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Personal viewpoint

Desulphurisation of flue gases: is there another way?

Britain has been called 'the dirty man of Europe' by its European Community partners at recent conferences concerned with the environment. One reason why is that we will not join the so-called 30% club to reduce overall SO₂ emissions by 30% by 1993 based on 1980 emission levels. Many papers have been written on the very complicated subjects of transboundary transportation of pollutants and their effects on forests and fish in rivers and lakes. Based on the evidence to date, the Government has decided to fit desulphurisation equipment at three major existing coal fired stations totalling 6000 MW of generating capacity and at all new coal fired power stations.

It would appear that this step has largely been taken to satisfy our European partners, particularly those in Scandinavia. Retro-fitting of desulphurisation not only increases the fuel required to produce a given power output but increases the cost of electricity by some 10% at each station where the system is fitted. Neither British industry nor the British public will welcome the rise, particularly when it is known that the price of electricity is already lower in other industrial countries nearby, such as France.

I suggest that there is an alternative or supplementary method which should be studied and which would be particularly suitable for Britain, namely the injection of an additive for neutralising acids into the flue gases at the outlet from the electrostatic precipitators fitted on coal

Continued overleaf

fired power stations. The technique for injecting a suitable agent, very finely divided magnesium hydroxide powder, is already well known as it is widely used for a different purpose (neutralising sulphuric acid deposited on cool surfaces in chimneys to prevent acidic smut emission) with oil-fired boiler plant and when oil-firing supplements coal-firing. Of the 19 coal-fired power stations with a capacity of 500 MW or greater operated by the CEGB in Britain, only three will have desulphurisation by the middle of the 1990s. The remaining 16 will be untreated.

Britain is an island off the coast of Europe lying well to the south-west of Scandinavia, this should be taken into account when considering transboundary transport of oxides of sulphur. Measurements have been made by the CEGB of the sulphur dioxide content of a power station plume as it travels at about 5%/h and that at least 50%, and probably 75% or more, will precipitate into the sea in transit between Britain and Scandinavia. A percentage will be oxidised to SO₃ in transit. Under wet weather conditions in the Scandinavian mountains, a proportion will be precipitated as so called acid rain.

If magnesium hydroxide of an appropriate particle size is added to the flue gases at the power station, very little of the additive will be lost as dry precipitation over the North Sea but a high percentage will precipitate with the rain in Scandinavia. The magnesium hydroxide will not react with the acids in the plume but will neutralise acids, particularly sulphuric acid, on the ground and in the streams and lakes.

The mean particulate size of the proposed magnesium powder is 3 µm in diameter. The very low rate of dry precipitation and high rate of wet precipitation which occurs when dust of this particle size is carried in the atmosphere is clearly illustrated by comparison with Saharan dust, and with precipitation measured by scientists from the Institute of Terrestrial Ecology of radioactive caesium compounds transported in the radioactive cloud from Chernobyl. When this cloud passed over southern and central England, the weather was dry and the measured precipitation on grass was less than 10 Bq/m². Rain was encountered over Wales, the Lake District and south-west Scotland and the measured precipitation rose dramatically to 1000 Bq/m² and peaked at some 4000 Bq/m².

Sir John Mason, The Royal Society, said at a recent NSCA (National Society for Clean Air) conference that two-thirds of the acidity in Norway is due to wet precipitation and that 30% of wet acid rain precipitated during less than 3% of wet days. The magnesia rain system would be controlled in a scientific manner using

meteorological forecasts so that injection would take place only when specified weather conditions were forecast, notably when the wind was from the western segment, conditions were comparatively dry over the North Sea and wet precipitation over ecologically sensitive regions in Scandinavia was anticipated.

There have been reports of acid rain affecting areas of Scotland. The magnesia rain technique could probably be applied effectively at local Scottish power stations, such as Longannet, again using weather forecasts and scientific control of injection.

It is claimed in Britain that we apply three criteria relating to pollution control.

(a) We use the best practicable means.

Desulphurisation is very expensive to install, takes several years to retrofit and is expensive to operate.

The magnesia rain system could be operated almost immediately, the additive is readily available, there would be no loss in plant efficiency and the operating cost would be about one-tenth of desulphurisation for a similar effect in ecologically sensitive regions.

(b) We use the best practicable environmental option.

The most commonly used desulphurisation method involves quarrying of large quantities of limestone, frequently in areas of outstanding natural beauty, which has to be crushed and conveyed to the power stations. An approximately equal volume of effluent has to be conveyed from the power stations for disposal.

The magnesia rain system involves manufacture of magnesium hydroxide by precipitation from the sea at a plant in Hartlepool using the same weight of dolomite as the hydroxide produced. The quantity required to be conveyed to each power station would be well below one-tenth of the weight of limestone for desulphurisation and there would be no effluent for disposal.

(c) The polluter pays. With desulphurisation the CEGB will pay very heavily at three power stations and nothing at 16 power stations.

With the magnesia rain system, using control by meteorologists, the cost would be less than one-tenth of the cost of desulphurisation at each power station. In practice, it could be even lower in cost and just as effective in the ecologically sensitive regions.

Full scale trials require to be carried out with the magnesia rain system.

Byrom Lees
Senior Fellow

Energy, high technology and economics in modern steelmaking

Dr F Fitzgerald FEng†

The fortunes of the British Steel Corporation have undergone a dramatic change in recent years (Fig 1). Enormous losses in the early part of the decade have been converted into significant profits and the Corporation is now confidently preparing to return to the private sector. This has been achieved against a decline in steel demand following the energy crises of 1973 and 1979 such that there is still, despite the restructuring of the industry worldwide, some 100 Mtpa excess capacity in the Western World, 30 Mtpa of which is in Europe. This has led directly to a weakness in prices although production costs are rising, producing a classical cost/price squeeze. Exacerbating the decline in demand has been the growth in steelmaking capacity of the developing countries for example Brazil and Korea, at the expense of the traditional steelmaking countries such as Japan, the USA and the UK. Their steel production grew by 43 Mtpa from 1976 to 1986 while in the same period that of the big three (Japan, North America and the EEC) fell by 71 Mtpa¹

In addition to these factors there was a rapid rise in energy prices and whilst prices for oil products have dropped in recent years they have become variable and typical of traded commodities.

Although there is currently a 'mini-boom' in the UK, it is likely that steel demand in the industrialised countries will at best stagnate or decline slightly in the 1990s², partly as a result of the more efficient use of steel, improvement in the quality and strength of steel products, but also from the replacement of steel by competing materials.

In the developing countries, on the other hand, provided that sufficient finance is available, growth rates of 2% and 3% pa are still possible, as development of their infrastructure will continue into the next century and investment goods and consumer durables will be increasingly required. Indeed, demand rises of 6%, 8% and 11% respectively, are being forecast in India, Taiwan and South Korea in 1988. The developing countries will, however, largely install capacity to meet this increased demand, becoming net exporters, and the traditional producers will continue to face a declining market.

It is against this background that the Corporation faces the twin challenges of its own privatisation and a return to free trading in steel in Europe. With the latter the UK industry's home market share will be at risk. At the same time there will be the opportunity to

export into Europe provided that quality and costs are competitive and increasingly Europe must be seen as the home market area.

The two largest controllable cost elements in steelmaking are those of labour and energy, being 25% and 18% respectively of current costs. Significant reductions in manpower and increases in productivity have already been achieved during the restructuring of the Corporation, and productivity levels are now the equal of our competitors in Europe. Indeed, latest figures show that the Corporation has surpassed German performance. Figure 2 shows changes in productivity in steelmaking in various countries with, on the upper abscissa the Corporation's output and on the lower the total numbers employed in the Corporation. The productivity figures are averages and vary widely for different products. The numbers employed were reduced as the Corporation concentrated its production on the larger, more modern and more efficient of its sites and operated a stringent staffing policy.

Energy consumption in a steelworks is a function of the rate of steel production and the Corporation's restructuring alone would have led to reduced energy consumption as it loaded the more efficient works. However, an energy conservation programme was launched in 1981. Figure 3 shows the change in energy consumption per tonne of liquid steel produced, and assumes the plant configuration which existed prior to the formation of United Engineering Steels. In addition to the effects of restructuring, it includes the

*Presented at the Shell Centre, London on 8 March 1988
†Managing director, Technical, British Steel Corporation

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effect of an increase in the proportion of the steelmake which is continuously cast, with approximately 10% improvement in yield over the ingot route, from 35% in 1981 to 73% today.

The effect on the Corporation's profitability is illustrated in Fig 4, which shows the gains made from the various initiatives offset by the effects of the cost/price squeeze mentioned above, (the cross-hatched area). It provides a good illustration of running hard to stand still.

Similar large changes in manpower and energy consumption in the Corporation will not be possible in future, though international comparisons indicate that both worthwhile manning and significant energy reductions can still be achieved; and indeed are necessary if the industry is to be successful in the international arena, as Table 1 which shows labour rates across the world, makes clear. It is a question of keeping up the pressure and applying modern 'high technology' concepts aimed specifically at improving productivity, conserving energy usage and at the same time improving product quality. This paper will present some of the techniques currently being applied to that end. It will also, I hope, demonstrate that it is wrong to lump all basic industries together under the term 'sunset'. Modern steelmaking operates in a highly competitive international market. It already uses and demands much wider applications of 'high tech' if it is to succeed.

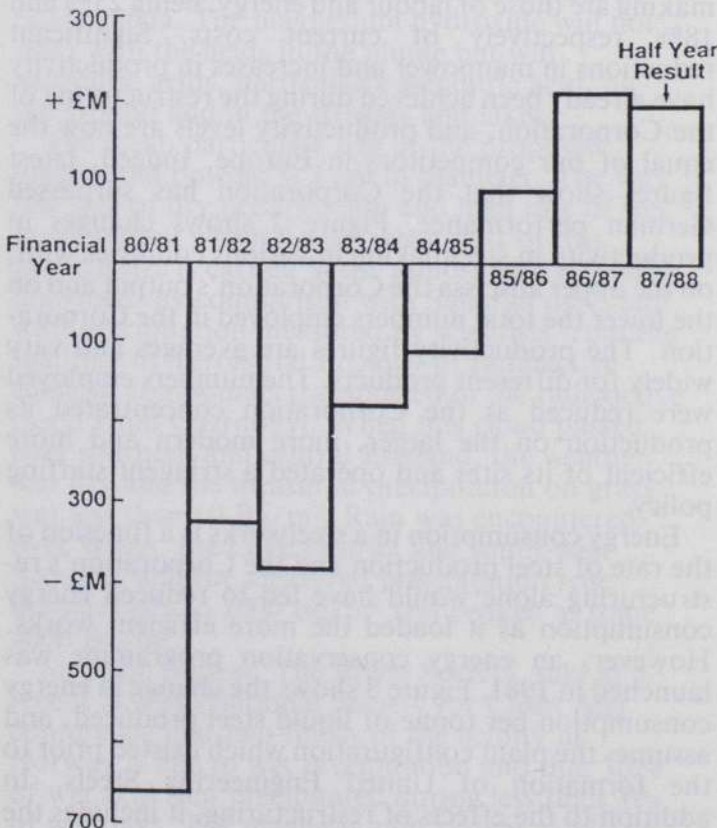


Fig 1: BSC profit summary

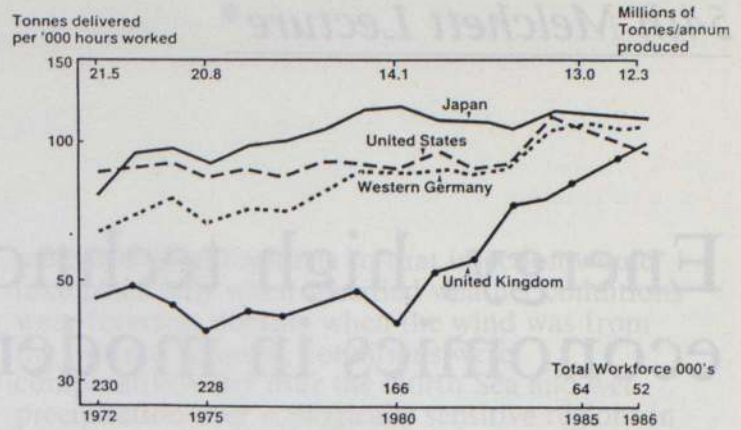


Fig 2: Labour productivity movements in certain countries 1972-1986

The energy conservation programme

The organisation of the energy conservation programme has been reported in detail.³ It depended on the ability to compare the performances of our own plants with each other and with our competitors. This is not as easy as it sounds. Energy consumption depends on the degree of vertical integration in the company and its product mix. It is critically dependent on the process route, on product yield, for which there is no internationally recognised definition and it is affected by a plant's loading.

These problems were addressed in a study of energy consumption in steelmaking commissioned by the International Iron and Steel Institute.⁴ It is based on collection and analysis of energy data reflecting good world practice at every stage in steelmaking. The results have real significance in that they are practically attainable and they are presented as energy flows in three reference steelworks, typical of those currently operating worldwide. A realistic method of calculating the effects of changes from the configuration of the reference plants on the energy consumption is also presented. It was thus possible to compare the

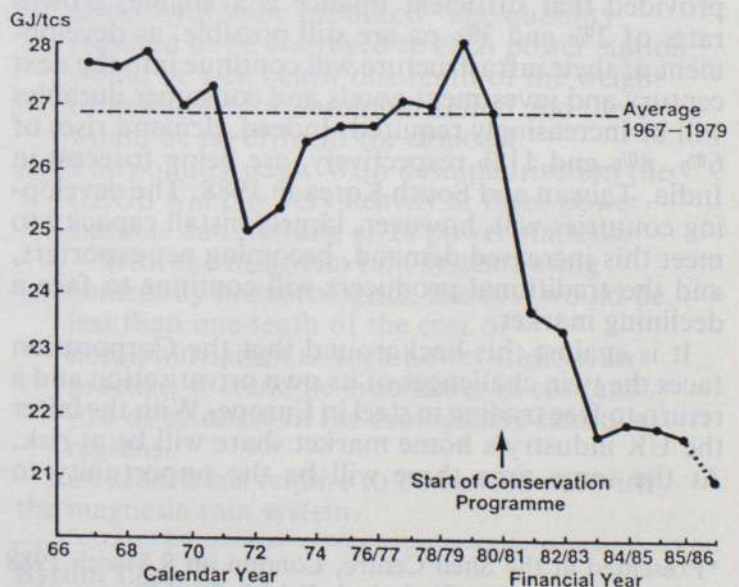


Fig 3: BSC energy consumption

54th Melchett Lecture The President's introduction

Dr Guy Masdin, president of the Institute of Energy, said that he was delighted to welcome such a large and distinguished audience to the Melchett Lecture which was to be presented by Dr Frank Fitzgerald, managing director, Technical and Board Member of the British Steel Corporation.

The foundation for Dr Fitzgerald's distinguished career was built at the University of Sheffield where he studied Fuel Technology, initially under Prof Sargant, and then completed his PhD when Prof Med Thring was in the chair. He spent a few early years working on rocket development and also lectured for a short period at Aston. Since then he has spent his entire career in the steel industry. Initially he worked at the United Steels Swinden Laboratories at Rotherham where he quickly built up a reputation for his research on heat transfer and fluid dynamic modelling to improve the design and performance of furnaces.

Later he moved to Teesside to become manager of the BSC Corporate Labs before progressing, via director of research, to his current position.

Dr Masdin said: 'In addition to his scientific strengths, Frank has other attributes which I respect and which I believe are essential to ensure the ongoing success of industrial R & D. These are: the ability to have a clear view of the ultimate business aims of the R & D — both short and long term



Dr Masdin, president of the Institute of Energy, is pictured (right) presenting Dr Frank Fitzgerald with the Melchett Medal. (Picture courtesy of Shell International Petroleum Company.)

and how they can be achieved; a strong commitment to support practical development programmes of sound basic research; a drive to encourage universities and other higher education institutions to produce skilled graduates and technicians well-trained in the technological skills, required by industry in the future.

'All these have been combined with a willingness to set up cooperative R & D programmes where complementary skills and benefits are shared. With the increasing cost and scope of industrial R & D this is an issue of increasing importance. In this respect BSC could make a major contribution to the initiatives being developed via CEST (Centre

for Exploitable Science and Technology). Moving now to Dr Fitzgerald's involvement with energy, I have noted over the years that in all his activities, the cost-effective selection and use of energy has been of paramount importance. He has been involved with the improved application — in established and new applications — of gas, oil, coal and electricity, in the full range of processes from coke ovens to the most advanced heat treatment furnaces. His overall aim has always been to produce a high quality product at internationally competitive prices.'

The president then presented Dr Fitzgerald with the Institute of Energy's Melchett Medal.

energy consumptions of different plants and to examine the effects of technical changes and operating practices on energy consumption.

The comparison showed that the Corporation's plants could not hope to equal some of the performances achieved by others. However, it showed up those process stages where energy usage was inefficient and indicated clearly that energy savings could be made without major capital spending, a result confirmed in practice. Many small schemes have been implemented. Figure 5 categorises the 120 energy saving schemes undertaken at a capital cost of £25 M in 29 months from 1985 to 1987 and indicates where the £31 M pa savings were made. Of the 120 schemes 40 required no capital expenditure and the average payback period for the other 80 was 15 months. In the three-year period from 1981 to 1984, £24 M capital was spent and a £31.2 M pa saving was achieved. In

May 1988

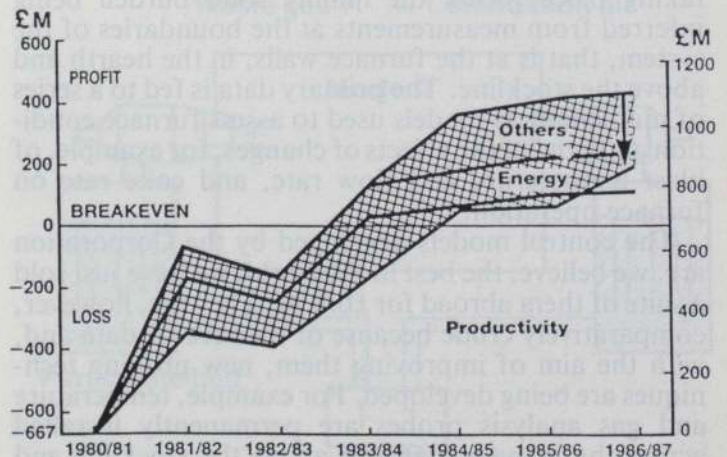


Fig 4: BSC profit movements. Indicative change from 1980/81

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Table 1: Hourly compensation costs for production workers in the iron and steel industry: 1984

	US dollars	Relative to the United States (%)
United States	20.3	100
Japan	11.0	54
United Kingdom	7.2	36
Continental EEC	10.1	49
Brazil	1.7	8
Mexico	2.3	11
Taiwan	2.1	10
Republic of Korea	2.1	10

both periods traditional waste heat recovery schemes gave least return because of the difficulty of using recovered heat effectively.

In the integrated works, major energy input is in ironmaking and in the scrap based electric arc works major savings have been made in heating furnaces. Developments in these two areas are briefly examined.

Ironmaking

The average annual performance of BSC's blast furnaces for the last six years is shown in Fig 6. In this period there has been an increase in productivity coupled with a substantial decrease in fuel rate. Reasons for this improvement include capital investment in new plant and improvements in charge quality, especially coke and sinter, following detailed laboratory and plant studies,^{5,6} but a major factor has been the development of new methods of blast furnace control.⁷

The blast furnace, the shaft of which may be up to 100 m in height and with a hearth diameter of 14 m, is a notoriously difficult system to monitor, the events taking place within the mainly solid burden being inferred from measurements at the boundaries of the system, that is at the furnace walls, in the hearth and above the stockline. The primary data is fed to a series of mathematical models used to assess furnace condition and predict the effects of changes, for example, of blast temperature and flow rate, and coke rate on furnace operation.

The control models developed by the Corporation are, we believe, the best in the world; we have just sold a suite of them abroad for £0.8 M. They are, however, comparatively crude because of the lack of data and, with the aim of improving them, new probing techniques are being developed. For example, temperature and gas analysis probes are permanently installed across the furnace diameter above the stockline and used to indicate the state of operation, but because mixing may occur the outputs are sometimes difficult to interpret. For that reason, routine measurements,

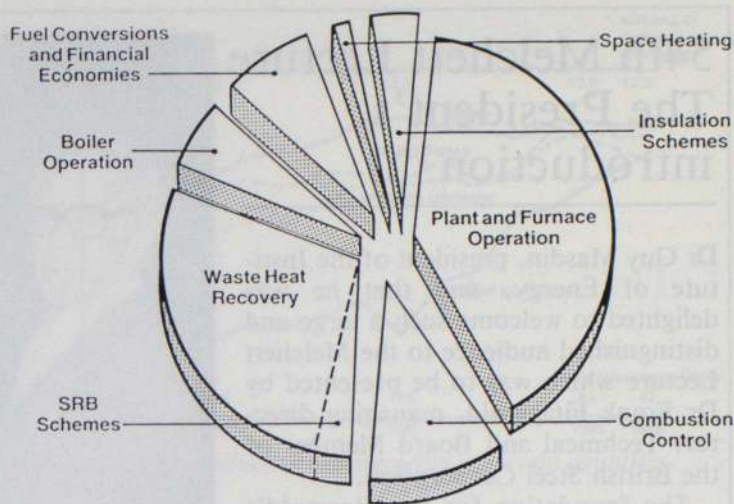


Fig 5a: Expenditure over 29 months, £29 M

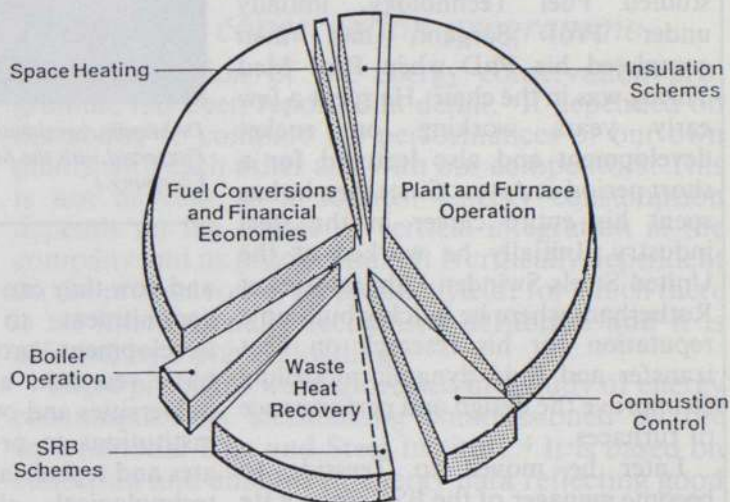


Fig 5b: Savings, £31 M pa at £2/GJ

once a shift, are now being made by driving probes into the furnace burden a few metres below the stockline, to relate the permanent measurements to events near the top of the stack. Probes for this duty are available commercially but their cost is so high that the Corporation has developed its own. The principle is to accept the downward movement of the burden, at about five metres per hour, which bends the probe and to equip the drive mechanism with a set of pinch rolls which automatically straighten the probe as it is removed from the furnace. A single probe can be used this way for about 200 traverses, that is 10 weeks' operations.

The probe is computer controlled automatically from the furnace control room. CO, CO₂ and H₂ content of the gases and the temperature are determined across the furnace diameter.

As work continues to improve probing techniques and thus knowledge of the furnace interior, the control models, furnace output and efficiency will all improve.

Heating furnaces

BSC Stainless, with an electric arc scrap-based process, has halved its specific energy use over a six-year period, Fig 7, mainly by the application of self-

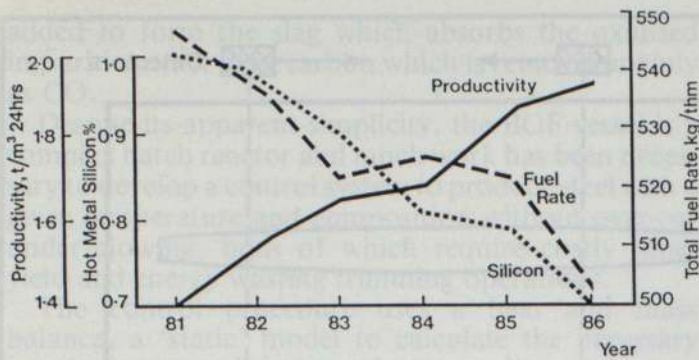


Fig 6: BSC blast furnace performance 1981-1986

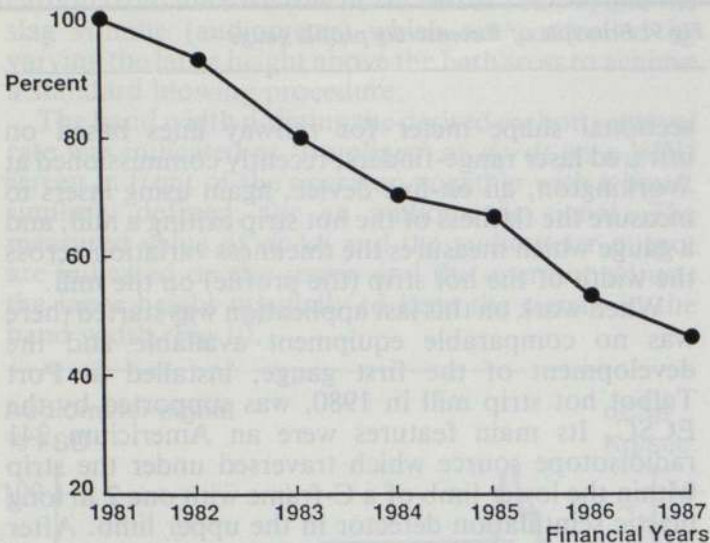


Fig 7: Reduction in energy consumption in BSC Stainless over the period 1981-1987

recuperative and self-regenerative burners, furnace designs which favour flow recirculation to even-out temperature differences in the furnace chamber and the stock, and ceramic fibre insulation.^{8,9}

In a self-recuperative burner design, waste gases are extracted through the body of the burner and preheat the incoming combustion air. Recuperative burners generally give about a 30% energy saving over equivalent cold air practice.

The regenerative burner system offers the highest potential for energy saving on retrofitting to existing furnaces. Two burners are fired alternatively, energy being recovered by passing the exit gases through a bed of particulate material which is used subsequently to preheat the combustion air, Fig 8. They have been applied successfully to slab heating and heat treatment furnaces with energy savings over cold air practice ranging between 35% and 60%. The burners can use both oil and gas and trials with low CV gas, when both air and fuel gas flows must be preheated, have been successful.¹⁰

Works energy monitoring and targeting

It is essential that energy use throughout a works is regularly analysed in detail so that divergence from recognised standards is identified quickly and

remedial action taken. Yet in many parts of industry energy recording is often done manually, at weekly intervals, and in many cases metering is inadequate. There is thus little possibility, except on a broad basis, of identifying adverse trends and appropriate actions.

At Brinsworth Mill an electronic monitoring and targeting system has been installed with help from the Energy Efficiency Office through the Demonstration Projects Scheme. The system is based on an IBM personal computer and is linked to over 90 sensors which meter electricity, steam, compressed air, water, natural gas and oil at key sites around the plant. The system automatically takes readings at fixed intervals and can readily display usage patterns. A daily record is produced for the mill engineer and daily records of energy use in individual areas are also transmitted to the managers. The system can be interrogated to assess historical performance. Specific energy use over a half-yearly period had been reduced by over 10%, stimulated by the easy access to information.

Energy conservation by indirect means

Minimum specific energy consumption is achieved in steelmaking when the yields of products are maximised, plant is operated continuously so that losses associated with cooling and reheating of process units (for example, direct rolling of hot slabs from the caster with either edge heating or a minimum of time in a reheat furnace) is avoided, and quality parameters in the product are met at each process stage, so that there is no requirement to re-work or recycle product

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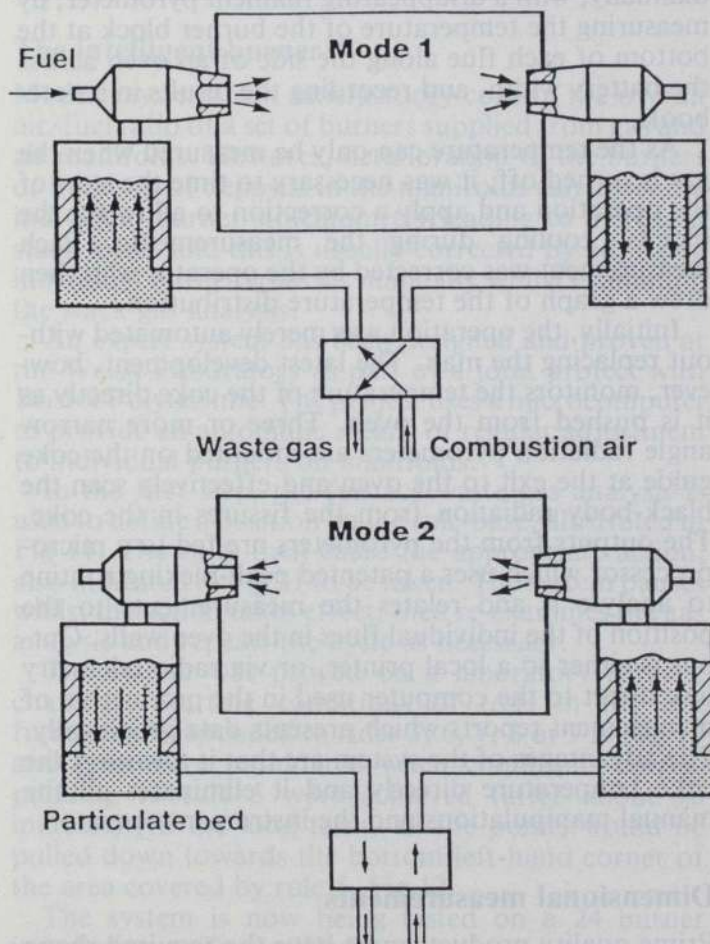


Fig 8: Regenerative burners

through any stage. Schemes to achieve these aims are usually justified in terms of yield and quality improvements, and cost savings from manpower reduction, but their effect on energy consumption can be significant. Some of the developments are described below. They are in three areas, namely instrument development expert systems and plant condition monitoring.

Instrument development

Although many of the measurement techniques used in the iron and steel industry depend on relatively simple principles; the production of instruments to give reliable information, regularly and consistently despite the harsh environment, demands considerable ingenuity. Most of the sensors used have been developed by the industry and I shall consider only two examples out of many.

Coke oven temperature measurement¹¹

Blast furnace performance is critically dependent on coke properties, particularly strength and reactivity, which for a given coal blend are governed by the rate and the final temperature of carbonisation. Previously this was inferred from the temperature distribution within the oven structure. It was determined manually, with a disappearing filament pyrometer, by measuring the temperature of the burner block at the bottom of each flue along the side of an oven across the battery width, and recording the results in a notebook.

As the temperature can only be measured when the gas is turned off, it was necessary to time the start of the operation and apply a correction to allow for the blocks' cooling during the measurements. Each measurement was corrected by the operator who then drew a graph of the temperature distribution.

Initially, the operation was merely automated without replacing the man. The latest development, however, monitors the temperature of the coke directly as it is pushed from the oven. Three or more narrow angle radiation pyrometers are mounted on the coke guide at the exit to the oven and effectively scan the black-body radiation from the fissures in the coke. The outputs from the pyrometers are fed to a micro-processor which uses a patented peak-picking routine to analyse it and relates the measurements to the position of the individual flues in the oven walls. Output is either to a local printer, or via radio telemetry link direct to the computer used in the production of management reports which presents data graphically. The advantages of the system are that it measures the coke temperature directly and it eliminates all the manual manipulations and the instrument operator.

Dimensional measurements

Prime quality products must have the required shape and thickness. New developments include a cross-

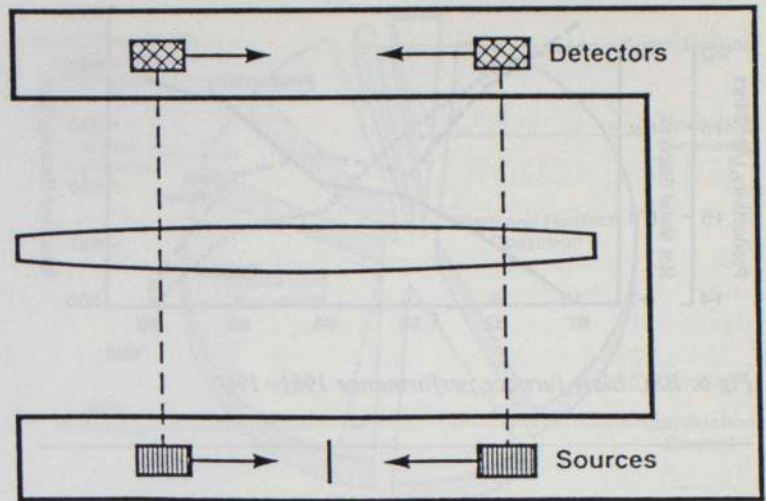


Fig 9: Principle of Ravenscraig profile gauge

sectional shape meter for railway lines based on infrared laser range-finders, recently commissioned at Workington, an on-line device, again using lasers to measure the flatness of the hot strip exiting a mill, and a gauge which measures the thickness variation across the width of the hot strip (the profile) on the mill.

When work on this last application was started there was no comparable equipment available and the development of the first gauge, installed at Port Talbot hot strip mill in 1980, was supported by the ECSC. Its main features were an Americium 241 radioisotope source which traversed under the strip within the lower limb of a C-frame with one 2 m long plastic scintillation detector in the upper limb. After correcting for variations in gauge along the length of the strip measured by the fixed, centre-line X-ray gauge used for automatic gauge control, precisions better than 0.3% with 95% confidence were obtained. Maximum thickness measurable was 6 mm steel.

Similar and improved gauges were installed at Llanwern hot strip mill in 1982, Shotton (pickle line), Ravenscraig (HS temper mill) and Trostre (pickle line). Further installations are planned.

The latest device is the Ravenscraig hot strip mill gauge,¹² currently undergoing commissioning and development. It has two detection/source units scanning simultaneously from opposite edges of the strip, Fig 9, thus reducing the scan time to 60% of that of the earlier gauges and providing symmetrical readings with potential for feedback control of the mill to reduce edge effects. Precision is better than 0.2% of the thickness measured and a gauge is now designed for thicknesses up to 25 mm.

Expert systems

An expert system is a computer program encapsulating a database of the knowledge within a restricted subject area of human expertise.

BOF steelmaking control¹³

The basic oxygen furnace consists essentially of a vessel in which hot metal from the blast furnace is refined by injection of oxygen. Additions of scrap and ore control the temperature of refining, and fluxes are

added to form the slag which absorbs the oxidised impurities other than carbon which is removed mainly as CO.

Despite its apparent simplicity, the BOF vessel is a complex batch reactor and much work has been necessary to develop a control system to produce steel with a given temperature and composition without over- or under-blowing, both of which require costly time, yield and energy wasting trimming operations.

The control procedure uses a heat and mass balance, a 'static' model to calculate the necessary inputs, for example hot metal, oxygen, lime and scrap, to achieve the required steel weight at the correct end point carbon and temperature. Sensors are then used during the oxygen blow to monitor the removal of carbon from the bath (the dc/dt versus t curve) and the slag volume (audiometer) which are controlled by varying the lance height above the bath so as to achieve a standard blowing procedure.

The band width defining the desired carbon removal rate was indicated as 'tramlines' of dc/dt on a VDU screen in front of the operator, together with a band, similarly defined, for an audiometric signal. The measured value of dc/dt and the audiometer output are indicated on the screen and the operator adjusts the lance height manually to keep the signals in the band width, Fig 10.

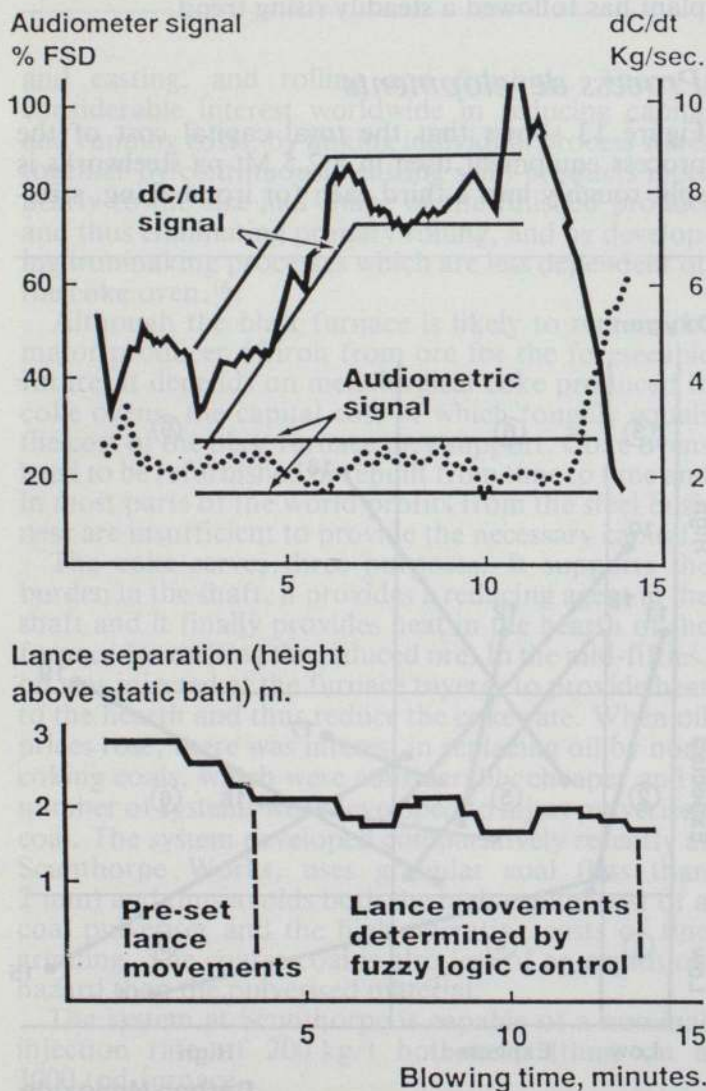


Fig 10: Automatic BOF control
May 1988

This system gives inconsistencies due to operator error and performance variability as operators change from shift to shift, and problems due to the fact that at times operators simply cannot react quickly enough to maintain control. Accordingly, the system has been completely automated using linguistic control, or the 'fuzzy-logic' technique, which essentially is the computerisation of the skilled and experienced operator's reaction to the data presented to him. For example, if the dc/dt value is low and the audiometer indicates a high slag volume, the skilled operator would deduce that the lance tip is too far away from the liquid surface and he would lower the lance; the computer does exactly that. Conversely, if dc/dt is high and the audiometer indicates a low slag volume, the lance would be raised. The degree of movement of the lance is directly related to the magnitude of the 'out of balance' signal received by the process computer.

To improve consistency of operations and product quality, an automated system of assessment has recently been developed. This involves examination by interrogation of data stored by the process control computer. The output of this examination gives automatic correction of the static model and the carbon removal rate (dc/dt versus t) control model. The interrogation procedure and the advice given is equivalent to the approach taken by an expert steelmaker were he to be presented with the problem. Unlike the expert, however, the computer based system is always available. The accuracy of the sensor signals is all important and the latest development monitors the condition of the sensors and advises of any necessary repairs or maintenance.

The intelligent burner¹⁴

Modern systems can satisfactorily control the overall air/fuel ratio of a set of burners supplied from gas and air manifolds. However, deterioration of the burners or build-up of deposits in the manifolds can upset the individual burner stoichiometry leading to increased stack losses and this is usually corrected by adjusting individual burner controls manually whilst examining the stack gas analysis.

An expert system has been designed and proven at the Welsh Laboratory as part of a joint project with Bristol Polytechnic. The project uses a microcomputer to provide an automatic means of regular adjustment to individual burners on manifolds.

In the first step, the furnace waste gas analysis is used to define a position on the rule-base, illustrated in Fig 11. The rules then cause the appropriate action, also indicated in Fig 11 to be taken. The system pauses whilst the action takes effect, then re-examines the gas analysis and repeats the cycle as necessary.

The system was proved on a laboratory furnace chamber. Starting conditions of tests in the hot furnace corresponded to rules 3, 6, 7, 8 or 9 in Fig 12 and tests were terminated when conditions corresponding to rule 5 were achieved (after about 10 minutes). In the long term, all the points would be pulled down towards the bottom left-hand corner of the area covered by rule 5, Fig 12.

The system is now being tested on a 24 burner installation at Troste Works.

Continued overleaf

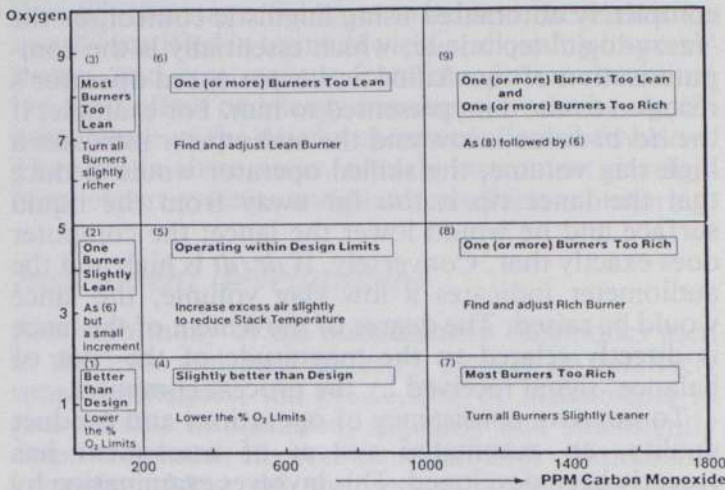


Fig 11: Rule base of artificial intelligence for intelligent burner

Savings accruing from implementation of the scheme will obviously depend on the particular circumstances. Energy savings of 2% to 5% for boilers and 5% to 20% for furnaces are possible. In the extreme circumstances where there is no fuel department or R & D involvement at a works, the savings could be higher than 25%. The need for an expert fuel technologist on site is eliminated and the system operates continuously.

Plant condition monitoring and condition based maintenance¹⁵

Condition based maintenance ensures that plant stoppages are minimised. Vibration monitoring, thermal imaging, gas analysis and oil gearbox debris analysis are techniques regularly used by the steel industry. Vibration monitoring of large, slowly rotating plant, is a research area of interest. Acoustic emission has been employed to monitor the incidence of stress corrosion cracking in the walls of large heated vessels, the pressure inside which is regularly cycled. The technique depends on the noise emitted from the root of a developing crack being picked up on an array of transducers mounted on the vessel. By triangulation the site of the crack is pinpointed, in much the same way as the site of an earthquake is pinpointed.

Historically, plant condition monitoring has been performed manually, on demand, by small teams of engineers in works' engineering or technical departments.

Routine monitoring has increased with the recognition of the need for condition based maintenance and the introduction of affordable, high powered, desk top computers and compatible microprocessor data collectors, such that plant condition data can be collected by a mixture of patrol monitoring and hard-wired special instrumentation or process control instruments and systems.

Since the majority of plant condition monitoring

signals are those of vibration, the collector is generally a vibration meter with the additional facility of a key pad for entry of other data. The data in the collector is loaded into the central computer at regular points during a patrol.

A condition based maintenance system has been developed at the Port Talbot continuous casting plant and in December the plant cast continuously 100 198 t of slabs in 329 hours 42 minutes. Management throughout had the satisfaction of knowing that key items were operating satisfactorily and were not likely to fail.

Scunthorpe Works have integrated a total of 13 portable data collectors into the inspection/maintenance cycle, monitoring a total of 4134 machines covered by 70 682 measuring points. An expert system, based on rules derived from accumulated experience, is used to interpret the results, which are then used to draw up maintenance schedules. The system is growing as further experience is accumulated, leading to development of more refined rules. During a recent five months of operation, an analysis of jobs arising as a result of data collection showed that 40% were due to lack of lubrication, a matter easily rectified. A maintenance manning reduction of 50 was also implemented shortly after the system was installed, the capital cost of the equipment was recouped within the five months and the availability of plant has followed a steadily rising trend.

Process developments

Figure 13 shows that the total capital cost of the process equipment used in a 2.5 Mt pa steelworks is split roughly into a third each for ironmaking, steel-

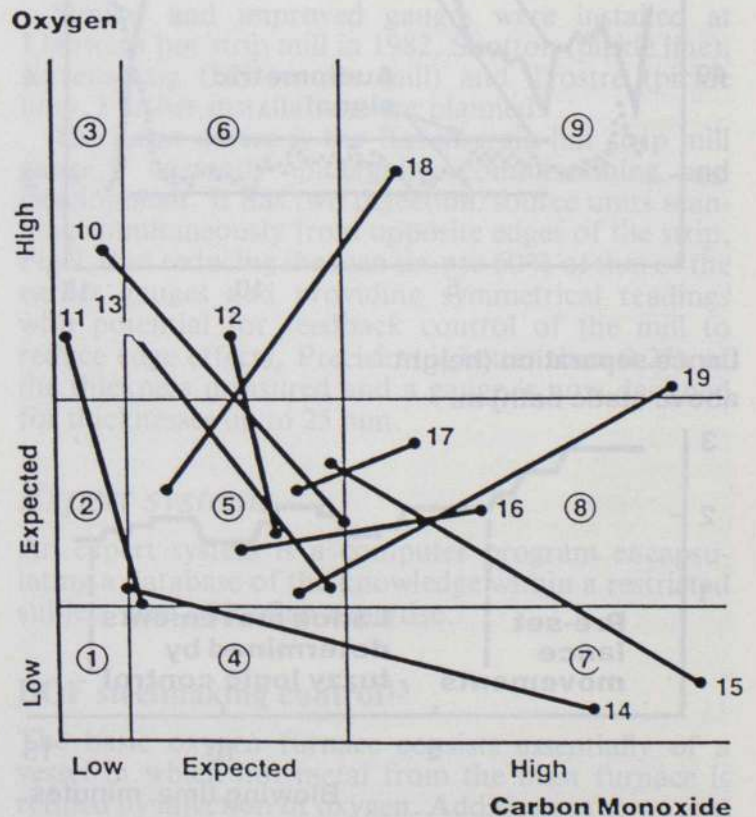


Fig 12: Starting and finishing conditions for 10 tests

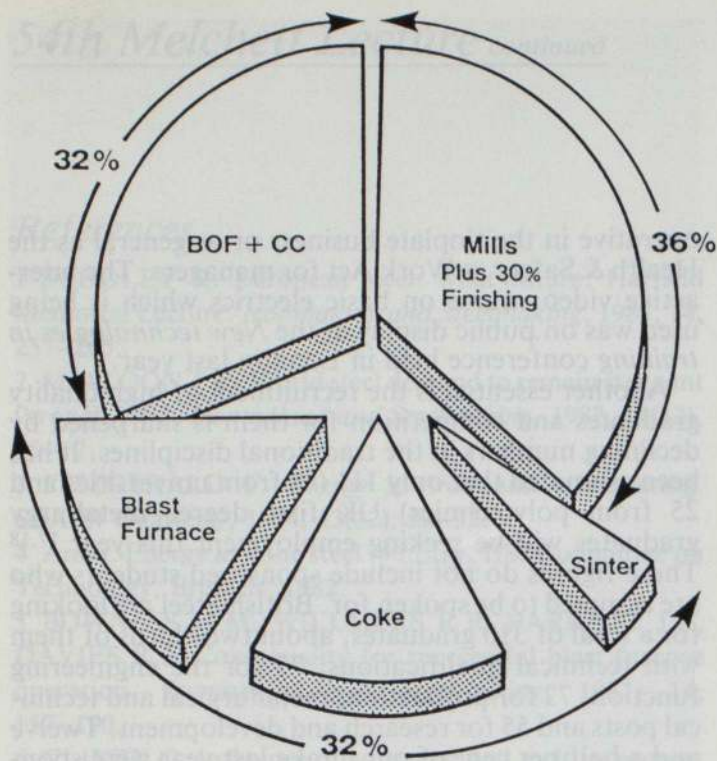


Fig 13: Breakdown of capital cost of an integrated steel plant of 2.5 Mt pa

and casting, and rolling and finishing. There is considerable interest worldwide in reducing capital and running costs, by linking individual process states together by continuously casting semi-products more nearly to the size and shape of the finished product and thus eliminating primary rolling, and by developing ironmaking processes which are less dependent on the coke oven.¹⁶

Although the blast furnace is likely to remain the major producer of iron from ore for the foreseeable future, it depends on metallurgical coke produced in coke ovens, the capital cost of which roughly equals the cost of the blast furnace they support. Coke ovens need to be refurbished or rebuilt from time to time and in most parts of the world profits from the steel business are insufficient to provide the necessary capital.

The coke serves three purposes. It supports the burden in the shaft, it provides a reducing agent in the shaft and it finally provides heat in the hearth of the furnace for melting the reduced ore. In the mid-fifties, oil was injected at the furnace tuyeres to provide heat to the hearth and thus reduce the coke rate. When oil prices rose, there was interest in replacing oil by non-coking coals, which were considerably cheaper and a number of systems were developed to inject pulverised coal. The system developed comparatively recently at Scunthorpe Works, uses granular coal (less than 2 mm) and thus avoids both the high capital cost of a coal pulveriser and the high operating costs of fine grinding. The coarse coal is also less of an explosion hazard than the pulverised material.

The system at Scunthorpe is capable of a nominal injection rate of 200 kg/t hot metal (thm) on a 3000 tpd furnace.

Results at injection rates up to 150 kg/thm (about

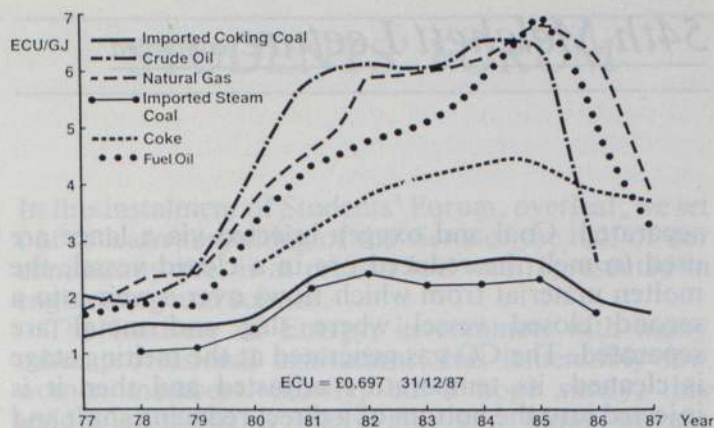


Fig 14: Energy prices in the European Community. Import prices (CIF) are shown for crude oil, consumer prices for natural gas for industry, heavy fuel oil and steam coal, and prices ex-works, in the Federal Republic of Germany for coke. Prices in ECUs (European Currency Units)

30% of normal coke requirement), show that approximately 1.0 kg of coke is displaced by 1.0 kg of coal.

With oil prices near to coal prices, however, Fig 14, it is difficult to make a financial case for installing coal injection rather than oil injection equipment. However, we take the view that coal prices will generally be lower than oil prices and this raises the question of what is the maximum amount of coal which can be injected into a conventional blast furnace and by how much can the coke rate be reduced. To answer that question we are equipping one of our Cleveland blast furnaces with coal injection equipment of up to 400 kg/thm capacity, and investigations are planned to start in April this year. This is a joint project with Hoogovens BV of Holland, supported by the ECSC.

Another ECSC supported joint project with Hoogovens has examined the design of a 100% coal based ironmaker and a conceptual drawing is shown in Fig 15. The reduction and melting stages are

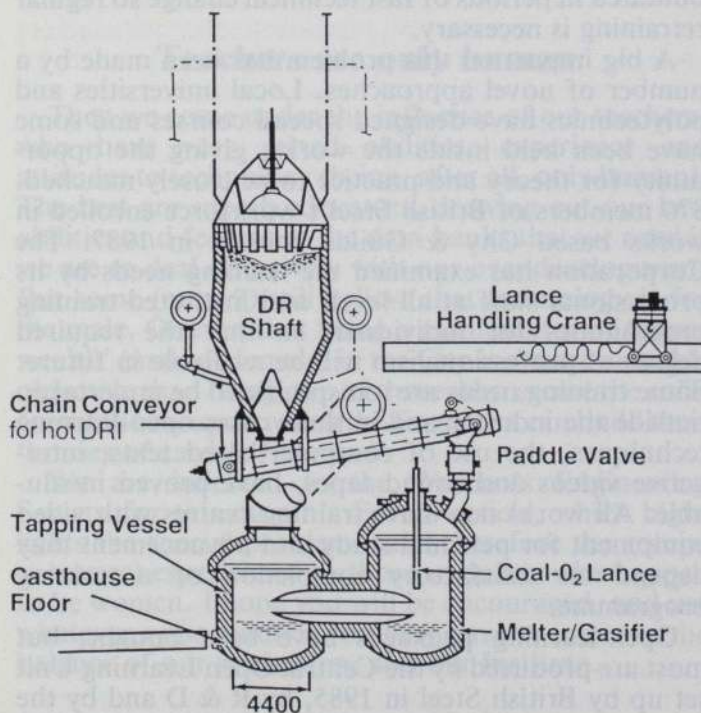


Fig 15: Hoogovens No 3 blast furnace conversion to CBF

Continued overleaf

separated. Coal and oxygen injected via a lance are used to melt the reduced ore in a closed vessel, the molten material from which flows over a weir into a second closed vessel where slag and metal are separated. The CO gas generated at the melting stage is cleaned, its temperature adjusted and then it is injected into the bottom of a direct reducing shaft and flows countercurrent to ore passing downwards. Hot reduced ore is discharged from the bottom of the shaft and conveyed to the melter vessel.

This process would have virtually the same energy requirements and running costs as a modern blast furnace, although the total capital costs for the ironworks without coke ovens would be much less. There is thus no incentive to install it until there is need for an incremental increase in iron production or coke oven plants need replacing.

Engineering: a learning profession

The steel industry has an enviable record of on-the-job training but this is a quite unsuitable way to deal with the rapid and accelerating changes in technologies currently occurring. Further, the industry's main task in recent years has been the stemming of enormous losses and its outlook of necessity had to be restricted so to some degree there has been a backlog.

However, if one considers the international scene, particularly labour rates, Fig 5, new technologies are essential indicator to compete and the success of introducing new technologies depends critically on the effectiveness of staff training. Skills quickly become outdated in periods of fast technical change so regular retraining is necessary.

A big impact on this problem has been made by a number of novel approaches. Local universities and polytechnics have designed special courses and some have been held inside the works, giving the opportunity for theory and practice to be closely matched. 870 members of British Steel's workforce enrolled in works based City & Guilds courses in 1987. The Corporation has examined the training needs by its professional staff at all levels and instituted training programmes for individuals so that the required degree of professionalism will be available in future. Some training needs are too specific to be undertaken outside the industry and in these cases open-learning techniques, the use of computer-based texts, interactive videos and sound tapes, have proved invaluable. All works now have training centres with video equipment for personal study and advancement may depend on satisfactory completion of a training programme.

Open-learning packages have been bought, but most are produced by the Central Open Learning Unit set up by British Steel in 1985, by R & D and by the businesses themselves. Packages cover the needs of all levels of staff from the operative up to management. They can be as specific as shear-line training for an

operative in the tinplate business or as general as the Health & Safety at Work Act for managers. The interactive video course on basic electrics which is being used was on public display at the *New technologies in training* conference held in London last year.

Another essential is the recruitment of high quality graduates and competition for them is sharpened by declining numbers in the traditional disciplines. It has been estimated that only 111 (86 from universities and 25 from polytechnics) UK first degree metallurgy graduates will be seeking employment this year.^{17,18} These figures do not include sponsored students who are assumed to be spoken for. British Steel are looking for a total of 310 graduates, about two-thirds of them with technical qualifications, 77 for the engineering function, 72 for production, metallurgical and technical posts and 55 for research and development. Twelve and a half per cent of our intake last year were sponsored by us. Clearly, we may have some difficulty getting sufficient high quality metallurgists this year.

In an attempt to tackle this problem British Steel is stepping up sponsorship to undergraduate courses of good quality students from schools in industrial areas, in the belief that students from an industrial community are more likely to return to industry. Support is given to universities in many other ways and British Steel was named the most helpful company in 1987 by the Student Industrial Societies' Association. Despite these initiatives we still have difficulty attracting really high quality technical people. In this I believe that we are not unique in British industry. Maybe as our fortunes wax the situation will improve but we should all be clear, energy usage, manpower productivity and product quality are inextricably linked and govern costs and competitiveness. All are critically dependent on the rapid exploitation of new technologies for which good quality, well trained staff are essential.

I hope that I have shown you enough to convince you that basic industry, if it is to succeed, needs all the 'high-tech' it can apply and that the term 'sunset industry' is an unhelpful and incorrect phrase and it is not doing any of us any good, uttered as it often is, by people who know least about industry and its tasks.

Acknowledgements

Only technical work carried out in British Steel laboratories and works is presented in this paper and the author readily acknowledges the achievements and help of his colleagues. Thanks for technical help and financial support for a number of the projects are proffered to Bristol Polytechnic and the SERC, to the Commission of the European Communities, the Department of Energy, Energy Efficiency Office and the ETSU Harwell.

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STUDENTS' FORUM

In this instalment of Students' Forum, overleaf, we set out to learn something of the views of the half of our community that is at present less well represented in engineering and science.

The Institute of Energy, in common with many other professional institutions, has lamentably few women members. Slowly, but I hope surely, this serious situation is improving, and today we are pleased to have the company of some 60 women who have joined the fascinating world of energy specialists.

A sad reflection

We have some long-standing women members who joined us in 1958, 1961, 1969, 1971 and so on, and in the last few years many more have joined us. But 60 women among a membership of around 5200 is still a sad reflection on a society, which has consistently and deliberately deprived women of the opportunities and encouragement to join in a most exciting and rewarding sector of life.

The basic genetic inheritance with which we all start, allows us an amazing range of options for life, given the right environment and help. The early influence of parents may be a very positive force to propel us forward in a technical career, or it may be a bit of a damper on our aspirations and abilities! Sadly, many have been conditioned to regard technology as a second grade option for their children, and not right for girls.

Teachers are only human

Then we come under the influence of our teachers, who have very mixed abilities, experience and attitudes to technology (being, after all, only human). The best are superb educators, drawing out our best abilities and feeding in the data-banks that we need if we are to deal effectively with our own development. But some (many?) still believe that technology is for the male. Or even that being a manipulator of 'paper wealth' (male or female) in the City is a more valuable objective than being one of those who create the solid foundations, upon which the financiers can build their 'houses of cards'. *How sad!*

We are indebted to the Women's Engineering Society for this month's Forum article, which highlights the special problems (and therefore the special successes) experienced by those engineers who happen to be women. I hope you will be encouraged, and use whatever opportunities you may have to improve the balance of our profession, and our Institute.

James P MacCarthy,
Chairman, Membership Committee.

Towards a more balanced profession

Penny Soper*

When I was a radio studio manager (the person who mixes and controls the sound) and the equipment would not work I would call for an engineer to fix it: the engineer was always a man. That was 15 years ago and I am sure that now there is a healthy sprinkling of women engineers at the BBC. I have to confess that until I joined the Women's Engineering Society (WES), as public relations officer, in September last year, although I had certainly heard plenty of talk about the scarcity of budding engineers and employers' efforts to encourage more girls to apply for engineering jobs, I had not realised what difficulties girls had to overcome to succeed in science and engineering

Last year the Women's Engineering Society Annual Conference was held at the University of Manchester Institute of Science and Technology (UMIST). The title of the conference was WISE (Women Into Science and Engineering) — Progress and Prospects. The following are comments that delegates expressed at the conference: if you are a woman student of engineering, I hope that you will get some encouragement from the way other women have faced and overcome the difficulties that they encountered. Despite those difficulties, or perhaps because of them, they derive great satisfaction from their work, and want to help other women achieve their objectives. (But, if this profile is you: male, 50, went to a boys' school, no girls on your course at university, married the girl-next-door, have three sons and have said: 'I'm not used to having women as colleagues,' read this and it may help you to gain an insight into how the women who are following you up the career ladder think and feel. Perhaps then you will find it easier to extend a helping hand. They need it.)

It has never been easy of course. Baroness Platt, outgoing chairman of the Equal Opportunities Commission and member of the Engineering Council, remembers the reaction of male colleagues at her first job: 'Oh my God, there's a war on and they've sent us a woman engineer too!' Hilda Blount, president of WES and legal adviser at Lucas Research Centre, Solihull faced what must, at times, have seemed a long struggle to become a chartered engineer, though help and advice did seem to materialise when she needed it most: 'I started my Inter-BSc at the tech and fortunately met a lady instructor whom I liked... I can remember one morning smelling that disgusting smell that comes from foundries and realising that I was happy: I was leaving home at 7 am for work at 7.30 am, then tech and home at 10 pm.'

One woman said: 'People are surprised when they find out what I do for a living and ask if I go around in

wellies and a hard hat. The answer is that I do when I am on site but that is only one part of my work.' Another said: 'I have never regretted my decision to become an engineer, basically engineering is solving problems and each new one is an exciting challenge. The only time it gets boring is when you have got a problem you can't solve.' Linda Maynard (North West Gas and immediate past president of the WES) says that engineering cares about people, 'you are bringing your skills to make an environment where people can live happily.' Someone else remarked: 'Engineering seemed the best way of using both technology and creative skills to do something practical. Girls are attracted to civil engineering in spite of its masculine image because they like the idea of building beautiful things.'

Considering the general perception of engineering as being a cold, dirty job it is amazing that children with no science and engineering links persevere with their ambitions. Daphne Jackson, professor of physics, dean of the Faculty of Science at University of Surrey and a past president of the WES, had, like most women in engineering, the example of her family to follow: in her case both grandfathers, father and brother. She was the first of her family to go to university. 'I received tremendous support from my parents in relation to my education, though they were anxious about the prospects for a woman in science. It was difficult to get started but I have never found it a disadvantage being a woman.'

Karin Hamid, project engineer with a firm of instrument makers, presents the opposite picture. She went to a local comprehensive where she says that she was 'distinctly average'. But when it came to her GCSE choices she decided that she wanted to do technical drawing. The headmistress was not encouraging, but was persuaded in the end. 'Apart from racist jokes and being a girl, I was clueless as well — I could not even work out how to tilt a drawing board — I took an awful lot of stick from the boys but was still determined to carry on.' After the first lesson the teacher

*Public relations officer, Women's Engineering Society



Courtesy of BBC Engineering

asked 'You're not just here to chase the boys are you?' Later, that teacher turned out to be very helpful and set Karin special assignments. By the fifth year she had caught up and came second in technical drawing and did well in maths and physics too.

Dr Jan Harding, Equal Opportunities Consultant, gave some interesting facts and conclusions on the success of girls doing science at school: '*Chemistry appears to have a greater success in attracting girls than does physics. It is possible that approaches to the presentation of chemistry, such as Salter's Chemistry Course, based at the University of York, and Chemistry from Issues (Harding and Donaldson 1986) are more motivational than traditional approaches. It is reported that "in mixed schools where physical sciences were generally unpopular with girls there was an average increase of 20% in girls taking chemistry, and in schools where even fewer girls opted for these subjects, the increase with Salter was 50%" (Times Education Supplement, 1987)*'.

We need similar changes in the presentation of physics. A project which addressed the question of presentation together with the retraining of existing teachers to teach physics, might prove economical and effective. A subject labelled 'technology' has a place in the proposed national curriculum. Current evidence suggests that few girls see this as relevant to them and their aspirations. Again technology must be presented within a framework that demonstrates to girls that the subject will address their needs and values.

Much evidence indicates that commitment to equality of opportunities, which sets out to reduce sex-stereotyping, is still rare within education and training systems. Where Local Education Authorities (LEAs) appoint a high status equal opportunities adviser there is more likely to be a professional commitment on behalf of its teachers.

The personal and social curriculum, imaginatively developed in some schools, that enables young people to examine attitudes, values and expectations can lead to a lessening of stereotyping. The foundations we lay for Women into Science and Engineering are still not sufficient, girls continue to suffer early disadvantages which even those who do choose to study physics find hard to overcome (APU 1986). Explicit positive action to support and encourage girls in science and technology is required at every stage of the education and training system. At times this may need to take the form of separate sex groupings. As they move through adolescence in secondary school, girls must also be enabled to develop leadership and management skills.

Working for the BBC, where actions are exposed to the public gaze, I never came across the overt sexist questioning that some of the WES members at the conference had faced in the past. Here are some examples: Linda Maynard, now in her thirties, took 12 months to find a job after her MA. At her first, long awaited, interview with a mechanical engineering company she was asked if she would be getting married and what did she feel about having children. This, of course, made her feel very angry; the question was irrelevant. Linda is now married with a three-year old son and has a list of achievements that would make a strong man quail. (Her second interview was with North West Gas, a straightforward affair and Linda has been with them since 1976).

Olivia Wellesley-Cole, now an electronics engineer, has also been appalled by the patronising style of questioning from interview boards. Questions like: 'Would she burst into tears if she was shouted at?', 'How would she cope with bad language on the shop floor?' 'Did she have a boyfriend?' Perhaps this kind of interviewing is more common than we would wish to believe. It would seem a good idea to include more women on interview boards.

Now what about that first placement or job? Dawn Halksworth and Olwen Cox graduated last year from University College Swansea as Masters of Engineering, their practical year was spent in an oil refinery. Their enthusiasm for the work was apparent: '*You have to be prepared to go everywhere and get dirty. In fact the mucky tasks are often the best bit of the job. You need a head for heights and a strong stomach, because when you get to the top of a 60 ft column it tends to sway.*'

Elizabeth Rhodes, lecturer in chemical engineering at Swansea, says that women can have a very successful career in engineering if they do not mind being the exception to the rule. She herself is only one of two women engineering tutors at the college so she is used to being out on a limb. She points out that 90% of graduates get a job within a few months of leaving university and end up with a career offering plenty of creative satisfaction.

For some women coping with shop-floor chauvinism is something they dread. '*On my first week the blokes would all stop working the moment I appeared and in a normally noisy factory that was embarrassing. They would start cat-calling and whistling. It was very annoying but it's no use getting aggressive, it only makes them worse. Eventually it does wear off if you*

Continued overleaf

don't let them see you are upset and you keep a sense of humour. You have got to prove yourself before they will accept you, no matter how many letters you have after your name.'

'Qualifications on paper give you the start but after that you work your way up, depending on how good you are, how quickly you think, how you approach technical problems and how you talk to people. You build on that. I want to be managing director of my firm one day.'

'The degree of work is theoretical. When you start work you feel that you are not using anything that you have learnt as it is all practicalities and you simply have to start from scratch. That is the most difficult thing to get over at first. You just have to do it and appear confident — even if you have to rush back and look up the specification afterwards. It can be quite daunting. I have never met any outright prejudice. On the Lloyds site I was the only woman out of 400 men. The only difference is that I get watched a lot — people laugh if you trip over, that sort of thing. When I joined Ove Arup I was so overwhelmed by how difficult it all was. Now I think to myself — I can do that too.' (Patricia West Building 1987).

Has the WISE campaign, started in 1984 to encourage more girls into science and engineering, worked? A survey of 54 universities and 31 polytechnics, published last year by the Engineering Council showed that 1956 or 10.5% of the 18 704 engineering students starting in the 1986–1987 academic year were female. Before the campaign in the 1982–1983 academic year out of a total of 15 227 new engineering students, women numbered 1195 or 7.8%.

This modest increase is not yet reflected in the number of women members in professional institutions. In 1984, the Institution of Mechanical Engineers had 78 000 members of whom 935 were women, including nine fellows. The Institution of Electrical Engineers has over 96 000 members of whom 1983 are women, including 14 fellows. In 1986 the Institute of Physics had 11 733 of whom 673 are women. These bodies have surveyed their women members to find out their views on a number of issues, including the support which is needed by women members and whether this is adequately provided. Of course it is not just within science and engineering that women are poorly represented; women in the UK hold less than 19% of management jobs and only 1% at director level, which compares with 35% in America.

Joanna Foster the incoming chairman of the Equal Opportunities Commission strongly believes that it is possible to combine career and family, *'But it's not easy. Women's career patterns tend to be different from their male colleagues. It's more start, stop, start, change, move. Falling school rolls, the skills shortage and sound economic imperatives are making this need to capitalise on the growing numbers of qualified women. Organisations are looking at the well researched barriers that have inhibited women's progress up the career ladder. They are devising new structures, systems which are more relevant, and designing and encouraging training programmes which help women and men look at the major changes facing us in our lives. Through these programmes they are gradually recognising the key role our attitudes have in the whole business of equal opportunities and*

career development for women.'

David Summerfield, head of the National Management Centre, British Gas told the conference that career opportunities for women were likely to be provided to the extent that they contribute towards long term business success. Career development is about maximising opportunities for personal growth at work within the boundaries imposed by the requirements of the company. *'We are similar to most large employment hierarchies in that our large numbers of female employees are concentrated towards the lower levels. As we move up the organisation the percentage of the workforce and their success rate tends to be better than that of men. When they apply for promotion, again their success rate is better than that of men, although the percentage of women applicants still reduces at the higher levels. Here are some guidelines to anyone who wants to ensure that company planning, however good, does not lead them into mismatches:*

- Monitor trends outside and inside the company which might affect your career
- Know yourself and what you want to achieve
- Establish realistic opportunities for making an increased work contribution
- Identify areas of competences — strengths and weaknesses
- Establish a personal development plan

He also advocated finding a mentor, male or female. A mentor should be well placed in an organisation so that the advice they give is pertinent. The best mentor will see opportunities that you have overlooked, or put aside, and encourage you to extend your experience and abilities.

On career development, the Engineering Council announced a consultative document in January 1988* with the objective of improving industrial competitiveness through a system in which individual engineers and technicians would be encouraged to draw up for themselves Career Action Plans. Those plans would set out how they would improve their current performance, anticipate future changes of role and generally enhance their professional development.

Career Action Plans should be undertaken with the help of employers and professional institutions. Continuing education and training should be planned for a year or more ahead and should use a variety of learning methods including: open learning, in-house training, work experience, professional institutions' learned society activities and courses, and further and higher education institutions. A series of pilot schemes will start this year. The Engineering Council sees the potential benefits to individual engineers as increased job satisfaction, career advancement and more earning power, and for the employers a more capable workforce both technically and managerially. I hope that in sharing with you some of the themes of our conference — I have given you a picture of, what would seem to many of us, an exciting future for the women engineers in our country. Well worth all that hassle.

For further information on the Women's Engineering Society, please contact Barbara Hunt on 01-589 5111 ext 4731 or write to WES, Imperial College of

Science and Technology, Dept of Civil Engineering,
Imperial College Road, London SW7 2BU.

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Industrial training... and motherhood

In response to Dr A J Willmott (*Energy World*, February 1988), the suggestion that the engineering profession, and energy engineering in particular, should examine what is best practice in industrial training is sensible, desirable, even essential. In all of these descriptions it mimics motherhood. The similarity does not end there for motherhood carries with it both a responsibility not to start something that cannot

be sustained and also a significant commitment of time.

The Education and Training Committee of this Institute has an established Training Panel which has embarked upon the approval and encouragement of training programmes in energy engineering. Progress relies upon the precious voluntary effort of the members of this panel which is always willing to consider volunteers to

help in its efforts. This letter thanks Dr Willmott for his unsolicited endorsement and seeks volunteers for the task who should write to John Willetts, the chairman of the Training Panel, c/o the education secretary at the Institute.

A J WILLIAMS

Chairman, Education and Training Committee

... and its assessment

I have read with interest the letter from Dr A J Willmott (*Energy World* February 1988) concerning the need for accreditation of industrial training and feel I must add my comments.

Dr Willmott is apparently not aware of the considerable thought and attention currently being given to this matter. The accreditation of industrial training has been exercising the minds of the Engineering Council and some of the major institutions for some time and a practical solution has yet to be found. The problem is of a different order of magnitude compared with the accreditation of degree courses. There are some 50 establishments providing engineering degree courses but it has been estimated that here may be as many as 10000 companies providing industrial training, if the small companies providing training for one student occasionally are counted.

Formal accreditation procedures as for degree courses are therefore out of the question except for the major well known industrial organisations which in general provide excellent training and for whom therefore accreditation is a formality. The outcome of the current investigations will be awaited with interest.

When industrial training is part of a degree course scheme the academic establishment usually accepts responsibility for its assessment and where the appropriate institutions are satisfied with the assessment procedures and standards they will accredit the training included in the course.

In my experience the content of a log book gives a good indication of the work done and the attitude of the student; and perhaps one solution is for the institutions to insist on its presentation at the membership interview stage.

One final point, I am surprised that Dr Willmott refers to students being offered 'non-technical work in extreme cases'. Most institutions include commercial experience as part of their training so that engineers get a wide understanding of industrial enterprises. I am sure Dr Willmott would support experience in such non-technical activities as accounting, marketing, communication training, and leadership training. The pity is that some of the engineering trainees find these non-technical activities so much more attractive that they move into them for employment.

The views expressed are of course my own and not necessarily that of the Institute although I am currently chairman of the Training Accreditation Panel.

J R WILLETS

Chairman, Training Panel

... no going back

The chairman of the Education and Training Committee shares my initials and seems to share my concern about the quality of industrial training sometimes offered to students who undertake industrial training as part of a sandwich degree course. His letter (above) seems to suggest a hesitancy on the part of his committee, however, that the assessment of industrial training implies a responsibility that perhaps cannot be sustained in the long term by the Institute because of the significant commitment of time of the members of the Training Panel who offer their services voluntarily.

Could Mr Williams allay my fears about this matter, or if he is unable to do so, indicate how the Institute proposes to respond to the SARTOR requirements, with particular respect to the so called EA3 and EA1?

Certainly as far as sandwich degree courses are concerned, the message from the Government's RISE report is that quality of training in industry, and its assessment is one criterion by which the future of this type of technical education in universities will be assured. Because the professional bodies accredit degree courses at universities and other institutions of higher education, some

responsibility must lie with the professional bodies in the monitoring of the quality of industrial placements.

Mr Williams says that this process 'mimics motherhood' and then indicates his reservations using this metaphor. Let me carry this one step further: the setting up of the Engineering Council in the post-Finniston period rendered the professional bodies, including the Institute of Energy, pregnant and there can be no going back now.

DR A J WILLMOTT

Member

INSTITUTE OF ENERGY CONFERENCES

The following programme of conferences is currently being organised by the Institute of Energy, and its associated overseas societies, and other UK societies 'in association' for the event. See also Branch Conferences on p 29.

In 1988		In 1989	
12/13 December	Fluidised combustion in practice — clean, versatile, economic Venue: Scientific Societies' Lecture Theatre, London Chairman: J S Harrison (British Coal)	19/20/21 April	First European conference on desulphurisation for coal processing systems (Institution of Chemical Engineers) Venue: University of Sheffield Contact: Conferences Department, Institution of Chemical Engineers on (0788) 78214
In 1989	Industrial energy management conference Chairman: J R Monson (British Steel)		
In 1990	(Dates to be announced) Ceramics for energy — new opportunities and applications Chairman: M L Hoggarth (British Gas)	7–12 May	6th international conference on fluidisation (Engineering Foundation, New York) Venue: Banff, Alberta, Canada Contact: Harold Comerer, Engineering Foundation, 345 East 47th Street, New York 10017. Telex: 126022
Conferences with which the Institute is in association:			
1988/89			
In 1988		27–29 November	3rd conference on tidal power (Institution of Civil Engineers) Venue: Royal Institute of British Architects, London Contact: Conference Office, Institution of Civil Engineers on 01-222 7722
6/7 December	National energy management conference and Exhibition (NEMEX '88) Venue: Metropole Hotel, Birmingham Contact: Energy Systems Trade Association (ESTA) on 045 387 3568		

Will you dare to predict the future

In 1963, 25 years ago, the Institute of Fuel (now Energy) organised a conference on The Future of Fuel Technology. The four major topic areas were Combustion and Heat Transfer; Generation of Steam and Power; Furnaces; Domestic Utilisation. There were many statements, some of which delegates may not wish to be reminded of! However, to be bold and adventurous in outlook ought not be a failure of Fuel Technologists and I venture to suggest that a conference on exactly the same topics drawing on the current generation of equally eminent fuel technologists would be most productive.

The following are some selected quotes from 1963 which, I think, make interesting reading today:

'Work done in the field of fuel technology will thus have to contribute to a more rational and more efficient use of fuels in general, and of fossil fuels in particular. Somewhere and some time you may feel that you are working for the benefit of mankind.'

'I think it is quite likely that when engineers are looking back on the present state of the water-tube boiler from 25 years hence, they will conclude that it had reached a stage of development roughly corresponding to that of the Brontosaurus.'

'... in 25 years from now, no solid lump coal will be taken away from the coal mines in railway wagons... coal

will be gasified at the pithead or underground... or... coal will be burned into electricity at the pithead'.

'Education in fuel technology must play a vital role in the future of industrial R & D in fuel utilisation.'

'... direct application of the results (of research) to industrial furnaces cannot be expected unless sufficient "translation" work is carried out by the fuel engineer or furnace designer...'

'There is an urgent need for textbooks... which will present the basic essentials in clear concise language...'

'A third fuel which is likely to be used extensively in shell boilers within the next few years is gas...'

'Even if the problems due to SO₃ can be avoided, there still remain the emissions of SO₂...'

'The use of fluidised beds may also be found to have advantages...'

'... I should like to draw attention to the difficulties experienced in bringing research to fruition.'

'... no preference will be given to either liquid or gaseous fuels for steam raising and power generation from the technical point of view. The decisive factor will be... their price.'

'The 4% loss of boiler efficiency when firing slurry instead of dry coal...'

'The gas turbine, sometimes in alliance, may be expected to grow in variety of use including cases where fuel economy is a major consideration'.

'... the author... has presented too optimistic a picture of the gas turbine as a prime mover.'

'Methanol... has considerable merit for fuel cell applications'.

'In other furnaces (than the blast furnace), coal is exposed to lively competition from liquid and gaseous fuels...'

'One of the contaminants of the atmosphere which will receive close attention in the future is nitric oxide'.

'The stability of flames seemed not to be very important to furnace constructors, but... this question, too, will arise'.

'The interest in higher gas velocities to increase the ratio of heat transfer suggests that future boilers will be dimensionally smaller...'

'I am firmly convinced that the future is with cheap gas'.

'The development of improved heat exchangers... could make a profound contribution to a wide variety of fuel problems...'

'Of great importance in the future will be the need for studying the overall requirements of a process in which fuel technology is important...'

'In the combustion process we will see increasing use of oxygen...'

Who now would like to forecast possible advances in fuel technology for the next 20 years?

PROF G D SERGEANT
Fellow

Nuclear power: policy and prospects

Edited by P M S Jones
John Wiley and Sons, 1987
416 pp. £75

Nuclear power: policy and prospects is the third volume in a series intended to present 'up-to-date technical, economic and environmental information about one energy source'. After an introduction it is divided into four sections. The first three discuss, respectively, technical background — fission, reactors, fuel cycles and other applications; areas of public interest including radiation, safety, risks, waste management and decommissioning; and world experience, in the US, France, Canada, the UK, Federal Germany, Japan, India and the developing countries. The final section, headed *Challenge and Opportunity*, considers 'The present world scene', 'The potential', 'The incentives', 'The constraints', and 'Past, present and future'.

P M S Jones, editor, and main author of this volume, has been a senior economist and planner at the UK Atomic Energy Authority for many years; his co-authors are drawn mainly from other nuclear establishments around the world. The picture they draw is suffused throughout with a rosy glow of self-congratulation. As they see it, nuclear power is a technology whose achievements are already vast and manifest. Its problems are comparatively minor, when not the result of malicious interference by a 'small group of activists', with the 'suspicion that any protest is exploited by unscrupulous groups in society to further their own political ends'.

It is difficult to discern in these pages any indication of the nuclear scene as reported, say, in the *Financial Times* — in which nuclear programmes around the world are stagnating, orders almost non-existent, performance erratic, costs rocketing, waste-management in chaos and the brief nuclear enthusiasm of utilities and financiers curdling. Jones and his co-authors appear to inhabit a parallel universe, in which these circumstances can be dismissed as incidental, unfortunate impediments to be brushed aside. Prize examples of this self-deception can be found in the commentaries on the developing countries, especially that on India's embarrassing nuclear adventure and the nuclear fiasco in Brazil; but Jones himself contributes a chapter on the UK that

exudes calm satisfaction about a nuclear industry track record others might call execrable.

As a demonstration of the mind-set of nuclear thinkers the book is well-nigh comprehensive. As a guide to nuclear policy and prospects in the real world it is wishful thinking writ large.
Walter C Patterson

Energy study of the North West region of the UK: Executive summary

March Consulting Group, 1987
45 pp. £5 (full report costs £45 for two volumes)

This publication, as its title suggests, is an executive summary of a much larger two volume report. The report was commissioned by the Commission of the European Communities Directorate General for Energy. It covers all energy usage in the North West of England, with pertinent information on the industrial, commercial, transport and domestic sectors. Both primary and secondary fuels are covered.

The summary gives brief details of final energy demand forecasts in 1990 and 2000 (with scenarios), and the scope for improved energy efficiency in the various sectors. A review of emerging technologies and the potential for alternative energy sources is included. The main conclusions and recommendations for further action are also summarised.

The summary states that 'the main emphasis of the study has been to produce results and initiatives which are not only of real value to the North West, but can be replicated in other parts of the UK and Europe', and the summary certainly confirms that this has been achieved.

The summary is well documented with understandable graphs and charts, well written, easy to understand and packs a lot of very useful information into its 45 pages.

The vital importance of energy conservation is necessarily highlighted by reports as comprehensive as this. This summary should prove of use to not only high energy users but also every organisation, whether private or public, within the UK.

Gary Ward

Wind energy 1987

Thomas F Jaras
Wind Data Centre, USA, 1987
314 pp. \$300

The publisher describes this book as the only source of comprehensive and complete statistics on wind turbine shipments and applications in the world and this is a very fair description of its purpose. Anyone needing hard evidence of the recent upsurge in the fortunes of wind energy has all he needs and more in this fascinating compilation. It catalogues the growth of the industry during the years 1981 to 1986 and covers all types of wind turbine — from small battery-charging units to the multi-megawatt giants. The information is presented in a series of tables — over 90 in all — which analyse the market using a number of classifications — for example, size and end use. The tables also show the origins and final location of all the turbines with import and export movements very clearly illustrated diagrammatically.

The book is, however, more than simply a collection of tables. It is divided into six chapters, each clearly presented and concentrating on a particular aspect of the market — regional trends and developments in the various market sectors for example. It ends with an assessment of future prospects and the author predicts that the present level of activity will continue — total production is now around 300 MW per year. The total value of this market is around \$250 M and has grown so rapidly that the graph showing this expansion needs a logarithmic scale. The tabular information is also supplemented by bar and pie charts which convey key trends very clearly.

The book clearly illustrates several important trends apart from the growth in the market — the increasing unit sizes in the electricity generating field and the reduction in cost per unit of capacity. These conclusions need to be teased out of the data but are nevertheless very clear. If there is a criticism of the book it is that a few summary tables, with less categorising of data would gently introduce readers who might otherwise be bemused by the vast quantity of information.

The book concludes with well presented product summaries for 150 manufacturers and to many this will be of equal value to the statistical data. All the essential technical features are included and the coverage is world-wide.

It is difficult to assess the overall accuracy of such a mammoth study but suffice to conclude that the reviewer could not fault the sectors of the statistics with which he is familiar.

D J Milborrow

Solar energy applications to buildings and solar radiation data

Edited by T C Steemers
D Reidel Publishing Company,
Dordrecht, 1987
180 pp.

This book contains the proceedings of the first contractors' coordination meeting of the third *Solar energy applications to buildings and Solar radiation data*, held on 13-14 November 1986 in Brussels.

Presentations were made by the contractors on the objectives of their research, the progress made and the planning for the future. The meeting was attended by the research area experts, who prepared the executive summary. Since the last four-year programme major changes have taken place in the emphasis of the research in these areas.

Passive solar R & D receives far more attention now than before. The reason is twofold; firstly, the recognition that some passive solar applications are already cost-effective and secondly, the growing awareness that solar architecture, besides saving energy, can improve human comfort both thermally and visually.

Shifting towards passive solar energy utilisation leads to a closer interference with the building industry. As the building industry is, in terms of employment, the single largest industry in Europe, this change in emphasis also means there could be a substantial increase in the number of professionals who might want to use the outcome of the R & D. Special attention is therefore given in this programme to technology transfer (projects SOLINFO and ARCHISOL).

The book refers to a new project which has just been launched called Building 2000. This seeks to encourage the use of passive solar techniques in the design and construction of non-domestic buildings by providing support to developers and authorities involved in building projects.

In *Solar Radiation Data* emphasis has been put on solar micro-climates in order to improve the interpolation between the iso-lines in the European Solar Radiation Atlas. Also in this

research area a new project, named SUNSAT has started. This project is a pilot programme to examine the viability of the methods developed in the second four year R & D programme to map global radiation data using satellite data from Meteosat.

There is a large quantity of useful material presented in this book, however, the layout leaves something to be desired. An enlarged table of contents would have improved the text.

I look forward to reading the final reports from the project contractors in a future publication.

Andrew W Cox

Principles of combustion engineering for boilers

Edited by C J Lawn
Academic Press, 1987
628 pp. £55

At last! A book which, judging by its title, deals specifically with a topic of importance which has, for so long, been a bit of a black out.

To quote from the preface 'Engineering is an art... or the art of the possible' and 'In the case of engineering combustion systems... engineers have tended to rely heavily on empiricism and extrapolation from previous experience'.

The editor, Dr C J Lawn of the Central Electricity Generating Board, has brought together a number of world authorities in the separate topics of combustion and in his opening remarks of the preface echoes the opening words of this review. Unfortunately, a few words later, he restricts his terms of reference to water tube boilers only. By narrowing the field with this exclusion of shell boilers which, because of space restrictions, may present greater combustion problems, his chosen title for the book is not met. A pity but full marks to Dr Lawn for setting out his own terms of reference early and clearly.

What, then, would a reader expect in a book on combustion applied to water tube boilers? Combustion of oil and pulverised coal are a must for inclusion, possibly also gas but this is not used in the same extent for power generation. Fluidised bed combustion is an important current development and, although it has not yet made the inroads into combustion systems which were originally expected, must be covered. These, except of gas, are all included but some other chapters cause initial surprise.

Cyclone combustors do not, at first glance, seem to be important in power generation until one realises that they already find many applications in both the USA and USSR. Combustion of coal/liquid mixtures has not, as yet, found many applications but inclusion is probably justified.

All of the chapters on these separate topics are well written with many references and should provide the design information which is needed.

Is there, then, a drawback? The answer is, possibly, in the affirmative. The work in the book is good but in a book of this sort it should be not only good but the best. It is puzzling to see a chapter on fluidised bed combustion which was not written in conjunction with the Coal Research Establishment at Stoke Orchard which must house much of the UK authority on the subject. Similarly the chapter on coal/liquid mixtures makes little reference to the conferences which have been held under the joint auspices of the Institution of Chemical Engineers and the Institute of Energy. There is no reference to the Journal of the Institute of Energy in the chapter on pulverised fuels. Have we been asleep? Is all the work on combustion going on around us without our knowledge? This may just be 'carping' but it may indicate that the selected authors are not necessarily the best in their fields. Only an expert in each field could make that judgement.

What conclusions can be drawn? This is certainly a very good book and one which has long been needed. It may be an excellent one. It is certainly a well presented book that lives up to most of its title subject to the foregoing criticisms, but it would be nice to think that this was only volume one of two with the second volume dealing with shell boilers.

R G Herapath

Basic engineering Thermodynamics

Rayner Joel
Longman Scientific and Technical,
1987
803 pp. £12.50

In the various prefaces to this book Mr Joel writes that it is aimed at OND/HND courses and the first year of an engineering degree course. In the latest preface he writes that he has taken the opportunity to rearrange part of the original text and to add and update some material. 'Basic laws and concepts of engineering thermodynamics do not change but the approach to their

Continued overleaf

understanding can be refined'. Presumably this quote is intended to cover updating of applications as well.

From this beginning one is prompted to ask: What makes a good text book? If your reviewer knew the answer to this question he might be writing instead of reviewing but there are possibly at least three factors. Firstly the book must be readily acceptable to students. It must be readable, it must be clear in its text and must explain how to do the necessary calculations. Secondly it must show the relevance of the theoretical work to practical applications. As teachers, we often hide behind the most esoteric mathematical analysis with little thought to real applications — we hope that somehow students will find the relevance. Lastly, but by no means least, it must be a useful reference for all aspects of the study up to the desired level.

Rayner Joel's book satisfies all these points (or nearly so). It is easy to read, it is accurate in its presentation of material, it is easily referenced, but above all it has plenty of worked examples on each topic and adequate descriptions of application ranging from steam boilers to modern internal combustion engines. It covers the subject from the fundamentals of the gas laws through the laws of thermodynamics to steam plant, petrol and diesel engines, combustion, refrigeration and heat transfer at a level suitable for the early years of an engineering degree course.

One chapter which your reviewer particularly liked was on engine testing, including the energy audit. Very few modern texts on thermodynamics include this aspect, almost as if practical engine testing was, somehow, not a respectable subject to teach. Another chapter is devoted to steam plant. It includes shell boilers as well as water tube. It mentions pulverised coal and shows a ball mill and where these fit into the boiler system. It covers flue gas clean up with cyclones and electrostatic precipitators. Fluidised bed combustion and nuclear reactors are just mentioned as are waste heat boilers. One can thus see the relevance of steam charts, superheat, wet steam etc to the practice of generation and use of steam. Similar comments apply to engine cycles etc.

Are there, then, any drawbacks? Regrettably the answer is yes. Why are there, in a modern text, 35 pages devoted to the steam engine (including two photographs) and only 26 pages (and no photographs) to steam turbines?

The quality of many of the photographs is poor. This is sad because a lot of useful information is lost, particularly in the finer detail of the internal combustion engines.

It is a pity, with such a readable text and one which would be well regarded by students, to have such a concentration on old-fashioned applications. Mr Joel has not updated the applications. Perhaps he will do so in the fifth edition — if so, it could be a best seller.

R G Herapath

China's potential in international coal trade

Guy Doyle

**IEA Coal Research, London, 1987
95 pp. £85 (member countries)**

This useful book has drawn upon authoritative organisations and publications in China, Hong Kong, Japan, USA, and Great Britain. The ingredients that went to derive final conclusions included a survey of China's coal industry and the factors affecting coal supplies, the transport infrastructure, the internal demand for coal, energy and trade policy, and foreign demand for China's coal.

'Conclusions' do not end the discussion, as there is a postscript about risks to the reform programme and 'open door' policy. This type of finishing-off could be copied with advantage by other writers whose conclusions may be subject to imponderables that outweigh statistics.

China's coal output is being expanded and should reach 1000 Mtpa soon. Transport by rail and sea, and handling facilities are all being developed; and new technologies from the West are all being espoused including fluidised bed combustion to replace the old ignifed derivative expansion, including sales to other countries between the Pacific and Indian oceans, where half the people in the world live.

Since a few percent of China's coal output sold on world markets would greatly affect both present international coal trade and the shipping rates, Guy Doyle's book is timely.

Although there are worked deposits in many provinces, the major outputs are in the north of the country, and the major demands are further south. Expansion of transport has included several ports, and there is provision for export of any surplus. Since the overall energy plan includes combustion equipment of higher efficiency, energy conservation measures that are much needed, and cleaning a higher proportion of the coal, the output of saleable coal has a fair chance of providing supplies for export.

Pundits sometimes point to the low quality of much of Chinese coal (the three general internal categories of up to 32% ash, up to 40%, and up to 49%, delivered) and to China's reputation for keeping herself to herself. But it is unwise to be too sure.

The resources available range from anthracite in the near-graphite range, right through British Coal and Seyler classifications through to lignites. There are some like the Staffordshire Cannel or Parrot coals, and even the occasional moutan wax. While there are certainly some very high ash contents in the Sapropelic coal range, there are other coals with very low ash contents, and many others amenable to conventional preparation techniques. Coals of exportable quality can indeed be produced in substantial tonnages and as experience in foreign business, and with contracts, grows there is no reason to imagine that Chinese coal exports will not grow too. Further, there is urgent need for foreign exchange both for purchases and for loan repayments, to say nothing of joint venture production.

This book should be on the desks of all coal exporters and importers worldwide. Its data and explanations will help its readers and users to make up their own minds in the light of their own experiences and forecasts. Further, it should be updated every two or three years as the China overall social and industrial development programme makes progress.

Brian Locke

BSI New service for exporters

If you export pressure vessels, one of the biggest headaches is keeping up-to-date with all of the regulations and specifications required by each individual country, not to mention translating them into English.

To help you overcome these problems, BSI Technical Help to Exporters has a series of Pressure Vessel Updating Services. The service is offered for four different countries: Germany, The Netherlands, France and Sweden. Subscribers receive a basic report on the country of

their choice, together with full English translations of the relevant documents and monthly updates containing latest amendments. *Technical help to exporters' engineers* is also available to subscribers.

For further information on the Pressure Vessel Information Service, contact David Rogerson, BSI Technical Help to Exporters, Linford Wood, Milton Keynes MK14 6LE. Tel: (0908) 220022 ext 2099.

Source: BSI

Electricity sell-off May hit fast reactor

Britain's £100 M-a-year fast reactor nuclear programme could be a casualty of privatisation plans for the electricity supply industry reports the *Financial Times*.

Executives at the Central Electricity Generating Board say privately that the programme no longer has a high priority in the board's long-term thinking.

Leaders of the nuclear industry fear that a privatised generating industry with no statutory obligations for ensuring long-term supplies will no longer feel strongly committed to a reactor it may not order as a series for a further 30 years.

The most serious effects of cuts in the programme would be in the Scottish Highlands, where more than 2000 work at the nuclear research centre at Dounreay.

The fast reactor is based on technology which could make Britain independent of uranium imports by using the national stocks of 'depleted' uranium from current nuclear activity.

As with the space programme, industry's unwillingness to invest could lead the Government to conclude that commercial prospects are too remote to justify its present level of investment.

Last year the CEGB contributed about £30 M towards the national fast reactor programme and was planning to increase it to £50 M. The balance of funding comes almost entirely from the Energy Department through contracts

agreed with the UK Atomic Energy Authority, which manages the programme.

The Department of Energy's recent white paper on privatisation, although promising protection for non-fossil electricity sources, makes no specific commitment to the fast reactor, the authority's biggest development programme.

The reactor has come under pressure from the Cabinet Office where technical advisers are scrutinising all main Government expenditure on research and development.

Mr John Collier, authority chairman, has been warned that his programme, like the one for space, must find more commercial support if it is to be maintained near its present level in the 1990s. Fast reactor technology has no defence implications and can expect no backing from the Ministry of Defence.

The authority has already embarked on plans to create a non-nuclear contract research service for Scottish industry at its Dounreay establishment.

Before the white paper, the nuclear industry believed there was a good chance that the CEGB would back plans for a new phase of fast-reactor development, involving construction of a demonstration reactor of commercial size with capacity of more than 1000 MW during the 1990s.

It would be built as part of a European collaboration involving France and West Germany, with backing from several European electricity companies.

The nuclear industry in Britain claims a big fast reactor could be built

for a 'relatively small' premium in capital cost compared with one more in a series of pressurised-water reactors.

Source: *Financial Times*

Fusion Gets to go-ahead

Thermonuclear fusion promises an inexhaustible supply of safe, clear and cheap energy and the Community has allocated more than 2 bn ECU (£1.3 bn) for its research programme, including the JET project at Culham.

But, as Alman Metten MEP, reporting for the energy committee pointed out, although current thinking estimates that it could play a role in Europe's energy supplies after the year 2030, there was as yet no firm evidence that controlled nuclear fusion could be achieved.

That was why the whole programme should be scrapped, said Undine-Uta Bloch von Blottnitz MEP. It was potentially dangerous and the Community should be supporting investment in alternative energy which was environmentally friendly.

But Madron Seligman MEP disagreed. The point of the research was to see if the idea was feasible. Only then could a rational decision be taken.

The programme was approved by 195 votes to 3 with the proviso that there is an independent evaluation by outside experts and an appraisal of environmental and economic implications at an appropriate time.

Source: *European Parliament News*

Wind power in the UK CEGB plans first park

Plans to produce electricity from Britain's first wind 'parks' and the world's first offshore wind turbine were announced by Lord Marshall of Goring, chairman of the Central Electricity Generating Board (CEGB).

Lord Marshall said that it was proposed to build three demonstration wind parks, each with 25 wind turbines. Three areas of the country with suitable windy conditions (the South West, West Wales and the Northern Pennines) were to be considered for possible sites. It was also proposed to

build a 750 kW wind turbine out at sea off the North Norfolk coast.

The £28 M wind parks programme, which could provide enough electricity for 15000 people, would be jointly funded by the Department of Energy and the CEGB. The £2 M offshore wind turbine would be a collaborative project by the Department of Energy, CEGB, Eastern Electricity Board, the turbine manufacturers and the EEC.

'We are very encouraged with the progress of this technology,' Lord Marshall told the British Wind Energy Association's Tenth Annual Conference at the CEGB's London Headquarters.

'In our judgement, on favourable sites where we can expect high wind speeds, it may now be possible to generate electricity at a competitive cost. We still have questions about the life expectancy and maintenance costs of the designs that are currently available, but we can only resolve those questions by getting further experience and moving beyond the research phase.'

Lord Marshall said that it was likely that three or four individual candidate machines would be chosen for evaluation before the three wind parks were built. Each wind park would have a peak generating capacity of eight megawatts.

Typical wind parks could consist of 30 m high wind turbines of either vertical or horizontal axis design with blades of 30 m diameter. Each machine would have an electrical output of 300-500 kW and a whole park would occupy an area of three to four square kilometres. They would have an expected operating lifetime of 25 years.

'If all goes well we would then wish to scale-up to parks involving several hundred machines, and that of course would require a rapid increase in land area. To give you some idea of what is involved, to generate the annual output of the Sizewell B power station, using wind power, we would require a land area of some 200 square miles.

'Therefore we are not just interested in the technical and economic performance of the machines, we are anxious to get some appreciation of the social viability of wind parks in this crowded island. We are very interested in the reaction of the British public to these new wind parks, and we shall be carefully monitoring the visual and other amenity aspects of them: noise output, interference with communications and their compatibility with the simultaneous use of the land for other purposes.'

The timescale for building wind parks was modest, although planning consent had to be obtained, Immediate

consultations would begin with local authorities, land owners, and environmental bodies. Detailed technical and environmental investigations would be undertaken at the preferred sites.

It was hoped that the parks would be constructed between 1990 and 1992, and if all went well wind parks might provide 25 MW in 1993.

Source: CEGB

Britain's coal reserves Estimates challenged

A new report, *The evaluation of the coal resources of the United Kingdom*, challenges the accuracy of optimistic UK coal reserves estimates and points to factors that may call for a significant downward revision. The report was commissioned from Dr R N Crockett of the British Geological Survey by the Coalfield Communities Campaign, which represents 80 local authorities of all political sides in coalfield areas, as part of efforts to assist coalfield local authorities in their strategic planning.

The report examines the background to the coal reserves debate. It highlights

the inadequacies in the way the resources are defined and measured, using three figures given by British Coal (BC) which are often quoted as estimates of UK coal resources. These are the figures for 'coal-in-place' estimated at 190 billion tonnes in 1979, 'recoverable reserves', 45 billion tonnes in 1979 and 'operating reserves', seven billion tonnes in 1979.

The report finds current claims that Britain has enough coal to last 300 years are based on a 'recoverable reserves' figure of 45 billion tonnes that bears little relation to the quantity of coal which can be mined economically as the figure relies on unrealistically high recovery assumptions. 'Recoverable reserves' are taken as that proportion of 'coal-in-place' considered to be recoverable by current mining technology under present economic conditions, 'coal-in-place' being defined as the gross quantity of coal whose limits are defined only by the physical constraints of maximum depth of working and minimum seam thickness.

Source: *Coalfield Communities Campaign*

Energy efficient technology IEA opens a new centre

The International Energy Agency (IEA) is opening a centre this month at Sittard, The Netherlands, to collect and distribute information on new energy-efficient technologies.

The centre, called 'CADET' (IEA Information Centre for the Analysis and Dissemination of Demonstrated Energy Technologies), is one of the IEA's cooperative energy research and development projects.

Nine member countries of the Organisation for Economic Cooperation and Development (OECD) launched the project by signing a formal agreement at the IEA headquarters in Paris.

The aim of the centre is to improve the exchange of information about technologies for reducing energy use in industry, transportation and the residential and commercial sectors, and thus to encourage wider use of energy-saving devices.

The centre will spend most of its time, during the first year, in collecting and cataloguing information about the many energy-efficiency demonstration projects underway in IEA countries.

The centre will also distribute information about these projects and analyse special technology topics or problems.

The initial participants in the CADET centre are Denmark, Finland, Italy, The Netherlands, Norway, Sweden, Switzerland, the United Kingdom and the United States. The operating budget for the first year is approximately \$500000.

For more information, contact: Peter Van Luyt, NEOM — Dutch Energy Development Company, PO Box 17, 6130AA Sittard, The Netherlands. Tel: (31) 4490-14451.

Source: *International Energy Agency*

Greenhouse effect More evidence

British scientists have uncovered more evidence that the Earth's atmosphere is being choked by pollution, forcing the world into a 'greenhouse effect' of global warming, reports *The Times*.

A computer analysis of international data completed by the climatic research unit at East Anglia University shows that last year's global temperature was the highest recorded. The finding confirms a trend which has persisted in the 1980s.

The average temperature for the year was 0.33°C higher than the global aver-

Energy World

age of 15°C for 1950–1979. The previous record was set in 1983.

Dr Phil Jones, senior research associate at the unit, said that the findings 'are not inconsistent' with the greenhouse effect, in which pollution traps the sun's heat, forcing up the global temperature. Similar conclusions have been reached by scientists in the United States and Russia.

Although the increase in temperature is small, scientists fear it could have dramatic long-term consequences for both weather patterns and sea levels.

In research to be published later this year, the unit found that Alaska and the Yukon experienced the biggest temperature rises but that Scandinavia's temperature has decreased slightly. Western Europe has experienced hardly any change.

(Last month the Watt Committee on Energy, in association with the Institute of Energy, held a seminar to discuss the Greenhouse Effect at 18 Devonshire St, London.)

Source: *The Times*

Natural gas... ... from sand!

Natural gas can now be produced from lens-shaped, low-permeability sandstone deposits more efficiently than in the 1970s, partly because of a multiwell experiment recently completed by the US Department of Energy (DOE), about nine miles southwest of Rifle, Colorado.

'This experiment has helped bring production costs down to the \$2.50 to \$3.00/thousand ft³ range,' Karl-Heinz Frohne, a petroleum engineer at DOE's Morgantown Energy Technology Centre, said. Gas companies were not significantly producing gas from tight sands when prices peaked at twice that range in the late 1970s.

Mixed results from production tests in lenticular (lens-shaped), tight gas sands in the 1970s pointed out a need for more knowledge about these sands. In this project, three wells were drilled in the Mesaverde Formation of the Piceance Basin in Colorado, one of three tight gas sand basins DOE has targeted for gas production research. The other two basins are the Uinta Basin in Utah and the Greater Green River Basin in Wyoming.

Recoverable gas in lenticular tight sands in these basins could represent a 20 to 40 year supply, according to 1987 US Geological Survey estimates. These estimates are higher than 1980 National Petroleum Council estimates because of the geological knowledge and pro-

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duction technology developed in this project.

Source: *US Department of Energy*

Landfill Minister opens new project

Mr Peter Morrison, Minister of State for Energy officially opened a project for generating electricity from landfill gas extracted from a large landfill site at Gerrards Cross, Buckinghamshire earlier this year.

The project began in 1987 and generates 1 MW of electricity. By the end of this year, the Summerleaze project will be exporting 3 MW to the national grid.

Commenting on the project, Mr Morrison said: 'I wish to congratulate all concerned with this excellent scheme, demonstrating the beneficial use of landfill gas for energy production.'

'Each year, the equivalent of 5 Mt of coal is buried in municipal refuse landfill sites. Over a quarter of this waste could be converted economically into useful energy, greatly cutting disposal costs to local authorities.'

'The first gas exploitation scheme in 1979 was highly successful and there are now 19 commercial schemes up and running in the UK, saving an estimated 120000 t of coal equivalent, with a further 14 expected to go ahead this year.'

Source: *Department of Energy*

Ankara converts... ... to natural gas

British Gas has won a contract to provide technical and managerial support to the Electricity, Gas and Omnibus Authority (EGO) of Ankara, the capital of Turkey, to convert the city to natural gas. The first phase of the conversion project, expected to cost up to \$200 M is being undertaken by another UK company, AMEC International, in association with Kutlutas Insaat of Turkey.

The conversion to natural gas will reduce the serious atmospheric pollution suffered in Ankara during the winter, caused by the burning of lignite or brown coal. Work is to begin on the project immediately, with some 250000 customers expected to enjoy the benefits of the clean new fuel when the project is completed in around three and a half years time. The conversion programme, planned by British Gas, can

later be expanded to serve many more of Ankara's population of over three million.

During the next few years 22 engineers will be working on the conversion project in Ankara. The company will also be responsible for training EGO managers and engineers both in Turkey and in the UK.

Source: *British Gas*

Australia Developing gas reserves

Australia's gas reserves have been identified as a major alternative fuel source in the wake of declining crude oil discoveries.

The Australian Minerals and Energy Council, in a report issued in Brisbane by the Minister for Primary Industries and Energy, John Kerin, who has recommended the greater use in the short to medium term of alternative fuels which require modest technological development.

Alternatives in this category are already economic or close to economic and include liquefied petroleum gas (LPG), natural gas in compressed and liquefied forms (NGV), and methanol.

'In the face of declining oil discoveries, Australia is fortunate in that it has abundant gas, coal and oil shale resources which can be developed in the longer term to provide transport fuels,' Mr Kerin said.

'In the longer term, the report recognises the need to be prepared to turn to techniques involving the larger-scale conversion of natural gas to gasoline/automotive diesel oil, oil from oil shale, and brown and black coal liquefaction which require large capital expenditures and great attention to economic feasibility.'

The report recommends: continuing the encouragement of substitution of automotive gasoline by LPG; encouraging through research, development and demonstration the substitution of LPG and NGV for automotive diesel oil in various applications, and accelerating such investigations in the immediate future; encouraging and monitoring work on the production and use of methanol in preparation for its potential emergence as a commercial fuel in the mid-1990s; encouraging research, development and demonstration to ameliorate any adverse environmental effects arising from the production and use of alternative fuels.

Mr Kerin said that the recommendation had been considered by federal and state government officials in develop-

ing national priorities and guidelines for research and development in 1988, under the Federal Government's National Energy Research, Development and Demonstration Programme. Source: *Australian Information Service*

World Bank and Japan cooperate India benefits

Three World Bank supported projects in India have received cofinancing totalling \$450 M (Yen62 billion) from the Export-Import Bank of Japan. The EXIM Bank funds will not be tied to Japanese imports.

The projects are the Second Ramagundam Thermal Power Project, being assisted with a World Bank loan of \$300 M; the Second Farakka Thermal Power Project, supported by a World Bank loan of \$300.8 M; and the Rihand Power Transmission Project, which has obtained financing of \$250 M.

This is the third cofinancing agreement between EXIM Bank and the World Bank. In March 1987, the two institutions signed a Yen150 billion cofinancing agreement to assist 21 high priority development projects in Indo-

nesia. In October 1987, a cofinancing agreement for Yen50 billion was signed to support an economic recovery programme in the Philippines, for which the World Bank had extended a \$300 M loan and a \$10 M technical assistance loan.

Source: *World Bank News*

Coal Buy British

British Coal has launched a major campaign to introduce a new *Guaranteed British Coal* symbol and persuade the country's domestic coal users to insist on British coal. At the same time the new symbol will start to appear in Approved Coal Merchants' premises and on lorries.

Mr Martin Cruttenden, British Coal director of Sales said: 'In recent months we have seen a big increase in imports of housecoal and other domestic fuels, threatening an important and valued market. Sometimes these imports are passed off as British.'

'The guarantee aspect of the campaign means that customers ordering British coal from their Approved Merchants will know that that is what they

are getting. It means that if they do have a quality problem with our coal, it will be quickly and fairly resolved.

'The campaign, backed by advertising in national and regional newspapers, will continue in the summer and by the autumn the symbol should be on all pre-packs containing our coal so customers really will be able to know what they are buying.'

Source: *British Coal*

Czechoslovakia Gets energy from rocks

A hot spring with a capacity of 20 litres per second, that can yield a thermal energy output of about four megawatts, was struck by geologists at Besenova in the Liptov basin in Czechoslovakia. It is the first successful geothermal bore hole in this region. At the mouth of the hole, 1987 m deep, the thermal water reaches a temperature of 61°C. This powerful spring will be used as a source of geothermal energy. Plans have been drawn up for building recreation and rehabilitation facilities there.

Source: *Czechoslovak News*

INSTITUTE NEWS

Council

A meeting of Council was held at Shell Centre on Tuesday 8 March 1988.

Co-opted member of Council

It was agreed that *H F Ferguson* should be co-opted to serve on Council following the AGM to be held on 26 May 1988.

Standing committee reports

Executive Committee

Executive Committee chairman, *B G Gills*, thanked the permanent staff for filling the gap left by the resignation of *Dr H M Lodge*.

He also reported that a new computer had been ordered and it was hoped that it would be installed in May.

Publications and Conferences Committee

N G Worley, committee chairman, reported on the nominations for the awards in the gift of the Publications and Conferences Committee. The Council ratified the awards, as set out in Appendix A. The awards would be presented at the Annual Luncheon.

New printers had been found for *Energy World*, which could save the Institute some £10 000 per annum. The company was confident that it would be able to increase advertising in *Energy World*. Mr Worley also reported that two advisory panels had been set up with *Dr J C McVeigh* as chairman of the panel for *Energy World* and *Prof N Syred* as chairman of the panel for the *Journal*.

It was reported that the *Energy World Reference Book and Buyers' Guide* had been delayed, but that it was anticipated that it would be going out to all members within the next week. This was the last year of the agreement with Manor House Press and the committee were discussing future plans.

Conferences currently being organised were gasification; fluidised bed combustion; industrial energy efficiency; applied energy research; and ceramics and energy.

Membership Committee

The chairman of Membership Committee, *J P MacCarthy*, reported on a meeting held to discuss Collective Membership.

The following recommendations had been decided upon:

- to change the name to Company Affiliate;
- the annual subscription for new applicants should be £250, with a gradual increase in the subscription rate for existing members;
- to remove all reference in the by-laws to 'two representatives and up to four nominated students' and replace with 'may nominate up to six persons who will have all rights of membership as exercised by Associates or Students, as appropriate.'

- to guarantee a minimum discount of 20% for Institute conferences;
- to guarantee a discount on advertising in *Energy World* and the reference book;
- to highlight the opportunity of advertising the company name by awarding student prizes.

It was agreed that no changes would be made to the bye-laws as regarding Collective Membership at the moment, as a major bye-law revision would be undertaken as soon as practicable to take into account recommendations arising from the strategy study.

It was agreed that Membership Committee should interpret the present title of Collective Member as including such categories as required, and at present this would be confined to Company Affiliates.

A meeting had also been held to discuss energy managers and Mr MacCarthy would be reporting on this to Executive Committee.

Education and Training Committee

The chairman of Education and Training Committee, *A J Williams*, thanked Council for their understanding of his absence from meetings of Council. He also thanked the permanent staff for their work on the initiatives.

Mr Williams reported that a sub-committee had been set up to look at training accreditation.

Education and Training Committee were looking at various initiatives in primary education (energy is one of the core subjects in primary science education), secondary and tertiary education.

Workshops are being organised to discuss energy as a cross curricular topic in secondary education. These are being funded by Esso. The first one, which is in London, will, it is hoped, be attended by the Minister of State at the Department of Energy.

The Institute had sought funding from the DTI for setting up an energy node on the NERIS (National Educational Resources Information Service) database. This was currently under review.

A proposal to the Department of Energy for the Institute of Energy to set up a full-time Energy Commission had been agreed in principle by the Minister of State. Mr Williams would report on future developments.

It was suggested that a letter be sent to SERC suggesting that energy be the subject for one of the inter-university research projects.

A Continuing Education and Training (CET) review had been passed to the Training Panel to examine and report on.

May 1988

International Committee

C E Pugh, chairman of the International Committee, reported that he had written to the Canadian Institute of Energy regarding their request for a quote for 500 copies of *Energy World* a month. He also reported that Australia wanted to strengthen their links with the Institute and he had written to them.

The South African branch wanted to set up their own institute because of the effect of the value the rand has on their subscriptions. It was agreed that the Institute should accept the scheme put forward by the branch, but that the South African branch should be told that the Institute would expect to receive a share of the Collective Membership fees and that individual members would have to pay the Engineering Council fee in full (where applicable).

B A Chamberlain reported that he would be going to India again shortly and that he would be happy to take any information on the Institute with him.

It was suggested that the majority of students on accredited courses are from overseas and that they should be asked to write a paper on energy in their own country for publication.

R H Gummer Exhibition

The nomination from Imperial College of *Dr K G Cheriyan* for his paper on *The development of a plasma jet for chemical processing* was approved.

Foxwell Memorial Award

The nominations received from Leeds and Sheffield Universities were approved.

Bye-law changes

It was explained that formal approval was now needed for the proposed bye-law changes, which had already been discussed by Council. This was proposed by *B G Gills* and seconded by *Prof A Williams*. Voting was 21 in favour: none against.

Midland branch

R Wainwright, chairman of the Midland branch, presented a cheque for £4619.14 to the president, *Dr E G Masdin*, being the profit made at their recent symposium.

The president expressed the Institute's thanks and appreciation for all the effort involved in raising such a significant contribution.

Shell hospitality

Shell was thanked through *Dr Masdin* for their hospitality.

Institute strategic planning

Council was divided into syndicates in order to discuss the key issues in the briefing document produced by *M C Roberts*. Mr Roberts would report back to Executive Committee and subsequently to Council.

In answer to a direct question from Mr Gills, Council approved using part of the capital reserves of the Institute to fund agreed initiatives under the strategic plan with the aim of strengthening the Institute's technical and financial position.

Appendix A

1 Steetley Award of the Institute of Energy

A G Hallett, A C Hay and A T Sheridan

The application of self-recuperative and regenerative burners in the steel industry

Journal: March 1987

2 Lubbock-Sambrook Award

E M Goodger and A F M Eissa

Spontaneous ignition research: review of experimental data

Journal: June 1987

and

Spontaneous ignition of falling droplets in the Cranfield pressure rig

Journal: December 1987

3 Foster-Wheeler Award of the Institute of Energy

D G Elliston, W A Gray, D F Hibberd, T-Y Ho and A Williams

The effect of surface emissivity on furnace performance

Journal: December 1987

4 Townend-BCURA Award

P Basu

Operation of an existing pulverised-coal-fired boiler as a circulating fluidised bed boiler — a conceptual study

Journal: June 1987

5 Babcock Power Award of the Institute of Energy

S Sampath and V Ganesan

Numerical prediction of flow and combustion in three-dimensional gas turbine combustors

Journal: March 1987

Shell Awards to Institute of Energy

Shell Research entertained most generously members of the Institute of Energy to dinner at the Shell Centre on 8 March 1988, after *Dr Frank Fitzgerald* FEng (managing director, technical, British Steel Corporation) had presented the 54th Melchett Lecture: *Energy, high technology and economics in modern steelmaking* (see pp 3-13).

H L Beckers (chairman, Shell Research), speaking at the dinner, referred to the decision of the Shell Grants Committee to contribute £5000 to the Institute in 1988 and in 1989 to fund Shell-Institute of Energy Awards. The Awards are intended to encourage advanced technological research in the fields of energy utilisation and conservation and the development of alternative energy forms. Should the scheme prove successful the Committee would be willing to consider extending it for a further period. *Mr Beckers, at the end of his speech, presented a cheque for £5000 to C E Pugh CBE (president-elect, Institute of Energy).*

The Engineering Council A chartered body for teachers?

Teachers should follow the example of Chartered Engineers and Chartered Accountants — to set standards for professional qualifications and establish a chartered body. Dr Kenneth Miller, director general of the Engineering Council, was expressing a personal view (on 11 March 1988), when speaking on the Council's campaign for more maths and physics teachers to increase the number of qualified youngsters going on to engineering and science courses in higher education.

Dr Miller said that only 32% of British youngsters stay on in full-time education up to 18 years of age, compared with 70% in France, 85 to 90% in the USA and West Germany and a staggering 96% in Japan.

'The shortage of maths and physics teachers is even greater than the statistics show,' Dr Miller told engineers and teachers at Plymouth. 'There is an alarmingly high percentage of teachers at present teaching mathematics who are unqualified in the subject. If we project forward a national curriculum with 40% of the time given to maths, science and technology we can see the size of the problem.'

The Government had taken a number of initiatives to correct the situation after the Engineering Council first highlighted the problem. The Council itself was encouraging suitable engineers, mathematicians and scientists from industry to take early retirement in their mid-fifties, and transfer

to a career in the teaching profession. The Engineering Council is also urging the Government to organise a well-defined career break scheme for women to return to teach shortage subjects. It was the teachers, however, who would play a crucial role in providing the country with a well-educated work force at all levels.

To provide high quality education for the whole ability range, it was essential that the teaching profession themselves received the appropriate initial education and training, and then continuing updating throughout their careers.

Dr Miller went on to express a personal view, saying: 'Teaching is the one profession which has not developed a professional body to set the standards for professional qualifications. However, I was pleased to see that there is to be a new attempt to launch a General Teaching Council. I would strongly support such a proposal. I believe that such a professional body is required to maintain a register of all practising members, uphold a code of conduct, and award designatory letters to match membership and fellowship.'

He said the standards for entry for all professions had three elements:

- 1 education — generally an honours degree;
- 2 an element of structured practical training; and
- 3 holding a position of sufficient responsibility for a prescribed period of time — probably two years.

These standards, particularly the final one of responsible experience, were all set by peer judgements. In Britain, the body itself was either a statutory body, such as the General Medical Council, or a chartered body. Examples of the latter category were

the Law Society, Chartered Accountants, Chartered Surveyors and Chartered Engineers.

A chartered body was the most appropriate choice for teachers. The independence that it would confer was a vital safeguard for the standards of the profession, and against unwanted influence of the Government of whatever political colour. 'This is particularly necessary when a large percentage of the profession, such as teaching, is in the employment of the state,' he said.

'Such a chartered body would, I personally believe, have at least two grades of corporate membership: Members and Fellows — the Fellowship grade might be appropriate for senior members of the profession, such as head teachers and heads of departments in secondary schools. It should also have a learned society role in running seminars and conferences on the developing teaching practices.'

Further information from the Engineering Council, 10 Maltravers Street, London WC2R 3ER (tel 01-240 7891).

Personal

Mrs Nancy Fitzroy, 1986-87 president of the American Society of Mechanical Engineers, was welcomed into the Institution of Mechanical Engineers on Wednesday 23 March 1988 as an Honorary Fellow of the Institution.

Dr J E Harris, leader of the Fuels Division, CEBG Berkeley Nuclear Laboratories, was elected a Fellow of the Royal Society on 17 March 1988. He was distinguished for 'his contribution to understanding the behaviour of components of nuclear power reactors under severe service conditions. This has led to new insights into the high temperature creep and oxidation of metals, as well as to substantial savings in the cost of electrical power generation.'

Dr C Lopez-Cacicedo, an electrochemical engineer from Madrid, is now centre director of the Electricity Research Centre at Capenhurst, Chester. He first joined the Research Centre as a research officer in 1971.

The Right Honourable Lord Robens of Woldingham (Companion), chairman of the National Coal Board from 1961 to 1971, has been appointed president of Snamprogetti Limited, the UK subsidiary of the International Snamprogetti engineering and contracting group. He had acted as chairman of Snamprogetti Limited since August 1980.

Obituary

P K Richards (Fellow) had been a member of the Institute since 1970.

D K Roberts (Fellow) died on 18 March after a long illness. He had been a member of the Institute for nearly 50 years.

Institute of Energy 1988 Branch conferences

South Coast

8 Sept (Th). One-day symposium: *NO_x*

generation and control in boiler and furnace plant. The Crest Hotel, South-sea. In association with the Combustion Institute (UK section).

North-Eastern

12 Oct (W). One-day energy conference and exhibition: *Energy efficiency in buildings*. Civic Centre, Newcastle upon Tyne.

1988 June/July meetings

North-Eastern

24 June (F). Wine and cheese evening.

Beamish Museum, Co Durham at 1830 h. *Please be punctual.*

South Wales and West of England

1 Jul (F). 15th Walter Idris Jones Memorial Lecture: *Computers, energy and steel*, by Dr Frank Fitzgerald FEng (managing director, technical, British Steel Corporation). Court Colman Hotel, nr Bridgend at 1130 h (coffee and reception at 1100 h). To be followed by branch annual lunch. See loose insert.

SPECIAL ANNOUNCEMENTS

South Wales and West of England: 15th Walter Idris Jones Memorial Lecture

Please see loose insert this issue.

The practical application of energy efficiency: Stockton-on-Tees, 8 June 1988

The Department of Civil and Structural Engineering and Building, Teesside Polytechnic, are holding their seventh annual one-day energy conference at the Swallow Hotel, Stockton-on-Tees on *Wednesday 8 June 1988*.

The cost is £35.00 (including VAT and one set of papers), which covers lunch, morning coffee and afternoon tea.

Provisional timetable

- 0900-0930 Reception desk opens for delegates.
0930-0935 Welcome to hotel by assistant director (resources), D G Leyland.
0935-0950 Opening paper by chairman for morning session, *M G Burbage-Atter* (chairman, North Eastern branch of the Institute of Energy and the Institution of Plant Engineers).
0950-1010 Paper 1 — *L Gillis* (South Tees Area Health Authority).
1010-1030 Paper 2 — *R Harrop* (B.A.S.F. Chemicals, Seal Sands).
1030-1050 *Coffee*.
1050-1120 Paper 3 — *Dr P Sedgwick* (Durham County Council).
1120-1140 Paper 4 — *E McLanders* (Associated Heat Services). *Contract energy management*.
1140-1210 Discussion on morning papers.
1210-1400 *Lunch*.
1400-1405 Introduction by chairman for afternoon session, *J Barton* (chairman, Teesside Energy Managers Group).

- 1405-1425 Paper 5 — *A Proud* (Yorkshire Regional Health Authority).
1425-1445 Paper 6 — *C R Hall* (Resinous Chemicals, Gateshead).
1445-1505 Paper 7 — *J Richardson* (formerly North Yorkshire County Council).
1505-1520 *Tea*.
1520-1550 Open forum.
1550-1600 Closing remarks.

Further information from M G Burbage-Atter, Teesside Polytechnic, Department of Civil and Structural Engineering and Building, Middlesbrough, Cleveland TS1 3BA (tel 0642 218121).

Energy management: Short course, Portsmouth Polytechnic

A five-day short course on *Energy management* will be held in the Department of Mechanical Engineering, Portsmouth Polytechnic from 19-23 September 1988.

Further information from Dr M R I Purvis, Department of Mechanical Engineering, Portsmouth Polytechnic, Anglesea Road, Portsmouth, Hants PO1 3DJ (tel (0705) 827681 ext 227/130).

Incineration and energy from waste: Short course, University of Leeds

A short course on *Incineration and energy from waste*, organised by the Department of Fuel and Energy, will be held at the University of Leeds from 26-28 September 1988.

Further information from Dr Paul T Williams, Department of Fuel and Energy, University of Leeds, Leeds LS2 9JT (tel (0532) 33-2504).

Continued overleaf

Call for papers: International gas research conference, Japan, 6-9 November 1989

The 1989 International gas research conference will be held at the Keio Plaza Inter-Continental Hotel in Tokyo, Japan from 6-9 November 1989. The conference is sponsored by Gas Research Institute, the International Gas Union, the American Gas Association, the US Department of Energy, and the Japan Gas Association. The Japanese gas industry is the conference host.

English and French are the official conference languages. However, simultaneous interpretation will be provided in Japanese, as well as English and French, at all plenary and parallel sessions. Interpretation will not be provided at the poster sessions.

Only high-quality R & D papers, containing original and previously unpublished results, will be accepted for presentation at the conference. Papers will be presented either orally in parallel sessions or at poster sessions. As at previous IGRCs, poster sessions will provide a particularly

valuable opportunity for direct personal exchanges between the presenters and the delegates.

Papers are invited on any research topic of relevance to the gas industry. Subjects covered will include: *transmission and storage; distribution; residential and commercial utilisation; industrial utilisation; gas supply; general and basic research.*

Submission of abstracts

Abstracts of 700-1000 words should be submitted, along with supporting graphs, sketches, or figures, and should give a clear understanding of the scope of the paper. All abstracts will be reviewed internationally. Only SI units should be used; however, other units may be added in parentheses. Abstracts may be in English or French. Titles should be as short as possible — preferably less than 90 characters. Authors may indicate their preference for oral or poster presentation.

Abstracts should be sent to the secretary of the Technical Programme Committee, 1989 International gas research conference, c/o Gas Research Institute, attention: Dan A Dolenc, 8600 West Bryn Mawr Avenue, Chicago, Illinois 60631, USA (tel 312/399-8226; tlx 253812 or 503802). Abstracts must be received by 31 July 1988. Further information from Dan A Dolenc (see address above).

Awards:

1. London Electricity Board's PEP Awards 1988

London Electricity's PEP Awards are given annually to encourage manufacturers to improve productivity and cut energy costs by using efficient electrical processes. Entries for the competition close on 1 June 1988. Any manufacturer with an energy saving story to tell should contact the energy utilisation team at their local LEB office for entry forms and further information. The London PEP Awards will be presented in September. The winners will then go forward to enter the national competition in November.

2. Powrmatic/NIFES Energy Management Award

The search has begun to find the energy manager responsible for the country's most effective energy management programme, who will win a top prize of £1000 in the tenth year of the Powrmatic/NIFES National Energy Management Award.

The competition enjoys the cooperation and support of the Department of Energy and is open to everyone responsible for the efficient use of energy resources — whatever the size of the organisation or the nature of its activities.

This year an important change has been made to the competition as this will be organised on a national basis, with the finalists representing those entries selected as the best throughout the country, irrespective of region. In past years, the overall winner emerged from a shortlist of winners previously successful in regional competition.

Again, the judges point out that entrants from large and small organisations have an equal chance of winning, with sound energy management principles being the chief criteria for success. The winner will be selected by an independent panel of judges from a group of finalists, each of whom receives a certificate and £50 cheque. The closing date is Tuesday 7 June 1988.

Further information from Powrmatic/NIFES, National Energy Management Award, GKPR, 60-63 Victoria Road, Surbiton, Surrey KT6 4NW (tel 01-399 1184).

3. 1988 Manufacturing Effectiveness Award

Prizes totalling £20 000 — of which £14 000 will go to the winner — will be presented to finalists vying for the 1988 Manufacturing Effectiveness Award when they meet in London for judging on Tuesday 6 December. The award, a City initiative in support of industry, is sponsored by insurance brokers Willis Faber and organised by the Institution of Mechanical Engineers.

As in the three previous events — in 1982, 1984 and 1986 — the award is being offered by Willis Faber for the best case study of a current improvement in manufacturing effectiveness within UK industry. Its objective is to assist in the regeneration of UK manufacturing by highlighting its success stories and by raising the profile of those engineering manufacturing organisations that are gearing themselves to meet and beat their foreign rivals.

Contenders for the award will be asked to demonstrate any substantial change that has resulted in a more effective manufacturing business, including aspects such as marketing, product specification, design, production services and the use of capital resources.

The award is open to any team of from one to four persons who have been involved in the success story. Notification to enter is required by 1 July and the submission of papers by 29 July. During September and October the preliminary judging panel will arrange for visits to the companies where a success story is located, both the contributing team and management on the site being interviewed. Final presentations in December will each comprise 15 minutes followed by questions from a judging panel.

Further information from Peter Pugh, manager, IMechE Engineering Manufacturing Division, 1 Birdcage Walk, London SW1H 9JJ (tel 01-222 7899; fax 01-222 4557).

4. BNES Plowden Prize

This is a prize awarded to the author of the best paper submitted. It is open to members and non-members of the British Nuclear Energy Society who are under the age of 27 years on 1 January of the year of the Award.

Papers may be on any aspect of the civil application of nuclear energy or any directly relevant science or tech-

nology, a range of topics consistent with the editorial policy of the Society's Journal *Nuclear Energy*. The prize will consist of £100 in cash plus a ticket to the Society's annual dinner, publication of the paper in *Nuclear Energy* and the opportunity to apply for sponsorship of up to £1000 for

foreign travel to attend a relevant conference or visit an appropriate establishment.

Further information from Secretariat, British Nuclear Energy Society, 1-7 Great George Street, London SW1P 3AA (tel 01-630 0726). Closing date 30 September 1988.

CONFERENCES

June 1988

Preinsulated pipelines today and tomorrow

Seminar, Herning (Denmark), 14 and 15 June 1988.

Details from Unichal, Generalsekretariat, Bahnhofplatz 3, Postfach 6140, CH-8023 Zürich, Switzerland.

Clean coal

Conference, London (Conference Forum, Sedgwick Centre), 15 and 16 June 1988.

Details from Friends of the Earth, 26-28 Underwood Street, London N1 7JQ (tel 01-490 0224/1555).

Pressure vessels and piping

ASME conference, Pittsburgh (PA, USA), 19-24 June 1988.

Details from ASME, 345 East 47th Street, New York, NY 10017, USA.

European fuel oxygenates

Third annual conference, Frankfurt-am-Main (FRG), 21 and 22 June 1988.

Details from Alcohol Week, PO Box 7167, Ben Franklin Station, Washington, DC 20044, USA (tel 703-892-8504).

Oil markets, now and tomorrow

European energy conference, Paris (France), 21 and 22 June 1988.

Details from DRI Energy Office, 13 rue du 4 Septembre, 75002 Paris, France (tel +33 1 42 60 37 00; tlx 216 083).

Interorbit and intersatellite links: systems and technology

Conference, London (London Tara Hotel), 29 and 30 June 1988.

Details from Laura Christie, principal conference organiser, ERA Technology, Cleeve Road, Leatherhead, Surrey KT22 7SA (tel 0372 374151 ext 2290 or 2488; tlx 264045; fax 0372 374496).

June/July 1988

Modern developments in boiling

May 1988

heat transfer and two-phase flow Seminar, New York (USA), 26 June-1 July 1988.

Details from Joan Masterton, Office of Continuing Studies, Rennselaer Polytechnic Institute, Troy, New York 12180 3590 (tel (518) 276 8351).

July 1988

Decommissioning of nuclear facilities

International seminar, London (Hilton International), 6 and 7 July 1988.

Details from Katie Lye, IBC Technical Services, Bath House (3rd floor), 56 Holborn Viaduct, London EC1A 2EX (tel 01-236 4080; tlx 888870; fax 01-489 0849).

Radioactive waste management

European Summer School, Cambridge (Christ's College), 11-14 July 1988.

Details from Katie Lye (see address above).

August 1988

Opportunities in the synfuels industry

Symposium, Bismarck (ND, USA), 29-31 August 1988.

Details from symposium on opportunities in the synfuels industry, University of North Dakota, Box 8277, University Station, Grand Forks, ND 58202, USA.

August/September 1988

Chemeca 88

Australasian chemical engineering conference, Sydney (Australia), 28 August-2 September 1988.

Details from Prof D L Trimm, School of Chemical Engineering and Industrial Chemistry, University of New South Wales, PO Box 1, Kensington, NSW 2033, Australia; tlx 26054; fax (02) 697-4642.

Inter-noise 88

International conference on noise con-

trol engineering, Avignon (France), 30 August-1 September 1988.

Details from Inter-noise 88 Secretariat, BP 23, 60302 Senlis Cedex, France.

European aerosol conference

Lund, Sweden, 30 August-2 September 1988.

Details from Dr B Georgi, secretary general GAeF, Universität Hannover, Herrenhauser Str 2, D-3000 Hannover 21, FRG (tel (0511) 762-3284; fax (0511) 762-3456).

September 1988

Drying

Sixth international symposium, Versailles (France), 6-8 September 1988.

Details from Prof M A Roques, ENS des Industries Chimiques, 1 rue Grandville, 54042 Nancy, France.

Stability and handling of liquid fuels

Third international conference, London (Cavendish Conference Centre), 13-16 September 1988.

Details from Miss Caroline Little, conference officer, Institute of Petroleum, 61 New Cavendish Street, London W1M 8AR (tel 01-636 1004; tlx 264380; fax 01-255 1472).

Carbon 88

Seventh international carbon conference of British Carbon Council, Newcastle upon Tyne, 18-23 September 1988.

Details from conference secretariat - Carbon 88, Society of Chemical Industry, 14-15 Belgrave Square, London SW1X 8PS (tel 01-235 3681).

Aviation turbine fuel specifications

MoD seminar, Bath (Assembly Rooms), 19-21 September 1988.

Details from Dr E M Goodger, School of Mechanical Engineering, Cranfield Institute of Technology, Cranfield, Bedford MK43 0AL (tel Bedford (0234) 750111 ext 2337/2300; tlx 825072).

Impact of atmospheric protection measures on thermal power plants

Seminar, Essen (FRG), 19–21 September 1988.

Details from Committee on Electric Power, UN Economic Commission for Europe, Palais des Nations, CH-1211 Geneva 10, Switzerland (tel (022) 346011; tlx 289696).

Air pollution modelling and its application

17th NATO/CCMS international technical meeting, Cambridge, 19–22 September 1988.

Details from Han van Dop, KNMI, PO Box 201, 3730 AE De Bilt, The Netherlands.

Furnaces 88

Conference and exhibition, Birmingham, 20–21 September 1988.

Details from Gillian Owen, PR and publicity manager, Furnaces 88, Queensway House, 2 Queensway, Redhill, Surrey RH1 1QS (tel (0737) 768611).

Disposal of radioactive waste in seabed sediments

International conference, Oxford (St Catherine's College), 20 and 21 September 1988.

Details from Ms Jean Pritchard, Society for Underwater Technology, 1 Birdcage Walk, London SW1H 9JJ (tel 01-222 8658; tlx 917944 IMELDN G).

Desulphurisation for coal processing systems

First European conference and exhibition, Sheffield, 20–22 September 1988.

In association with Institute of Energy. Details from Mrs Julie Tayler, conference officer, Institution of Chemical Engineers, 165–171 Railway Terrace, Rugby CV21 3HQ (tel (0788) 78214; tlx 311780; fax (0788) 60833).

October 1988

CoalTrans 88

Conference, Rotterdam (The Netherlands), 18–20 October 1988.

Details from conference secretary, CS Publications, McMillan House, 54 Cheam Common Road, Worcester Park, Surrey KT4 8RJ (tel 01-330 3911; tlx 8953141 Carsys G; fax 01-330 5112).

Technology and technology exchange

International congress, Pittsburgh (PA, USA), 18–20 October 1988.

Details from Ms Renate Siebrasse, operations manager, Battelle London, 15 Hanover Square, London W1R 9AJ (tel 01-493 0184; tlx 23773; fax 01-629 9705).

November 1988

European gas seminar

Milan, Italy, 23 and 24 November 1988.

Details from European Study Conferences, Douglas House, Queen's Square, Corby, Northants NN17 1PL (tel (0536) 204224; tlx 341543 CORWKS G; fax (0536) 204218).

November/December 1988

Liquid-solid flows

Third international symposium, Chicago (USA), 28 November–2 December 1988. *To be held during the ASME winter annual meeting in Chicago.*

Details from Prof M C Roco, Dept of Mechanical Engineering, College of Engineering, University of Kentucky, Lexington, KY 40506-0046, USA (tel (606) 257-8925).

COMMERCIAL

New range of pressure jet oil burners

Nu-way, a subsidiary of Wolsley, are expanding into the domestic central heating market with a newly launched range of pressure jet oil burners: the Boxer range.

Nu-way are marketing three basic Boxer models designed for use with kerosine or gas oil and with outputs ranging from 14.7 to 33 kW. Key features include a compact design to match the latest slimline boilers; the Boxer is also the first burner of its kind to use an electronic high-frequency ignition transformer.

Reader enquiry no 5/1

Larger gas-fired heater

In recent years, commercial and industrial buildings have been getting larger, for example the introduction of superstores and hypermarkets and other retail premises, and of larger industrial units, notably in the new Enterprise Zones created by the Government.

Combat Engineering have responded to the demand for larger heating units by launching a new gas-fired warm-air unit heater with a capacity of 300 000 Btu/h. The new heater is manufactured to conform to BS 5991 and is available with a direct drive axial (CUHA) or

a belt drive centrifugal fan system (CUHB) and also has a ducted (CUHD) unit for connection to purpose-made duct distribution systems. The CUHA unit utilises two fans powered by 125 W motors and the CUHB unit uses a massive 550 W motor to power two parallel centrifugal fans.

The new heaters utilise a half-inch natural gas connection or can be LPG fired to special order. Automatic ignition with remote reset facility is fitted as an extra on all unit heaters but will be included as a standard item on this new 300 000 Btu/h model. A 254 mm flue is required to exhaust the products of combustion to atmosphere.

An advantage of the heater is that it is designed to be suspended from brackets or can even be shelf-mounted on non-combustible material.

Reader enquiry no 5/2

Extended Recupovent

Thermal Technology's range of Recupovent ventilation/heat recovery units has been extended to include two new sizes and more optional extras. There are now seven Recupovent sizes capable of handling between 0.04 to 1.2 m³/s.

Each package consists of a

double-skinned insulated casing containing a standard Thermal Technology 'TT' aluminium plate recuperator for air-to-air heat recovery and a supply and exhaust air fan. The recuperator extracts energy from the exhaust air and transfers it to the incoming supply air. Heat transfer efficiencies vary between about 50 to 70%. Special units for swimming pools can be supplied with polyurethane-coated aluminium or stainless steel recuperators.

Further heating of the supply air is achieved by the use of a low-pressure hot water heater battery. Alternatively, electric heater batteries can be supplied complete with a multi-function control panel. For applications where noise is critical a full range of matching attenuators is now available to meet any given noise criteria.

Reader enquiry no 5/3

New industrial boilermaker established in Lincoln

A new company has been founded in Lincoln to produce industrial steam and hot water boilers for processing and commercial applications. Beel Industrial Boilers was formed following the termination of boiler manufacturing by

Babcock Robey in Lincoln, in November 1987, and will be controlled by Neville Beel, who was managing director of Babcock Robey from 1978.

The new company will employ an experience of management, design and engineering expertise in the production of generation and heat transfer plant and equipment for steam raising and hot water systems.

Reader enquiry no 5/4

Energy-saving dewatering filter

Valmet Paper Machinery have developed a new filtering method for mechanical dewatering of sludge and suspensions without using a large amount of energy. The product based on this method, Ecosuc, is similar to a vacuum disc filter and has applications in the chemical and mining industries as well as in metallurgy.

In this type of filtering, solid particles are separated from liquids containing high concentrations, and the water content in the filtered sediment is reduced to a very low level. The filtering material in the Ecosuc filter consists of microporous ceramic plates, developed by Valmet Paper Machinery. During operation the pores in the