

---

**04-4 IUTAM Symposium on One Hundred Years of Boundary Layer Research  
Göttingen, Germany, August 12-14, 2004**

**a) Scientific Committee**

D.H. van Campen (The Netherlands), P. Huerre (France), T. Kambe (Japan), G.E.A. Meier (Germany, Chairman), H.K. Moffatt (United Kingdom), A. Roshko (USA), F. Smith (United Kingdom), K.R. Sreenivasan (Italy, Chairman), I.J. Wygnanski (USA)

**b) Short summary of scientific progress achieved**

One hundred years ago, Prandtl wrote a seminal paper on boundary layer theory which laid the foundation for modern fluid dynamics. From that extraordinarily original paper has sprung a research area of great consequence in aerodynamics and hydrodynamics. The idea has led to the development of countless approximate methods in nonlinear mathematics. It is a tribute to Prandtl's genius that today's researchers find the boundary layer a valuable concept while tackling challenging problems. It is especially impressive that the enormous increase in computing power has not made the idea outdated. Indeed, proper application of computing methods requires an understanding of boundary layers even in contexts far outside those initially conceived by Prandtl.

The Symposium celebrated the centenary of Prandtl's paper on the boundary layer and brought together a diverse community of researchers working on different aspects of the boundary layer. That the research area continues to engage a large, wide-ranging and active band of scientists and engineers was evident in the attendance of experts. The Symposium covered an appropriate combination of established and new work, with theory, experiments and computations describing many of the different types of boundary and other layers, incorporating traditional as well as novel applications.

The Scientific Programme comprised 3 days with the presentation of 41 Lectures and 5 Posters, organized into 6 Sessions. Scientific progress arose through all the major topics discussed at the Symposium. The scientific program of the meeting is listed at f).

The meeting was fascinating, interdisciplinary and stimulating. Ideas were put forward on all the above aspects. In addition, the meeting served as a forum for assessing progress in the understanding of laminar and turbulent flows, steady and unsteady flows, two-dimensional and three-dimensional modelling, and incompressible and compressible behaviour. The scientific sessions highlighted, in particular, the roles of theory, experiments and computations throughout and the desirability of comparing their predictions with each other. The need to develop new areas of application as well refining work in traditional challenging areas was emphasized.

### c) Countries represented and number of participants

77 registered participants from the engineering, physics and applied mathematics communities attended regularly the technical Sessions of the Symposium, coming from 16 different countries, according the following geographical distribution: Austria (2), France (3), Germany (33), India (2), Israel (1), Italy (1), Japan (4), Malaysia (1), Russia (2), Serbia-Montenegro (1), Spain (2), Sweden (1), Switzerland (3), The Netherlands (3), U.K. (4) and USA (14). A number of German Scientists from DLR also attended some scientific sessions.

### d) Publication of Proceedings of the Symposium

Full papers of both lectures and poster presentations are going to be published as Symposium Proceedings by Springer Science and Business Media (former Kluwer). For each submitted paper, the review process has been driven by getting a review either from members of the Scientific Committee (primarily) or from other participants of the Symposium, with the aim of achieving a standard of the Proceedings comparable to that of refereed journals in the field. Some contributions have been reviewed by two experts. As of today (29 June 2005) the review process is finished. All articles are with the Publisher for layout-check.

### e) Financial supports

Some funds were made available by:

- International Union of Theoretical and Applied Mechanics (IUTAM)
- Springer Science and Business Media (former Kluwer Academic Publishers)
- Deutsche Forschungsgemeinschaft, DFG, Bonn, Germany

### f) Scientific program

#### Thursday, August 12, 2004

**Session 1:** Classification, Definition and Mathematics of Boundary Layers

**G.E.A. Meier:** *Prandtl's Concept and the Work in Göttingen*

**T. Kambe:** *Vorticity in Flow Fields Related to Prandtl's Work and Subsequent Developments*

**P.R. Spalart:** *The Full Lifespan of the Boundary-Layer and Mixing-Length Concepts*

**J. Cousteix, J. Mauss:** *Rational Basis of the Interactive Boundary Layer Theory*

**M. Oberlack:** *Symmetry Methods in Turbulent Boundary Layer Theory*

**M. Hafez, E. Wahba:** *Viscous/Inviscid Interaction Procedures for Compressible Aerodynamic Flow Simulations*

**Session 2:** Instability of Boundary Layers and Transition

**D. Henningson:** *The Application of Optimal Control to Boundary Layer Flow*

**V. Theofilis**, A. Fedorov, S.S. Collis: *Leading-Edge Boundary Layer Flow: Prandtl's Vision, Recent Developments and Future Perspectives*  
**E. Reshotko**, A. Tumin: *Application of Transient Growth Theory to Bypass Transition*  
**Y.S. Kachanov**: *Routes of Boundary-Layer Transition*  
**J.D. Crouch**: *Instabilities in Boundary-Layer Flows and their Role in Engineering*  
**A. Seitz**, K.-H. Horstmann: *In-Flight Investigations of Tollmien-Schlichting Waves*  
**M. Gaster**: *The Influence of Roughness on Transition*  
**O.S. Ryzhov**, E.V. Bogdanova-Ryzhova: *Boundary-Layer Instabilities in Transonic Range of Velocities, with Emphasis on Upstream Advancing Wave Packets*

### **Friday, August 13, 2004**

#### **Session 3: Boundary Layers Control**

**I. Wygnanski**: *A Century of Active Control of Boundary Layer Separation – A Personal view*

**P.R. Viswanath**: *Boundary Layer Separation Control by Manipulation of Shear Layer Reattachment*

**W. Saric**, H. Reed: *Stability, Transition, and Control of Three-Dimensional Boundary Layers on Swept Wings*

**T. Corke**, E.H. Matlis: *Transition to Turbulence in 3-D Boundary Layers on a Rotating Disk - Convective and Absolute Instabilities*

**A. Seifert**, L. Pack-Melton: *Control and Identification of Turbulent Boundary Layer Separation*

#### **Session 4: Turbulent Boundary Layers**

**J. Jimenez**: *The Near-Wall Structures of Turbulent Boundary Layer*

**A.J. Smits**, M.P. Martin: *Turbulence in Supersonic and Hypersonic Boundary Layers*

**H.-H. Fernholz**: *The Role of Skin-Friction Measurements in Boundary Layers with Variable Pressure Gradients*

**R. Narasimha**: *Laminar-Turbulent-Laminar Transition Cycles*

#### **Session 5: Numerical Treatment and Boundary Layer Modelling**

**W. Rodi**: *Turbulence Modelling for Boundary-Layer Calculations*

**H. Fasel**: *Instability and Transition in Boundary Layer Flows: Direct Numerical Simulations*

**F. Menter**, Y. Egorov: *Re-Evaluation of the Scale-Equation in Turbulence Modelling*

**F.T. Smith**: *Industrial and Biomedical Applications*

### **Saturday, August 14, 2004**

#### **Session 5: Numerical Treatment and Boundary Layer Modelling (continuing)**

**J. Kim**, J. Lim: *Analysis and Control of Boundary Layers: A Linear System Perspective*

**P.W. Duck**, J.P. Denier, J. Li: *The Development (and Suppression) of very Short-Scale Instabilities in Mixed Forced-Free Convection Boundary Layers*

**Chr. Davies**: *Computational Studies of Boundary-Layer Disturbance Development*

**Session 6: Special Effects in Boundary Layers****H.G. Hornung:** *Hypersonic Real-Gas Effects on Transition***A.A. Maslov:** *Stabilization of Hypersonic Boundary Layer by Microstructural Porous Coating***P.A. Monkewitz, H.M. Nagib:** *The Asymptotic Structure of High-Reynolds Number Boundary Layers***R. Friedrich, J. Sesterhenn:** *Instabilities near the Attachment-Line of a Swept Wing in Compressible Flow***A. Kluwick, St. Braun:** *Structure Formation in Marginally Separated Aerodynamic and Related Boundary Layer Flows***H. Nagib, Chr. Christophorou, P. Monkewitz:** *High Reynolds Number Turbulent Boundary Layers Subjected to Various Pressure-Gradient Conditions***H. Beazard, Th. Daris:** *Analysis of Adverse Pressure Gradient Thermal Turbulent Boundary Layers and Consequence on Turbulence Modelling***C.J. Kähler:** *The Significance of Turbulent Eddies for the Turbulent Mixing in Boundary Layers***G. Kawahara, S. Kida, M. Nagata:** *Unstable Periodic Motion in Plane Couette System: The Skeleton of Turbulence***B.W. van Oudheusden:** *The Reference Temperature Method Reconsidered and its Relation to Compressible Couette Flow***K.R. Sreenivasan:** *Ludwig Prandtl and Turbulent Thermal Convection***Poster-Presentation****A. Goharzadeh, A. Khalili:** *An Experimental Investigation of the Brinkman Layer Thickness at a Fluid-Porous Interface***B. Gölling:** *Experimental Investigations of Turbulent Separated Flows***B. Rasuo:** *On Boundary Layer Control at Two-Dimensional Transonic Wind Tunnel Testing***K.-Kh. Tan:** *A New Theory of Boundary Layer Instability***T. Tatsumi:** *Scale-Separation in Boundary Layer Theory and Statistical Theory of Turbulence***Report composed by Hans-Joachim Heinemann**