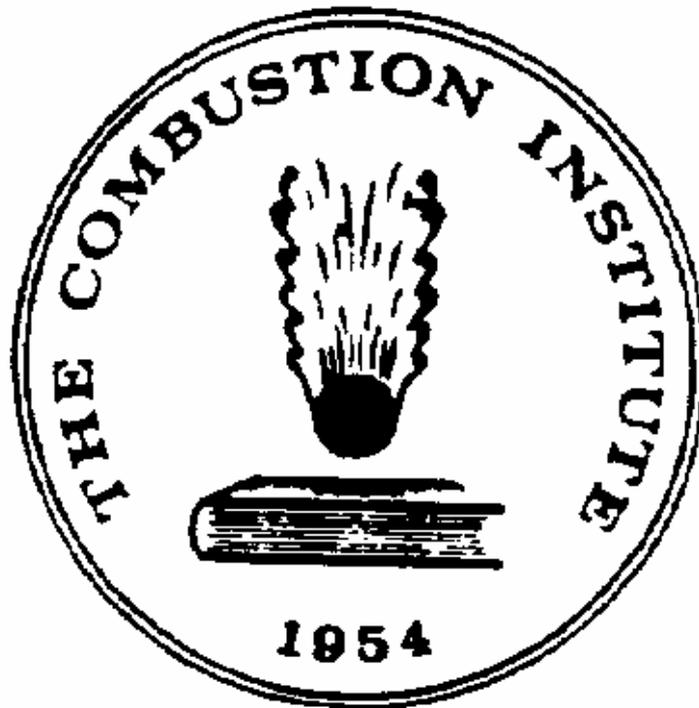


THE COMBUSTION INSTITUTE

(British Section)



NEWSLETTER

VOLUME 99/2

DECEMBER 1999

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World Wide Web version of this *Newsletter* at:-
http://www.chemeng.ucl.ac.uk/research/combustion/nl99_2/

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EDITORIAL

I still don't know what I shall be doing at the turn of the millennium, but I hope I shall have finished this *Newsletter* by then! Without some very faithful regular contributors this edition would be very thin; please would some of you out there find a little time to write a contribution fit for the first edition of the next millennium (to be published in March/April 2000)? Don't use the excuse that the new millennium doesn't start till 2001!

Ken Palmer (what would the *Newsletter* be without him?) has, as he promised, provided an interesting millennial report; Alec Melvin writes to continue the debate on the state of Discussion at Combustion Symposia started by David Smith and continued in the last *Newsletter* by Arthur Lefebvre and, as usual, our Hon Secretary fills in many gaps.

The year 2000, or Y2K as it has become known, is the year of the Edinburgh Symposium and the organising sub-committee have been working hard to make this a specially good meeting. I am hoping to have some articles about Edinburgh and the Symposium in the next edition of the *Newsletter*.

Most of you will know the news about the change in title of the Symposia Volumes. Ed Law wrote "...starting from the 28th Symposium, the volumes of the published papers will be entitled *Proceedings of the Combustion Institute, followed by the specific volume number (Volume 28 for the next Symposium)*. I hope this settles the citation issue once and for all. Now that citation is no longer an obstacle, we certainly look forward to receiving your finest work for presentation at the 28th Symposium. This revised title has since been unanimously approved by the Executive Committee and the Board of Directors [of the Combustion Institute]". Together with Jay Gore, of Purdue, I look forward to editing this newly-named publication.

Don't forget to renew your membership of the British Section and to recruit new members. A form is enclosed with this *Newsletter* to enable you to do so. More copies may be photocopied, or printed off from the www.

With very special wishes for Christmas, the New Year and the New Millennium.

Tony Burgess

TWENTY-EIGHTH SYMPOSIUM (INTERNATIONAL) ON COMBUSTION 30 JULY-4 AUGUST 2000

Papers to Sue Terpack by 15 December 1999:

The Combustion Institute
5001 Baum Boulevard, Suite 635
Pittsburgh, PA 15213-1851, USA.

Tel: (412) 687 1366
Fax: (412) 687 0340
e-mail: combust@telerama.lm.com

Work-in-Progress abstracts to John Griffiths by 14 April 2000.

See the Symposium website at <http://www.efm.leeds.ac.uk/edin2000/>

COMBUSTION PEOPLE

Felix Weinberg

Members will be pleased to learn the news of another award to Professor Felix Weinberg, FRS, through the following exchange of notes between Ken Bray and Felix Weinberg.

Dear Felix,

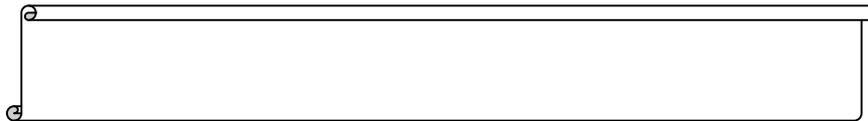
The Committee of the British Section of the Combustion Institute asked me to write to congratulate you on the award of the 1999 Smolenski Medal of the Polish Academy of Science in August of this year.

We were all very pleased to learn of this honour, which is so well deserved, and which brings reflected credit to combustion science in this country.

Congratulations again, and best wishes.

Yours sincerely

Ken



SUGDEN AWARDS: 1998 and 1999

The announcement of the 1998 Sugden Award was made by the Section Chairman at the one-day meeting held in Cambridge in September 1999. The recipients were G.M. Makhviladze, J.P. Roberts and S.E. Yakhush, for their paper

“Numerical Modelling of Fireballs from Vertical Releases of Fuel Gases”

published in *Combustion Science and Technology*, 1998, **132**, 129 - 223.

For the first time in the history of the prize it was not possible for an author to be present to receive the award. Nevertheless, congratulations were offered *in absentia* to the authors for this contribution to combustion science.

A subcommittee has been set up, under the Chairmanship of Professor Ken Bray, to consider papers for the Sugden Award to be given for the most significant published contribution to combustion research in 1999. The subcommittee will review *Combustion and Flame*, *Combustion Science and Technology* and *Proceedings of the Royal Society*. Any other papers that members wish to be considered should be submitted to the Honorary Secretary. To be eligible, papers should have a substantial research content and at least one author should be a member of the Combustion Institute in the year of publication and at the date of submission to the panel.

John Griffiths

MEMBERSHIP FEES

At this time of the year members are reminded to renew their subscriptions, via the Secretary, using the form* which accompanies this Newsletter, and with the appropriate fee paid by cheque. At its last meeting the Committee agreed that, for the year 2000, the subscription should remain at the current rate in all categories of membership. Perhaps members will accept this in recompense for the relative inconvenience of payment by cheque.

The Committee has discussed, on several occasions, setting up one form or another of electronic payment. Whilst such procedures are not so satisfactory for an organisation of the size and style of the British Section - please bear in mind that all administration of the Section is by voluntary effort - there are increasingly compelling reasons that we should move into the "electronic age". It appears that a compromise position that would help to minimise the administrative burden is for the subscription to be fixed for a few years once arrangements are in place. Accordingly, we hope that alternative procedures may be offered for 2001 and beyond, but probably at a higher membership fee.

John Griffiths

**A Renewal of Membership form is also on the web along with the Newsletter. It may be printed off and used for new and existing members. Please try to recruit a new member.*

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Work-in-Progress abstracts to John Griffiths by 14 April 2000.

See the Symposium website at <http://www.efm.leeds.ac.uk/edin2000/>

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COMBUSTION THEORY

A report on a one-day meeting of the Combustion Institute (British Section) held at Selwyn College, Cambridge on 14 September 1999

This meeting, organised principally by Stewart Cant at Selwyn College, comprised of six presentations, which are summarised below. The AGM of the Section was also held during the meeting.

Following the welcome by Dr Stewart Cant, Prof. Ken Bray, as Chair for the morning session, invited Prof. John Clarke to talk on *Asymptotics and Detonations*. The emphasis by John was placed on how the physics of detonations is linked to full numerical treatments of the phenomenon by asymptotic theory. The weak - strong detonation transition was very neatly encapsulated in the asymptotic analysis, whereas the numerics capture very clearly the discontinuities in behaviour. The true birth of a detonation wave is distinguished by a complex interaction that is highly localised in space and time, and which demands very high accuracy from both numerical and asymptotic approaches which complement each other very effectively.

Professor Ann Dowling gave the next presentation, in which she elaborated on theoretical developments connected with *Lean Premixed Prevaporised (LPP) Combustor Dynamics*. This practical problem has been studied by Ann in laboratory scale rigs mimicking components of the RB211 gas turbine. A feedback mechanism is established from pressure oscillations in the plenum which, through changes in the air flow velocity, are communicated to the fuel-air ratio and amplified by the consequent unsteady rate of heat release in the combustion chamber itself. Phase lags, as a result of the convection time delay in the connecting duct, play a significant part in the problem. How the unsteadiness arises from changes in fuel/air ratio is not fully understood but, otherwise, much of the theoretical foundation is well developed. There are particular families of resonant frequencies, which give different responses according to whether the growth rate for disturbances is positive or negative.

Dr Andy McIntosh brought the morning session to a close with a talk on *Acoustics and Premixed Flames*. He described the one-dimensional interactions that can occur when pressure wavelengths (scaled to the diffusion lengths) are comparable with the reciprocal of the burning velocity (scaled to the sound speed). Perhaps the crux of the issue is that Rayleigh heat addition, which is in phase with the pressure rise, gives an amplification. The contrast is the possibility of flame broadening and extinction owing to a pressure fall in an expansion wave. Andy showed that as the strain rate of a flame is increased it becomes more susceptible to extinction by a pressure fall.

Under the Chairmanship of Prof. Bill Jones, Prof. John Brindley opened the afternoon session with a presentation entitled *Lagging Fires: A delicate interplay of physics and chemistry*. John described experiments, modelling, and a simplified theoretical interpretation of the potential for spontaneous ignition of flammable liquids in a porous insulation material surrounding a hot pipe. The focus of his talk was the mitigation of spontaneous ignition by liquid evaporation and vapour dispersion, and how the local environment within the lagging could be controlled by these physical effects. The understanding had been developed through comparative studies involving hydrocarbons of significantly different reactivity.

Dr Caroline Lowe then introduced *Theoretical Models for the Ignition and Combustion of Solid Propellants*. Her principal interests are in ignition, combustion and the interfacial

behaviour of solids under transient conditions, with applications in solid propellant rocket motors. This is a complex problem involving two-phase fluid dynamics, a receding boundary between solid and gas, some interesting physics and chemistry on the surface and a wealth of interesting flame-fluid interaction processes. Once again, both numerical and mathematical treatments are used in a complementary manner.

Dr Alex Burluka concluded the afternoon with a short presentation of a *Reference Scalar Field Model for Turbulent Combustion*. Alex developed the idea that the reference scalar field can be used as an additional probability dimension to help improve the accuracy of modelling the means and variances of scalar variables in turbulent combustion systems. A number of interesting issues were raised, and a lively discussion took place concerning the advantages and disadvantages of the new model and the general field of probabilistic approaches to turbulent combustion.

Stewart Cant and John Griffiths

MINUTES OF THE ANNUAL GENERAL MEETING held at 1.45 pm during the meeting described above

Present: J. Adler, M. Braithwaite, K.N.C. Bray (Chairman), R.S. Cant, C.F. Carter, R. Crookes, P. Gray, J.F. Griffiths (Secretary), W.P. Jones, C.J. Lawn, K.H. Luo, A.C. McIntosh, K.N. Palmer, C.H. Priddin. **Apologies for absence:** were received from M. Brown, A.R. Burgess, D.D. Drysdale, M. Fairweather, A.N. Hayhurst, H. Michels, C. Morley, D.B. Smith and A.S. Tomlin.

- 1. The Minutes of the AGM held on 23 September 1998** were signed as a correct record.
- 2. Matters arising:** There were no matters arising other than items on the Agenda.
- 3. Chairman's report**

The Chairman thanked colleagues on the Committee for their contributions throughout 1998/9. He noted that Professor Greenhalgh had made very substantial contributions to the Committee over many years. Dr Morley had also served the Section assiduously as its Treasurer, and he was thanked for that service. The Chairman noted that the Secretary had reached the end of his term of office, but, at the request of the Committee, he had agreed to serve for one further year, as a co-opted Committee member.

4. Honorary Secretary's Report

Membership of the Section, at 252 members, remains approximately constant but not static. There have been more than twenty gains and losses throughout the year, the majority relating to postgraduate students. A circular to combustion people on the UKELG register generated 8 new members for the Section. UKELG, the Combustion Physics Group and the British Section are somewhat similar in size. There is only about 20 - 25% overlap of the membership of these groups. The response from UKELG members might indicate that the Section is at about its natural size.

The Spring one-day meeting on Industrial Combustion Hazards, held at Leeds, and organised jointly with UKELG, attracted over 50 participants. The Autumn meeting on Combustion Theory, during which the AGM took place, was organised and hosted by Dr Stewart Cant, at Selwyn College, Cambridge, Thirty-seven registrants attended the meeting. Section members had received details throughout the year of a number of co-sponsored meetings with Combustion Physics Group of IOP and the Combustion Engines Group of IMechE.

Two excellent Newsletters were issued to members in the course of the year. A *Newsflash* of the Combustion Institute was also circulated to members following receipt from the Pittsburgh office. More notices were circulated by e-mail than has been the case in previous years. However, all Section business was sent individually to members also by post. About 2/3 of the members have registered an e-mail address. This information is shared with the central office in Pittsburgh.

Travel grants of £250 per person to contribute to the cost of attendance at the Joint Meeting of the British, French and German Sections, held at Nancy, were awarded to 4 students so that they could present papers or posters. This meeting was most enjoyable and was very successful, although the representation of British Section membership was relatively small.

An invitation to members to attend the second meeting of the Greek section of the Combustion Institute in November 1999 had been received.

5. Honorary Treasurer's report

The Secretary presented a statement of accounts audited at the end of 1998, on behalf of the Treasurer. A deficit for the year was attributed to the payment of travel grants for the 27th Symposium. As a consequence, accumulated funds had fallen slightly. Some expenses for the 28th Symposium are recorded in these accounts but they will be transferred eventually to a separate Symposium account. A new bank account had been opened with COIF Charity Funds because it attracts a higher rate of interest without loss of flexible access. The Section income now exceeds £10,000. So, in accord with the terms of the Charity Commission, it has been necessary to submit the accounts to that body. The Section accounts were audited by Drs Davies and Sykes, who were thanked for their services. The report was received without further discussion.

6. Election of Committee members, 1999 - 2002

Fifty-five ballot papers had been returned to the Secretary in response to the postal ballot. Following a count by the appointed tellers, the Chairman declared Drs Cant and Smart to be re-appointed for the period 1999 - 2002, and Drs Brown, Kalghatgi and Tomlin to be appointed to the Committee for the period 1999 - 2002.

7. Any other business: There was no further business and the meeting closed at 2.10 pm.

JFGriffiths (2/11/99)

FIRST INTERNATIONAL DISPOSAL CONFERENCE

Thoughts on a meeting organised by the Swedish Section in November 1997

The First International Disposal Conference was held at Lund, Sweden, in November 1997. A copy of the proceedings was sent to me earlier this year, by Stig Johansson, and some reflections from it may be of interest to British Section members. Anyone wishing to read the proceedings in detail can obtain a copy from Bjorn Soderberg, at Hansson Pyrotech AB, PO Box 93, SE-427 23 Billdal, Sweden (email: b.soderberg@hansson-pyrotech.com). For the record, the Second International Disposal Conference - a two day meeting - is expected to be held at Linkoping University, Sweden, in November 2000. Further details may be obtained from Ola Listh, FOA, SE-172 90 Stockholm, Sweden (email: listh@sto.foa.se).

The initiative to establish this series of meetings stems from the need for the destruction of hazardous materials, such as explosives and propellants, in safe and environmentally acceptable ways. But, clearly, there are links to the disposal of a very wide range of materials when combustion processes are involved. This was reflected in the papers presented at the meeting, which cover a wide range of subjects, including waste management strategy, energy recovery and pollution control as an integral part of incineration, EU legislation for energy conservation requirements in the construction of packaging materials, as well as aspects which addressed the safe handling and destruction of munitions.

Whilst most of the content of the meeting originated from Sweden, the international perspective was maintained by contributions from the UK and Germany. This must surely grow as the urgency of the problems and the awareness of this series of meetings both increase.

It is entirely appropriate that applied science occupied much of the meeting, but there were also departures into more fundamental aspects. Marcus Alden, Lund University, showed what sorts of measurements could be made in furnaces and other combustion systems using laser diagnostic techniques. Stig Johansson, Packforsk, Sweden, discussed combustion fundamentals under the title "What is a flame?". (In his paper he reminds us of the delightful remark by Faraday, "...*what a vigorous thing flame is...*") Theoretical aspects were taken up in discussions of the modelling of residence times and temperature distributions in furnaces and boilers, by Bjorn Zethraeus, of The Bioenergy Centre at Vaxjo University. The control of atmospheric pollution featured in papers concerned with NO_x reduction from incineration plants and new combustion techniques to which the SNCR de-NO_x process is applied.

Finally, by way of explanation of the "packaging issue", which may be mystifying members, amongst directives that are emerging from the European Commission is a "combustibility criterion" for packaging. Incineration plants must be designed so that there is a net heat output which will raise the product gas temperature to a specified extent under prescribed conditions. This has implications for the materials being incinerated, so that packaging material - to eventually be incinerated - must be demonstrated to be capable of a "calorific gain". That is, it must make a suitable exothermic contribution to the overall process of incineration when a variety of materials are included.

John Griffiths

THIRD INTERNATIONAL SEMINAR ON FIRE AND EXPLOSION HAZARDS

To be held at the Low Wood Hotel, English Lake District, 10 - 14 April 2000

The deadline for submission of abstracts has now passed, and a total of 134 abstract proposals have been received from 23 countries. In addition, there has been a substantial response from people interested in attending the conference.

The conference organising committee is currently in the process of reviewing all of the abstracts submitted and preparing the preliminary conference programme. Notification of acceptance will be sent out shortly.

The second Conference Announcement containing the programme, accommodation information and conference registration details will be available after 15 December 1999. Conference bookings will be taken after this date, and as the level of response is expected to be high, delegate places will be allocated on a 'first come first served' basis.

Keynote Speakers and Presentations

H. R. Baum	<i>Mathematical Modelling of Fire Plume Dynamics</i>
A. M. Birk	<i>Observations from Medium Scale BLEVE Experiments</i>
B. E. Gelfand	<i>Features and Simulation of Non-Ideal Explosions</i>
G. Holmstedt	<i>Flame Spread</i>
J. H. Lee	<i>Deflagrations, Quasi-Detonations and Chapman-Jouguet Detonations</i>
J. B. Moss	<i>The Field Modelling of Compartment Fires</i>
J. G. Quintiere	<i>Some Aspects of Fire Growth</i>
F. Tamanini	<i>Partial-Volume Deflagrations - Characteristics of Explosions in Layered Fuel/Air Mixtures</i>

More details from:-

Professor Georgy M. Makhviladze,
Centre for Research in Fire and Explosion Studies,
University of Central Lancashire,
Preston, PR1 2HE, UK
e-mail: g.makhviladze@uclan.ac.uk
www.uclan.ac.uk/research/fire.htm

INTERNATIONAL WORKSHOP ON UNSTEADY COMBUSTION AND INTERIOR BALLISTICS

To be held in Saint Petersburg, Russia, 26 – 30 June, 2000

First Announcement and Call for Papers

OBJECTIVES:

- to reconstruct the tradition of regular scientific international meetings in St Petersburg
- to provide a forum for discussion of new ideas and their application to the design of advanced energetic systems;
- to promote communication between scientists of different profiles in common topics.

The Workshop organisers are interested in wide participation of young scientists.

TOPICS:

Theory of Unsteady Combustion

Stability of Rocket Motor Operation

Transition Processes in Combustion Chambers

Combustion of Metal Droplets in Active Media

Experimental Study of Unsteady Combustion

Interior Ballistics

Two-Phase Flows in Combustion Chambers

Combustion of Solid Propellants

CO-ORGANISERS:

Prof. F.E.C.Culick, California Institute of Technology

Prof. B.V.Novozhilov, Institute of Chemical Physics;

Prof. O.Ya.Romanov, Baltic Academy of Engineering, Economics and Culture

CONTRIBUTIONS: oral and poster presentations in English or Russian

REGISTRATION FEE:

US\$350, US\$250 (post-graduate students), US\$200 (students), to include:

- | | |
|--|---------------------------------|
| Transportation from/to airport/railway station | Admission to all sessions |
| Name-tag and programme | One copy of Abstracts |
| List of participants and other information | One ticket to Welcome Reception |
| Refreshments during breaks | Half-day sightseeing tour |
| One copy of the Workshop Proceedings (to be mailed after the workshop) | |

LOCATION: The Workshop will be held in Saint Petersburg or in Saint Petersburg's lovely suburbs. The social program will include half-day sightseeing tour and museum visits.

CALL FOR PAPERS: Papers will be selected on the basis of extended abstracts sent via e-mail to: Dr. V.A.Babuk: <kaf_m1@bstu.spb.su>, or <babuk@peterlink.ru>

The extended abstract:

- Prepare in English using Word 6.0/95 or Word '97, (14 point, Times New Roman), single-spaced, single-column format without page numbers. Reproduction will be HALF SIZE. Margins to be : top, 25mm; bottom, 20mm; sides, 20mm.
- Diagrams, equations, and tables should be placed close to their citation in the text. The SI metric system must be used
- Title should be in BOLD CAPITAL LETTERS (16 point) followed by names of authors in ITALIC CAPITAL LETTERS and their affiliations.

Deadlines: *Application form - December 30, 1999.*
Extended abstracts - January 30, 2000.
Acceptance - February 20, 2000.

COMPUTATIONAL AND EXPERIMENTAL METHODS IN RECIPROCATING ENGINES

An International Conference organised by I Mech E and co-sponsored by the
Combustion Institute (British Section) and UnICEG to be held at I Mech E
Headquarters, London on 1 – 2 November 2000

Members of both organisations will be able to register at a special rate. Since the meeting is already in its planning stage, any member who may wish to contribute should consult the organisers urgently. The details of the meeting are as follows.

THEME: Advanced computational and experimental techniques are essential for the development of internal combustion engines, since legislation, market pressures and competitors to the reciprocating engine present an increasingly challenging environment for commercial success. Advances in computational and experimental methods play an important role in engine design and the aim of this conference is to present the latest developments and their application to research, advanced engineering and product development. This conference is a successor to earlier successful meetings on 'Experimental Methods' and 'Computers in Engine Technology'.

SCOPE: Preference will be given to papers that combine computational predictions with experimental validation, novel experimental methods and application of both experimental and computational methods at all stages of product development. Possible topics include:

***Thermo-Fluids:** Flows in inlet and exhaust systems, In-cylinder flows, fuel sprays and mixture preparation, combustion, emissions. Engine cooling and thermal management. Catalyst performance. Warm-up.*

***Mechanical Systems:** Design analysis of major components, durability, friction, wear and NVH.*

***Use of CAE Methods:** Integration of CAE methods to achieve "Right-First-Time" design.*

***New Methods for Powertrain/Vehicle Calibration:** test-bed simulation of vehicle and driveline co-simulation, analytical calibration.*

***Advanced Test Methods:** In-cylinder diagnostics for flows, fuel sprays and combustion, novel methods for development of mechanical systems, design of experiments to optimise testing.*

***Emissions Measurements:** Particulate sizing, hydrocarbon speciation, time-resolved measurements.*

ORGANISING COMMITTEE: Richard Johns, Ricardo Consulting Engineers Ltd. (Co-Chairman), Richard Stone, University of Oxford (Co-Chairman), Morgan Heikal, University of Brighton, Jack Read, AVL (UK) Ltd., Steve Read, Rover Group Ltd., Nigel Weaver, Ford Motor Company Ltd., Mike Yianneskis, King's College London.

GENERAL: The conference will be especially useful for users of computational techniques in design and development; those people responsible for developing new experimental or computational techniques for engine design and development, performance evaluation, emissions compliance and calibration; managers wishing to learn how new techniques can reduce the duration of design, development and testing; suppliers of engine test equipment and systems, CAE analysis or testing software and users of test equipment responsible for performance evaluation, emissions compliance and engine calibration.

Many opportunities are available for sponsorship of various aspects of the conference. A supporting exhibition is planned alongside the conference.

FOR MORE DETAILS CONTACT:

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“ARE YOU CONTENT WITH THE LEVEL OF DISCUSSION AT COMBUSTION SYMPOSIA?”

David Smith started it in Newsletter 98/2! Arthur Lefebvre added to it in 99/1. The following letter from Alex Melvin on the subject was received by the editor recently. Further discussion by readers is encouraged.

10th September 1999

Dear Tony,

I was very interested in Professor Lefebvre's comments on the feebleness of discussions at Combustion Symposia and would agree with him that one of the main purposes of such symposia should be the encouragement of lively discussion. However, such discussion, if it is to be profitable, should be of new ideas or hypotheses in combustion - or, if novelty is at a premium, at the very least of contentious claims. For the purpose of determining whether meaningful discussion is possible, it seems to me that Symposium papers could be divided into two categories: first, those proposing new ideas or developments and second, those which would be most appropriately classified as 'curve fitting' exercises. I first heard the second category described by an eminent UK professor of mechanical engineering in relation to the closure problem in turbulence modelling. The gist of his argument was that we invoked closure equations to avoid facing up to the problems of our lack of understanding of turbulence and that we substituted arbitrary parameters/equations for understanding so that we could 'curve fit' to experimental results. This procedure excused us from the responsibility for developing new science and allowed us to produce non-contentious papers which were largely beyond criticism. Clearly, such 'curve fitting' papers would not be appropriate for open discussion because there would be little to be said either for or against them.

Professor Lefebvre identifies reaction kinetics as a topic which could do with a rest. Flame kinetics modelling used to proceed by guesses at modest sets of realistic reactions. Here the emphasis was on insight, and partial successes in modelling were achieved, partly as a result of open discussion of the merits of conflicting kinetic hypotheses. Then we had the change to 'curve fitting' where simple one-dimensional flames were modelled by using a hundred plus species and two to three hundred reactions - truly multiple parameter systems capable of fitting to any experimental data. Such processes proved impractical to use with any but the simplest flame configuration and the next stage was to reduce the hundreds of reactions to a minimal set. So now we are left with flame models which contain lots of equilibrated reactions, a substantial number of steady state reactions (as per 1930's combustion science) and four to six usually chemically-impossible reactions which form the basis of a small and easily soluble differential equation set. The explicit introduction of a non-feasible set of reactions for the purpose of modelling is again pure 'curve fitting' - in the same category as turbulent closure. Having reached such a dead end, we might expect little in the way of breakthroughs in kinetics insight in the near future and we might as well follow Professor Lefebvre's suggestion and drop flame kinetics as a discussion topic for future Symposia.

In this context, one should also not forget computational fluid dynamics packages in their application to combustion modelling, particularly as papers employing them may well involve both turbulence modelling and reaction kinetics. The hope for meaningful discussion of such papers seems to be limited since, if a commercial package is used, the

core of it and the arbitrary assumptions made in the modelling are so 'black box' in nature that even the authors - and certainly the audience - are unaware of the modelling bases. In such circumstances, CFD counts very much as 'curve fitting' when applied to a practical combustion configuration.

Are we better off for discussion topics with papers which limit themselves to the presentation of experimental techniques and their application to combustion science? Many new, mainly spectroscopic, techniques claimed to be for flame investigation have appeared in the past decade. It would seem appropriate for the Combustion Symposia to set aside a fair amount of time for discussion on how useful such techniques are in combustion studies. I have the distinct impression that many techniques are being developed for their own sake and not for their utility as combustion tools. This seems to be why we see them used for the simplest flames: one-dimensional low temperature flames with thick reaction zones, usually at reduced pressure. Not too long ago, I had the task of trying to find a technique for temperature measurement in a particular high temperature flame. I was told that CARS and hydroxyl LIF would do the job. CARS turned out to have such poor spatial resolution that it was measuring the ambient temperature round the flame, while hydroxyl LIF had all the problems of excited rotational-vibrational temperatures we used to see in flame hydroxyl emission spectra in the 1950's. In fact, more insight into the behaviour of the high temperature flame was provided by the 1950's work of Gaydon and Broida than by any of the modern techniques. It seems to me that future Combustion Symposia ought to allot time specifically for critical discussion of the relevance of modern experimental techniques to the provision of combustion information and the identification of those techniques which, although of interest in themselves, are unlikely to be applicable to generating new insights in combustion.

Useful discussions at Symposia can best be developed if new ideas are generated in the papers accepted. Vigorous discussions can indeed be generated by 'curve fitting' papers when authors with conflicting curve-fitting ideas clash, but these are generally unprofitable exercises and generate heat rather than enlightenment. There is no substitute for new developments for the generation of worthwhile discussion. Symposia committees and paper reviewers need to sit down and decide whether they wish to actively encourage new ideas. In this context, perhaps they should apply age discrimination and actively promote discussion of novel developments from combustion scientists under thirty-five. It is unlikely they would be able to encourage anything new from the over-fifties who nowadays form a substantial part of the attendance at the Symposia.

Yours sincerely,

Alec Melvin

DOME AND PALACE

Ken Palmer, who has become a most prolific contributor to the Newsletter, links, in his own inimitable style, some interesting interlinking scientific and engineering events of the past millennium and looks forward to the next.

We are all very aware of the millennium, but 1999 provided a clutch of happenings for people with scientific interests. Apart from the solar total eclipse, which many will have noticed, it was also a year in which there were two full moons in both January and in March, but none in February. True at least in the UK, but not in Australia because they are 10 hours in front and were not on the path of the eclipse either (sorry, mates). The second full moon in a month is sometimes known as a blue moon, origin obscure, and happens on average once in about two years. Some more to look forward to.

1999 also saw the bicentenary of the Royal Institution, in Albemarle St, London. The prime mover in its foundation was Benjamin Thompson, who was born in North America but decided to emigrate to London in 1776. In 1795 Thompson set about raising support and funds, all from private sources, to found an Institution with the broad objective of applying science to life and particularly to the alleviation of poverty. His personal interest was in the improvement of the efficiency of combustion processes in domestic heating and kitchens; he was appalled by the smokiness of the air in London. He was so successful in fund raising that the Royal Institution has been with us, in the same premises, ever since. The first Director was Thomas Young, of Modulus and Interferometer fame, and the second was Humphry Davy who personally isolated more naturally occurring chemical elements than anybody else. Whilst Young and Davy might well have carved careers elsewhere, Davy's assistant and successor Michael Faraday would have continued in his job as a bookbinder; physics and electrical engineering would have been much the poorer.

But first, after leaving America and coming to London, Thompson had moved on to Bavaria, where he took charge of the manufacture of gun barrels in the royal arsenal in Munich. The process involved boring holes in iron blanks, the frictional heat being removed by a flow of cooling water. Thompson concluded from observations of work done and the temperature rise of the water that heat was a form of energy, and not just a magic fluid released from the iron. So the concept of the mechanical equivalent of heat was born. For this, and other good works such as founding the Englische Garten in Munich, and encouraging the Bavarians to grow potatoes and drink coffee, Thompson was made Count Rumford, of the Holy Roman Empire. The title of Rumford derived from the town which was his base in New Hampshire.

On returning to London in 1795 he endowed the two Rumford medals at the Royal Society and inaugurated his campaign for the Royal Institution. In 1802, after its successful launch, he moved to Paris. He married the widow of the chemist Lavoisier, and continued to live there unhappily until his death in 1814. (Lavoisier had been guillotined, but not before he had shown that water was produced from two volumes of hydrogen and one of oxygen, the reaction causing no change in total mass).

During its existence the Royal Institution has accumulated an enormous library, embracing a very wide range of topics, and has bookshelves all over the premises showing how cultured we scientists really are. In one meeting room, on a shelf over the fireplace, the titles include:

Brown's Principles of Gunnery
Mosquitoes of Ethiopian Region Part III
History of Christ's Hospital 1834
Tegetmeier on Pheasants
Reports by the Juries 1851 Exhibition Vol II.

Comparison of the 1851 Exhibition with the Millennium Festival is no doubt a project in many educational establishments, to be published in great detail in due course. But mention of Juries is evidence that the 1851 Exhibition was a serious business, with the quality of exhibits assessed by independent experts. The theme of the Exhibition was Arts and Manufactures; Engineering was a Useful Art. This was exemplified by the Exhibition building itself, which was the brainchild of Joseph Paxton.

He was born in 1803 in a Bedfordshire village, and at age 23 was a gardener at the Horticultural Society grounds in Chiswick, west of London, when he was talent-spotted by the Duke of Devonshire (the 6th Duke, and son of Georgiana the subject of a recent best seller) and offered the job of Head Gardener at Chatsworth House in Derbyshire. He accepted, and travelled by stagecoach to Chesterfield, whence he made his way to Chatsworth arriving at 04.30. The gates were locked, so he climbed over and made an inspection of the gardens. At 06.00 he had twelve gardeners out with brooms, sweeping the lawns. After inspecting the water supplies to the gardens, he had breakfast with the Housekeeper and fell in love with her niece (he married her the following year). By 09.00 he reckoned he had already done a fair morning's work.

The gardens prospered under Paxton's care, and he progressively became estate manager not only at Chatsworth, but also at the Duke's many other properties. Paxton additionally took charge of a number of projects, two of which particularly show his innate engineering skills.

The Duke was a regular visitor to St Petersburg in Russia, where he threw generous parties. Consequently he was friendly with Tsar Nicholas I, whose Summer Palace down the river from St Petersburg was well provided with fountains. In 1843 it was announced that the Tsar would visit Britain the following year, so the Duke thought it would be fun to construct a fountain at Chatsworth taller than any of the Russian ones and he asked (commanded?) Joseph Paxton to oblige. A reservoir, fed by several local streams, was excavated on a hilltop 100 m above the house. It covered 3.6 hA (36,000 m²), to a depth of 2 m, and the banks were lined with stone slabs. At the bottom end of the supply pipe to the fountain a specially designed valve was installed which took 5 minutes to open manually, to avoid water-hammer. The fountain, with associated pool, is situated to the south of the house. Full marks to readers who have already deduced that the water is not recirculated. Normally the jet plays to a height of 80 metres, but can be higher under favourable weather conditions. The whole project was completed in 6 months; the fountain has played ever since and is a considerable attraction to the visiting public. Recommended.

Unfortunately the Tsar never visited Chatsworth, although the fountain was named the Emperor in his honour. Instead he was taken to Vauxhall station in south London to see the trains. He was impressed but clearly did not quite understand, because ever since the Russian word for any railway station has been pronounced 'voksal'. But who amongst his entourage would dare to correct an autocrat? An example of Hazard Analysis and Risk Assessment.

The second project for Paxton involved the Victoria water lily. This plant was discovered in 1837, in South America, and was remarkable for its leaves 1.5 m diameter with upturned

edges which floated on the water. Seeds were brought to Kew Gardens, where they germinated but failed to grow or flower. Paxton took a cutting to Chatsworth, put it in warm water but it did not grow further. He constructed a stirrer to make the water turbulent, and the lily grew phenomenally with huge flowers. The Duke decided that a conservatory should be built, to house the lily and other tropical plants. The area of the conservatory was to be 4,000 m² surrounded by a 1 m high stone wall. Paxton was then faced with the problem of designing the glazed roof. He had no formal engineering training, indeed it is doubtful whether he ever attended school, and structural engineers were not then available in north Derbyshire. So he reverted to engineering science.

He had noticed that when he put his infant daughter on a leaf, to test its buoyancy, the leaf did not distort or collapse. He used the same pattern of radiating and cross ribs for the roof of the conservatory. The glazing was held by light wooden beams, supported from below by light iron tubular columns also used to drain the rainwater. The structure of the roof thus reflected that of the lily leaves; an elegant solution. Truly, Engineering is a Useful Art.

The conservatory remained in use until World War I, after which it was demolished. Fortunately drawings have been preserved.

So how did Paxton become involved in the 1851 Exhibition? At the planning stage a Committee was set up to invite designs for the Exhibition Building, which was to be sited in Hyde Park, London. The specification required that it was capable of coping with thousands of visitors, should be a temporary structure, and should not require the cutting down of some elm trees 30 m tall on the site. The Building Committee received more than 200 designs, but decided that they were all impracticable or unsuitable. The Committee then produced its own design which was a brick building with immense classical portico and with a large dome at the far end. When published it was treated with derision by the public, as being a cross between St Paul's Cathedral and Euston Station. Not really surprising as the Committee members included architects and railway engineers. The Committee had therefore rejected all proposals but was unable to put forward an acceptable alternative. Connoisseurs of Official Committees will recognise the symptoms.

By June 1850 the situation was desperate because the Exhibition was to be opened by Queen Victoria on 1 May 1851. Word was dropped into the Committee Chairman's ear about the Chatsworth conservatory. Paxton was asked to produce a design for the Building, and given nine days to put the details on paper. He spent the first two in North Wales watching Robert Stephenson (who was on the Building Committee) raising his railway bridge over the Menai Straits [1], and thinking. Back at Chatsworth he made drawings for a rectilinear building, of iron and glass, with galleries and a transept to accommodate the elm trees. The Building Committee accepted in principle, giving Paxton another seven days to produce detailed costings which had to be less than for their own design. At £80,000 they were, easily. (Multiply by about 150 to get present day equivalent). The go-ahead was given and site work started at the end of July 1850.

The building was 560 x 135 m in plan and 33 m high at the transept. A building of this size, of iron and glass, had not been attempted anywhere before and many of the design details were novel. For instance the glass was supported in double guttering, externally for carrying away rainwater and internally for condensed water. The structure was essentially portal framing with rigid bracing, the elements being of standardised sizes. In this way construction could commence whilst further elements were still being manufactured. Much of the detailed design and production was the responsibility of Charles Fox, of a Birmingham ironworks. (Later he set up the engineering consultancy of Freeman, Fox and

Partners). The building, now known as the Crystal Palace, and its contents, were ready by mid-April 1851 and the ceremony on May 1 went to schedule.

The Exhibition closed in mid-October, and by then 6 million people had visited and viewed exhibits that ranged from high technology to primitive artefacts. The Juries were kept busy. The Crystal Palace was dismantled and re-erected with extensions at Sydenham, on the fringe of south London. In 1936 it caught fire, and was burned to the ground. How was it that a building of iron and glass, still structurally sound, was destroyed by fire? The contents were flammable.

But the 1851 Exhibition had made a substantial profit, Paxton received £5,000 and a knighthood, and the surplus was invested in South Kensington - museums, Imperial College, and later the Royal Albert Hall, plus more. The Chemical Society was offered free accommodation but declined on the basis that members would find difficulty in attending meetings in so remote a suburb. Some money was used to endow 1851 Scholarships which later enabled overseas people such as Rutherford, Florey, Oliphant... to come and work in the UK.

In 1858 the 6th Duke died, and as he had been too busy with Paxton to marry and produce an heir the title passed to a distant relative. The 7th Duke was a mathematician, who became in turn Chancellor of London and of Cambridge Universities. The family surname is Cavendish, and the Duke had a hand in the foundation of the Laboratory.

One of his ancestors was Henry Cavendish (1731-1810) who acquired a house on Clapham Common, but not in a moment of madness. He was a bit mad all the time: having inherited £1 million at age 21 he decided to devote his life to scientific research. He was interested in hydrogen and carried out balloon experiments; he also found that water was composed of two parts hydrogen and one part oxygen but unlike Lavoisier did not discover the conservation of mass. He measured G , the gravitational constant (the force of attraction between unit masses whose centres of gravity are unit distance apart). Nowadays G is still not known with the high accuracy expected for universal constants, so Cavendish's pioneering work is highly creditable and was recognised when the Cavendish Laboratory was named.

It was to the Cavendish that Ernest Rutherford came via Manchester University to develop his work on the structure of the atom. He was born in New Zealand, the fourth of ten children of a wheelwright. Many years later when he was a Nobel Prizewinner, President of the Royal Society, member of the Order of Merit, and a Lord, he sat on the 1851 Scholarship Committee. At one meeting there was a proposal on the agenda to reduce the number of Scholarships in order to save money (how very familiar that now sounds). Discussion went round and round but he stayed silent. Eventually he thumped the table and said that if it were not for the Scholarships he would never have been able to come to Britain to do his research. End of debate.

In fact Rutherford soon adapted to the English social scene. There is the story that he was alone in the Senior Common Room in Trinity College when the door opened and a priest walked in. An embarrassed silence followed since there was no third person present to introduce them, as English social protocol preferred. Eventually Rutherford said:

“Good afternoon, I am Lord Rutherford”, to which the priest replied:
“Good afternoon, I am the Archbishop of York”.

Then followed an even longer embarrassed silence because, as Rutherford subsequently explained, neither man believed the other.

Rutherford was a member of numerous committees, including the Council of DSIR (the Department of Scientific and Industrial Research). One of its research stations was the Fuel Research Station at Greenwich, near to the site of the Millennium dome but now obliterated. The Station was set up during World War I mainly to study the conversion of coal into fuel oil, for use by the Royal Navy. As the principal element in coal is C, whereas fuel oil is roughly CH_2 the problem is essentially hydrogenation. Sounds easy, but no. There are two practicable approaches. One is known as the Fischer-Tropsch process, and involves the passing of steam through burning coal to make CO and H_2 and then reacting these gases over catalysts at elevated temperatures and pressures to synthesise hydrocarbons. The second approach is to dissolve the coal in an organic liquid, and hydrogenate directly using suitable catalysts. Initially Fischer-Tropsch was favoured, and work continued on it until closure of the Station in 1958, and its transmutation into the Warren Spring Laboratory at Stevenage. The basic problem was increasing the yield, so that the method was economic. Under favourable conditions 1 tonne of gasoline can be made from 4 tonnes of coal. Nowadays the retail price of gasoline, before tax, is about £120 per tonne, so coal needs to be a lot less than £30 per tonne for the process to be profitable.

The Millennium dome's combustion connection is not only with the Fuel Research Station; it is built on the site of a large gas works where the pyrolysis of coal was economically viable. But inside the dome the exhibits do not seem to highlight combustion, intentionally at least. One of them does consist of 200 tonnes of recycled cardboard, 'capable of withstanding temperatures up to 400 °C' - but the dimensions of the test specimen were not stated.

As a structure the dome has great novelty; it is 365 metres in diameter and 50 metres in height. Its volume is much greater than that of the Crystal Palace, and it is just a lot larger than any other dome. Previously the largest dome in England was that in Buxton, which covered the courtyard of the Duke of Devonshire's stables (now the Devonshire Royal Hospital). Yet another link with the Cavendishes. Hopefully the Millennium dome engineers will be given their due credit. Perhaps the Engineering Institutions could raise their status in the eyes of the public by inaugurating a Useful Arts Council. The other Arts Council would be livid. And how about some Millennium Scholarships to match those from 1851?

Ken Palmer

Reference

1. Combustion Institute (British Section) *Newsletter*. November 1996. 24-27.

COMBUSTION CALENDAR

1999

DECEMBER 1999

1-2 DECEMBER

London, England. FUEL INJECTION SYSTEMS. A meeting organised by the Combustion Engines Group of IMechE co-sponsored by the British Section of the Combustion Institute. Details: e-mail: m_powell@imeche.org.uk

7-9 DECEMBER

Leeds, England. THE ECONOMICS OF FIRE PROTECTION. A short course. Details: Alison Whiteley, CPD Unit, School of Process, Environmental and Materials Engineering, University of Leeds, Leeds LS2 9JT. Tel: (0113) 233 2494, Fax: (0113) 233 2511, e-mail: shortfuel@leeds.ac.uk

21 DECEMBER

London, England. GASOLINE FUEL INJECTION. A UnICEG meeting. Details: Colin Garner, Department of Mechanical Engineering, Loughborough University, Loughborough LE11 3TU. e-mail: C.P.Garner@Lboro.ac.uk

2000

JANUARY 2000

10-14 JANUARY

Leeds, England. ULTRA-LOW NO_x GAS TURBINE COMBUSTION. A short course. Details: Alison Whiteley, CPD Unit, School of Process, Environmental and Materials Engineering, University of Leeds, Leeds LS2 9JT. Tel: (0113) 233 2494, Fax: (0113) 233 2511, e-mail: shortfuel@leeds.ac.uk

17-21 JANUARY

Leeds, England. COMBUSTION INSTRUMENTATION, CONTROL AND LOW NO_x BURNER EMISSIONS. A series of one-day courses; *Flow measurement, Temperature measurement, Burner management and air/fuel control, Burner emissions – measurement and control, Gas burner NO_x reduction*. Details: Alison Whiteley, CPD Unit, School of Process, Environmental and Materials Engineering, University of Leeds, Leeds LS2 9JT. Tel: (0113) 233 2494, Fax: (0113) 233 2511, e-mail: shortfuel@leeds.ac.uk

17-21 JANUARY

Leeds, England. FIRE DYNAMICS AND MODELLING. A short course. Details: Alison Whiteley, CPD Unit, School of Process, Environmental and Materials Engineering, University of Leeds, Leeds LS2 9JT. Tel: (0113) 233 2494, Fax: (0113) 233 2511, e-mail: shortfuel@leeds.ac.uk

24-29 JANUARY

Geneva, Switzerland. CLEAN ENERGY 2000. Details: Clean Energy 2000, 3 rue de Varembe, POB 200, CH-1211 Geneva 20, Switzerland. Tel: (22) 910 3006, Fax: (22) 910 3014.

FEBRUARY 2000

16-18 FEBRUARY

Paris, France. FIRST INTERNATIONAL SYMPOSIUM ON AIR POLLUTION. Details: Direction de la Protection de l'Environnement, 7 rue Maleville, 75008 Paris, France. Tel: (1) 45 61 54 70, Fax: (1) 45 61 54 90.

MARCH 2000

5-8 MARCH

Amelia Island, Florida, USA. EIGHTH INTERNATIONAL CONFERENCE ON NUMERICAL COMBUSTION. Details: www.siam.org/meetings/nc00

6-9 MARCH

Clearwater, Florida, USA. 25th INTERNATIONAL TECHNICAL CONFERENCE ON COAL UTILIZATION AND FUEL SYSTEMS. Details: Barbara Sakkestad, Coal Utilization and Fuel Systems Conference Committee, 104 Edith Drive, Rockville, Maryland 20850, USA. Tel: (301) 294 6080, Fax: (301) 294 7480, e-mail: barbarasak@aol.com, web: coaltechnologies.com

13-17 MARCH

Leeds, England. FIRE SAFETY DESIGN. A short course. Details: Alison Whiteley, CPD Unit, School of Process, Environmental and Materials Engineering, University of Leeds, Leeds LS2 9JT. Tel: (0113) 233 2494, Fax: (0113) 233 2511, e-mail: shortfuel@leeds.ac.uk

20-22 MARCH

Leeds, England. INDUSTRIAL AIR POLLUTION MONITORING. A short course and associated exhibition of monitoring equipment. Details: Alison Whiteley, CPD Unit, School of Process, Environmental and Materials Engineering, University of Leeds, Leeds LS2 9JT. Tel: (0113) 233 2494, Fax: (0113) 233 2511, e-mail: shortfuel@leeds.ac.uk

SPRING 2000

Venue to be decided. INCINERATION TOPIC. The Combustion Institute (British Section) Spring meeting. Details will be available nearer the date from John Griffiths.

APRIL 2000

5 APRIL

Castle Bromwich, England. ENGINE THERMAL ISSUES. A UnICEG meeting. Details: Colin Garner, Department of Mechanical Engineering, Loughborough University, Loughborough LE11 3TU. e-mail: C.P.Garner@Lboro.ac.uk

10-14 APRIL

Leeds, England. DIESEL PARTICULATES AND NO_x EMISSIONS. A short course. Details: Alison Whiteley, CPD Unit, School of Process, Environmental and Materials Engineering, University of Leeds, Leeds LS2 9JT. Tel: (0113) 233 2494, Fax: (0113) 233 2511, e-mail: shortfuel@leeds.ac.uk

10-14 APRIL

Lake Windermere, England. THIRD INTERNATIONAL SEMINAR IN FIRE AND EXPLOSION HAZARDS. Details: Georgy Makhviladze, Centre for Research in Fire and Explosion Studies, University of Central Lancashire, Preston PR1 2HE, England. Tel : (01772) 893222, Fax : (01772) 892916, e-mail: g.makhviladze@uclan.ac.uk

web: <http://www.uclan.ac.uk/fire.htm>. See also this *Newsletter*.

11-12 APRIL

Leeds, England. CHP – TECHNOLOGY, SAFETY AND ENVIRONMENT. A short course. Details: Alison Whiteley, CPD Unit, School of Process, Environmental and Materials Engineering, University of Leeds, Leeds LS2 9JT. Tel: (0113) 233 2494, Fax: (0113) 233 2511, e-mail: shortfuel@leeds.ac.uk

11-14 APRIL

Porto, Portugal. 5th EUROPEAN CONFERENCE ON INDUSTRIAL FURNACES AND BOILERS. Details: INFUB c/o Albino Reis, Rua Gago Coutino, 185-187, 4435 Rio Tinto, Portugal. Tel: (2) 9734624/9730747, Fax: (2) 9730746, e-mail: conference@infub.pt
web: <http://www.infub.pt>

MAY 2000

4-5 MAY (?)

Leeds, England. CFD IN COMBUSTION ENGINEERING. A short course. Details: Alison Whiteley, CPD Unit, School of Process, Environmental and Materials Engineering, University of Leeds, Leeds LS2 9JT. Tel: (0113) 233 2494, Fax: (0113) 233 2511, e-mail: shortfuel@leeds.ac.uk

8-12 MAY

Leeds, England. FIRE FLAMMABILITY AND EXPLOSIONS with GAS AND DUST EXPLOSION PROTECTION DESIGN. A short course. Details: Alison Whiteley, CPD Unit, School of Process, Environmental and Materials Engineering, University of Leeds, Leeds LS2 9JT. Tel: (0113) 233 2494, Fax: (0113) 233 2511, e-mail: shortfuel@leeds.ac.uk

8-12 MAY

Portland, Oregon, USA. INTERNATIONAL CONFERENCE ON INCINERATION AND THERMAL TREATMENT TECHNOLOGIES. Details: Lori B Cohen, University of California, EH&S, 300 University Tower, Irvine, CA 92697-2725, USA. Tel: (949) 824 5859, Fax: (949) 824 1900, E-mail: lbarnow@uci.edu

9-11 MAY

Budapest, Hungary. 5TH INTERNATIONAL CONFERENCE ON COAL UTILISATION SCIENCE AND TECHNOLOGY. Details: Zoltan Katona, Department of Energy, Technical University of Budapest, 1111 Budapest, Muegyetem rkp. 3, Hungary. Fax: (1) 463 3273, or, in the UK, John Tucker, Tel: (01242) 763361.

JUNE 2000

11-15 JUNE

Calgary, Alberta, Canada. 16TH WORLD PETROLEUM CONGRESS. Details: 16th World Petroleum Congress, 1350, 144-4 Avenue SW, Calgary, Alberta, Canada T2P 3N4. Tel: (403) 218 2000, Fax: (403) 218 2002, e-mail: cdn.assoc@wpc2000.com, web: www.wpc2000.com

13-15 JUNE

Berlin, Germany. INTERNATIONAL SPACE STATION FORUM 2000. Details: web: <http://www.estec.esa.int/ISSForum2000>

26-30 JUNE

Saint Petersburg, Russia. INTERNATIONAL WORKSHOP ON UNSTEADY COMBUSTION AND INTERIOR BALLISTICS. Details: e-mail: Dr. V.A.Babuk: <kaf_m1@bstu.spb.su>, or <babuk@peterlink.ru> See also this *Newsletter*.

JULY 2000

23-27 JULY

Cambridge, England. 16TH INTERNATIONAL SYMPOSIUM ON GAS KINETICS - To include Dynamics and Kinetics of Elementary Reactions, Atmospheric Chemistry and Combustion and Plasmas. Details: Gillian Southwell, Secretary to the 16th International Symposium on Gas Kinetics, University Chemical Laboratory, Lensfield Road, Cambridge, CB2 1EW, England, Fax: (1223) 336362, web: <http://www.gk2.ch.cam.ac.uk>

23-28 JULY

Las Vegas, NV, USA. ENERGEX 2000: 8th INTERNATIONAL ENERGY FORUM. Details: P Catania, Faculty of Engineering, University of Regina, Regina, SK S4S 0A2, Canada. Tel: (306) 585 4363, Fax: (306) 585 4855, e-mail: peter.catania@uregina.ca, web: <http://www.energysource.com/ief/updates/>

10-13 JULY

Lisbon, Portugal. TENTH INTERNATIONAL SYMPOSIUM ON APPLICATIONS OF LASER TECHNIQUES TO FLUID MECHANICS. Details: Prof. Manuel V. Heitor, Dept. of Mechanical Engineering, Instituto Superior Técnico, Ac. Rovisco Pais, 1049-001 Lisboa Codex, Portugal. Tel: 841 73 79 / 841 73 32, Fax: 849 61 56, e-mail: llaser@dem.ist.utl.pt

30 JULY-4 AUGUST

Edinburgh, Scotland. TWENTY-EIGHTH SYMPOSIUM (INTERNATIONAL) ON COMBUSTION. Its getting nearer! Papers to Sue Terpack, The Combustion Institute, 5001 Baum Boulevard, Suite 635, Pittsburgh, PA 15213-1851, USA. Tel: (412) 687 1366, Fax: (412) 687 0340, e-mail: combust@telerama.lm.com by 15 December 1999. Work-in-Progress abstracts to John Griffiths by 14 April 2000. See the Symposium website at <http://www.efm.leeds.ac.uk/edin2000/>

AUGUST 2000

13-16 AUGUST

Cairns, Queensland, Australia. FIFTH INTERNATIONAL CONFERENCE ON GREENHOUSE GAS TECHNOLOGIES. Details: GHGT-5 Secretariat, Colin Paulson, CSIRO Energy Technology, PO Box 136, North Ryde, NSW 1670, Australia. Tel: (2) 9490 8790, Fax: (2) 9490 8819, e-mail: c.paulson@det.csiro.au

SEPTEMBER 2000

10-15 SEPTEMBER

Sorrento, Italy. FIRST INTERNATIONAL SYMPOSIUM ON MICROGRAVITY RESEARCH & APPLICATIONS IN PHYSICAL SCIENCES & BIOTECHNOLOGY. Details ESTEC Conference Bureau, PO Box 299, 2200 AG Noordwijk, The Netherlands. Tel: (71) 5655005, Fax: (71) 5655658, e-mail: confburo@estec.esa.nl

12-14 SEPTEMBER

Birmingham, England. THIRD UK MEETING ON COAL RESEARCH AND ITS APPLICATIONS. Organised by the Coal Research Forum. Details: Mrs H J Graham, Power Technology Centre, Radcliffe-on-Soar, Nottingham NG11 0EE, England. Tel: (0115) 936 2460, Fax: (0115) 936 2205, e-mail: helen.graham@powertech.co.uk

14 SEPTEMBER

Loughborough, England. ENGINE MODELLING. A UnICEG meeting. Details: Colin Garner, Department of Mechanical Engineering, Loughborough University, Loughborough LE11 3TU. e-mail: C.P.Garner@Lboro.ac.uk

1-2 NOVEMBER

London, England. COMPUTATIONAL AND EXPERIMENTAL METHODS IN RECIPROCATING ENGINES. An International Conference organised by I Mech E and co-sponsored by the Combustion Institute (British Section) and UnICEG. Details: Mrs Uloma Otuonye, Conference and Events Department C587, Institution of Mechanical Engineers, 1 Birdcage Walk, London SW 1H 9JJ. Tel: 0207 304 6864, Fax: 0207 222 9881, e-mail: u_otuonye@imeche.org.uk

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