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NEWSLETTER

of the

Coal Research Forum

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EDITOR'S COMMENTS

You may have noticed a small change on the front cover of this newsletter – the absence of Alan Walker's name. After 8 years and 25 issues he decided to retire editor, having a year earlier retired from carbon science. It feels like almost the end of an era, and my first instinct was to start this newsletter with a tribute to his tireless editing work. That was before I looked back to the editor's comments in the last issue and realised that he had beaten me to it and described the changes (or lack of them) over the years better than I could have done. But I would like to add a personal note and say 'Thank you, Alan'. I have enjoyed reading your newsletters over the years, and would have been far worse informed if it had not been for their regular appearance on my desk. I hope I will be able to live up to anywhere near the high standards you have set.

Back to business, this edition kicks off with an account of this years AGM held on the 25th of April. We also have two other reports from the Combustion Division Meeting held on the 7th of February and the joint meeting with the British Carbon Group held in March. In addition, the newsletter features the (edited) talk given by Brian Ricketts to the IChemE Energy Conversion Technology Subject Group on 5th December 2000. I would like to take this opportunity to thank him and all the other people who have contributed to this edition. I see my role as that of the person who assembles the pieces into a whole, not the one who writes the entire newsletter. If you have anything to contribute, please do not hesitate to do so. It does not have to be a feature length article. Sending in a cutting or a quote which caught your eye will be just fine. Or if you like to voice your opinion – we are happy to print letters to the editor.

One thing that is missing from the newsletter is the Inaugural Lecture of our esteemed chairman (academe) John W. Patrick. Nearly a decade after having become a professor they finally caught up with him and he gave a very enjoyable public lecture under the catchy title 'Black Magic –that's Carbon'. I agonised long over whether to include it, but he covered so much ground and introduced such a large number of carbons impacting on our lives that I finally decided that it was beyond the scope of this newsletter. I was not the only one though who thought that it was so good it ought to be put in writing and published. If this happens, I will certainly let you know.

Hope you enjoy the newsletter, and I am waiting for your mail to make the next one bigger and better!

Report of the 12th General Annual Meeting

held on the 25th April 2001
at the RJB Mining (UK) Headquarters in Harworth

About 35 members assembled in the pleasant, modern headquarters of RJB Mining to hold this year's annual meeting. After a brief welcome by B Ricketts the morning was devoted to the AGM which was chaired by J Patrick. The minutes from last year's AGM were accepted without comments. The Secretary, D McCaffrey, reported that the CRF had another good year fulfilling its objective of bringing together industrial and academic coal researchers and initiating many fruitful discussions. A number of events were held in that spirit, which also featured heavily in the reports from the divisional chairmen. The main events over the last year were:

- "Material Requirements for Advanced Power Generation" A joint meeting with the Network on Materials Technologies for the Power Generation Industry held at Cranfield University on the 25th January 2000. (see report in newsletter No 28).
- The 2000 AGM was held on the 3rd of May 2000 at Rio Tinto Technical Services in Bristol and included presentations by our hosts and on current DTI supported projects. (see report in newsletter No 29).
- "Advanced Sensors and Instrumentation Systems for Combustion Control" A co-sponsored meeting with the IEE Control-Instrumentation and Measurement Systems Group held on the 27th of June in Birmingham. (also in newsletter No 29)
- The Third UK Meeting on Coal Research and its Applications was held on the 12-14th September 2000 at Aston University. (newsletter No 30)
- A joint meeting with the IChemE on Emission Limits for Steam Raising Plant took place in October 2000.

There was also the 5th Custnet conference in May, at which D. McCaffrey represented the CRF. And in October the annual BCURA Robens Coal Science Lecture was given by Prof. Mao Jianxiong from Beijing University (see newsletter No 30). All in all 2000 has been a busy, eventful year.

The Treasurer, M Thomas, reported - by mail – that the accounts for the calender year 2000 are healthy and income exceeded outgoings by just over £600. The membership for 2000 was up slightly from previous year and now stands at 54, of which 21 are industrial, one corporate, 28 academic and 4 individual.

Three posts on the executive committee were up for re-election, the Chairman (industry), the Secretary and one Representative from Industry. There was one nomination per post and all were elected unopposed. Following the Executive Meeting which immediately followed the days events the almost unchanged Executive Committee is composed of:

Joint Chairmen:	A R Jones (Industry)
	J.W. Patrick (Academe)
Secretary:	D J A McCaffrey
Treasurer:	K M Thomas
Representatives from Industry:	B E Ricketts
	M K G Whateley
	R R Wilmers
Representatives from Academe:	M Cloke
	D R Dugwell
	E Hampartsoumian

Seconded Members: G Riley
S Hanson (Newsletter Editor)

For the third year running there was a presentation by and about EPSRC. This year it was given by P Bates, who is in the Energy Sector Team. He explained that in addition to the programmes based on traditional teaching subjects EPSRC has now identified 12 key sectors, of which energy is one. Industrial briefs in these sectors will be produced alongside the business planning documents for the programmes. The Engineering Programme (formerly "General Engineering") is by far the largest programme and operates predominantly in responsive mode. Managed programmes have been reduced in favour of responsive mode funding. ESR21 and RNET are running their course and will be reviewed in due course. Ropa awards are still available, but will be reviewed over the summer. Co-funding with the DTI in energy areas is being set up and will be advertised when it is fully in place. The procedure will be to gain DTI approval first and then submit the proposal to EPSRC for the usual review process. Possibly some DETR funding may come out of the newly set up Carbon Trust. Following the presentation A Jones stressed again that we need to undertake steps to get coal experts into the Peer Review Colleges.

The morning was concluded with a presentation about BCURA by D McCaffrey in his role as BCURA's Technical Officer. After a brief history, which explained the origin of the funds available for research grants, he outlined the target areas, which cover the entire spectrum from mining to advanced power generation. The total funding available in a year is in the order £300k. It funds smaller projects, such as PhD studentships with a moderate equipment allowance. It mostly co-funds projects, e.g. by topping up the funds for existing part-funded projects. BCURA has a joint funding arrangement with the DTI, which was renewed for 3 years in 1999. Further information can be found on http://www.bcura.org/ . The site describes the format for outline and full proposals, as well as all the requirements once a project has received funding. I would like to pass on the heart-felt request from the Technical Officer to please, please, please follow these instructions carefully.

The afternoon was given over to presentations from our hosts RJB Mining plc and their subsidiary RJB Consultancy Ltd. The first two presentations came from the consultancy side and focussed on exploration. A Carmichael (Geologist) explained data acquisition and storage procedures and the modelling capability of the software used. To the layman it was very impressive how the geological contours can be built up from holes in the ground. It was even more impressive to learn how much it costs to drill the holes, at least £100k per hole. J Knight (Managing Director) gave examples of recent exploration projects; a phosphate mine in Egypt, a gypsum mine in Italy and a coal mine development in Iran. RJB Consultancy does not limit itself to geological mapping, it also gives technical support and training in countries such as Malawi, the Philippines and Romania. And they recently appraised an underground mine in Poland for international investment. It also falls into their remit to prepare technical reports, like a recent one on coal preparation technology under the DTI CCT programme.

The third talk was given by K Waite (Group Planning Engineer) from the planning department for deep mines. The planning department seems to have the difficult task of taking in the information from all the other departments, from sales to geology, and formulates 5-year rolling plans, which are revised every year. Research participated in or initiated by RJB is selected in accordance with the targets identified in these plans. One of the targets at present, for example, is improving the man riding systems, which led to participation in two ECSC projects on improving and modelling highly stressed railways. Another current research area is methane drainage.

Next J Brough (Coal Preparation Engineer) gave an overview of the improvements sought after in coal processing. Mineral fines are targeted, because they incur the highest processing costs, revenue loss and disposal costs. The high moisture retention of fines lowers the CV and they can cause handling problems. Spiral classifiers in combination with slurry centrifuges could be an alternative to froth flotation, which would eliminate the need for reagents and flocculants. But centrifuges are expensive to install and maintain and tend to loose some coal in the centrate. For very small particle sizes froth flotation is still thought to be the only viable method, but combining it with a spiral classifier has advantages. After separation the mineral fines are dewatered, thickened and disposed of in settling lagoons. An alternative to lagoons is the tailings plate press, which is expensive, but could become viable as tipping ground becomes scarce and more costly. Current research explores dry alternatives for separating out mineral fines, such as air jig cleaning and air cyclones. RJB is currently constructing a dry cyclone, from a design by Grant Budge, as part of its R&D activities under an ECSC project.

The penultimate talk by M Allen (Environmental Manager) dealt with environmental matters. He regretfully commented on the poor public image of open-cast or, as they are now more often referred to as, surface mines. It is wholly undeserved as all systems are upgraded to comply with the international standards for environmental management systems. As an example of these upgrades he cited the dust monitoring system, which is now continuous and on-line, and not only raises the alarm when high dust levels are recorded, but also pages the site operators to effect a quick response. RJB also have considerable expertise in land reclamation. For example, they successfully reclaimed the highly contaminated Orgreave site. An area often looks more attractive after it has been restored than it was originally, with added features such as lakes or recreation grounds. In that way communities which accept the temporary disruption from nearby surface mine can actually benefit from it in the long run. In the sense that the landscape is fully restored after the end of the mining operation and no lasting damage is done, it is almost a sustainable activity.

Last, but by no means least, B Ricketts imparted his thoughts on the future of coal utilisation, modestly entitled ‘A Quick Look at Coal’. Many of the ideas are dealt with in the following article, so I hope I will be forgiven for not going into any detail. Summarising, it appears that most pollution problems related to coal are in the process of being solved, except for CO_2 emissions. But compared with the rapidly increasing and seemingly uncontrolled emissions from the transport sector, at least they are stable. If the transport CO_2 emissions could be tackled by moving away from the high-carbon oil derived fuels, to natural gas initially and perhaps finally to H_2, then this would open up opportunities for clean coal technologies. Power generation from a premium fuel like natural gas seems wasteful when coal (and waste) gasification provides a route to high efficiencies, lower overall emissions and even a source of H_2.

A Jones (chairman academe) concluded the meeting by thanking all the speakers for their very interesting, informative contributions, and RJB Mining for their hospitality. He feels that the Forum is succeeding and that the case for coal is gradually being heard. Finally, he expressed our gratitude to D McCaffrey for all the hard work he has put in over the year. Quoting directly ‘Without David there would be no Coal Research Forum’.

s.h.

Appendix: I found an article about the launch of the Carbon Trust, which makes me think that it will be a big task to interest them in coal:

The Times, 21/3/2001, Prescott goes all green with launch of climate group

BY HELEN STUDD

"John Prescott, the Deputy Prime Minister, started a partnership between business and environmental lobby groups yesterday aimed at tackling climate change.

The Carbon Trust, chaired by Ian MacAllister, managing director of Ford, and supported by Friends of the Earth, will promote research into energy-saving technologies. It will also be responsible for distributing £200 million to encourage the development of low -carbon technologies in Britain over the next two years.

Although £33 million of the trust's initial budget of £50 million will come from the climate-change tax levied on businesses, the rest is expected to come from government subsidies. Stepping into the passenger seat of the first hydrogen-powered Ford car to be seen on British roads, to celebrate the launch, Mr Prescott acknowledged the link between cars and climate change. ……."

Can anybody give me a definition of low-carbon technology? It has become quite a buzz word since the latest climate change policy statements. And maybe a few examples (don't say hydrogen powered cars!)?

Coal in a Changing Climate

Presentation by **Brian E Ricketts** CEng MIMechE
to the IChemE Energy Conversion Technology Subject Group
on 5 December 2000 at Bristol University

Since the privatisation of the coal industry in 1994 the economic and political climate within which it operates has continued to evolve. Coal, with its high carbon intensity, has become a prime target for those trying to reduce the effects of human activity on our planet.

The main market for coal is electricity generation. Worldwide 36% of the electricity is generated from coal. Modern, civilised society is unthinkable without electricity, but the environmental impact of generating it causes a dilemma. It forces us to look at ways of reducing consumption of both fossil and nuclear energy, which together currently meet 97% of our global energy needs. Unless the developed countries condemn large parts of the world to continued fuel poverty energy consumption will continue to rise. It is unlikely that renewable energy sources will make a significant contribution in the short run. Excluding large scale hydro plants they currently account for less than 1% of world energy supply. Sustainable development will therefore have to be achieved with conventional forms of power generation. For this to happen governments have to plan ahead and have policies based on believable forecasts in place. The growth in energy demand, the relative cost of fuels, the reliability of technologies and environmental constraints all play a part in shaping what the future will bring. Many long-term European forecasts, including those of the UK government, show a strong growth in natural gas consumption and a decline in coal use. European gas prices are linked to oil prices. In March 2000 the Department of Trade and Industry anticipated prices of between $11-$22 per barrel. In fact the average price of oil over the first eleven months of last year has been at almost $30 ($28.60) a barrel. The spot price of UK gas has doubled because suppliers can now export to mainland Europe where prices have firmed with the high oil price. Many commentators now doubt the viability of further new gas-fired power generation.

Contrarily, UK coal burn predictions have always been on the low side, mainly because assumptions about the reliability of other forms of generation were over-optimistic and growth in energy demand was underestimated. For example, in March 2000 the DTI published energy projections that form the basis of the UK's Climate Change Programme. Coal burn in UK power stations for 2000 was forecast to lie in the range of 30-35 million tonnes, a sizeable reduction on the 1999 burn of 40.5 million tonnes. The outturn for 2000 was around 45 million tonnes, some 12% higher than predicted. The reasons for the larger demand for coal were nuclear outages, electricity failing to be delivered from France following the storms there and the continuing unreliability of gas-fired CCGT power stations. Without the ability to quickly turn to coal-fired power stations to make up for the shortfalls the UK might have faced electricity shortages.

In 2000 the UK electricity demand rose by 3% compared with 1999, which, as it allegedly is getting warmer, cannot be attributed to heating demand. One possible contributing factor is the increasing use of the Internet and growth in the IT sector in general. The question is how to meet the rising electricity demand in the UK and world-wide.. Two thirds of all oil reserves are concentrated in the Middle East. Almost three quarters of all gas reserves are held in the Middle East and Former Soviet Union. Coal is the only fuel that shows a fairly even spread of reserves around the world. Amongst Member States of the EU, coal accounts for around 90% of proven energy reserves. In an enlarged European Union, bringing in countries like Poland and the Czech Republic, this percentage would be even higher. Despite the EU's large coal reserves, it currently imports around 50% of its primary energy. In November 1999, the European Commission published "Energy Outlook to 2020". It predicts a growing dependency on imported energy, with two thirds of all supplies being imported by 2020 following large scale nuclear decommissioning across Europe.

In 1995, the capacity of nuclear stations was 132GW. Within the EU, France alone has plans for new nuclear power stations. By 2020 the only nuclear power left will be the 1.2GW from Sizewell B and about 16GW in France. There is a need to replace the equivalent of 350million tonnes of coal per annum by 2030 just to maintain current electricity output.

In 1997, the European Commission issued a White Paper for a community strategy on renewable sources of energy proposing a target of 12% by 2010. The bulk of this should come from biomass and organic waste fuels. To put this into some sort of perspective, this amount of biomass, if grown as coppiced willow, would require a land area equivalent to the combined size of Belgium, Holland and Denmark. Aspirations for windmills are scarcely more believable, with 60,000 windmills, covering an area the size of Luxembourg, needed to meet the target. Even the Commissions own energy predictions judge it unlikely that the renewable targets will be met by 2010.

Under the Kyoto agreement, the EU has an obligation to reduce greenhouse gases by 8% before 2010. However, the Commissions communication on the European Climate Change Programme predicts a 7% increase over the period. Only three countries, Germany, Luxembourg and the UK, are on track to meet their obligations under the Burden Sharing Agreement. Of the three countries, Germany is on track largely because of reunification, Luxembourg because of changes at a single steel mill, and the UK because of the "dash for gas" during the 1990s. All of these are unique events that are hardly likely to be repeated.

Looking at the global picture, Kyoto provides for a 5.2% reduction below 1990 levels by 2010. However, the US Energy Information Administration predicts a 40% increase in global carbon emissions over the period in its reference case.

Frank Loy, the US negotiator at COP6, recently stated that it would be impossible for the USA to meet its Kyoto commitments without deploying the full range of mechanisms allowed. In fact, commitments could be met with real carbon reductions if the US replaced

existing coal-fired plants with modern clean coal ones. Nearly 60% of US electricity is generated from coal, so a 20-30% improvement in efficiency would allow the country to meet its 7% Kyoto target without any further measures.

Given the huge coal consumption in developing countries, the best way to achieve serious reductions is through the transfer of clean coal technologies (CCTs). But we can only do this if technologies have been commercially proven at a significant scale. The European coal industry stands at a crossroads and must decide its future role. It can stand back and allow its market to be eroded by gas, or it can actively promote investment in clean coal technologies, both to benefit from Europe's most abundant energy resource and to help meet environmental targets.

Liberalisation and deregulation characterise Europe's internal energy markets and favour short-termism. A free market, left to its own devices, will never properly value the environment nor provide long-term security of supply. There is now an urgent need to kick start the development of CCTs in the EU before we become overly dependent on imported gas. As with any new technology, initial deployment costs are high and financial support is required. When the technology becomes proven and more units are built, costs fall quickly as was witnessed with gas-fired CCGT. To effect the construction of the first commercial CCT units, the coal industry proposes the adoption of a scheme where consumers pay a small levy on the price of their electricity, as a "sustainables" or "clean energy" obligation. This would avoid the need for capital subsidies from Government. The consumer would benefit from the long term development of diverse and secure energy supplies. This method has been successfully adopted before in the UK to support renewables and nuclear energy.

The cost would not be excessively high. Electricity from IGCC plants is estimated to be generated at just over 3p/kWh. Compared with renewables such as offshore wind farm at 5p/kWh, biomass at over 8p/kWh and photovoltaic cells at around 15p/kWh this sounds very reasonable.

The adoption of a clean-coal demonstration programme within the UK would bring significant benefits. As already noted, it would protect the diversity and security of energy supplies. Emissions of carbon dioxide would be reduced by up to 30% and sulphur dioxide by 95% as well as significant reduction in other pollutants. It would create opportunities for UK industry to profit from a world market that the International Energy Agency forecasts to be worth $500 billion before 2010.

Further Reading:

The EC Green Paper "Towards a European strategy for the security of energy supply" was published last November, and you could fight your way through the nearly 200 pages of it. But a visit to the RJB web-site saves you the trouble, if you like to hear the case for coal gasification http://www.rjb.co.uk/top/clean.htm

Quote : **"By 2020, 66% of gas will be imported into the European Community mainly from Norway, North Africa and Russia. "**

The theme was also picked up in RJB New Scene No 57, January/February 2001

Quote: " The construction of a full scale clean coal technology demonstration plant represents a 'crucial bridge' between research and development and the achievement of commercial maturity. That's the verdict of John Glasson and Andrew Chadwick of Oxford Brookes University, whose studies conclude that the cost and risk associated with such developments requires government involvement to encourage private sector participation. They also conclude that **energy policy is too important for short-term policies**. A longer and wider

strategic assessment of fuel mix is required along with key socio-economic issues, reserves, security of supply, balance of payments and export potential. "
Curiously, this snippet of information was set into an article about RJB's subsidiary EOS Ltd, which serves the purpose of helping them to diversify and grab a slice of the 'green power' pie before the 10% renewables deadline in 2010. They are looking into, amongst other things, using RJB land to erect wind turbines and cultivating energy-rich crops for burning in power stations.

Flue Gas Desulphurisation and Emissions Control

Combustion Division Meeting
held on the 7th February 2001
at Ratcliffe Power Station

After the success of the Combustion Division Meeting at Blue Circle Cement two years ago (Newsletter No 24) the "mini-seminar" with plant visit format was also adopted for this meeting. The morning was given over to listening to five very knowledgeable speakers on various aspects of FGD and the afternoon was devoted to a tour of the desulphurisation plant at Ratcliffe power station. For those with enough stamina and another half hour to spare, a tour of the Powergen 1MW Combustion Test Facility was also on offer after the official end of the meeting.
The meeting was attended to maximum capacity with just over 30 attendants (not counting our hosts from Powergen). It was particularly heartening to meet some participants from industry who do not normally associate themselves with coal-related issues. This must be counted as a success for the single-topic seminar format and the hard organisational work by the Combustion Division chairman A Thompson. Before I come to the technical contents, our gratitude should also be extended to Powergen for the use of their excellent conference facilities, the pleasant buffet lunch and copious quantities of coffee.
After a warm welcome from A Thompson, who was chairing the meeting, the first talk was given by D Acres from TXU Europe. It dealt with emission limits for coal-fired power stations and the question if they are an effective mechanism for pollution prevention. Apparently setting limits on a pollutant is not as straightforward as it may seem. Certainly, the concentration of a pollutant emitted determines the potential harm, but the way in which it is dispersed and the sensitivity of different ecosystems to it can vary widely. Because of the complexities involved long-term, large-scale impact predictions are the most reliable, so that annual limits are likely to be the most robust. Currently in the UK, in line with the Large Combustion Plant Directive from 1988 and the UNECE Sulphur Protocol from 1994, there are B and A limits for SO_2. The former regulate the total annual emissions for a company and aim at meeting the national limit, the latter apply to individual plants regulating the local impact. At present there are, however, no instantaneous limits, i.e. maximum concentrations that must not be exceeded at any time. This is going to change with the UK National Air Quality Strategy (AQS), which will be enforced by 2005. It aims to make a clearer link with the local environmental impact and sets local SO_2 emission limits based on 15 min averages. An annual limit of 100ppb not to be exceeded more than 35 times will be set. This is based on dispersion modelling, even though it is doubtful that it can be applied with such short-term precision.

The overall limit of SO_2 emissions is also set to be tightened under the 1999 Gothenburg Protocol. By 2010 coal fired plants with a capacity above 500MWth will be limited to 400 mg/Nm^3. Depending on the new Large Combustion Plant Directive, which is currently under negotiation, the new limits may be introduced as early as 2008 and possibly tightened even further. There may be some flexibility regarding plants which are due to close soon after the limits come into force, but as a general rule it can be assumed that all plants which are to operate beyond 2008 must comply. This is thought to be impossible without using Flue Gas Desulphurisation. The conclusion of the talk is therefore that in future all power stations will be fitted with some form of FGD.

Having been convinced of the inevitability of FGD, the following three talks concentrated on the history, design and operation of the plant retro-fitted at Ratcliffe power station, which was completed in 1996. T Howard took the lead with a presentation on various design aspects. It was interesting to note that the choice of FGD was not a foregone conclusion and that other options such as coal cleaning and in-furnace SO_2 removal had been considered. Once FDG had been selected, the question was which of the numerous processes was most suitable. The limestone – gypsum process was found to fit the criteria best. It was specified to remove more than 90% of the SO_2 with an availability of 97.5%. Also, it can handle the high chlorine UK coals (0.35% mean) and was possible to install during routine maintenance time. The process yields gypsum, which can be sold as a useful product provided it meets the industrial specifications regarding moisture content and purity.

The central parts of the installation are the absorber towers, standing 43m high with a 16.2m diameter. 150 nozzles on 5 levels spray the limestone slurry into the flue gas stream. The SO_2 reacts with the lime, which after further oxidation in the sump of the tower yields gypsum. Two hydrocyclones are used to dewater it, with the off-take from the second being treated as waste water before being discharged. The treatment sludge is re-fired in the power station. The flue gas needs to be re-heated to above 80°C before reaching the stack, which is achieved by regenerative heating using the in-coming flue gas. Several of the components require special linings to withstand the chemical attack by the reactants in the process.

The plant consumes 350,000 t of limestone annually and 35MW of power to achieve its goal.

W Quick followed with a more specialised presentation about the effect of wet limestone FGD on the fate of trace species. He stressed that the FGD plant is not treated as a dust removal system. The flue gas enters it after it has undergone electrostatic precipitation with a dust load below $50mg/Nm^3$. Nevertheless, it does have the effect of further reducing this dust load to below 5 mg/Nm^3, and most of the outgoing dust appears to be gypsum. The temperature in the absorber is only about 50°C, so that volatile species may condense out. Also, soluble species would be expected to be washed out. This is the case with hydrogen halides, some 98% of HCl and 72% of HF were found to be removed. As almost complete dust removal occurs, mass balances of both volatile and non-volatile trace elements show high retention ratios. This includes Hg, which is particularly well retained in its oxidised form. Another category of undesirable trace species are the 210 congeners that make up the dioxin and furan groups. Their formation is not fully understood, but thought to occur during poor combustion, although post-combustion formation can also occur. They are either in the vapour phase or adhere to dust particles. 7 dioxins and 12 furans were measured. At a non-FGD power station 57 pg/m^3 were detected, at a FGD containing one 12 pg/m^3. PAH's are also thought to form during poor combustion and 15 of them were monitored. Most of them fell below their detection limits. Data for a non-FGD and FGD plant again showed a much lower reading for the latter, $0.08mg/m^3$ against $0.58mg/m^3$.

VOC's are even more difficult to deal with as not even a definitive list of all the compounds considered to be in that category exists, and very rarely the same number of compounds are monitored.
In conclusion, the work presented in this paper demonstrated that wet FGD has the added benefit of removing species other than the target SO_2 by wet scrubbing. This is particularly effective for residual dust removal and hydrogen halides.
K Ward, the FGD plant manager at Ratcliffe, shared his operating experience with us, after setting the mood with a Powergen video aimed at educating the wider public.
The history of the Ratcliffe FGD plant began in 1987/8 with an 18 month test-scrubber trial. At that time no FGD was installed in the UK and experience with high Cl coals was extremely limited. An application to build the plant was made in 1990 and consent given the following year. Commissioning took place between 1993 and 1995. The work proceeded perfectly on schedule and to budget and no out-time of the power units was required specially for the installation. The FGD plant is completely integrated with the power generation and controlled from the main plant. A small maintenance team is located at the plant site though. The operating experience so far has been very positive. All the gypsum produced has been of saleable quality. No problems beyond those to be expected at any plant have been encountered.
The final presentation of the day was given by R Tabberer, also from Powergen. He took us back into the general domain offering an overview of FGD plant and process development. The topic was to be dealt with in a separate article loosely based on a recent DTI Technology Status Report from which he derived some of the information. The editor apologises for not having got round to actually writing the article and strongly recommends the Technology Status Report No 012 published in March 2000 to any reader interested in the comparative technical and economic merits of different FGD technologies.
Well prepared by the morning's presentations we were treated to a visit of the FDG plant at Ratcliffe. As somebody who usually encounters plants as flow diagrams in textbooks and technical journals I really do consider it a bit of a treat to get close to the real thing. The first and most lasting impression is that of the sheer size. The addition of FGD has by the look of it nearly doubled the area occupied by the power station. The ducts carrying the flue to and from the plant have twice the height of a double-decker bus (quote tour-guide), but do not actually look their size in proportion to the absorber towers. The second impression was how clean the plant looks, I did not realise 'clean technology' was to be taken so literally.
All in all I think the rest of the participants would agree that we had a most informative, stimulating day. In the spirit of the concluding remarks by Professor Patrick (chairman academe) another big thank you to the organiser, A Thompson, to all the speakers and to Powergen for their hospitality. *s.h.*

As a very pleasant surprise, I have also received an account of the meeting from another participant. **Chris Tyler (*Manager Technical Activities,* IChemE),** after being prompted with the question "What's happened to Coal Utilisation Subject Group?" wrote:

"Under the guise of the Coal Research Forum (CRF), the Coal Utilisation Subject Group (CUSG) is thriving. It is now 12 months since members of CUSG decided to subscribe to CRF en bloc and now benefit from more frequent meetings on a wider range of topics and receive a regular newsletter to boot.
More than 30 delegates, including several from CUSG, enjoyed Powergen's lavish hospitality at a CRF meeting held at Ratcliffe-on-Soar Power Station on 7 February 2001. Alan

Thompson, Chairman of CRF Combustion Division chaired the mini-seminar which was followed by a tour of Powergen's £250M Flue Gas Desulphurisation Plant (FGD).
The event was attended by a good mixture of industrialists – equipment and service providers, plaster board manufacturers, academics and environmentalists.
David Acres, TXU Europe, set the scene by outlining UK emission limits for coal fired power stations. He commented on a new draft Large Combustion Installation Directive setting tougher limits especially for SO_2, which would necessitate all remaining coal fired power stations to install FGD by 2008 to comply.
The following four presentations were presented by Powergen staff. Tony Howard and Ken Ward described in detail, the genesis and operational experiences of the FGD plant. Richard Tabberer followed on with a taxonomy and summary of the relative merits of the many alternative FGD processes commercially available. Will Quick presented a mass of analytical data showing the effect of wet limestone FGD treatment on emissions of trace species.
The FGD plants (one for each of the four 500MW boilers) were most impressive in terms of their design and plant layout. The most striking feature however, was the exceptionally high level of cleanliness – clearly a very safe plant to work on!
Due to the corrosive nature of the products handled in the plant, tanks were lined with rubber and ducts with glass flake vinylester. Many of the pipes were also manufactured from glass-fibre reinforced plastic (GRP).
Finally, some statistics:
The 2000MW power station consumes 2Mtpa coal and 350ktpa limestone and produces 160ktpa SO_2 which is converted into 500ktpa high grade gypsum."

I am glad to hear I was not the only person who enjoyed that meeting. And, hopefully, if more members can be incited to make contributions the newsletter will become more representative and less dependent on my own little views and opinions.

Who runs the coal-fired power stations in England and Wales?

The 10^{th} anniversary of the flotation of PowerGen (now Powergen) and National Power (recently 'de-merged into Innogy and International Power) falls into this newsletter trimester. Following a few recent conversations along the lines of how difficult it is to keep track for a non-business minded person, I went on the Web to investigate. The table below summarises the owners of the coal-fired power stations in England and Wales in February 2001. Of course, some of it may be out of date already by the time you read this in May. Things are moving fast in the competitive world of privatised power generation.
When the CEGB was privatised the fossil-fired generation plants were allocated to National Power (about 30 000 MW) and PowerGen (about 18 400 MW). In 1996 the Eastern Group, now TXU Europe, acquired 5 power stations with a generating capacity of about 6000MW from the two companies. In 1999 AES Electric, part of the AES Corporation based in the US, purchased 4000MW capacity's worth in the form of Drax, Europe's largest coal-fired power station. They also bought the small, closed down Uskmouth station and have been busy refurbishing and expanding it. Edison Mission Energy, subsidiary of another large US conglomerate, Edison International, bought two large coal-fired power stations from PowerGen. The promise to sell some more of its generating capacity had secured PowerGen the government go-ahead for the purchase of East Midland Electricity.

This meant that by the end of 1999 over 50% of the coal-fired generating capacity in England and Wales was owned by subsidiaries of large US firms.
Also in 1999 British Energy, originally privatised as Nuclear Electric and endowed with 7 of the 13 nuclear power stations in England and Wales, entered the coal-fired generation market by buying National Powers 2000 MW Eggborough station. A few months after completion of the deal they re-mortgaged the station to the tune of £550m, which presumably means that coal alongside with the tax payer is now subsidising the nuclear industry.
The latest station to change hands was the 2000MW Cottam power station which PowerGen sold to London Electricity last year. As London Electricity has been part of EDF since 1998, this gives the French electricity company a share of about 8% of the coal-fired generating capacity in England and Wales.
At the end of the first 10 years after privatisation the original two recipients of the CEGBs large coal fired plants have divested themselves of the majority of them. Generously counting the two dual fuel stations Didcot A and Kingsnorth, they now have a stake of only around 15 % each of the coal-fired generating capacity in England and Wales. But they have diversified greatly into other forms of generating electricity, distribution of electricity and numerous ventures abroad.

Company	Power Station	Output / MW	Operating since
Innogy	Aberthaw B	1 401	1971
	Tilbury	680	1968
	(Didcot A	2 010) *	1972
Powergen	Ratcliffe	2 000	1968
	(Kingsnorth	1 954)*	1970
TXU Europe	West Burton	1 972	1968
	High Marnham	945	1959
	Drakelow	976	1965
	Rugeley B	996	1972
	Ironbridge B	970	1970
AES Electric	Drax	3 870	1974
	(Fifoots Point	336) **	
Edison Mission Energy	Ferrybridge C	1 966	1966
	Fiddler's Ferry	1 444	1971
British Energy	Eggborough	1 965	1968
London Electricity	Cottam	1 970	1969

* dual fuel
** under construction

Beyond coal: In the 10 year period between 1989 and 1999 the share of electricity generated from coal has dropped from 64.6% to 38.6%. Meanwhile the percentage generated using gas rose from a negligible 0.7 to 27.1%. This large increase in gas consumption for electricity production has its roots in the popularity of CCGTs (combined cycle gas turbine) units. In the 1990s some 18 600 MW of CCGT capacity has been commissioned, with a further 4 200 MW under construction, and plans for up to another 13 000MW possible in the near future. In those 10 years, to my knowledge, no coal plants have been constructed in the UK, and I do not

know of any plans to do so in the future in spite of the advances in CCTs. The closest comes AES Electric's refurbishment of Uskmouth, renamed to Fifoots Points, which is said to bring it up to the latest CCT standards. I stand to be corrected if I am wrong about the lack of new coal-fired plants; and in this case I would not mind being wrong at all. If anybody has heard of or is involved in an exciting new coal-related project – how about a feature for the September newsletter? *s.h., 15/02/2001*

Update: I was right, overtaken by events the article is already out of date, quoting The Guardian, Monday April 9th , 2001 : "The German energy firm E.ON today announced it is to take over Powergen, the British electricity company, in a £9.6bn deal hailed as a platform for overseas growth…….The deal is expected to give Eon a foothold in the American as well as the British market. E.ON's chairman, Ulrich Hartmann, said that, following the merger last year that created E.ON, the group had positioned itself as one of the "top players in Europe"." Apparently E.ON was formed not to long ago in a merger of Veba and Viga. Its power generation division comprises some 30 coal, gas and oil-fired stations in Germany, which makes it the largest electricity provider there. It already operates in 15 European countries, and has set itself a mid-term aim of rapid expansion.

Preparation, Properties and Applications of Coal-based Carbon Materials

A joint meeting of the Coal Research Forum and the British Carbon Group
University of Nottingham
27 – 28th March 2001

This year the University of Nottingham took its turn in hosting the annual joint meeting with the British Carbon Group. 34 participants assembled in Florence Boot Hall to discuss coal-based materials and to socialise over two lunches, an excellent conference dinner and numerous tea breaks. Admitted almost half of the attendants were distinctly local in origin, but hopefully nobody felt overwhelmed by the strong home crowd. I have been told that we excluded a number of people whose diaries had already filled up for those dates by the time we finally circulated the invitations, and I would like to apologize to everybody who missed the event for that reason. I would like to console you by saying 'you did not miss much', but that would not be true. The 15 presentations were all of a high quality and, each speaker having been allocated a generous 30 minutes, of considerably more detail than at most meetings.

The title of the meeting was worded in such a way as to encourage non-combustion applications without excluding combustion related work. This achieved a wide spread of topics ranging from 2t graphite electrodes to meso-carbon micro-beads only visible under a microscope.

We were treated to a step-by-step description of the production process of artificial graphite, with a generous supply of samples to hand around (J. Fisher, UCAR) and were simultaneously assured that the graphite industry was in good shape. Graphite featured again later in the day under the aspect of modelling its combustion (R. Backreedy, University of Leeds), which appeared to me to be quite a challenge requiring advanced chemistry and a lot of computing power.

Coal tar pitches were considered from different perspectives by one industrial (N.R. Turner, Koppers) and two academic speakers (C.E. Snape and J.W. Patrick, both from the University of Nottingham). Far from being undesirable by-products, we were told, they are high value raw materials custom made into performance specified products. The same can be said, possibly to a lesser extent, for another product, which many of us might just have considered a waste product (M. Cloke, University of Nottingham). Different components of the fly-ash left after pf combustion are much sought after in the building industry, provided they meet certain specifications, for use in cement, grout, breeze blocks etc.

Another big area in carbon science is that of active carbons. The physical chemistry involved in adsorption and desorption was considered in this light (K.M. Thomas, University of Newcastle-upon-Tyne). The mechanism of activating coal-tar pitch derived meso-carbon micro-beads with KOH was also re-examined (B. McEnaney, University of Bath). The redox and adsorption potential of untreated coal was considered (J. Lakatos, University of Nottingham), and found to be promising in some coals with the right amount and type of oxygen. The problem of mineral matter in coal, which would be seen as undesirable impurities in a coal-derived active carbon, was addressed by suggesting a HF/HNO_3 based demineralisation process (K.Steel, University of Nottingham).

Coal handleability was also included with a presentation on testing the confined and unconfined cohesion of particulate coal (Z. Zhong, University of Edinburgh).

A few speakers concentrated on presenting analysis methods, such as thermogravimetric analysis to test coal and char reactivity (T.J.Mays, University of Bath), bi-reflectance imaging (I. Glasspool, Imperial College) and automated petrographic analysis (K.Louden, Corus R&D Technology). The final talk of the 2-day event was devoted to a traditional coal product – metallurgical coke (S. Hanson, University of Nottingham).

We had some good, un-rushed discussions during the meeting, and few people left without having learnt anything new. In that respect I would call the event a resounding success, and am greatly looking forward to the next joint meeting to broaden my view of coal / carbon science and technology even further. It only remains to convey the thanks from both groups to the organisers at the University of Nottingham, J.W. Patrick and M. Cloke, and the support staff in the catering and accommodation departments of the university. s.*h.*

EPSRC Web-Watch

The current EPSRC support in the research area Coal Technology amounts to £614,817 spread over 6 projects. I probably should not mention it, but to get a perspective on what proportion of the EPSRC funding this amounts to, 6388 projects are running supported with just over a billion pounds.

As the number of Coal Technology projects is so small, we have room in this newsletter to print the entire list:

AN OPTICAL INSTRUMENT FOR THE ON-LINE DETERMINATION OF CARBON IN ASH
Professor AR Jones, Imperial College of Science, £155,260

DEVELOPMENT OF AN INNOVATIVE METHODOLOGY FOR MODELLING VARIATIONS IN THE COMPOSITION OF COAL SEAMS
Dr DJ Large, University of Nottingham, £49,274

ESR21:THE DEVELOPMENT OF ADVANCED ON LINE PF FLOW MONITORING AND CONTROL
Dr A Aroussi, University of Nottingham, £131,336

ROPA: AN INVESTIGATION INTO THE EFFECTS OF MATRIX SWELLING ON COAL PERMEABILITY FOR ECBM & CO2 SEQUESTRATION
Professor S Durucan, Imperial College of Science, £85,860

THE DEVELOPMENT & IMPLEMENTATION OF AN ADVANCED COAL COMBUSTION SUB-MODEL FOR CFD CODES
Professor A Williams, University of Leeds, £130,484

THE LINK BETWEEN COALBED METHANE SORPTION & MICROLITHOTYPE STRUCTURE
Dr E Lester, University of Nottingham, £62,602

The research area of Combustion fares better with 95 projects totalling around £14 million. Mostly, of course, the combustion of gaseous and liquid fuels are featured. But a few projects appear to be concerned with coal, mainly in the combustion modelling bracket, without mentioning coal in the title and avoiding it in the abstract as much as possible. The only combustion research area project to mention coal in the title is a fairly recent addition:

THE PREDICTION OF FINE PARTICULATE EMISSIONS FROM OIL- AND PULVERISED-COAL-FIRED COMBUSTOR
Professor FC Lockwood, Imperial College of Science, £175,735

Talking of recent additions, one of the features on the EPSRC web-site is the list of projects announced in the last five weeks. Currently, as I am writing this, the five weeks cover the 19th February to the 23rd March. There were 287 new projects funded with a total of nearly £50 million. Unless I failed to spot it, none was in the coal research area.
Another interesting feature is the top 20 by value list. The largest single sum (£8.4 million) goes to the University of Southhampton for research in the field of microelectronics.

Web-Watch 2: Up to date on the Clean Coal Technology Programme

You can read the full government policy on CCT on http://www.dti.gov.uk/cct/policy.htm (Last modified: March 12, 2001). But if you have not got the time here is the conclusion:
"This combination of factors has encouraged the DTI to review UK RD&D requirements in the cleaner coal technology field, and to continue its support for high-risk strategic R&D. Government support for demonstration is not perceived to constitute value for money in a country with surplus coal-fired capacity that is moderately efficient. However, the Foresight Task Force has identified a case for demonstration after about 2005, and the Government will re-examine the position as part of its evaluation of the Cleaner Coal Technology Programme in about three years time.
If you look up the aims of the CCT programme on http://www.dti.gov.uk/cct/aims.htm (Last modified: March 10, 2001) you will learn that "The DTI plans to spend £12 million on cleaner coal technology over the next three years. If the gearing of 4: 1 achieved during the last Coal

R&D Programme is maintained in the new programme, Government input would prime total UK-based R&D activity valued at well in excess of £60 million in those three years alone with more during the second three-year period of programme operation."
The latest round of invitations to express an interest in participating closed on April 12th. It was very heavily geared towards Underground Coal Gasification (UCG), with two of the three topic areas (drilling techniques and environmental impact) devoted exclusively to it.
The project profiles for some on-going and recently completed projects funded or part-funded through the DTI CCT programme can be downloaded from http://www.dti.gov.uk/cct/pub/profiles2.htm in PDF format, although some of the most recent additions may be missing as it was last modified on May 30th 2000. The list of the more recent available files reads as follows:

* Technology Transfer of Commercial sized UK underfeed Stokers to Romania.
* Trace Element Partitioning During Combustion of pf With Inert Additives.
* Enhancing Handleability Through Coal Blending using Multi-Parameter Optimisation
* UK - China Coalbed Methane Technology Transfer
* The Effect of High Carbon-In-Ash on Particulate Emissions and Electrostatic Precipitator Performance
* Introduction to China of Supercritical Boilers and Emerging Clean Coal Technologies
* Neural Modelling and Control of Coal-Fired Boiler Plant (Neuromon).
* Heat Recovery Steam Generator for Integrated Gasification Combined Cycle Demonstration Plant in China.
* Potential Cost and Efficiency Savings Through Improved Multiphase Flow Application in UK Fossil-Fired Power Generation.
* Extension of Sulphate Melt Data for Computer-Based Modelling of Utility Boilers.
* Innovative Supercritical Boilers for Near-Term Global Markets.

And if you are still short of something to read, on 6 December 2000 the Foresight Energy & Natural Environment (ENE) Panel published a report outlining its priorities and recommendations for action. You can download the report "Stepping Stones to Sustainability" from http://www.foresight.gov.uk/default800ns.htm

And finally, courtesy of my predecessor A. Walker, a little piece he thought might cheer up us (few) women working in the field:

Woman powers to top at Didcot
By Nina Montagu-Smith
Daily Telegraph – Monday 9th April 20

NINA SKORUPSKA, 39, has been appointed the first woman manager at Didcot power station.
She is also the first woman to be made a manager by the power group Innogy or its predecessor, National Power, from which it demerged in October 2000. Mrs Skorupska, who is married with no children, will run the combined cycle gas turbine station in Oxfordshire. She lives nearby in Berkshire.
A spokesman for Innogy said: "She controls the plant and has engineering qualifications, but her role is essentially a managerial one. She will not be rushing around with a spanner, although she has done that before. We believe she is the first woman to hold a post like this."

With a largely academic background - a chemistry degree and PhD in combustion from Newcastle University - Mrs Skorupska has worked for Innogy, and National Power before it, for some time. She specialises in fuel combustion and is an authority on aspects of coal assessment for combustion.

CALENDAR

Date	Title	Location	Contact
27th June 2001	**Joint Meeting of the Environment and Characterisation Groups** **"Characterisation of Coals to Predict the Environmental Impact of Combustion Processes"**	**Drakelow Business Centre**	**Dr M. Cloke** **SChEME** **University of Nottingham** **Nottingham** **NG7 2RD** **tel: 0115 9514169** **e-mail:** **michael.cloke@nottingham.ac.uk**
13th September 2001	Autumn Meeting of The Combustion Institute The programme will include the **incineration** of a wide variety of waste materials, such as biomass, sewage sludge, domestic garbage, polymers, etc and will include **co-firing with coal**. Different types of combustor and gasifier will be discussed, as also will the pollution from them and the associated combustion and operating problems.	Department of Chemical Engineering, University of Cambridge	Prof Allan Hayhurst Dep't of Chemical Engineering Cambridge University Pembroke Street, Cambridge CB2 3RA. tel: 01223 334790 fax: 01223 334796 e-mail: allan_hayhurst@cheng.cam.ac.uk
30th September to 5th October 2001	11th International Conference on Coal Science "Exploring the Horizons of Coal"	Palace Hotel San Francisco CA	Hosted by The National Energy Technology Laboratory (NETL) http://www.netl.doe.gov
4th-7th December 2001	18th Annual International Pittsburgh Coal Conference "Coal's International Future: The Technical Challenge"	Newcastle City Hall, Newcastle, New South Wales, Australia	http://www.engrng.pitt.edu/~pccwww/ Note: Deadline for abstracts is on the 15th May
21st November 2001 (provisional)	**" A Selection of UK Papers from the International Coal Science Conference, 2001, San Francisco, USA "**	**The University of Sheffield**	**David McCaffrey** **The Coal Research Forum** **P.O. Box 154** **Cheltenham** **GL52 5YL** **Tel: 01242 236973** **Fax: 01242 516672** **e-mail: david.mccaffrey@easynet.co.uk**