THE

2021 NUSSELT- REYNOLDS PRIZE

BESTOWED TO

KEMAL HANJALIĆ

AT THE

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

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

KEMAL HANJALIĆ

After earning his Ph.D. at Imperial College, Kemal, or Kemo, as he is known among the community, rejoined his alma matter – the University of Sarajevo where he climbed the academic ladder to full professor (1981) and served as director of a research institute and Dean of the Faculty of Mechanical Engineering. Subsequently, he got engaged in public governance, was appointed as Mayor of Sarajevo and then as Cabinet Minister in the Government of Bosnia and Herzegovina in charge of science, technology, and informatics. In the early nineties, after returning to the academic realm he took a leave at the University of Erlangen, Germany. Unable to return to his homeland due to the eruption of war and dissolution of Yugoslavia, in 1993 Hanjalić accepted a professorship at Michigan Technological University. Soon however, he was back to Europe to fill the Chair of Thermo-Fluids at Delft University of Technology, where he stayed until his mandatory retirement in 2005. Since then, Hanjalić has continued his research activities through visiting appointments at TU-Darmstadt, Sapienza University of Rome, (Marie Curie Chair, 2007-10) and Novosibirsk State University in Russia (Lead Scientist Grant, 2011-2016), with intermittent engagements at the University of Sarajevo.

Hanjalic is the founder and organizer of the conference series Turbulence Heat & Mass Transfer held in continuation since 1994. He served for a decade as Editor-in-Chief of the Flow, Turbulence & Combustion journal. He has been long associated with the International Center for Heat & Mass Transfer (ICHMT) and served as the Chair of its Executive Committee and the President. Among many honors and awards, Hanjalic is a Foreign Member of the Russian Academy of Science, International Fellow of the UK Royal Academy of Engineering, Member of the Academy of Sciences and Arts of Bosnia and Herzegovina, Fellow of ICHMT, ASME and of the Institute of Physics (UK). He is an awardee of the Max-Plank Research Prize, State Decoration of Finland "Commander 1st Class, Order of Lion of Finland" and Royal Decoration of the Netherlands "Officer of the Order of Oranje-Nassau".

Hanjalić has published over 250 journal papers on topics of heat and fluid flow, turbulence measurements, modelling and simulation, thermal convection, magneto-fluid-dynamics, combustion, and thermal engineering. He is internationally recognized and cited as one of the pioneers and a major contributor to the development of mathematical models of turbulence and transport processes for the Reynolds-averaged Navier Stokes (RANS) equations, credied among others as one of the originators of the popular 'standard k-ε turbulence model'. Notable contributions include the development of differential and algebraic second-moment closures accounting for effects of solid walls, unsteadiness and multiscale dynamics, thermal and concentration buoyancy, double diffusion, magnetic field and, more recently, the hybridization of the RANS methods with the large-eddy-simulations. These developments have to a large extent been complemented with his innovative experiments that provided further insight into the physics underlying the modelling arguments and invaluable data to evaluate the modelling hypotheses and validate his models and computational methods.

Citation

The Nusselt-Reynolds Prize is awarded to Kemal Hanjalić for his outstanding contributions to the modelling of turbulent fluid flow and heat transfer, which constitute the cornerstone of the computational fluid dynamics (CFD), and for devising smart experiments to support his arguments and validate the models.

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
2017 – J. R. Thome, EPFL Lausanne, Switzerland

2017-2021 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.