Viskanta, Purdue University, USA
1993 – R.J. Goldstein, University of Minnesota, USA
1997 – G.F. Hewitt, Imperial College of Science, Technology and Medicine, UK
1997 – J.H. Whitelaw, Imperial College of Science, Technology and Medicine, UK
2001 – R.J. Adrian, University of Illinois, USA
2001 – A.E. Bergles, Rensselear Polytechnic Institute, USA
2005 – M. Shoji, Kanagawa University, Japan
2009 – K.R. Sreenivasan, International Centre for Theoretical Physics in Trieste, Italy
2009 – D. Poulikakos, ETH Zürich, Switzerland
2013 – B. E. Launder, University of Manchester, UK

2013-2017 NUSSELT - REYNOLDS PRIZE BOARD

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WILHELM NUSSELT (1882 ·1957)

Ernest Kraft Wilhelm Nusselt was born in Nürnberg on November 25. 1882. His early education was received in München and in 1907 he obtained his doctoral degree from the Technische Hochschule München. His dissertation dealt with the thermal conductivity of insulating materials. After studying for some time with Mollier at Dresden and gaining industrial experience with Sulzer, Switzerland, and Badische Anilin und Sodafabrik (BASF), Germany, he became Professor at Karlsruhe in 1920. After five years he returned to the Technische Hochschule München to take up the Professorship of the Institute of Theoretical Machine-Science.

Nusselt was an engineer who combined mathematical prowess with well conceived and executed experiments. His habilitation thesis, obtained two years after his doctoral degree, clearly demonstrated on the basis of experimental evidence that the heat transfer coefficient for the flow of gases through a pipe depended on fluid properties and fluid velocity, confirming the original postulation of Sir Isaac Newton. Nusselt continued with this problem and eventually reached a satisfactory theoretical formulation for laminar flow.

The foundations for the science of heat transfer can be traced to his 1915 paper on The Fundamental Law of Heat Transfer. This paper deals with the similarity of heat transfer phenomena and demonstrated that from specific heat transfer cases, insight and extensions to related cases can be realized. This contribution will make us remember him forever, via the non-dimensional Nusselt number: $Nu = h\, l / k$.

Although primarily interested in heat transfer, he also applied his considerable talents to combustion and mass transfer problems, the fruit of which have found their way into the category of “seminal” contributions to their respective fields. A good example is his analysis of laminar film condensation in 1916.

Nusselt contributed extensively to the body of scientific literature through 51 publications. He also supervised 36 doctoral candidates, perhaps the most notable of whom was Professor G. Ackermann for whom an extraordinary chair was created in München. Nusselt's contributions resulted in significant recognitions, the most notable of which were the Gauss Medal and the Grashof Commemorative Medal.

An examination of Professor Nusselt's publications reveals clarity of thought, which is no surprise given his ability to write exceedingly well. He enjoyed nature and was challenged by the unknown. Above all, he was a man of principle. He combined all these qualities and the result was the establishment of a major field of engineering. Few can claim such credentials.

OSBORNE REYNOLDS (1842-1912)

Osborne Reynolds was born in Belfast on August 23, 1842. He obtained his university education at Cambridge, with a B.A. in 1867 and a M.A. in 1870. Although he did not formally obtain a doctoral degree, he was elected a Fellow of Queens' College, and in 1877 was elected to the Royal Society, the most prestigious and honoured scientific society in Britain. Indeed, it was from the Society that he received the prestigious Royal Medal in 1888 for "...the application of scientific theory to engineering."

Upon completion of his M.A., he was appointed at the tender age of 26, to the newly established chair of engineering at Owens College, Manchester. Reynolds established fluid mechanics, as well as other subjects, as a field of scientific enquiry. His celebrated demonstration of laminar and turbulent states of fluid motion, published in 1883, has been referred to countlessly in lectures and textbooks. He contributed also to the basic understanding of steam engines, condensers and evaporators while elucidating the basic scientific mechanisms that governed the operation of these devices. He used a combination of physical insight or conceptual imagination with mathematical and experimental ability. This was, and still is a key component in the ability to make fundamenta1 contributions to our knowledge and which eventually leads to a better understanding oft the world around us.

Reynolds was a prolific writer. He produced considerable written material on diverse subjects that filled three volumes of his collected works and also he was awarded two patents. Perhaps the most celebrated of his contributions, beautifully simple and yet providing tantalizing hints of the more complex while demonstrating the genius of the engineer is now immortalized in the nondimensional number that bears his name. The very mention of the Reynolds number stirs up visions of the interplay of forces governing fluid motion.

Reynolds educated many students who wrote theses on a variety of subjects and who in their own right went on to establish themselves as worthy “sons” of their academic “father”, the most notable being J.J. Thomson, Nobel Laureate, President of the Royal Society and Master of Trinity College, Cambridge.

Osborne Reynolds was a sensitive individual, who possessed astonishing ingenuity, was generous, giving praise, and stood admiration of others while remaining humble of his own abilities.