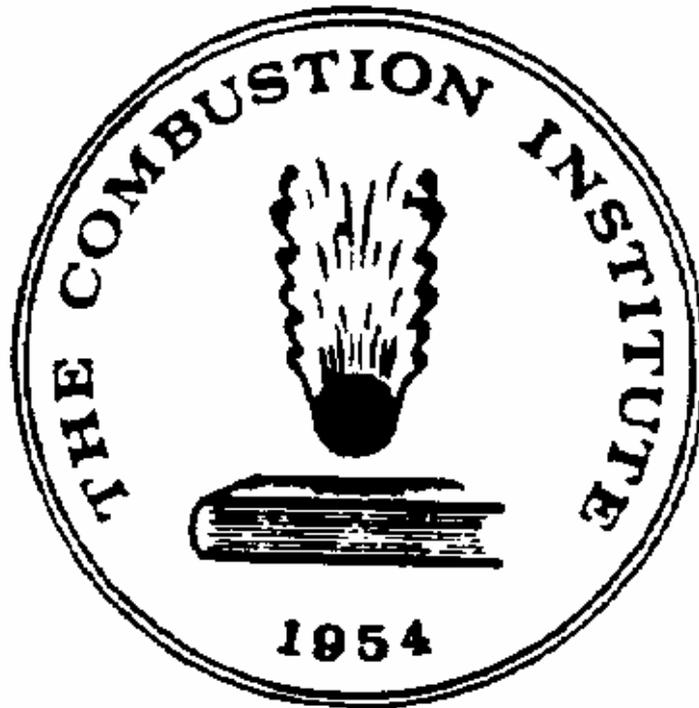


THE COMBUSTION INSTITUTE

(British Section)



NEWSLETTER

VOLUME 2000/1

JUNE 2000

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World Wide Web versions of this *Newsletter* at:-
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EDITORIAL

The last issue of the *Newsletter* was supposed to have been a Millennium edition and I had several pieces in it recognising the dawning of the New Millennium and worrying about the Y2k problem. Apparently I was wrong on both issues! Y2k was more like Y worry as most of the dreadful predictions failed to materialise. I did send, and receive, a few messages dated 4 January 1980 (I had a very old computer at work), but that was all!

And, as we were celebrating the “Turn of the Century” with friends, I was told that all the drinking I had done that night was in vain; the new millennium starts next January, so I have to do it all over again! Get your articles ready now for the **real** millennium *Newsletter*.

Seriously, please write something for an edition soon; as you will see, I still have to rely on a few “old faithfuls”.

While pleading for action, John Griffiths tells me that there are many members who have not renewed their membership for 2000. He has sent reminders to you all. We need to maintain, and hopefully to increase our membership numbers. This is the last *Newsletter* to be sent to members whose subscriptions have lapsed.

I promised an “Edinburgh” edition this time (actually I promised to send it a lot earlier than this); There are several articles related to this summer’s special event in Edinburgh, but not as many as I had hoped. Everyone has been so busy on one aspect or other of the Symposium, that the *Newsletter* lost out. David Smith reveals some of the pitfalls and successes in the organisation of such a large event. Perhaps some of the attendees would write for me about their experiences in Edinburgh for a post- Symposium edition.

I bullied my wife to try to emulate her successful article about Sir William Hamilton for the Naples’ Symposium. I think she has produced an equal, although I may be biased!

What we shall do without Ken Palmer if he ever stops writing I am not sure. We have another article from him here, with a little mention of Edinburgh, and he is already working on another for the Autumn/Winter edition.

Don’t forget the Autumn meeting of the Section; provisional details are in this *Newsletter*. The AGM of the Section will be held at this meeting which is planned for 20-21 September in Leeds.

I should like to apologise to John Smart and Barrie Jenkins for failing to publish their article on rotary kilns in the last *Newsletter*. I am sorry that somehow I mislaid it, but hope that you will find it interesting now.

See you in Edinburgh, I hope. I understand that we have around 1000 registrants plus 300 accompanying guests, and the numbers are still rising.

Tony Burgess

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COMBUSTION PEOPLE

I seem to have missed several pieces of news about our combustion colleagues. I am sorry that some of the following is rather old. Please keep me informed so I can pass on both the good and the sometimes sad news.

I am delighted to pass on the news of several well-deserved promotions to chairs:-

John Griffiths has been promoted in the Department of Chemistry at Leeds.

Allan Hayhurst has been awarded a Personal Chair at Cambridge.

Peter Lindstedt (Chemical Engineering) and **Alex Taylor** (Mechanical Engineering) have received internal promotions at Imperial College, London.

Congratulations to them all.

Tony Burgess

AGM OF THE COMBUSTION INSTITUTE (BRITISH SECTION)

20-21 SEPTEMBER 2000

The AGM of the Section will be held during the joint meeting of The Combustion Institute (British Section) and The Combustion Physics Group of The Institute of Physics in Leeds on 20-21 September. The exact time and date of the meeting will be notified to members separately.

Two members of the British Section committee are retiring at the end of their first period of service (three years) on the committee in October 2000. They are Dr Mike Fairweather and Professor W (Bill) P Jones; both are eligible for re-election.

Nominations from members of the British Section for these two vacancies should be sent to the Hon. Secretary, Professor John Griffiths, at least a month before the meeting.

COMBUSTION MODELLING AND VERIFICATION

The Autumn Meeting of The Combustion Institute (British Section) and Institute of Physics (Combustion Physics Group) to be held on 20-21 September 2000 at the Houldsworth Building, University of Leeds

PROVISIONAL PROGRAMME

Wednesday 20 September

09.30 *Registration and Coffee*
09.50 *Welcome and Introduction*

SAFETY RESEARCH

- 10.00 **Combustion Research at the Health and Safety Laboratory**
Dr Stefan Ledin, Health & Safety Laboratory
- 10.30 **Title to be announced**
Dr Suresh Kumar, Fire Research Station
- 11.00 *Coffee*
- 11.30 **Combustion Models for Compartment Fires**
Prof Barrie Moss, Cranfield University
- 12.00 **Towards a Better Understanding of Non-Premixed Turbulent Flames and Fires using DNS**
Dr Kai Luo, Queen Mary and Westfield College
- 12.30 *Lunch*
- 13.30 **Flame Spread Models for Fire Simulation**
Dr Phil Rubini, Cranfield University
- 14.00 **Optical Diagnostics for Turbulent Flame Propagation in Explosions**
Dr Graham Hargrave, Loughborough University

GAS TURBINES

- 14.30 **Modelling Soot Formation and Consumption in the Gas Turbine Combustor**
Dr Helen Brocklehurst, Rolls Royce
- 15.00 *Tea*
- 15.30 **Large Eddy Simulation for Combustion Flows**
Prof Bill Jones, Imperial College
- 16.00 **Title to be announced**
Prof Peter Lindstedt, Imperial College
- 16.30 *Discussion*
- 17.00 *Close*

Thursday 21st September

09.00 *Registration and Coffee*

INTERNAL COMBUSTION ENGINES

- 09.30 **Current Requirements and Practices in IC Engine Research**
Dr David Towers, Gaydon Test Centre, Ford Premier Auto Group
- 10.00 **The Quantitative Imaging of Fuel, Liquid and Vapour, for Combustors and Engines**
Prof Douglas Greenhalgh, Cranfield University
- 10.30 **Measurements of Burning Rates in Single and Two Phase Mixtures**
Dr Malcolm Lawes, University of Leeds
- 11.00 *Coffee*
- 11.30 **Problems of Modelling Combustion at High Pressure**
Prof Derek Bradley, University of Leeds
- 12.00 **Modelling of Partially Premixed Combustion in SI Engines**
Dr Stewart Cant, University of Cambridge
- 12.30 *Lunch*

UTILISATION

- 13.30 **CFD Modelling of Combustion Processes used in Electricity Generation**
Allan Jones or Speaker to be announced, PowerGen
- 14.00 **Application of a Non-Equilibrium Thermodynamic Model to a Kerosene Fueled Furnace**
Dr K Atkinson / Dr Chris Wilson, DERA
- 14.30 **Lean Methane Oxidation Chemistry On and Near Platinum Surfaces**
Dr Valerie Dupont, University of Leeds
- 15:00 *Tea*
- 15.30 **20 years of Measurement and Prediction of Complex Combusting Flows at Cardiff**
Dr Nick Syred or Dr Phil Bowen, University of Cardiff
- 16.0 *Discussion*
- 16.30 *Close*

Venue Houldsworth Building, (Clarendon Road / Woodhouse Lane)
University of Leeds, Leeds LS2 9JT.

<u>Registration Fees:</u>	Members:	£35 one-day £60 two-days
	Non-members:	£60 one-day £85 two-days
	Students:	£20 one-day £30 two-days

Registration and enquiries

Alison Whiteley, CPD Unit, SPEME, University of Leeds, LEEDS, LS2 9JT
Tel: 0113 233 2494 **Fax:** 0113 233 2511 **E-mail:** A.Whiteley@leeds.ac.uk.

Accommodation arrangements can be made, as required. Further details will be sent to all Section members in the meeting announcement.

EDINBURGH ORGANISATION: Behind the Scenes

As a regular attendee of Combustion Symposia, I was aware in a general sort of way that they took a lot of planning. But only now do I realise just how much time and energy it takes to organize a big conference and the myriad of issues - large and small - that have to be decided. Below I try to give some flavour of how this one has gone, based on my involvement over the past four years and particularly over this year.

Three previous symposia have been held in the UK - the 7th at Oxford and London in 1958; the 10th at Cambridge in 1964 (incidentally the first I attended); and the 17th at Leeds in 1978. About 10 years ago, the British Section committee decided it might be appropriate to hold another one here and began preparing a bid. One thing that has changed significantly over the years is the size of the Symposium: Oxford/London had 508 delegates (from 20 countries); Cambridge had 850 delegates (from 24 countries), while Leeds had 800 (from 33 countries). Since then, the number of delegates has risen to 1100 or 1200 plus 2 to 300 accompanying guests. This puts severe constraints on the choice of venue and it quickly became apparent to us that few UK campuses could accommodate this number. Indeed, a thorough search yielded only two and Edinburgh got the nod.

We originally made a bid to host the 26th Symposium. In the event, Naples was selected. Initial disappointment turned fairly quickly to relief as we realized this meant that someone else would be doing the hard work. But, as time passed, ambition returned and four years later we were knocking at the door again – this time successfully.

Although there is combustion research at Edinburgh universities, it is not a major activity there. So there is not locally based group of individuals to run things and it must be done largely from a distance. We appreciated all along that this would complicate the process. Early on, this impinged in a fairly abstract way and it is only now that the disadvantages of long distance organization really strike home. This has been ameliorated by having fine professional help from our conference organisers, Clansman Monarch. Another large change in conference organization is the emergence of Professional Conference Organisers (PCO). They take much of the heart-ache out of the organising and, with their wide range of contacts and experience, do a much better job than we amateurs could ever manage on our own.

One interesting early lesson was the way in which the conference grapevine operates. I still don't quite know how it happened but information that the Combustion Symposium was to be held in Edinburgh was circulated in some list of forthcoming events. The Edinburgh International Conference Centre enquired whether we would like to hold the event there (No, all along the University was our natural choice); several PCOs approached us to assist with the organization – Clansman was just one of many we could have employed. Those of you at Boulder may remember Sean entertaining us with his bagpipes at the Wednesday afternoon outing. Sean was our Clansman representative and, since the combustion Symposium differs in several important respects from many other conferences, we felt it was important for our main link to gain first hand experience. Unfortunately, Sean is no longer with Clansman but, in his place, we were very fortunate to have Katherine Penker to carry things through almost to the end. Then, earlier this year, we learned that Katherine was pregnant and would be on maternity leave during our event. She took maternity leave in mid-May and we now have another Sean (O'Sullivan) looking after us. The above suggests we experienced hiccups along the way; in fact, there have been few.

The pattern that has evolved is of joint organization: Clansman doing most of the work but in consultation with a small Planning Committee, chosen by the British Section Committee and consisting of Chris Lawn, Chris Morley, Phil Gaskell, Stewart Cant, Dougal Drysdale and myself. Much of the organization of the Symposium covers obvious-enough issues: choice of best lecture rooms, hotels, venues for social events, menus for banquet, etc. etc. But along with these self-evident questions came a whole gamut of less obvious issues. Below I have picked out a few of these (some obvious others perhaps less so) to indicate how things have gone.

Choosing venues

One of our major first tasks was to select venues for technical and social events. It took several attempts to finalise these and all the committee was involved. But particular credit goes to Chris Lawn for worrying about the facilities for the technical program: which lecture rooms to hire; what ancillary rooms to have (admin office, reading room, lecturing preparation/practice room, etc.); should we have a quiet room? and so on. One particular concern was the choice of rooms to house posters. We wanted to allow as many poster boards as we could without undue squash. We also wanted to have a set of rooms close to each other for housing them. This proved tricky but possible. Then, having decided which rooms to use, Chris had the task of deciding how many posters could sensibly be accommodated. I can picture him at home poring over sketch plans of the rooms shuffling around small paper cut-outs of posters: How many can we squeeze down this wall? How much space should we leave between rows? He had it sorted and then Dougal suggested that it might be more efficient to place boards along diagonals rather than straight across the rooms. Back to the drawing board.

We think the rooms that we have for the technical program are good - six lecture rooms close to each other in two adjacent buildings, with the plenaries in the wonderful McEwan Hall just a couple of minutes away. Posters are in one of the buildings and ancillary rooms (admin office, etc.) in the other. All nicely bunched.

We also had fun and some headaches choosing venues for the social events. We were all knocked out by the glorious Royal Museum of Scotland. Initially we hoped to have it for the banquet but this proved impractical. But we are now using it for the Welcome Reception and it should kick things off to a great start. Choice of the venue for the Wednesday outing fell to Phil and me. Sean (he of the bagpipes) took us out to Oxenfoord Castle where we met the owner, who was just starting to develop the site commercially. We wanted to hear about fun activities and he had great ideas for us - sheepdog trials, mini-highland games, quad biking, falconry, archery! We've kept many of the ideas but dropped some; archery among 1000+ people (all novices) seemed like an accident waiting to happen. But we have the President lined up for the first bungee jump. (Just kidding, Dan.)

Weather

At one of our planning meetings in January, we were discussing the Wednesday afternoon outing. By then we had agreed on Oxenfoord Castle as the venue and were discussing the content of the afternoon's outdoor activities. The key word here is 'outdoor'. I thought I was a worrier but Chris Lawn runs me a very close second. "What happens if it rains?" he asked. Obvious question but tricky to answer. One way forward was to get relevant weather statistics. So, next day I rang the Glasgow Weather Centre and spoke to an earnest young guy. They run a commercial service, from which one can buy monthly historical records for a basic £85 plus £2:80 per month. So information on the past 10 Augusts would cost us £113. But, he told me, in a case like ours, it's not worth it, as Edinburgh weather in August is so variable. For the 25 years from 1961, August was very wet (Oh help!) but since then it has dried out a bit (thank goodness!) and anyway the

rain is often just a shower. I suggested for an outlay of £100+, a prayer mat might be a better bet; he agreed that an appeal to higher authority made as much sense as consulting him and there we left it. Does anyone remember Wednesday outing at the Penn State Symposium? It rained heavily and we all had to shelter under the trees. (*My recollection is of being soaked through to my underwear and eating a chicken drumstick floating in a pool of rain water on a soggy paper plate. But we had fun! - Editor*) At least, we'll have some canvass cover at Edinburgh but that appeal to higher authority might not come amiss.

(As a footnote to the above, rugby union fans will remember the Scotland-England match held in Edinburgh earlier this spring. It rained buckets and England lost. The following Monday, Chris Lawn rang me: "Did you see the match?" he said. I said I hadn't (I'm not really a rugby fan) but I had heard what happened. "See" he said, "that's what can happen in Edinburgh". It was worse in late April, when the rugby league cup final was also held in Edinburgh. Two days before the match, the pitch and changing rooms at Murrayfield were flooded. The ground staff managed to clear the mess in time for the match but it was touch-and-go for a while. I was expecting another call from Chris. In the event none came; perhaps he felt that he'd already made his point.)

Of course weather in Edinburgh can be good. Take the occasion that Dan Seery and Jim Driscoll visited back last September. They came for a few days to check out facilities, mainly for the technical program - Dan as Institute President and Jim as one of the chairs of the technical program. The weather was glorious and, after the main business was completed, we sampled a few of the many pavement cafes and bars, enjoying the sun and scenery. I think they were impressed by Edinburgh; It certainly felt good to me. Happy days!

Tea/Coffee breaks

Not quite in the same league as some of the above perhaps, but still important. There's always a scramble for tea and coffee at break-time, especially on the first day or so before things settle down. We left Stewart to do most worrying about this. The Edinburgh system is to use self-service trolleys. But we may have to serve 1200 or so people in about 20 minutes. How many trolleys and where best to place them? I also managed to get Dan worrying about this; he was doing back-of-the-envelope sums (20 trolleys for 1200 people in 20 minutes equals 20 seconds per cup). We should just about manage. Then there's the choice of nibbles to accompany the drink. In the USA, they do this in a big way and Boulder served a great selection of accompaniments. Naples was good too. Should we have cakes, buns and pastries? "Dry biscuits" said Stewart, "they're quicker and less messy". He stressed this was based entirely on practical considerations but some of us could feel a Scottish puritanism poking through. "Good quality ones, though" he said; perhaps it was just the practicalities he was concerned about.

Staying in Edinburgh

Organising a conference from a distance makes it essential to place great reliance on phone, FAX and especially e-mails. (How on earth was anything done before e-mails?) But occasional meetings in Edinburgh have been essential. For several of us, this meant overnight stays: very nice, you're thinking and so it is, well usually. But, on the first such occasion, I scanned an Edinburgh tourist web page for a cheap bed & breakfast (we're always trying to keep costs down). There were dozens and dozens listed, so I chose one more or less at random. Next day Phil rang me about accommodation and decided to opt for the same place. Then Stewart rang "I hear you're recommending a place" he said. I stressed it was not a recommendation but he'd be welcome to join us. So the three of us decided to stay at the same place. Oh dear! Well, it was central and it was cheap but it's

hard to find anything else in its favour. Stewart has still not forgiven me for subjecting him to a night of purgatory in the dismal attic. We've moved slightly up-market since then and allowed Clansman to find hotel beds for us. And don't worry - the B&B place doesn't feature in our selected Symposium accommodation.

Choosing the poster image

Although the Symposium is clearly established and well known among devotees of combustion, it is still sensible to advertise widely to attract a good attendance. Also a tradition has grown up for having imaginative posters and related advertising materials. Via Clansman, we employed a graphic designer to help us with this.

We had fun trying to decide on an image for the poster. Clearly one hopes to show off the venue to good effect but we also hoped to have some 'combustion' theme. The obvious thing, especially for millennium year, was a firework theme. We wanted a shot of fireworks over some significant Edinburgh landmark, such as the castle. Edinburgh has a vast collection of photographic images available. A search was made, which turned up several. Although it seems an obvious enough drawback in retrospect, the point only became apparent when we looked at these pictures – fireworks are set off at night; therefore it's dark; therefore the background doesn't show up very well. In fact, the pictures could have been of almost anywhere. Back to the drawing board.

Phil Gaskell proved to be a good person to have around, as he seems to have a keen eye for these things. Near Edinburgh train station is a market area and, on leaving the station on one occasion, Phil noticed someone selling original water-colours of Edinburgh – not in the Turner class but quite imaginative. He spoke to the artist who agreed that, if we bought one, we could reproduce it for the poster. Phil agreed that he would follow it up on the next visit to Edinburgh – but by then the guy had disappeared and we had no contact details. Back to the drawing board again. But Phil was not beaten.

On a train to Edinburgh for another of the Planning meetings, he was browsing through one of those magazines that railway companies provide. There was a nice shot of Edinburgh. Phil had the presence of mind to cut it out; we passed it to Katherine at Clansman, saying "find one like this". She did and that's the image on the poster, web page and Symposium announcements.

Not quite the end of the story.... As is standard practice, we had Edinburgh posters two years ahead at the Boulder Symposium. Paul Ronney's wife was there. She's a teacher of gifted children back in L.A.; she thought the poster might stimulate her class and requested a dozen copies to use as a school resource. You never know - one of tomorrow's combustion researchers might be among her charges.

Getting the sculpture to Edinburgh

Regular Symposium attendees will remember the flame sculpture that is used as a centre-piece of the Symposium venue. It is passed on from one meeting to the next. It stands about 1m high and has a simple LPG diffusion flame licking around a metal structure.

I realised that this would be arriving at some stage but, having received no word from Boulder, lazily decided not to press the issue. Whenever it turned up would be soon enough. But, returning from a family holiday last August, I learned that it was sitting in a warehouse in Liverpool and was starting to attract storage charges of £6 per day shortly to rise to £8. There was an inevitable delay while it cleared customs and the final bill (believe it or not) was £376, including £45 customs clearance and £156 customs VAT. (I still cannot explain the last figure.) It's now sitting in a large wooden box in a lab in the Fuel & Energy Department in Leeds, awaiting transport to Edinburgh. Inside the box, along with

the instructions on how to use it (sort of), are various labels and notes, including one clearly in the name of Numa Manson. I think this means that the sculpture dates back at least to the Poitiers Symposium in 1968. Can anyone confirm this?

Setting the registration fees

Chris Morley mostly had to worry about this one. The Institute's instructions are to base registration costs on breaking even but not deliberately making a large profit (on the other hand, making a loss would be a bigger disaster). One key issue is the expected number of delegates on which to base costs. The only information one has on which to base this estimate comes from previous symposia. Attendance was 1180 at Boulder; 1201 at Naples; 1218 at Irvine but only 627 at Sydney. Are we likely to be up with the 1200's or is a lower figure more appropriate? Suppose some calamity crops up between setting the costs and registration time, so that people decide not to come. On the other hand, if we are too pessimistic and things go well, we'll set the fees higher than necessary. We finally assumed a break-even attendance of 950 delegates but are hoping for 1200+. As I write, numbers are around 1000 (with 300 accompanying guests) and rising nicely.

What else?

A whole range of other issues has arisen: T-shirts for student helpers (how many, what sizes, colours and images?); Symposium banner (how big, what colour; where to place it?); formal letters of invitation to those needing to apply for visas; design of tickets for social events.... The list goes on. I've learned a huge amount about conference organizing and, still with two months to go, I am quite sure my education is not yet complete. I'm looking forward to that drink at the Farewell Reception. See you at there.

David Smith

**DON'T FORGET THE
TWENTY-EIGHTH SYMPOSIUM (INTERNATIONAL) ON COMBUSTION
IN EDINBURGH
30 JULY - 4 AUGUST 2000**

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

EDINBURGH: A Kaleidoscopic View of a Schizophrenic City

When the Editor of this *Newsletter* “suggested” that I write an article “about Scotland and Edinburgh”, I asked him whether he wanted an historical account of Scottish history, a detailed description of Edinburgh à la travel guide, a selection of the more colourful characters associated with Scotland’s capital city or perhaps an overview of the above. “Yes” he said hopefully! I felt a straightforward historical account would be out-of-place in a scientific publication, the “travel guide” approach would pre-empt Clansman Monarch’s programme and no seriously-minded reader of this *Newsletter* would be interested in tabloid-style revelations of people who have lived, loved, killed or have been killed in the “Athens of the North” – would they? Hence this kaleidoscopic impression of Edinburgh.

Edinburgh, Scotland’s capital, dominates the history and imagination of the Scottish nation. Its history was given formal shape in Castle, Palace, New Town and Old: a city home to poets, princes, painters and scientists. It even has a geological history enclosed within its boundaries, for example Arthur’s Seat, an extinct volcano. So it had to grow from its geographical limits, a city built on seven hills, fledging the ridge running between the Castle and Palace with teeming tenements (the first British block of flats) and then tumbling down the surrounding slopes as the population expanded in the 18th Century.

But Edinburgh was never designed. It happened and grew with time and need. Probably the first habitation was a Pictish encampment. Then the Romans arrived staying briefly. After 410 AD when Rome was sacked by the Barbarians and Roman soldiers left the northernmost outpost of the Roman Empire, the Angles came. King Edwin of Northumbria arrived in the 7th Century, giving the settlement its name, according to some historians.

The mention of names leads inevitably to one of the more familiar descriptions of Edinburgh as “Auld Reekie”. How appropriate that in writing for a combustion newsletter reference is made to the unpleasant-smelling pall of smoke and fumes that hung over the town, one reason for the name “Auld Reekie”. Another suggestion for this soubriquet however, refers to the smell of corruption which many felt lay beneath the apparent ultra-respectable, even staid and puritanical aspect of Edinburgh with its fine large and genteel Georgian houses around Charlotte Square. Yet in the narrow, fetid “wynds” in the Old Town characters such as Burke and Hare thrived. Even half a century earlier an upright pillar of the Scottish Kirk, Deacon Brodie, was in reality a depraved murderer and thief. Along the Royal Mile is Deacon Brodie’s Tavern named for this citizen of Edinburgh who was the inspiration for Robert Louis Stevenson’s “The Strange Case of Dr Jekyll and Mr Hyde”. Even the names and phrases describing Edinburgh reveal a schizophrenic nature.

“Auld Reekie” is not the only nickname applied to Edinburgh. The “Athens of the North” is perhaps more famous thanks to its seven hills and the large number of impressive Greek Revival buildings. But, unlike Athens, Edinburgh can be a dark and brooding place especially in the Old Town with sheer walls, gables and turrets. So the “Auld Reekie” image is recalled to mind; a city of dark imagination which, on a grey winter’s day can appear cold and frightening. Yet the American architectural historian, Henry Russell-Hitchcock, described Edinburgh as “the most extensive example of a Romantic Classical city in the world”. So, just as when a kaleidoscope is twisted and different broken images appear, Edinburgh is two cities; Old and New, Romantic and dank, “Auld Reekie” and “Athens” joined together along Princes Street.

Robert Louis Stevenson described the city as “a profusion of eccentricities, a dream of masonry and living rock, my precipitous city”. Edinburgh Castle grows out of a precipice, the Castle Rock, an extinct volcanic plug, indeed it dominates it and the skyline of old Edinburgh. The western face of the Castle Rock is sheer. On the East side a narrow strip

of rock runs steeply down the length of a mile – the Royal Mile. Throughout the last 1000 years people built upon this narrow strip under the Castle's protection. These buildings **were** Edinburgh. Edinburgh Castle is a proper castle with winding stairs, ruined walls, immense ramparts and, on the highest point on the Castle Rock, St Margaret's Chapel, constructed in the 11th Century on the orders of Queen Margaret, the Saxon wife of Malcolm III, Canmore. Margaret was brought up in Hungary, credited with bringing Continental sophistication to Scotland and was renowned for her charity, regularly feeding 300 beggars daily at the castle gates. Her son, David I relocated the Royal Court here from Dunfermline and founded Holyrood Abbey. Later, Robert the Bruce had the Earl of Moray destroy the Castle, but then relented and ordered the restoration of the chapel. It has been restored several times since then, most recently in 1993 to commemorate the 900th anniversary of Margaret's death.

During the Scottish War of Independence the Castle was attacked by Edward I, the "Hammer of the Scots", in 1296 "with engines which cast stones over the walls, sore beating and bruising the buildings within". It fell within a week and Edward later stole the *Stone of Destiny* used to solemnise the inauguration of Scottish Kings at Scone Abbey, but the Stone is now back in Scotland in the Honours of Scotland Exhibition within the Castle's precincts in Crown Square.

In Crown Square also is the Castle Palace with Queen Mary's Apartments, where can be seen the tiny room where Mary Queen of Scots gave birth to James VI of Scotland, later to become James I of England. A small window in the room was opened and the baby was lowered down a vertical drop to be baptised. Mysteries surround this room – who was James' father? Was he Lord Henry Darnley, Mary Queen of Scots' second husband? He narrowly escaped death when an explosion, generally assumed to be the work of the Earl of Bothwell, later to become Mary's third husband, blew up Kirk o' Fields, the house in which Darnley was recuperating from an attack of smallpox. Darnley's strangled corpse was later found in the garden of the ruined house. Perhaps James' father was David Rizzio, Mary Queen of Scots' Italian secretary who was butchered in front of the pregnant queen at Holyrood House, being stabbed 56 times by the jealous Darnley and his accomplices. But then, James closely resembled the son of the Countess of Mar, another close friend of Mary! In 1830, a fire damaged the room in which Mary had given birth to her son and during the restoration work a small coffin was found in the walls. The contents and coffin were put back inside. Whose was the infant body?

Edinburgh Castle and the Palace of Holyrood (Holyrood House) may be separated by the Royal Mile but their history and that of Edinburgh and Scotland are inextricably linked. David I, son of Malcolm III and Queen, later Saint, Margaret founded the Augustinian Abbey of Holyrood in 1128, and a guest-house was included and used as lodgings by Scottish Kings. David is thought to have chosen the site when he fell from his horse as it reared up being confronted by an angry stag. The king looking up from the ground saw a shining cross between the stag's antlers and vowed to found a chapel on the spot.

In 1498 James IV made Edinburgh the capital of Scotland and Holyrood Abbey was extended into a Royal Palace. It was on March 9th 1566 that Rizzio was murdered in the queen's rooms in this Palace. The two rooms at the top of the tower became a shrine to the cult of Mary Queen of Scots and they are probably the most visited rooms in Edinburgh. It was supposedly from this part of the Palace that Mary's son, James, ran down the stairs in his underwear to receive the news brought to him by a messenger, who had covered 400 miles on horseback in two-and-a-half days, that he was now King of England as well as of Scotland. In Holyrood Palace Mary, Queen of Scots was compelled to justify her Catholicism to John Knox, when she first landed in Scotland after her return

from France, but Knox is more associated with the High Kirk of St Giles, founded in the 12th Century and named after the patron saint of cripples, lepers and nursing mothers.

St Giles' interior is mainly 15th Century but its really most illustrious period was the 16th Century when John Knox would regularly preach to more than 3000 people. His first book "The Blast of the Trumpet against the Monstrous Regiment of Women" directed against the rule of the catholic "Bloody Mary" Tudor (Mary I of England) and Mary of Guise (Mary Queen of Scot's mother-in-law) and his second book, "The First Book of Discipline" (laying the foundation of literacy in Scotland) make him sound a joyless martinet, but at the age of 59, he married a seventeen-year-old girl and rode up Canongate in great style with her on their wedding day.

In the pavement just in front of the entrance to St. Giles are a set of heart-shaped stones. These are all that remain to mark the site of the "Heart of Midlothian", Sir Walter Scott's nickname for the Old Tollbooth, the forbidding building that served as council chambers, police station and town jail for several centuries before being demolished in 1817. These stones are the only place in Edinburgh where spitting is allowed – in fact it is supposed to be lucky to do so!

Close to the High Kirk of St Giles (the correct name, not St Giles' Cathedral since bishops were abolished in the Church of Scotland in 1689) is Lady Stair's House built in 1622 by a wealthy merchant. It is now the Writer's Museum celebrating the lives and works of Scott, Stevenson and Burns. The house was named after the beautiful but foul-mouthed, Lady Elizabeth Stair, who lived in the Close, now called Ladystair Close. She suffered badly at the hands of drunken men. She jumped from a window to escape her murderous first husband, Lord Penrose, who immediately left the country where he attempted to remarry. This attempt was foiled by her brother who attacked the would-be bridegroom at the altar. Strangely, Elizabeth knew of this event before her brother returned after seeing it as a vision in a tinker's mirror! Although she vowed never to remarry, she was forced to do so to save her reputation after the Earl of Stair appeared half naked at her prayer window on the High Street. Her second husband was almost as brutal as her first! Close by Lady Stair's house lies Brodies' Close, where in the late 1770s Deacon Brodie, respected town councillor, pillar of the church and the OJ Simpson of his day, lived.

Fifty years after Brodie, Edinburgh buzzed with rumours of the disappearance of many people who had all frequented the Fiddler's Arms public house just before vanishing. Eventually William Burke and William Hare, the infamous "Body Snatchers" were tracked down. These two Irishmen murdered at least 15 people and sold their bodies to the anatomy doctors at Edinburgh University, too interested in research into the human body to enquire about the origin of their ready supply of raw material for their studies! Burke was hanged in 1829 after Hare gave evidence against him. Hare either died a beggar in London in the 1860s or, some believe, made his way to the United States. Partly because of their nefarious deeds, Jeremy Bentham, one of the Humanist founders of University College London, bequeathed his body to medical science thus making it proper and fashionable to do so, ending the necessity for the grisly work of the "Resurrectionists".

But, shake the kaleidoscope again and Edinburgh is revealed to be the birthplace or chosen city of residence for more illustrious people. John Napier, the inventor of logarithms, was born in Merchiston Castle. He spent twenty years perfecting his log tables but fancied himself as an inventor; witness his rudimentary armoured vehicle, fore-runner of the tank and the beginnings of a pocket calculator among some of his ideas. Alexander Graham Bell, another native son who received his early education in Edinburgh, and eventual inventor of the telephone, developed a speaking machine with his father, using a lamb's larynx and parts of a human skull, which succeeded in saying "mama".

Perhaps the greatest British philosopher. David Hume, was born in Edinburgh and retired there, but the university which educated him refused him a chair and he became the Keeper of the Advocates Library, earning a pittance. He had to travel abroad to receive the recognition his work deserved. *O tempora, o mores!*

Every time a bank note is used the financial whizz-kid, John Law, should be remembered for he was the first to propose the use of paper money boasting that he could turn paper into gold! A colourful economist (is this a contradiction in terms?) he was a goldsmith, banker and scientific gambler (another contradiction?). He killed a love rival in a duel, was sentenced to death, pardoned, re-imprisoned and then escaped. Recaptured, he escaped once more and journeyed to Holland, Genoa and Venice, speculating in foreign currencies and picking up a wife on the way! Some colourful 20th Century politicians spring to mind in parallelling his life but the laws of libel prevent the writer from naming them! France adopted Law's scheme for a national bank in 1716 and he became a French national. By now, very wealthy through his involvement with the French East India Company, he ordered the construction of what was to become New Orleans. After becoming Controller General of Finance for France he lost all in the French economic collapse and died in poverty in Venice.

A more staid, perhaps more typical citizen of Edinburgh (although he was stolen by gypsies at the age of three) was Adam Smith, author of "The Wealth of Nations". He is considered to be the father of modern economics, expounding the concepts of the division of labour and also *laissez-faire*.

A mere roll-call of the poets and writers born or choosing to spend time in the "Athens of the North" should make a bibliophile's mouth water. Daniel Defoe, Allan Ramsay, James Boswell, Sir Walter Scott, Percy Bysshe Shelley, Thomas de Quincy, Thomas Carlyle, Robert Louis Stevenson, Sir Arthur Conan Doyle (who modelled Sherlock Holmes on his medical tutor, Dr Joseph Bell) right up to modern-day writers such as Muriel Spark. Her wonderful creation, Miss Jean Brodie, was inspired by the pupils and teachers of the girls' school Muriel Spark attended. She said that she could always spot a fellow ex-pupil from their use of the semi-colon and the utterance of "nevertheless" said with "pursed lips and rhyming with lace". This list must also include the wonderfully awful poet, William McGonagall, now achieving cult status as the world's worst poet.

Lack of time and space means the briefest of mentions for Greyfriars Bobby, the faithful dog whose statue can be seen outside Greyfriars Kirkyard, the Lincoln Memorial built in 1893 to honour Scottish-American soldiers who died in the American Civil War, or the fact that in 1842 Edinburgh had 200 brothels, whose business peaked at the time of the annual reunion of the General Assembly of the Church of Scotland!

Edinburgh truly is a schizophrenic city!

The last word goes to a **Glaswegian** poet, Alexander Smith, who in uncharacteristically generous spirit, described Edinburgh as a city where ***"there abides, above all things, a sense of its beauty the New (Town) is there looking at the Old. Two times are brought face-to-face and are yet separated by a thousand yearsThere is nothing in Europe to match that"***

June Burgess

UNWANTED COMBUSTION

Those who earn a modest living trying to improve the efficiency of combustion and its associated devices, and investigating why it works anyway, should spare an occasional

thought for colleagues trying to put fires out. Maybe the improvers lie awake at night worrying about others less fortunate; or maybe they have more interesting things to do. As an antidote to insomnia the detailed statistics of all 850,000 fires annually in the UK are recommended by those required to work with them. In book form the full figures would not have the discursive narrative of Whitaker's Almanack, the idealism of a railway timetable, or the remorseless logic of tables of logarithms.

But the Home Office kindly produce an annual summary bulletin, from which indications of current British lifestyles can be gleaned. The latest bulletin covers fires in 1998, single copies of which are available **free** [1]. Pensioners should appreciate the generosity. They need to know because there is a link between age and the probability of dying in a fire. After taking account of the age distribution of the population, the probability of being a fatal casualty shows a bimodal distribution. If placid middle age is taken as the baseline, then children age 1-5 years are 1.4 times more likely to be fatalities. No doubt the result of mobility mixed with lack of discretion. But those over 80 years are 3.6 times more likely to die from fire. Possibly the result of immobility mixed with lack of discretion. This general pattern has existed for many years, so the elderly should be extra vigilant if they want to outwit the actuaries. In 1998 an estimated total of 643 persons died from fires, mainly in dwellings, which means that the death rate per million population had fallen steadily by about 30% over the preceding decade. Back in the early 1970's about 1000 persons died annually from fires. So we are moving in the right direction, probably with some contribution from research, but the annual death toll from unwanted combustion is diminishing reluctantly.

The figures for non-fatal casualties, in fires attended by public fire brigades, are much less comforting. Over the previous ten years the number has increased by about 47% to over 18 000, again mainly in dwellings. The main increase has been by inhalation of gas or smoke, and not by burns which have decreased to less than 2 000, but the picture is made more complex by an increasing tendency to take precautionary medical checks.

But what are the main sources of ignition for fatal and non-fatal fires in dwellings? For fatal fires it is smoking materials (don't smoke in bed), and for non-fatal fires cooking appliances get the blame. Electric cookers cause about twice as many fires as gas cookers (they have done so for many years). In general, household appliances are themselves reasonably safe, it is their misuse that leads to trouble. This is the case with potato chip/fat pan fires, which represent about 30% of the total. So be careful when frying, stay awake, and think what to do if the pan ignites; turn off the heat supply and cover the pan with its lid or a wet cloth. Do not throw a bucket of water over it. One volume of water will generate more than 1,500 volumes of steam and burning oil aerosol! If the fire does not subside go outside, close the door, and call the fire brigade. For those people affluent enough, the invention of oven chips is welcome, as they neatly sidestep the problem. A benefit not mentioned in chip advertisements (...don't be burned to a crisp...).

Apart from taking care with combustion, what else can the householder do? Install smoke alarms and **keep them in working order**. In 1998 it is estimated that 82% of households had at least one smoke alarm, up from only 8% in 1988. Smoke alarms provide earlier discovery of fire, are associated with lower casualty rates, and lead to less fire damage. The commonest smoke alarms contain a speck of americium as the active component; americium is an α -emitter which generates a micro-current. Smoke particles interfere and the reduction in current causes the alarm to sound. But even smoke alarms can cause problems. In September 1999 silver was being reclaimed from old detectors, in a laboratory at Harwell. Staff were evacuated within a 100-metre radius, and a local school closed, because of the build-up of unstable silver compounds in a flask [2]. Radioactivity

was not involved. Chemical details of the incident were not reported, but although the silver compound did not in fact explode the management probably fulminated.

Designers of detectors still have challenges ahead. Melanophila beetles are able to detect pine forest fires many kilometres away [3]. They seem to do it by a combination of infra-red and chemical detection of combustion products, and as they are only 1 cm long they carry a lot of technology. When this is elucidated even better detectors might be available.

Of course not all fires are accidental; some are malicious and, if with criminal intent, are arson. About one fifth of all fires in dwellings are malicious, compared with more than 40 per cent of fires in other buildings. Malicious fires cost insurance companies more than £1 million per day. There is hope: the numbers of fires are tending to fall. Sheds, garages and schools are particular targets. Cars show a dichotomy. Three quarters of accidental fires start in the engine compartment, whereas 84% of malicious fires start in the driver/passenger compartment. There is an additional reason for visiting areas of outstanding natural beauty: working out how the abandoned cars were destroyed.

Meanwhile the Edinburgh Symposium looms. The Scots seem to have a particular affinity for combustion. Per million population they have about 50% more fire casualties than England and Wales, and they have kept this up for many years. Indeed back in 1528 an Edinburgh bookseller was burned at the stake for importing the works of Martin Luther, on direct orders of the Scottish Parliament [4]. The punishment seems to have been discontinued, unless the statistics are concealed in Scotland/Outdoor fires/Fatalities =17. But the Scottish Parliament was re-established in 1999, so if attending the Symposium and carrying books, hurry past any large heaps of logs.

The fire statistics are published in order to provide information for informed debate, and to provide data for future use. Is there cynical humour in the proposal that the more information that is available the more balanced the arguments become? Not all victims of pressure groups would agree. There is certainly a vein of humour in the upper strata of Public Administration. An example from the top stratum in the Treasury was a retirement present for a Permanent Secretary from colleagues - a picture of a rhinoceros - and inscribed "I may have my faults, but being wrong is not one of them."

A maxim that is deserving of wider application, may be even in the domestic arena.

On second thoughts, perhaps not.

Ken Palmer

References

1. Watson, L., and Gamble, J., Fire Statistics United Kingdom 1998, Home Office Statistical Bulletin, Issue 15/99, 1999. ISSN 0143 6384.
2. New Scientist, 25 September 1999, page 23.
3. New Scientist, 7 August 1999, page 36.
4. Davies, N. The Isles - A History. Macmillan. London, 1999, page 462.

COMBUSTION IN THE ROTARY KILN

Industrially, many minerals are processed into valuable product in the high temperature rotary kiln. Typical examples are the manufacture of cement, lime, alumina and a broad range of ferrous and non-ferrous metals and oxides. These are all direct-contact processes with the flame exposed to the material being processed and the dominant form of heat transfer being by radiation. Air preheat levels are high, typically in the range 500 to 1000°C, and consequently lead to very high flame temperatures resulting in the required effective radiative heat transfer. Dependent on the process, kilns vary in length between 25 and 150m, rotate between 1-5 rpm, have wide ranges of air, secondary air preheat and primary air percentages employed, and fire an extremely wide range of fuels. One common feature, however is that all these processes, when conducted in the rotary kiln the flame result in direct thermal, chemical and aerodynamic interface with the material to be processed, and this has very important consequences with respect to process optimisation.

Dependent on the location of the particular plant, location of fuel reserves and road, rail, sea or pipeline links, the range of fuels fired can vary widely. Also there are process restrictions on which fuels can be fired to avoid unnecessary contamination of the product with products of incomplete combustion or complete combustion residues such as ash.

The matching of the combustion process, particularly the heat flux and aerodynamic flow profiles with the requirements of the material being processed is also critical. A mismatch can cause the production of unsaleable product or severe damage to the kiln lining.

However, the largest manufactured product in rotary kilns in the world today is cement. Worldwide (excluding China) some 1,209 million tonnes of cement clinker was produced in 1997, mainly in rotary cement kilns. In China, official production figures amounted to over 500 million tonnes in 1996 for mini, medium and large cement plants. Cement clinker is manufactured in a range of rotary kiln designs with the flame direction counter-current to the flow of the process material.

The oldest rotary kiln technology for cement manufacture in Europe is the wet process. This technology is rarely newly-built today because of the high heat requirement (6300-7800 kJ/kg cement clinker). There are however, many wet-process kilns still in use. In North America long dry kilns were introduced, rather than wet, due to feed material properties and many of these kilns are still in use.

The traditional wet processes call for the preparation of homogeneous slurry containing about up to 40% water. Wet kilns are normally fitted with slurry heat exchangers, which are usually suspended chains that are heated by the kiln flue gases. Due to their large surface area, the chains act so as to evaporate effectively the water and break up the resulting cake into a nodular dry material. The subsequent calcining and clinkering reactions take place in the calcination and burning zone of the kiln. The clinker commences to cool down in the burner end of the kiln and falls into the cooler, where it is cooled by ambient secondary air which is preheated by direct contact with the cooling clinker. Wet process kilns can be up to 130m in length.

To meet the wet preparation requirements in a more energy efficient manner the semi-wet process was introduced. In the semi-wet process, a slurry with up to 40% moisture is produced. The slurry is subsequently de-watered resulting in a filter cake containing about 20% moisture. The filter cake is pelletised and introduced onto a travelling grate preheater where the feed pellets are dried and partially calcined by direct contact with the hot kiln exit gases. The main calcining and clinkering reactions take place in the kiln.

A further variant is the semi-dry process. Here, dry raw materials are homogenised and formed into pellets by the addition of small amounts of water (circa 12%) on a dish noduliser. The pellets are distributed onto a grate preheater system (Lepol Grate). The kiln exhaust gases pass through the grate thus drying, and in some cases, partially calcining the feed material prior to being feed to the kiln. Semi-wet and semi-dry kilns are of similar length to wet process kilns as nearly all of the processing is occurring in the kiln itself. Typical specific fuel consumptions of semi-dry process kilns are around 4000 kJ/kg.

A further development in process design is the dry-process. This represents the major share of kilns now in use. In the dry process the raw materials are dried and homogenised into a dry raw feed material. There are two main dry processes; those using suspension preheaters alone and those using preheaters combined with a precalciner.

Early developments used preheater systems that typically consisted of a series of cyclones. Within the preheater cyclones, the raw material is preheated and a degree of calcination takes place by heat transfer with the hot kiln exhaust gases. In a precalciner system a high level of calcination takes place in the precalciner where some 50/60% of the fuel input is fired into the precalciner. The partially processed material then enters a comparatively short rotary kiln where the final calcination and clinker-formation reactions take place. Specific fuel consumptions of dry-process kilns are in the range of 3500-3800 kJ/kg for kilns equipped with suspension preheaters and 3100-3400 kJ/kg for those equipped with precalciners.

The strategy behind the design of rotary kiln firing systems is to reduce energy consumption, ensure stable kiln operation, ensure consistent clinker quality is produced and ensure reducing conditions do not exist within the burning zone where the main clinkering reactions take place. It is also important to ensure refractory life is not compromised and for kilns fired with pulverised coal, to ensure that an optimum ash deposition pattern is achieved to encourage homogeneous incorporation of the ash within the clinker and prevent ash ring formation.

Gas, oil, petroleum coke, and a range of waste materials are also regularly fired. Worldwide however, coal is the most widely used fuel and a wide range of systems exist for the drying and milling of coal prior to firing into the kiln. The primary firing techniques are described below.

The simplest and historically the most common firing system is the direct-fired system. Here, the coal is dried, pulverised and classified in a continuous system. The hot primary air from an air heater or from the clinker cooler is used to dry the coal and the amount or percentage is dictated by the drying requirements of the fuel and the type of mill used. This can lead to high levels of primary air (up to 40% of stoichiometric). These high levels of primary air limits the amount of secondary air introduced to the kiln from the clinker cooler. Burners for direct-fired systems are typically open-ended pipes known as mono-channel burners.

Primary air percentages and momenta vary widely throughout the industry in an effort to optimise and match the burner aerodynamics to that of the kiln. Non-optimised matching can cause severe operational problems with regard to creating reducing conditions on the kiln wall and clinker, refractory wear and reduced efficiency due to having to run at high excess air levels to ensure effective burnout of the fuel within the kiln. In a direct-fired system the coupling between the mill and burner means that a mill shutdown invariably will result in loss of the kiln production.

To overcome some of the operational problems of direct-fired systems and to give more

effective combustion control, semi-direct fired systems were developed. These systems are essentially variants of the direct-fired system. Here all the air from the mill passes to the burner but the pulverised coal is de-coupled from the primary air via a cyclone or bag-house system and reintroduced and separately metered downstream of the mill fan. Burners used in these systems are also typically of the mono-channel design.

In more modern cement plants indirect fired systems are most commonly used. In these systems, neither primary air nor coal is fed directly to the kiln. All moisture from coal drying is vented to atmosphere and the pulverised coal transported to storage via cyclone or bag filters. Pulverised coal is then densely conveyed to the burner with a small amount of primary transport air.

Burners used in these systems are usually of a multi-channel design with further clean primary air entering the burner through a number of two annuli concentric with the coal channel. One of the channels is conventionally swirled to create an internal recirculation zone (IRZ) to aid flame stability

As the primary air supply is decoupled from the coal mill in multi-channel designs lower primary air percentages are used, normally between 5 and 10%. The multi-channel arrangement also allows for a degree of variation in the mass flows and velocities to the various streams comprising the multi-channel design and allows for a degree of flame optimisation. This is an important feature if a range of fuels is fired.

Similar to the mono-channel design, input conditions to the multi-channel burner must be optimised to secondary air and kiln aerodynamics if optimum operation is to be achieved.

NO_x is becoming of increasing concern in the cement industry as IPC legislation will certainly regulate NO_x emissions. This is expected to pose operational problems. The cement manufacturing process requires high flame temperatures (above 2000°C), an optimised heat flux profile in the kiln and efficient heat recovery from the final cement clinker. The consequence of these requirements is that thermal NO_x dominates the NO_x formation process. Even with coal that has a significant fuel NO_x contribution, thermal contributes often over 80% to the overall emission.

We all know that to reduce thermal NO_x requires reduction in flame temperature and/or a modification in heat flux profile which can only be expected to compromise cement production rate, product quality and process efficiency without careful optimisation. Injection of recycled cement kiln dust – if this is a possibility, offers an option in terms of increasing the thermal ballast in the flame and increasing radiative heat transfer, both reducing flame temperature. Low-NO_x burners are available with varied levels of success reported, mid-kiln injection – normally of recycled tyres offers the possibility of creating an environment for in-kiln fuel staging. Fuel staging in the precalciner for processes equipped with this component is also a possibility as is back end clean-up options such as SCR and SNCR. However, all these techniques (and there are other possibilities) may cause process optimisation difficulties that need to be addressed. These issues should be resolved by sensible discussion between the Cement Industry and the Legislative bodies. Also very little research is sponsored by government bodies into combustion optimisation and NO_x reduction and the authors can only encourage that this area be considered more favourably when research grants are awarded in the future.

John Smart and Barrie Jenkins

COMBUSTION CALENDAR

2000

JULY 2000

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. Programme available at <http://in3.dem.ist.utl.pt/lisboa-laser>

18 JULY

London, England. ENVIRONMENTAL MATHEMATICS WORKSHOP. Organised by the Natural Environment Research Council (NERC) and the Engineering and Physical Sciences Research Council (EPSRC), the key output of the workshop will be ideas for inclusion in a proposal to NERC and EPSRC for a jointly funded programme in 'Environmental Mathematics'. Details: Sheila Drury, NERC, Polaris House, North Star Avenue, Swindon, SN2 1EU, Tel: (01793) 411611, Fax: (01793) 411502, e-mail: sdru@nerc.ac.uk, web: www.nerc.ac.uk/science/whatsnew.htm

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: (01223) 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, SKS4S 0A2, Canada. Tel: (306) 585 4363, Fax: (306) 585 4855, e-mail: peter.catania@uregina.ca, web: <http://www.energysource.com/ief/updates/>

30 JULY

Edinburgh, Scotland. SECOND INTERNATIONAL WORKSHOP ON CHEMKIN IN COMBUSTION. A forum for exchanging ideas and exploring new directions, to be held immediately before the Combustion Symposium. Details: Kimberly Whitaker, Sandia National Laboratories, Mail Stop 9056, Livermore, CA 94551-0969, USA. Tel: (925) 294 2014, Fax: (925) 294 2276, e-mail: chemkin@ca.sandia.gov, web: <http://www.ca.sandia.gov/chemkin/workshop/>

30 JULY-4 AUGUST

Edinburgh, Scotland. TWENTY-EIGHTH SYMPOSIUM (INTERNATIONAL) ON COMBUSTION. See the Symposium website at <http://www.efm.leeds.ac.uk/edin2000/>
See also this *Newsletter*

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

13-18 AUGUST

Cesme, Turkey. INTERNATIONAL CENTER FOR HEAT AND MASS TRANSFER - THE TURBINE 2000 MEETING co-sponsored by ASME. Details: R J Goldstein, University of Minnesota, Department of Mechanical Engineering, 111 Church Street SE, Minneapolis MN 55455. Tel: ++1 612 625 5552, Fax: ++1 612 625 3434, e-mail: rjg@me.umn.edu, web: <http://ichmt.me.metu.edu.tr/upcoming-meetings/Turbine-2000/announce.html>

SEPTEMBER 2000

3-6 SEPTEMBER

Edinburgh, Scotland. FIRE SCIENCE AND FIRE INVESTIGATION. A short course. Details: Office of Lifelong Learning, The University of Edinburgh, 11 Buccleuch Place, Edinburgh EH8 9LW, Scotland. Tel: ++44 (0)131 651 1180, Fax: ++44 (0)131 651 1746, e-mail: lisa.ellis@ed.ac.uk

4-5 SEPTEMBER

Cranfield, Bedfordshire, England. ATOMISATION AND SPRAYS. A short course. Details: Mary Howard, CPD Administrator, School of Mechanical Engineering, Cranfield University, Cranfield, Bedford MK43 0AL, England. Tel: ++44 (0)1234 754644, Fax: ++44 (0)1234 750728, e-mail: m.howard@cranfield.ac.uk, web: www.cranfield.ac.uk/sme

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

11-13 SEPTEMBER

Darmstadt, Germany. 26TH ANNUAL CONFERENCE ON LIQUID ATOMIZATION AND SPRAY SYSTEMS (ILASS 2000). Details: Sekretariat ILASS2000, FG Strömungslehre und Aerodynamik, Technische Universität Darmstadt, Petersenstrasse 30, 64287 Darmstadt, Germany. Tel: ++49 (0)6151 16 2854 or 3354, Fax: ++49 (0)6151 16 4754, e-mail: ilass@sla.tu-darmstadt.de

11-15 SEPTEMBER

Pittsburgh, PA, USA. SEVENTH ANNUAL PITTSBURGH COAL CONFERENCE – ENERGY AND THE ENVIRONMENT. Details: Pittsburgh Coal Conference, University of Pittsburgh, 1130 Benedum Hall, Pittsburgh, PA 15261, USA. Tel: (412) 624 1480, Fax: (412) 624 1480, e-mail: pcc@engrng.civ.pitt.edu, web: www.engrng.civ.pitt.edu/~pccwww

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

18-22 SEPTEMBER

Leeds, Yorkshire, England. FIRE AND EXPLOSION PROTECTION AND INVESTIGATION. 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: cpd.speme@leeds.ac.uk, web: www.leeds.ac.uk/fuel/shortc/sc.htm

20-21 SEPTEMBER

Leeds, Yorkshire, England. COMBUSTION MODELLING AND VERIFICATION. A joint meeting of The Combustion Institute (British Section) and The Combustion Physics Group of The Institute of Physics. The AGM of each group will be held during this meeting (contact the Hon Secretaries of each group for details of each AGM). Details: John Griffiths, School of Chemistry, University of Leeds, Leeds LS2 9JT. Tel: ++44 (0)113 233 6462, Fax: ++44(0)113 233 6565, e-mail: johng@chem.leeds.ac.uk or Alison Whiteley, CPD Unit, SPEME, University of Leeds, Leeds LS2 9JT. Tel: ++(0)113 233 2494, Fax: ++44 (0)113 233 2511, e-mail: A.Whiteley@leeds.ac.uk

25-26 SEPTEMBER

Leeds, Yorkshire, England. INCINERATION OF MUNICIPAL WASTE. 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: cpd.speme@leeds.ac.uk, web: www.leeds.ac.uk/fuel/shortc/sc.htm

25-28 SEPTEMBER

Joensuu, Finland. INTERNATIONAL CONFERENCE ON WOODY BIOMASS AS AN ENERGY SOURCE – CHALLENGES IN EUROPE. Details: Brita Pajari, European Forest Institute, Torikatu 34, FIN-80100 Joensuu, Finland. Tel: ++358 13 252 0223, Fax: ++358 50 359 0362, e-mail: brita.pajari@efi.fi

26-28 SEPTEMBER

Leeds, Yorkshire, England. POLYMERS AND TEXTILES IN FIRES. 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: cpd.speme@leeds.ac.uk, web: www.leeds.ac.uk/fuel/shortc/sc.htm

OCTOBER 2000

23-25 OCTOBER

Madrid, Spain. COALTRANS 2000. Details: Coaltrans Conferences Ltd., Nestor House, Playhouse Yard, London EC4V 5EX, England. Tel: ++ 44 (0)20 7779 8945, Fax: ++44 (0)20 7779 8946, e-mail: coaltrans:euromoneyplc.com, web: www.coaltransconferences.com

NOVEMBER 2000

1-2 NOVEMBER

London, England. COMPUTATIONAL AND EXPERIMENTAL METHODS IN RECIPROCATING ENGINES. Details: Uloma Otuonye, Conferences and Events Department C587, Institution of Mechanical Engineers, 1 Birdcage Walk, London SW1H 9JJ, England. Tel: ++44 (0)20 7304 6864, Fax: ++44 (0)20 7222 9881, e-mail: u_otuonye@imeche.org.uk

5-10 NOVEMBER

Santa Fe, New Mexico, USA. LEAN COMBUSTION TECHNOLOGY AND ITS CONTROL. Details: United Engineering Foundation Conferences, 3 Park Avenue, 27th Floor, New York, NY 10016-5902, USA. Tel: ++1 212 591 7836, Fax: ++1 212 591 7441, e-mail: engfnd@aol.com, web: www.engfnd.org

27 NOVEMBER-1 DECEMBER

Leeds, Yorkshire, England. SPARK IGNITION ENGINE 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: cpd.speme@leeds.ac.uk, web: www.leeds.ac.uk/fuel/shortc/sc.htm

28 NOVEMBER-1 DECEMBER

Beijing, China. 2000 CHINA INTERNATIONAL ENVIRONMENT, RENEWABLES AND ENERGY EFFICIENCY EXHIBITION AND CONFERENCE. Details: CERE'2000 Secretariat, 1 Sandaojie, Jianguomenwai, Beijing 100022, PR China. Tel: ++86 10 6515 7760 / 5027, Fax: ++86 10 6515 8442, e-mail: cisc@midwest.com.cn, web: www.ciscexpo.orgcn.net

DECEMBER 2000

4-6 DECEMBER

London, England. TWENTY-FIRST CENTURY EMISSIONS TECHNOLOGY. Details: Stephanie Love, Conferences and Events Department C588, Institution of Mechanical Engineers, 1 Birdcage Walk, London SW1H 9JJ. Tel: ++44 (0)20 7973 1312, Fax: ++44 (0)20 7222 9881, E-mail: s_love@imeche.org.uk, web: www.imeche.org.uk

2001

MAY 2001

20-25 MAY

Palm Cove, Queensland, Australia. INTERNATIONAL CENTRE FOR HEAT AND MASS TRANSFER, SECOND SYMPOSIUM ON ADVANCES IN COMPUTATIONAL HEAT TRANSFER (CHT'01). Details: Professors Graham de Vahl Davis and Eddie Leonardi, CFD Research Laboratory, The University of NSW, Sydney, NSW, AUSTRALIA 2052. Tel: ++61 2 9385 4099 or ++61 2 9385 4252, Fax: ++61 2 9663 1222, e-mail: cht01@cfm.mech.unsw.edu.au, web: <http://cht01.mech.unsw.edu.au>

MAY 29 – JUNE 1

New Orleans, LA, USA. SYMPOSIUM ON SEPARATED AND COMPLEX FLOWS III: THE ASME FLUIDS ENGINEERING SUMMER MEETING. Details: Prof. Brian E. Thompson, Dept. of Mech, Aero and Mech., Jonsson Eng. Center 2049, Rensselaer Polytechnic Inst. Troy, NY 12180-3590, USA. Tel: ++1 518 276 6989, Fax: ++1 518 276 6025, e-mail: thompson@rpi.edu

SEPTEMBER 2001

30 SEPTEMBER-5 OCTOBER

San Francisco, CA, USA. 11TH INTERNATIONAL CONFERENCE ON COAL SCIENCE: EXPLORING THE HORIZONS OF COAL. Details: David A Clarke, Power Technology, Radcliffe-on-Soar, Nottingham NG11 0EE, England. Tel: (0115) 936 2452, Fax: (0115) 936 2363, e-mail: dave.clarke@powertech.co.uk

OCTOBER 2001

14-19 OCTOBER

Antalya, Turkey. INTERNATIONAL CENTRE FOR HEAT AND MASS TRANSFER SYMPOSIUM ON VISUALISATION AND IMAGING IN TRANSPORT PHENOMENA (VIM'01). Details: e-mail: arinc@metu.edu.tr, web: <http://ichmt.me.metu.edu.tr/upcoming-meetings/Vim-01/announce.html>

DON'T FORGET THE

TWENTY-EIGHTH SYMPOSIUM (INTERNATIONAL) ON COMBUSTION

IN EDINBURGH

30 JULY - 4 AUGUST 2000

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