

# **FIRE SAFETY SCIENCE— PROCEEDINGS OF THE THIRD INTERNATIONAL SYMPOSIUM**

*Editors*

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Brian Langford

Fire Research Station, Borehamwood

**INTERNATIONAL ASSOCIATION  
FOR FIRE SAFETY SCIENCE**



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# Preface

The Third International Symposium on Fire Safety Science was held at the University of Edinburgh, Scotland, from 8–12 July 1991. There were 321 registrants attending two parallel sessions in which 92 papers were presented. Thirty countries were represented: Australia, Belgium, Brazil, Canada, China, Denmark, Finland, France, Germany, Hong Kong, India, Ireland, Israel, Italy, Japan, Korea, Malaysia, The Netherlands, New Zealand, Norway, Poland, Portugal, Spain, South Africa, Sweden, Switzerland, Union of Soviet Socialist Republics, United Kingdom, United States of America and Yugoslavia.

The formal opening ceremony was conducted in the George Square Theatre by Lord James Douglas-Hamilton, Minister for Home Affairs and the Environment at the Scottish Office. Welcome addresses were given by Sir David Smith, Principal of the University of Edinburgh and Dr Philip Thomas, Chairman of the International Association for Fire Safety Science. Sir David Smith read a message of welcome from His Royal Highness the Duke of Edinburgh, Chancellor of the University and Patron of the symposium. Following the opening ceremony, Dr P. H. Thomas delivered the Howard W. Emmons Plenary Lecture entitled 'Fire Flames and Dimensional Analysis'.

Papers were accepted on the basis of their quality and originality in the science of fire safety and its applications. Eighty-six papers from the 168 offered were accepted after peer review. In addition to these and the plenary lecture, eight invited papers were also presented during the course of the symposium by Professor T. Hirano, Dr V. R. Beck (delivered by Dr D. Yung), Dr J. McQuaig (delivered by Dr B. Thomson), Professor Y. Uehara, Dr M. Curtat, Mr D. Gross, Professor H. Luck and Dr J. E. Snell.

At the Thursday evening dinner, Dr P. H. Thomas was presented by Professor Emmons with the H. W. Emmons Invited Lectureship Award. The plaque recording the names of all Award recipients was passed on to the University of Edinburgh to retain until the next symposium.

Professor P. J. Pagni, Chairman of the Awards Committee, presented the Medal of Excellence for the best paper of the Second Symposium. That paper by H. R. Baum and B. J. McCaffrey was entitled 'Fire Induced Flow Field—Theory and Experiment'. The award was received by Dr Baum and by Mrs Carme McCaffrey on behalf of her late husband. At the committee meeting of the International Association for Fire Safety Science held during the symposium it was agreed that this award be designated the Philip Thomas Medal of Excellence.

The chapters that follow are in the order of the ten technical sessions at the symposium with invited papers collected together in an opening section. Three papers accepted but not delivered to the symposium are not included.

A new feature of this symposium was the Poster Session. Twenty-four posters were displayed in the foyer of the Appleton Tower where breaks between lectures were taken. Titles and authors of posters are listed towards the end of this volume.

The Association would like to record its gratitude to all the committee appointed to organise the various aspects of this successful symposium. It would particularly like to thank Dr D. Drysdale, Chairman of the Arrangement Committee, and his team for their efficient organisation of an enjoyable and technically valuable symposium, and Dr T. Kashiwagi, Professor S. E Magnusson, Dr J. G. Quintiere and Professor Y. Uehara who coordinated the reviews of manuscripts. The Chairman of the Publications Committee also wishes to thank Lilian Lawson, Pat Walsh and other colleagues at the Fire Research Station for their unstinting support.

The Association acknowledges the support of the following organisations for their generous contributions which helped ensure the success of the symposium

ABB Impell Ltd  
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*Geoffrey Cox*  
Chairman, Publications Committee

*Borehamwood, UK*  
*July 1988*

# International Association for Fire Safety Science

The International Association for Fire Safety Science (IAFSS) was established in 1985 at the First International Symposium on Fire Safety Science held at the National Institute of Standards and Technology (then the National Bureau of Standards), Gaithersburg, Maryland, USA. It was founded with the primary objectives of encouraging research in the science of preventing and mitigating the adverse effects of fires and of providing a forum for presenting the results of such research. In 1988 the Association acquired the status of a registered charity in England and Wales.

Since its inaugural meeting, the Association has grown in stature and influence under the guidance of its officers and Committee. These were: Chairman, Dr P. H. Thomas; Vice-Chairmen, Dr R. Friedman, Professor K. Kawagoe and Professor O. Pettersson; Secretary, Professor T. Hirano; and Treasurer, Professor J. G. Quintiere. Committee members were: Mr G. Cox, Dr M. Curtat, Professor R. W. Fitzgerald, Dr T. Z. Harmathy, Professor S. Horiuchi, Dr M. Kersken-Bradley, Mr H. E. Nelson, Professor P. J. Pagni, Mr K. S. Pedersen, Professor D. J. Rasbash, Professor P. G. Seeger, Dr J. E. Snell, Professor Y. Uehara, Dr J. Unoki, Professor T. Wakamatsu, Professor R. B. Williamson and Dr W. D. Woolley.

During the course of the Third Symposium a new committee was nominated and elected at the general meeting of the Association. The new committee was constituted from those above but with the replacement of the retiring members, Dr Harmathy, Professor Rasbash and Dr Snell, by Dr D. D. Drysdale, Dr G. C. Ramsay and Mr K. Richardson respectively. Dr T. Kashiwagi was also elected to fill an outstanding vacancy. Retiring members were thanked for their contribution by the Chairman Dr P. H. Thomas, himself also retiring as an officer along with Professor K. Kawagoe. New officers elected to serve until new elections in 1994 were: Chairman, Professor J. G. Quintiere; Vice-Chairmen, Dr R. Friedman, Professor T. Hirano and Professor O. Pettersson; Secretary, Mr G. Cox; Treasurer, Professor Y. Uehara.

This Third International Symposium in Edinburgh completes a cycle of host venues following Gaithersburg and Tokyo in the three geographical regions most active in fire safety science. A new cycle begins again in North America with the next symposium to be held in Ottawa. Papers are accepted on the basis of peer review and an increasing number have been offered to each symposium. The new committee elected at the general meeting during this symposium is of the opinion that some expansion in activity can be entertained without loss of quality and it is proposed that some regional activity can be introduced without impairing the status of the main symposia. This responsibility has been passed to the Vice-Chairmen to take forward.

Developments in the fire research world are moving rapidly. There are new journals, new societies engaged in professional fire safety engineering, new academic educational activities and formal cooperation between research

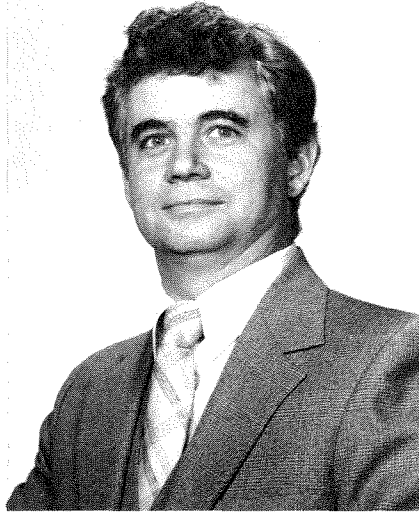
managers. The Association intends to expand its activity so as to play a full part in these developments.

*Philip Thomas*

Chairman, International Association for Fire Safety Science

*Borehamwood, U  
July 1999*

# In Memoriam



**Professor Bernard J. McCaffrey**

It was with great sadness that the fire research community learned of the death in April 1990 of Professor Bernard J. McCaffrey. He was posthumously a joint recipient of the award for Best Paper at the Second Symposium, and the award was accepted at this Third Symposium by his widow Carmel.

Professor McCaffrey was famous for his careful fire research, in particular his fire plume quantification, as described in his award-winning paper. His measurements and analyses provide a standard of excellence by which other plume studies are judged.

Professor McCaffrey received his early education in New York City, culminating in a BS from Manhattan College in 1964. He received his MS from the University of Connecticut in 1966, and his PhD in Mechanics from the State University of New York at Stony Brook in 1973 with a thesis on 'The Oscillatory Behaviour of Carbon Monoxide Oxidation'. He was a Research Fellow in Aeronautics at the University of Southampton in 1974 and a guest worker at the Fire Research Station, Borehamwood, in 1978.

From 1974 to 1987 he served as Mechanical Engineer in the Center for Fire Research at the United States National Bureau of Standards. His research included the detailed physics and chemistry of diffusion flames, the design of exquisite fire research instrumentation, the analysis of fire plume mechanics and the growth of fires in enclosures. His innovative extinguishment technique for oil and gas well fires led to a US patent for a new suppression system. He earned the Department of Commerce Bronze Medal in 1983.

In 1987 he was appointed Associate Professor at the University of Maryland where he planned to expand his research in combustion and thermoscienc fundamentals. He received the Best Teacher award from the College c Engineering at the Baltimore Campus in 1988. At the time of his death, he ha nearly completed the establishment of a new fire research laboratory at th University of Maryland.

His pioneering work on fire plumes, compartment fire temperatures an diffusion flame extinction has helped lay the foundation for fire safety science. Hi scientific publications are noted for their reliability, unusual precision an uncompromising integrity. In addition to his technical competence an dedication to fire research, he was noted for his delightful personality and goo fellowship. Survived by his wife Carmel and two children, Andrew and Ciar. Professor McCaffrey was an exemplar of the family man, an accomplishe violinist and a good vintner. The fire research community will miss both th pleasure of his company and the significant research he left incomplet Saddened by his loss, we are pleased to be able to award him posthumously th International Association for Fire Safety Science Medal of Excellence.



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