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PREFACE

The 21st International Congress of Theoretical and Applied Mechanics (ICTAM04) took place August 15 - 21, 2004, in Warsaw, Poland. It was organized by Polish National Committee of IUTAM, Institute of Fundamental Technological Research of the Polish Academy of Sciences (IPPT PAN) and Warsaw University of Technology. The Congress venue was the main building of Warsaw University of Technology.

The idea of congresses devoted to mechanics, can be traced back to a conference on problems of fluid mechanics in Innsbruck, 1922. It was organized by four individuals, whose names, are and will, remain very well known to next generations of scientists, C. W. Oseen, T. Levi-Civite, T. von Kármán, and L. Prandtl. This conference was so fruitful, that the organizers decided to arrange similar meetings in the future, every four years, and to extend the scope of the future meetings to include solid mechanics. Hence a series of meetings started eighty years ago with the 1st ICTAM held in Delft, Netherlands.

From the meetings of the Congress Committee sprang the idea of a more permanent organization to look out for the world interests in the mechanical sciences. Thus, IUTAM, the International Union of Theoretical and Applied Mechanics, was formed on September 26, 1946. In 1947 IUTAM became a member of ICSU, the International Council of Scientific Unions, itself founded in 1931. The highest authority of IUTAM is the General Assembly, with delegates from the Adhering Organizations, each of which is affiliated with a national learned society in a given country.

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T.A. Kowalewski

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Alfred Kluwick	(Austria)	<i>representative of CISM</i>	
Valery Kozlov	(Russia)	Eiichi Watanabe	(Japan)
Edwin Kreuzer	(Germany)	Feng-Gan Zhuang	(China)

Congress Committee

The IUTAM General Assembly establishes a standing **Congress Committee** which is responsible for the organization of International Congresses of Theoretical and Applied Mechanics at regular intervals. The members of the Congress Committee are appointed by the General Assembly as scientists active in theoretical or applied mechanics and need not to be members of the General Assembly. Rules of procedure of the Congress Committee and its Executive Committee are given in the IUTAM Statutes.

Prof. Hassan Aref (USA) 2004, *member of XCCC*

Prof. Ted Belytschko (USA) 2006, *representative of IACM*

Prof. Martin P. Bendsøe (Denmark) 2004, *representative of ISSMO*

Prof. Dimitri Beskos (Greece) 2006

Prof. David Bogy (USA) 2004

Prof. Dick van Campen (Netherlands) 2004

Prof. David Durban (Israel) 2004

Prof. Fernand Ellyin (Canada) 2006, *representative of ICM*

Prof. Juri Engelbrecht (Estonia) 2004

Prof. Norman Fleck (UK) 2006

Prof. Ben Freund (USA) 2004

Prof. Graham Gladwell (Canada) 2004

Prof. Peter Gudmundson (Sweden) 2004

Prof. Michael Hayes (Ireland) 2006, *representative of ISIMM*

Prof. Tsutomu Kambe (Japan) 2004

Prof. Bhushan Karihaloo (UK) 2004, *representative of ICF*

Prof. Alfred Kluwick (Austria) 2006

Prof. Valery Kozlov (Russia) 2006

Prof. Edwin Kreuzer (Germany) 2006

Prof. Yu Ku (USA) 2006

Prof. Gary Leal (USA) 2004, *representative of ICR*

Prof. Peter Lugner (Austria) 2004, *representative of IAVSD*

Prof. Fernando Lund (Chile) 2004

Prof. Keith Moffatt (UK) 2004, **Chairman**, *member of XCCC*

Prof. Peter Monkewitz (Switzerland) 2004

Prof. René Moreau (France) 2004, *member of XCCC, representative of HYDROMAG*

Prof. Niels Olhoff (Denmark) 2004, *member of XCCC*

Prof. Timothy J. Pedley (UK) 2004, **Secretary**, *member of XCCC*

Prof. Bernhard Schrefler (Italy) 2006, *member of XCCC*

Prof. Kazimierz Sobczyk (Poland) 2006

Prof. Pierre Suquet (France) 2004

Prof. Ernie Tuck (Australia) 2006

Prof. Manuel G. Velarde (Italy) 2006, *representative of CISM*

Prof. Eiichi Watanabe (Japan) 2006

Prof. Feng-Gan Zhuang (China) 2004

Year, where stated, indicates end of term.

Scientific Program

Contemporary mechanics poses both, the fundamental problems from the area of pure science, and its strong links with modern technology. It spreads over such areas of our knowledge as oceanography, physical chemistry, biology, medicine, geophysics and astrophysics. Hence, any conclusions deduced in the framework of mechanics, are likely to have a value for other fields. We may easily find prove of it in the scientific program of the ICTAM04. It consists of plenary opening and closing lectures, sectional lectures, mini-symposia, and contributed papers presented in lecture and seminar presentation sessions. These were intended to cover all aspects of mechanics.

All contributed papers were peer reviewed. Recommendations had been received from Pre-selection Committees of the National Committees of the nine countries: Canada, France, Germany, Japan, PR China, Poland, Russia, UK and USA. Moreover, recommendations had been received from the Chairs of the Mini-Symposia and of the Pre-nominated Sessions with classifications of the papers submitted within the topics of their Symposia/Sessions. Finally, the International Papers Committee paid careful attention to the above recommendations. Accordingly, of the 2086 eligible submissions 1574 contributions were invited by the IPC for their presentation. The total number of submitted and accepted papers represents a quite substantial enhancement relative to the previous congresses, providing evidence of vitality of the contemporary mechanics.

This volume of Proceedings consists of a book with full texts of invited talks and attached CD-ROM with Extended Summaries of 1225 papers presented during the Congress by authors¹. We have tried to assemble the paper volume with an extensive index of names and papers collected on the CD-ROM. We hope that this volume - pre-ordered at the Congress in record numbers - will be found useful not only as a document of the event but to asses achievements and new paths of research in mechanics of 21st Century.

¹ From 1273 papers presented during the Congress we exclude multiple presentations and those given by proxy.

Codes used for Lectures and Sessions

Throughout the book and CD-ROM all papers are coded using letters and numbers denoting appropriate session code, presentation type, presenting author's ID, presentation day, time and lecture room. Following codes are used to mark sessions:

OL, CL - Opening and Closing Lectures

SL - Sectional Lectures

MS - Mini-Symposia

Pre-nominated Sessions:

FM - Fluid Mechanics

SM - Solid Mechanics

FSM - Topics involving Fluid and Solid Mechanics

Acknowledgements

We would like to express our thanks to our colleagues from the IUTAM Congress Committee, and from the International Papers Committee. Their advice and efforts have helped us to overcome some problems, connected, as usual, with the organization of world-wide meetings.

Special gratitude goes to the Chairs responsible for Mini-Symposiums and Pre-nominated Sessions. Their work in organizing sessions, encouraging papers submission in the area of interest, and later reviewing all papers cannot be overestimated. Smilingly, we are deeply indebted to members of the nine National Committees for their valuable contribution to the reviewing procedure.

The organization and execution of the Congress is performed by the Institute of Fundamental Technological Problems Polish Academy of Sciences and Warsaw University of Technology. The detailed work of organization is due to many persons from both institutions, personnel of PCO Mazurkas Travel as well as numerous external co-workers. Without their extremely valuable help organization of such meeting would be impossible. Thank you all so much!

W. Gutkowski

T.A. Kowalewski