Down a Modern Coal Mine
SHAFTS AND TUNNELS

The average depth of a British shaft is about 450 metres and the deepest is 1,000 m. The new mine being constructed at Asfordby in North East Leicestershire will have twin shafts 32 m in diameter with a special concrete lining varying between 0.5 - 1 metre thick to resist hydrostatic and rock pressures. Such large diameter shafts eliminate coal clearance bottlenecks and in the new Asfordby shaft 25 tonne capacity skips will transport coal to the surface.

Whether access to reserves is by shafts or drifts, tunnels are needed to reach new areas of coal and more than 400 km of these underground roadways are driven each year in British coal mines - double the length of all the tunnels in the London underground system.

For every 1,000 tonnes of coal produced, 5 metres of roadway have to be driven to develop new reserves which replace used capacity. About half the tunnels are driven in rock to obtain access to coal seams; the other half are in coal (or mainly coal) to open out faces.

Gaining access to reserves by a drift (a sloping tunnel) gives more flexible coal clearance because the coal is brought out on continuously running conveyor belts, avoiding the risk of a bottleneck caused by restricted shaft capacity. This inclined tunnel into shallow coal reserves - averaging between 1,500 and 2,000 m long and dipping at up to 1 in 4 - is driven by a heavy duty roadheading machine with men setting steel roof supports as they advance.

At any one time there are about 350 roadheading machines at work in British mines cutting and loading rock in excavations for underground roadways.

Lasers now help to drive accurately 50 km of tunnels a year, their glowing red dot identifying the centre of the heading face so that development teams operate with total precision.

MINING COAL

The main source of coalface machinery is at the face-end where a variety of equipment - roadhead supports, armoured flexible conveyor, drive units, anchorages for the power loader haulage chain plus roadheading machinery and other mechanised roadside packing - is located.

Investment in two new concepts of mechanised mining - Advanced Technology Mining (ATM) and Heavy Duty Mining have improved both efficiency and safety on the coalface.

The ATM concept brings together items of proven coalface equipment for remote or automatic operation.

Heavy duty coalfaces operate with particularly robust equipment costing between £5-7 million. This includes power loaders of up to 800 kN which cut the coal to depths of a metre or more, and shield supports which provide an unbroken ceiling of steel to support the roof and protect against stone flushing from the waste-the now unsupported area from where the coal has been extracted.

In-built strength and reliability mean that Heavy Duty face equipment has a longer life than conventional machinery, reducing maintenance and repair costs substantially.

Both are completely mechanised longwall mining systems which begin by driving parallel tunnels into the coal seam. The connecting link, 200-300 m long and at right-angles between them, is the coalface. A power loading machine travels the full length of the face, cutting coal from the seam and automatically loading it on to a flexible steel conveyor for the first stage of transport out of the colliery. The operator is in the safe working area along the entire coalface, protected by hydraulic powered supports which keep the roof and the floor apart after the coal has been extracted. On each cutting run along the coalface the power loader extracts coal to a depth of about 300 mm; the assumed support roof.

Above: One of Britain's biggest tunnelling machines at work driving a main roadway development to access new reserves of coal.

Below: A Ranging-drum shearer cutting and loading coal. The cutting drum is raised and lowered by electro-hydraulic controls and water sprays suppress dust.
Coalmines may all have the same function but each one has a special character and geology of its own. Just like people in a way. There's something special too about the miners themselves - their comradeship and teamwork. Skilled in the use of the most modern mining equipment, faceworkers extract the coal from rich underground seams, others control its movement to the surface where it is prepared and graded for its many markets: power stations, various industries and many thousands of homes up and down the country. A modern coalmine is a huge, bustling "round the clock" efficient business with a surface complex which comprises impressive winding towers, power house, coal preparation plant, fan house, workshops, stores and offices, lamproom, medical centre, baths, canteen and other essential services. At the pithead, in the winding room, a winding engineman controls the cages in their trips to and from the pit bottom - at times with men, at other times with essential supplies of machinery and spares - and also raises the coal which may be in huge skips.
Fresh air enters the mine down one shaft, circulates underground and is discharged through another shaft.

Powerful fans are used for this purpose. Below ground, hundreds of men and thousands of pounds worth of equipment work together in the many, important, skilled tasks necessary to cut and load coal from the face for swift transport to the pit top.

Transfer point from GATE CONVEYOR to TRUNK CONVEYOR

DOWNCAST SHAFT

TRUNK CONVEYOR unloading into a BUNKER and SKIP

AIR INTAKE

AIR RETURN
COMPUTER CONTROL

Remote and automatic control of mining operations is gradually increasing through technological developments introduced by British Coal's Headquarters Technical Department at Bretby. A colliery at work can be monitored by computers in a control room on the surface using new technology known as MINOS (short for Mine Operating System) which is designed to improve efficiency and safety and assist management decision making.

MINOS computer systems supervise underground mining operations including coal production, mineral transport networks, water pumping and power distribution. They also keep a watch on the mine environment including its ventilation system, gas levels and climate.

Automated mining systems on the coal face use advanced technology sensing devices and computers to guide the cutting machine in the coal seam and to control the support systems as the coal face moves forward.

Above: The MINOS control system, monitors and records data on coal conveying, skip winding ventilation and coalface operations.

Right: The main computer centre at Cannock, Staffordshire. Magnetic tape are stored in a purpose built tape library ready for loading into the computer.

Below: Underground temperatures can reach 30°C at some deep mines. Mine refrigeration units reduce the temperature at the coalface and improve working conditions.

COMPUTERS

Coal was one of the first British industries to use computers on a large scale.

The industry's fully-developed computer network is operated by British Coal Information Technology and Operational Research Services at Cannock. Over 3000 terminals at collieries, workshops, stores and other offices are connected to the network.

Computers calculate all the industry's statistics, ranging from productivity to analysis of mine air and stock control involving new purchases worth nearly £800 million a year, and cover all financial services. Adequate computer capacity has to be available at peak times to meet the industry's needs. British Coal is, therefore, able to carry out external bureau work on contract and more than 1000 companies use these off-peak services, which include processing wages for 260,000 outsourced workers.

With one of the biggest computer networks in Europe - British Coal intend to stay in the forefront of new developments.

MINING ENVIRONMENT

At every mine a constant check is kept round-the-clock throughout the year on the underground environment.

Powerful fans located on the surface ventilate up to 40 miles (64km) of underground roadways at an average size colliery, each fan using 3000 kw and six metres in diameter extract as much as 360 cubic metres of 'used' air a second from the colliery's upper shafts to ensure a sufficient supply of fresh air into the downcast shaft.

At collieries the emphasis is now on dust prevention at source and all power loaders and tunnelling machines are fitted with internally-fed water sprays, most using water jets directed on the cutting picks at the moment of impact. Water pressures of 100 psi and sometimes higher are used and new designs of dust suppression devices are being introduced. Trials of exhaust ventilation methods of dust control on coalface machines, using high pressure water sprays which draw air through tubes and also capture small dust particles, are in progress. Dust concentrations can be reduced by increasing the ventilation flow, but there is a limit because at high velocities pick-up of coarse dust occurs.

During the drugging of roadways, special air curtains mounted onto roadheading machines also keep dust away from the operators.

Hand-held detectors called methanometers are an alternative to the traditional flame safety lamp for checking 'firedamp' (methane) levels underground. Hand-held thermal imagers have been introduced to detect heat sources.

Sensitive fire detectors are used underground to detect even the slightest increase in temperature. They measure carbon monoxide or carbon dioxide and can effect immediate action.

British Coal's Information Technology and Operational Research Services have also developed a computer based alarm programme called MDA (Multi Discriminating Alarm), which encompasses a wide range of individual overheads.
COAL PREPARATION

Coal is supplied for power generation, steel making, industrial steam raising and domestic and commercial purposes in many different sizes and qualities. Coal preparation plants are the vital link between the colliery and the customer.

Modern preparation plants, many taking the entire output from several collieries, ensure that customers get the right size and quality of coal they order. Some are computer-controlled and are highly automatic in operation - a transformation from the days when boys and women hand-picked rock from coal. Now computer control washing, sizing and blending operations separating on average one tonne of shale from every two tonnes of coal mined. Ash is automatically analysed, and coal qualities blended, with a few operators using visual display units to supervise the process.

The mineral input to preparation plants ranges from large lumps to small particles of which 70 per cent is below 28mm, including up to 20 per cent less than 0.5mm. Coal cleaning efficiency is high, the separated discard containing less than 2 per cent of low grade coal. Coal is normally separated by a gravity process such as the suspension of magnetite in water so that coal floats and shale sinks and the finest coal (minus 0.5mm) is recovered by froth flotation.

TRANSPORT

Coal mining is Britain’s biggest industrial transport system, moving each year about 75 million tonnes of coal, 50 million tonnes of excavated rock and waste and about 55,000 men underground on 26 million journeys. In addition 500,000 tonnes of materials of all kinds are transported into a mine.

Coal faces generally needed to be worked further away from the shaft as seams are systematically extracted and at some pits it is not unusual for miners to travel 11 km or more to reach their workplaces. Fast and efficient transport is essential to enable them to keep expensive coalface machinery fully utilised.

Britain’s coal seams are rarely level, so the roadways which follow them also tend to undulate, making diesel or electric loco-hauled transport difficult to operate because of steep gradients. To overcome the problem mining engineers adopted a haulage system using a steel rope (continuous cable wound and braked from a powerful electric engine at one end of the transport run) which responds to signals from the train guard. Approximately 5,500 of these systems are operating at collieries in Britain.

Large roadways in some mines make it possible to use electric trolley locos with power from an overhead line using a pantograph. Permanently-laid track allows speeds of up to 50 kmh to be achieved in well-ventilated roadways free from the fumes of diesel locos. Trolley-battery locos, now being developed, will be able to leave the main route to travel along smaller roads towards the coalface where there is no overhead wire.

More than 95 per cent of total coal output is transported out of collieries by conveyors - the rest in mine cars.

Britain’s coal industry is a world leader in developing and exploiting new methods of mining and using coal.

More than £10,000 million has been invested during the last 10 years in new and replacement mining capacity, systems, equipment and research using computers, micro-processors, transducers, lasers, radio isotopes and other advanced engineering and scientific devices.

Mineworkers and craftsmen skilled in mechanised mining are now being assisted by the development of remote and automatic controls which benefit production efficiency, mining safety and improve working conditions.

New technology is essential to British Coal which meets nearly one third of the country’s entire energy needs. Coal is Britain’s major fuel with a real future.