No. 36 **January 2003**

NEWSLETTER

of the

Coal Research Forum

Edited by: Dr Svenja Hanson

HAPPY NEW YEAR 2003

to all members of the CRF
and other readers of the Newsletter

EDITOR'S COMMENTS:

Welcome to the 36th edition of the CRF Newsletter, and a Happy New Year to all readers. I am afraid this January 2003 edition does not quite measure up to some previous ones in volume. Could our regular contributors have had their minds on other matters recently? Well, I'll certainly be off to do my Christmas shopping as soon as this file has been saved. With no Forum meetings since the hugely successful September 2002 conference, nor any other major coal research events in the UK I am aware of, it was not easy filling this edition. All the more reason to be enormously grateful to Professor Jim Williamson, who very kindly gave permission for an abridged version of his BCURA lecture to be included. I hope you will enjoy reading it as much as I enjoyed attending the lecture!

Contact Details:

David McCaffrey

The Coal Research Forum
P.O. Box 154
Cheltenham
GL52 5YL

Tel: 01242 236973
Fax: 01242 516672
E-mail: coalresearch@coalresearchforum.org
Website: http://www.coalresearchforum.org

Dr S Hanson
SChEME
University of Nottingham
Nottingham
NG7 2RD
Tel: 0115 9514198
Fax: 0115 9514115
e-mail:
svenja.hanson@nottingham.ac.uk

Student Bursaries for the 2003 ICCS

It seem a bit early to start thinking about this years International Conference on Coal Science, which, after all, does not take place until November. But saying this, the deadline for submitting abstracts is the 1st of February, so, if you want to present your work to fellow coal researcher from all over the world in lovely, warm Queensland (when it is cold and wintry again on this hemisphere) it is high time to get moving. Details, including the website to visit for downloading the electronic submission form for abstracts, are included in the calendar. The Coal Forum realises that attending such a conference at a far-away venue is not easy to finance, especially for students, and would like to help. **Up to 6 travel bursaries for up to £250 are on offer to bona-fide full-time students wishing to attend the ICCS 2003. To apply, the abstract submitted to the conference with a brief supporting letter from the students supervisor, should be sent to the Coal Forum as soon as possible**. The bursaries come with no obligations to the recipient other than to supply a short essay about his or her impressions of the conference to the Newsletter for inclusion in the January 2004 edition.

51st BCURA Coal Science Lecture
The Royal Institution, London, 14th October 2002

The BCURA Coal Science Lecture was back at the Royal Institution this year, after last years brief interlude, the joint venture with the Combustion Engineering Association. For the full experience of a tradition in scientific excellence it truly is hard to beat; if anything, the past can become almost a little over-bearing. Although, if Professor Williamson suffered from such sentiments, it did not show. He certainly got into the spirit of the venue and at times it almost felt like we were being treated to one of the popular Christmas Lectures. I was later told that this was the first time for 'live chemistry experiments' to feature in a BCURA Coal Science Lecture; and the flames, smoke and controlled mini-explosions were a big hit with the audience. But before I convey the wrong impression, the lecture was anything but trivial. It took us from the historical perspective on coal use, through all the recent and current environmental issues to the future prospects for coal. Prof. Williamson has kindly granted permission to include a shortened version of his excellent lecture in the Newsletter:

"Recent Advances in Coal Science and their Applications",
by Professor Jim Williamson, ICSMT

" ….. Worldwide use of coal now exceeds 4 billion tonnes per annum and production increases at a rate of 2 to 3% each year. Almost half this coal is used to produce electricity. The best estimates, for example the predictions made by the IEA, indicate a continued growth in coal usage for the next 50 years, with much of the increase coming from the developing countries such as India and China. Yet, in the UK, and indeed throughout much of the industrialised world, coal faces an uncertain future.

In the UK, there can be few industries that have seen such change in recent years as the coal and generating industries. I should like to show you how coal scientists have responded to the changing scene, and I hope that I can demonstrate that coal science, or to be more exact, how our knowledge of different coals, their combustion and gasification behaviour, has developed to meet the challenge that the industry faces today.

By 1990, global warming and the problems of emissions associated with burning fossil fuels had been widely accepted. Emissions of NO_x and SO_2 gases were the known precursors of acid rain and CO_2 became labeled as the major greenhouse gas. The potential environmental hazards from the trace elements and heavy metals known to be present in coals, albeit in small quantities, were also recognised. Environmental concerns became the issues of the day, with the introduction of legislation on emissions for new and established coal burning power stations. The introduction of any new technology demands an even greater understanding of the materials and the processes that you are dealing with. I have chosen six areas to look at; these are the control of NO_x and SO_2, carbon in ash, ash slagging and fouling, trace elements in coal, the modelling of coal combustion and the future for coal:

NO_x and SO_2

Methods for reducing NO_x and SO_2 emissions have received considerable attention and the technology here is now mature and the costs of retrofitting these systems has fallen considerably in recent years. Scrubbing the flue gases with a slurry of limestone in water can remove 90% or more of the SO_2, to give $CaSO_4$, a product that can be used to replace natural gypsum in the manufacture of plasters and wallboards. Drax was the first power station to have FGD installed and now three of our largest power stations have flue gas desulphurisation units. A further 7 power stations have units planned or under construction. This means that 14 GW of coal-fired generation will meet the internationally agreed emission limits for SO_2, allowing us to burn up to 40m tonnes of coal each year at these plants.

Reducing NO_x emissions has required a much more detailed knowledge of the combustion process and the way in which NO_x is formed. Nitrogen is present in both the coal and the combustion atmosphere. All our power stations have been fitted with low NO_x burners, in which the combustion gas is introduced in stages to the flame so that the initial conditions are reducing, to allow NO_x already formed to be reduced back to nitrogen. Flame temperatures are lower than conventional combustion conditions and this reduces the amount of thermal NO_x produced from N in the atmosphere.

When low NOx burners have been fitted, emissions of NO_x are less than half those from conventional combustion systems. Other techniques are available for reducing the NO_X levels even further by introducing additional fuel to the boiler, either gas or coal, above the flame. These systems are known as “coal-on-coal” or “gas-on-coal” combustion. Additionally, injection of NH_3 into the flue gas or the use of Ni-based catalysts can bring the NO_x levels down to very low levels.

Our own work in this area has been directed to improving the methods for predicting how much NO_X will form with a given coal. The analysed N content of a coal and the fuel ratio give little more than an indication of how much NO_x will form. Dr Jon Gibbins, with support from the EPSRC, BCURA and industry has developed a High Temperature Wire Mesh Reactor for the very rapid heating of coal particles. Heating rates of 10^4-10^5°C/s to temperatures of 1800°C or more provide heating rates that are similar to those experienced by coal particles in a flame. It has been shown that the essential feature with regard to the amount of NO_X that forms is the rate at which the volatile matter from the coal is evolved and the amount of N that remains in the char when devolatilisation is complete. The development of techniques such as the heated wire mesh reactor have been invaluable in characterising the large range of coals that are now on the market.

Carbon in Ash

The introduction of low NO_X burners lead to an increase in the amount of unburned carbon in the fly ash. This increase represents a reduction in the thermal efficiency of the combustion process and in some cases the ash was no longer suitable for sale as a cement replacement material. Dr Gibbins and I were intrigued to know more about the nature of the unburned carbon. Could the level of unburned carbon be predicted for a given coal and set of combustion conditions? A BCURA funded project enabled us to establish that much of the unburned carbon had a low chemical reactivity. We then had to examine in more detail the components of the coal and the reactivities of the char formed from the macerals on devolatilisation. Coal petrologists have an extensive list of the various components that make up a coal, each category reflects a different plant origin or the conditions under which the coal has been formed. Vitrinite and liptinite, the most common macerals in UK coals, form porous char structures which are much more reactive than the chars formed from inertinite. But if vitrinite chars are heated to a sufficiently high temperature, a structural reorganisation takes place that lowers their chemical reactivity to the same level as that of the char found in a power station ash. We needed further confirmation that these transformations could actually occur. Dr Nigel Russell, again with support from BCURA, looked more closely at the effects of thermal annealing of chars. He used a technique known as High Resolution Transmission Electron Microscopy to achieve magnifications of 10^6 to 10^7 times and was able to follow the change from an amorphous carbon structure to an ordered graphitic one in chars made from a high vitrinite content coal. This was the evidence that we were after. We knew that a char with a graphite-like structure would have a lower free energy and would therefore be less reactive.

Ash Slagging and Fouling

Slagging and fouling of boilers from mineral matter in the coal has always been a major operational problem. Deposits that build up on heat transfer surfaces act as an insulating layer, reducing heat transfer and therefore the thermal efficiency of the boiler. Flue exit gas temperatures increase with ash deposition, so that ash particles that should have been solid when they left the boiler can still be sticky and can deposit in the convective passes of the boiler. Large accumulations of slag, sometimes weighing several tonnes, can become dislodged, fall and damage the water and steam pipes in the boiler. Large pieces of slag can bridge and block the ash hopper at the bottom of the furnace. In severe cases an unscheduled outage for several days, with complete loss of generation, may be the only solution.

Since privatisation, the generators have been able to be much more selective in the coals they burn. The UK mines producing the troublesome coals have been closed and we now import a wide selection of coals from around the world. No two coals are the same and we now use coals with mineral assemblages not found in UK coals.

Laboratory techniques to predict coal ash slagging have been notoriously unreliable. Some predictions are based on empirical parameters that are calculated from the chemical composition of the ash, but such predictions assume that the ash behaves as a homogeneous product that is in equilibrium with its surroundings. Such conditions are not found in a real boiler. Other predictive techniques are based on the properties of the ash, such as ash fusion temperatures or the viscosity of the ash at certain temperatures. These techniques are equally unreliable since they fail to reflect the mineral-mineral interactions that occur in the flame and interactions as ash particles deposit on a surface.

We have approached the problem from another direction, taking a far more pragmatic view. We decided to replicate the combustion and ash forming processes on a laboratory scale, keeping the conditions of residence times and temperatures as close to those in a boiler as possible. We designed and built a reactor that is 5m in length, with a temperature gradient from 1600°C at the top to 1200°C at the bottom. These temperatures are close to the flame temperatures and exit gas temperatures in a large utility boiler. Pulverised coal is introduced into the top of the reactor and ash particles take 2-3 sec to reach the bottom. Sampling ports at intervals down the reactor enable ash samples to be extracted from the combustion atmosphere at different residence times, or a probe can be inserted on which deposits accumulate. The deposits formed in this way show all the same characteristics as deposits taken from boilers. But whereas a boiler trial would require several thousand tonnes of coal, the laboratory reactor requires just a few kilograms of coal for each trial.

The next step was to examine the deposit and to provide some quantitative measure of the slagging propensity of the coal ash. Coals can then be ranked alongside one another in terms of severity of slagging. The characterisation of deposits has been greatly aided by recent developments in electron microscopy and elemental analysis. My colleague Fraser Wigley is one of a dozen or so experts around the world who have these facilities and the expertise to develop the programmes to analyse the data. The analytical technique is known as computer-controlled electron microscopy (CCSEM). Each characterisation may involve 1500 –2000 individual chemical analyses that provide information about the size, shape and associations of each particle analysed. The technique may be used to characterise the minerals in a coal, the nature of the fly ash produced or a slag or deposit. The technique can be used to follow the mineral transformations that occur to the minerals in a coal in forming the ash and then a deposit.

Trace Elements

The 1990 US Clean Air Act identified 11 elements, namely Be, Cr, Mn, Co, Ni, As, Se, Cd, Sb, Hg, and Pb, as being the most environmentally hazardous. All these elements are found in coals, but with the exception of Mn are present in very small concentrations. In the early 1990's little was known about the concentration and variability of trace elements in UK coals, similarly little was known about what happened to these elements when the coal was burned or gasified. Our own work in this field has been supported by grants from BCURA and the European Community. We were able to confirm earlier studies, mainly work done by the Australians, that most of the trace elements in a coal are present in the mineral matter. Coal cleaning processes to reduce the ash content of a coal will therefore lower the concentration of most of the trace elements. However, with most coals, it is impossible to remove the finely dispersed mineral matter by the normal physical coal cleaning processes.

Hg is an element for which environmental emission limits are likely to be introduced; and Hg has some interesting chemistry. A survey of Hg in coals from across the world has shown that the concentrations range from about 0.02 to 3.0 ppm. In the case of UK coals the highest Hg concentrations that we encountered are about 0.1 ppm. On combustion or gasification the fate of a trace element in coal is largely determined by its volatility at the combustion temperatures. Hg is highly volatile and remains in the gas phase.

It has been established that most of the Hg in a coal occurs with the mineral pyrite, an iron sulphide. The Hg may be present in solid solution in the pyrite or it may be there as Hg sulphide, a mineral known as cinnabar. All Hg compounds have very low free energies of formation, which means that when heated they readily decompose. On combustion the Hg is released from the coal as either elemental Hg^o or as the sulphide or chloride. As the temperature increases the compounds of Hg become increasingly less stable and by 600ºC elemental Hg is the only stable form. As the combustion gases cool further reactions can occur and the chlorine content of the coal plays an important role. At temperatures below 600ºC elemental Hg can be oxidised by either HCl or nitrogen dioxide. An important feature here is that Hg^{2+} is soluble in aqueous solutions, whereas the elemental Hg is not. So boilers fitted with scrubbers or a flue gas desulphurisation (FGD) unit will remove the oxidised Hg from the flue gases. A study made by fuel technologists at Powergen has shown that elemental Hg can be absorbed on the surface of unburned carbon in the fly ash, so if the carbon-in-ash from burning the coal is low, then activated carbon can be added to the cooling flue gases. Activated carbon is not cheap, but the retention rates can be as high as 90%. So fuel technologists have processes available that would remove almost all the Hg from the flue gases if and when the legislation is introduced.

Modelling

The last 10 years or so have seen an enormous increase in the power and speed of computers. Computational Fluid Dynamics (CFD) has been used to model a wide range of industrial processes. Fuel scientists and engineers have made an increasing use of CFD models as both an investigative tool and as an aid to optimise burner and furnace design. Modelling the coal combustion process is complicated. The codes used must include numerical models that describe the devolatilisation process, particle swelling and char burn out. The initial codes contained relatively simple models, and with an absence of suitable data, frequently incorporated empirically derived constants to describe many of the key processes. It is hardly surprising that the predictions were sometimes far from satisfactory.

However, basic research into some of the key features of combustion, for example, rates of devolatilisation, nature and structure of the carbon char, oxidation rates for different types of char, the effects of included mineral ash and then the thermal annealing of the char at high temperatures have all provided data that has lead to significant improvements to the earlier models.

Work that has impressed me has come from the Sandia Laboratories in California. Dr Robert Hurt and others now have a “carbon burn out model” that predicts with accuracy the carbon burn out to the final 1% or less of the char in a laboratory reactor.

Our own boiler manufacturers have their own in-house codes that can be used to good effect in optimising both the design and combustion conditions. Similarly, the generators have developed coal quality impact models, such as VISTA, that predict the effects of a coal change. GNOCIS is a neural network control system that optimises boiler operating conditions to reduce NOx, carbon-in-ash and fuel costs. These are further examples of how coal science and advanced computing power has given improvements in power station performance

The Future for Coal

The IEA has predicted that coal will remain the largest single energy source for power generation for the next 20 years. Worldwide coal reserves are enormous with availability for another 200 to 300 years at the present rate of usage, whereas production of oil and gas will begin to decline rapidly before the middle of the century. While oil and gas prices rise, world coal prices are now at an all time low and likely to remain so for the immediate future. Despite this, the future for coal in the UK seems less than certain.

The Governments’ Energy Review published in the spring of 2002 offered little by way of comfort for the coal industry and for coal-fired power generation. The UK has promised to substantially reduce CO_2 emissions to meet the Kyoto promises. The Government also has a policy to move to zero CO_2 emissions by the year 2050. The Energy Review presented a picture of ever increasing dependence on gas and a substantial increase in energy from renewable sources. Much emphasis was placed on wind power, and we have recently had a government announcement of a scheme for up to 300 wind turbines on the Isle of Lewis to generate 600MW of power. These wind turbines would be the largest yet to be built. The capital cost of such a scheme would be enormous and the Isle of Lewis is hundreds of miles from the National Grid. Such a scheme would, at best, produce just 1% of our energy requirements. What is also seldom mentioned is that UK wind turbines only operate on average for 30% of their time; at other times there is either too little or too much wind for generation.

We currently depend on approximately 25% of our electrical power from 14 nuclear power stations. October 2002 has seen the near collapse into administration of British Energy. Government loans of £650m have allowed the company to continue trading while a future for the company is sorted out. One of the problems is that the New Energy Trading Arrangements (NETA) introduced in March 2001 have forced the wholesale price of electricity down by 40% or so, to less than 2p per kWh. When all the costs are added up, British Energy now loses 0.4p on every kWh it generates. While wholesale electricity prices remain at such low level, no generator can make any profit unless it has a list of customers to sell the power on to. We now await an Energy Policy, due to be announced by the Government at the end of 2002. I have little confidence that coal is going to appear high on this agenda, but perhaps the uncertain international situation following the 11th September and current events in the Middle East may cause some second thoughts.

Top of my agenda would be a policy that looked for security of supply. Coal has a vital role to play in providing a security of supply from a diverse mix of fuels. To allow ourselves to become increasingly dependent on gas, which from 2010 could only be by importing gas from the most politically unstable regions of the world, would seem to me to be an act of incredible folly. To be dependent on gas from Russia, with an overland pipeline that stretches for thousand of miles, would place us in an impossible situation and the greatest risk of an interruption to supply.

Coal offers long-term security with supplies from politically stable countries. In real terms the price of coal has fallen 29% over the past 10 years. Owners of coal-fired power stations have shown a willingness to invest in the latest pollution control equipment and to continually refurbish old plant. But this can only continue if the market arrangements allow them to make a reasonable return on their investments.

Next on my agenda would be support for the development of processes that would reduce the environmental effects of combustion or gasification of coal. CO_2 capture and storage have been shown to be technically feasible. The costs are not prohibitive if, for example, the CO_2 is used to enhance oil recovery from depleted North Sea oil wells. Additional oil from the BP Fortes oil field would yield the Treasury an extra £300m in taxes; more than enough to support a full-scale demonstration of CO_2 capture and storage technology.

In the longer term ultra-critical combustion conditions can provide a process with a high conversion efficiency, while combined cycle gasification (IGCC) of coal would build on the success of gas turbine technology, a field in which the UK is a leader. But to maintain an industry with an export potential of new technologies requires building demonstration plant that can show that the new technology actually does work. This will require a programme of continuous research and development. Government support for coal R&D has been meagre to say the least, particularly when viewed alongside our international competitors. £2m was spent in the UK in support in 2000, compared to £85m spent in the USA and £61m in Japan. This is a serious issue and has to be addressed.

Clean coal technologies are available and, with the right incentives and support could provide the UK with the basis for a sustainable energy policy that not only meets the long-term objectives identified by the Royal Commission on Environmental Pollution, but also at a cost that the consumer could afford. ” *JW*

The vision in Vision 21 - or: Could H_2 be the future of coal?

Vision 21 complements the US DOE Clean Coal Programme and envisages a fuel and product flexible, virtually pollution-free energy plant. The approach is to develop a suite of technology modules that can be interconnected in different configurations to produce selected products Unlike single purpose power plants that produce only electricity, it would also produce a combination of liquid fuels, chemicals, hydrogen and industrial process heat. It would not be restricted to a single fuel type, but could process a wide variety of fuels such as coal, natural gas, biomass, petroleum coke and municipal waste. It would generate electricity at unprecedented efficiencies, and coupled with carbon sequestration technologies, it would emit little, if any, greenhouse gases into the atmosphere. Advanced gas separation and cleanup are critical to achieving such hybrid systems with fuel and product flexibility and carbon sequestration. One hybrid system that is showing great promise is the integration of gasification with a fuel cell. Such a hybrid has the potential to achieve up to 60 percent efficiency and near-zero emissions.

Under the Vision 21 program, FuelCell Energy Inc has been given the go-ahead to install a 2 MW fuel cell power plant at the Wabash River Energy Ltd., a coal gasification-combined cycle power plant which is part of the Energy Department's Clean Coal Technology Demonstration Program. The 260-megawatt Wabash River plant has been operating since November 1995 and is currently one of only two commercial-scale coal gasification power plants running in the United States. Most fuel cells entering commercial markets are designed to use natural gas or methane gas produced from municipal waste treatment plants. The fuel cell planned for the Wabash River plant will be the largest yet to be fueled by gas made from coal. FuelCell Energy expects to be ready to ship the fuel cell from its fabrication plant to the Wabash River site in the second half of 2003. A one-year test program would begin soon after the fuel cell arrives and is connected to the coal gas system. The project cost will be $32.3 million, half of which will be provided by the US Energy Department.

References:
http://www.fe.doe.gov/coal_power/vision21
Steinfeld, J. W. G., Hebb, J., *Power Engineering International* , November, 2002
Ritter, S. K., C&EN, October 7, 2002

…..and more 'feel-good' news on clean coal technology (on the other side of the Atlantic)

The 35-year old Northside Generating Station, Jacksonville, Fl, received a $630 million 'facelift'. In a 5-year effort, completed in October 2002, state-of-the-art clean coal technology has been installed. Equipped with new, circulating fluidized bed combustors, the power station is now reputed to be one of the cleanest coal burning plants in the world. Its two advanced combustors each generate 300 MW of power. The 12-story circulating fluidized bed combustors, supplied by Foster Wheeler Energy Corp., are the largest of their type in the world.

The plant is not only cleaner than before, it now generates two-and-a-half times more power. Using coal instead of the more expensive oil and gas the plant previously burned is expected to help keep electric rates low and stable in the Jacksonville area. The US Energy Department contributed more than $74 million to the project as one of the original projects under its Clean Coal Technology Program. The federal funding went to install one of the two combustors. JEA, who own the power station, converted the second boiler entirely with its own funding. Under its funding agreement, the US Energy Department will collect data from plant operations through April 2004. The plant will then continue to operate as a commercial facility.

Reference: http://www.netl.doe.gov/publications/press/2002/tl_cct_jea.html

….. but at least coal is not the main pollution culprit in the UK anymore

Extracts from "50 years after the great smog, a new killer arises. Attention turns to car fumes on anniversary of 1952 disaster" by Paul Brown, environment correspondent, The Guardian, 30 November, 2002

" …..Pollution had been seen as the price of progress, but the smog of 1952 woke the public to the terrible toll. The National Society for Clean Air (NSCA) says of the smog: "It marks the dividing line between the general acceptance of air pollution as a natural consequence of industrial development, and the understanding that progress without pollution control is no progress at all." …. The government's policies were at least partly to blame [for the smog]. To maximise revenue, the UK was exporting its clean coal and keeping the sulphur laden "dirty" coal for UK power stations and domestic fires….. The government quietened public fears by setting up a committee of inquiry. It recommended a Clean Air Act which became law in 1956, gradually bringing an end to open hearth coal fires. London and provincial cities continued to have smogs, but they became less dangerous as people switched to central heating and smokeless fuels, and by the mid-1960s they had disappeared.

….Tim Williamson, policy officer of the National Society for Clean Air, said the killer was no longer smoke from domestic fires but car fumes. Government estimates are that 24,000 people a year had their lives shortened as a result of air pollution. ……. In 1950 there were 4m vehicles registered in Britain, half of them cars; now there are 28m vehicles, 85% of them cars. Coal provides only 15% of energy for home heating.

"We have defeated one problem only to create another, and like the government of 1952 this one has yet to come to terms with the problem," Mr Williamson said "

BCURA Coal Bank on the Web

There cannot be many coal scientists in the UK who have not, at one time or another, received samples from the BCURA Coal Bank. With the coal market ever increasing in mobility, it is becoming quite a challenge to obtain a representative suite of coals for the more fundamental end of coal research. For this reason the Coal Bank has become invaluable. Originally established in 1982 as the CRE Coal Bank with the intention to supply universities and other research organisations with small quantities of representative UK deep mined coals, it now comprises 36 well characterised specimens, including a number of internationally traded coals. The Coal Bank Brochure is now accessible on the web from the BCURA website (http://www.bcura.org/coalbank.html) and comprehensive data on all the coals stored and available for research can be downloaded in pdf format. This should make using the Coal Bank even easier. Sample requests are taken by conventional (paper) mail only, as before, and paper copies of the updated brochure are still obtainable from the same address:

Mr Jason Powis at EMC Environment Engineering Ltd, Stoke Orchard, Cheltenham, Glos. GL52 7RZ. Tel: 01242 673361, Fax: 01242 677258, Email: jason.powis@emc-environment.com

CALENDAR OF COAL RESEARCH MEETINGS AND EVENTS

Date	Title	Location	Contact
First quarter of 2003 (date to be announced)	**Meeting of Advanced Power Generation Division. "Underground Gasification and Carbon Dioxide Sequestration"**	**Provisionally Cranfield University, Bedfordshire**	**Mr P W Sage, Future Energy Solutions, 154 Harwell, Didcot, Oxfordshire, OX11 0QJ, Tel : 01235-432098 Fax : 01235-432753 E-mail: peter.sage@aeat.co.uk**
12-14 Feb 2003	2nd regional conference on energy technology: towards a clean environment	Phuket, Thailand	RCETCE's Secretariat, Joint Graduate School of Energy and Environment (JGSEE), King Mongkut's University of Technology Thonburi, 91 Pracha-uthit Road, Bangmod, Tungkru, Bangkok 10140, Thailand Tel: +66 2 470 8309 Fax: +66 2 872 9805 Email: rcetce@jgsee.kmutt.ac.th
March 10 - 13, 2003	The Clearwater Conference The 28th International Technical Conference on Coal Utilization & Fuel Systems Theme: Coal: Energy Security for the Future	Sheraton Sand Key Hotel Clearwater, Florida, USA	Barbara A Sakkestad, Coal Technology Association, 601 Suffield Drive, Gaithersburg, MD 20878, USA Tel: +1 301 294 6080 Fax: +1 301 294 7480 Email: BarbaraSak@aol.com Internet: www.coaltechnologies.com
19-20 Mar 2003	2nd annual Australian coal seam and mine methane conference	Brisbane, Qld., Australia	Peter Lagios, IBC Conferences Australia, Level 2, 120 Sussex Street, Sydney, NSW 2000, Australia Tel: +61 2 9080 4307 Fax: +61 2 9290 3844
Wednesday 15th May 2003	**Annual Meeting of the Coal Research Forum**	**Provisionally, Innogy plc., Swindon, Wiltshire**	**Dr D J A McCaffrey The Coal Research Forum, PO Box 154, Cheltenham, GLOS, GL52 5YL Tel: 01242-236973 Fax: 01242-516672 E-mail: david.mccaffrey@easynet.co.uk**
Wednesday 18th June 2003	**Meeting of the Coal Preperation Division**	**Venue to be Announced**	**Mr Chandu Shah, SChEME, The University of Nottingham, Nottingham, NG7 2RD Tel: 0115-951-4104 Fax: 0115-951-4115 E-mail: chandu.shah@nottingham.ac.uk**

Summer 2003 (Date to be Announced)	**Meeting of Coal Conversion Division/Work of Industry to Academe**	**Provisionally Monkton Coke Works, near Barnsley**	**Prof J W Patrick, SChEME, The University of Nottingham, Nottingham, NG7 2RD Tel: 0115-951-4175 Fax: 0115-951-4115 E-mail: john.patrick@nottingham.ac.uk**
March 2003 (date to be announced)	**Meeting of Combustion Division**	**Provisionally, Fibrowatt, Thetford, Cambridgeshi re**	**Dr A W Thompson, SChEME, The University of Nottingham, Nottingham, NG7 2RD Tel: 0115-951-4198 Fax: 0115-951-4115 E-mail: alan.thompson@nottingham.ac.uk**
15-19 Sep 2003	20th annual international Pittsburgh coal conference	Pittsburgh, PA, USA	Pittsburgh Coal Conference, University of Pittsburgh, School of Engineering, Dominion Center for Environment and Energy, 1249 Benedum Hall, Pittsburgh, PA 15261, USA Tel: +1 412 624 7440 Fax:+1 412 624 1480 Email: pcc@engr.pitt.edu Internet: www.engr.pitt.edu/pcc
Monday 13th October 2003	52nd BCURA Robens Coal Science Lecture	The Royal Institution, Albermarle Street, London	Mr J D Gardner, BCURA Company Secretary, Gardner Brown Ltd., Calderwood House, 7 Montpellier Parade, Cheltenham, GLOS, GL50 1UA Tel : 01242-224886 Fax : 01242-577116 E-mail : john@gardnerbrown.co.uk
2-6 Nov 2003	International Conference on Coal Science	Cairns Convention Centre, Qld., Australia	12th ICCS, PO Box 268, Toukley, NSW 2263, Australia Tel: +61 2 4393 1114 Fax: +61 2 4393 1114 Email: iccs@aie.org.au Internet: www.aie.org.au/iccs