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THE COAL SECTOR IN INDIA

REPORT PREPARED BY THE SECOND COAL MISSION
TO INDIA OF THE MINISTRY OF OVERSEAS DEVELOPMENT

R M Graham-Harrison, Ministry of Overseas Development
H L Rhodes, National Coal Board
J T Roberts, Ministry of Overseas Development

AUGUST 1978

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1. INTRODUCTION

1.1 Background to the Mission

1.1.1 In 1974 the Ministry of Overseas Development (ODM) appointed a Coal Mission to survey the Indian coal mining sector and to examine the scope for British assistance to it. Following the recommendations of the Mission, a grant of £10 million for the coal sector was signed in 1975. This grant was expected to be largely allocated by 1978/79 and in April/May 1978 a second Coal Mission appointed by the ODM visited India for three weeks to review developments and policies since the 1974 Mission and to consider the scope for further assistance to the sector.

1.1.2 The terms of reference of the Mission agreed with the Government of India were to:

1. Report briefly on the organisational, managerial, technical, financial and economic situation of the Indian coal mining industry, highlighting developments and changes since the 1974 Mission.
2. Review the handling of specific problems in the sector identified by the last sector Mission.

These include:

- x - demand forecasting and investment planning,
- transport and power supplies,
- x - cost control and project monitoring,
- the adequacy of exploration for coal,
- the supply of equipment and spares,
- the need for the experimental provision of mechanised equipment and appropriate training,
- research and development,
- investment appraisals.

Particular attention should be paid to demand forecasting, investment planning and cost control procedures.

3. Discuss the future plans of the industry, the investment required to meet forecast demand and the economics of meeting demand at least cost.
4. Discuss the role of coal in relation to other primary fuels in India and any steps required to promote its utilisation so that it plays an appropriate part in meeting India's energy needs.
5. Review the performance, both technical and economic, of the manufacturers of equipment for the coal sector and report on the import requirements of the sector.
6. Report on the use-made of UK sector aid for coal and make recommendations on the future level of such aid and on any changes to its composition or organisation which may be thought appropriate.

1.1.3 The Mission comprised the following members:

R M Graham-Harrison	South Asia Department Ministry of Overseas Development
H L Rhodes	Director of Overseas Mining National Coal Board
J T Roberts	Economic Planning Staff Ministry of Overseas Development

1.1.4 During the tour the Mission visited and held discussions with senior representatives of the following Government bodies and public and private enterprises:

Government of India

Ministry of Energy (Department of Coal)
Ministry of Energy (Department of Power)
Ministry of Finance (Department of Economic Affairs)
Ministry of Finance (Bureau of Public Enterprises)
Ministry of Industry (Department of Heavy Industry)
Ministry of Railways
The Planning Commission
Directorate-General of Mines Safety

Coal India Ltd

Headquarters, Calcutta
Eastern Coalfields Ltd, Sanctoria,
Bharat Coking Coal Ltd, Dhanbad
Central Coalfields Ltd, Ranchi
Western Coalfields Ltd, Nagpur
Central Mine Planning and Design Institute Ltd, Ranchi

Singareni Collieries Co Ltd

Tata Iron and Steel Company Ltd

Mining and Allied Machinery Corporation Ltd

Heavy Engineering Corporation Ltd

Jessop & Co Ltd

Jardine Henderson Ltd (Meameco Division)

Jardine Victor Ltd

Bharat Heavy Electricals Ltd

Minerals and Metals Trading Corporation Ltd

Central Fuel Research Institute

Central Mining Research Station

Indian School of Mines

In addition, the Mission held discussions with officials of the British High Commission in New Delhi and the British Deputy High Commission in Calcutta.

1.1.5 The present report may be read in conjunction with that of the first ODM Coal Mission in 1974, in particular for the technical description and review in the latter report of the coal mining methods used in India.

1.1.6 The Mission would like to express its appreciation and thanks to the many Indian officials and managers it met for the assistance and hospitality received throughout its visit to India. It is also most grateful to the British High Commission in New Delhi and the Deputy High Commission in Calcutta for their support and hospitality.

1.2 The Role of Coal as a Fuel in India

1.2.1 In appointing two Coal Missions and in providing a special grant of aid for the sector, the ODM has recognised the importance of coal to the Indian economy. India's principal fuel source is "non-commercial fuel", for example firewood and cow-dung; a survey of 1970/71 showed that nearly 65% of fuel consumed (in calorific terms) was non-commercial. But of the commercial fuels coal is by far the most important, accounting for two-thirds of commercial energy consumption in India. As the following estimates by the Mission show, the share of coal has been sustained at this level in the 1970s, due in large part to measures taken to reduce oil consumption following the oil price rise of 1973/74:

Consumption of Commercial Fuels (10¹² kcal)

	<u>1970</u>	<u>1977</u>
Coal & Lignite	425	583
Petroleum	185	264
Hydro & Nuclear Electricity	24	33
Natural Gas	<u>6</u>	<u>15</u>
Total	<u>640</u>	<u>895</u>
(Share of coal %)	(66.4)	(65.1)

1.2.2 Coal reserves in India, particularly of low grade coal, are very large. Identified saleable reserves of non-coking coal have been estimated at 24 bn tonnes. Long term plans are to treble the industry's production. If this is achieved there are still sufficient reserves left to meet requirements for at least 100 years. Although in the near future off-shore oil and gas will take a growing share in the Indian market for commercial fuels, known reserves of oil and gas will make a comparatively short-lived contribution to India's energy needs. For this reason the Government of India, like that of the UK, is looking to coal to satisfy energy requirements in the longer term and in particular regards coal as the primary fuel for thermal power generation.

2. DEVELOPMENTS IN THE COAL MINING INDUSTRY SINCE 1974

2.1 Organisation

2.1.1 In 1974, when the first ODM Coal Mission visited India, the nationalised coal industry, accounting for 97% of total output (78 million tonnes in 1973/74), comprised three separate companies. The largest of these was the Coal Mines Authority Ltd, which had been created in 1973 out of both private and public companies, produced about 70% of total output, and itself comprised three production divisions, Eastern, Central and Western. The second largest producer, with over 20% of output, was Bharat Coking Coal Ltd, which had been created in 1971 with the nationalisation of coking coal mines. The third and oldest producer, with 7% of total output, was Singareni Collieries Co Ltd, a public sector enterprise since 1947. The remaining 3% of output was produced by the "captive" mines of two steel companies, the Tata Iron and Steel Co Ltd (TISCO) and the Indian Iron and Steel Co Ltd (IISCO).

2.1.2 The coal industry was restructured in November 1975 when Coal India Ltd was set up as a holding company with subsidiaries created out of the former divisions of the Coal Mines Authority and Bharat Coking Coal. Coal India's five subsidiaries are Eastern Coalfields Ltd, Bharat Coking Coal Ltd, Central Coalfields Ltd, Western Coalfields Ltd and the Central Mine Planning and Design Institute Ltd.

2.1.3 Coal India accounts for almost 90% of the coal industry's total output, which in 1977/78 was about 102 million tonnes. The subsidiaries of Coal India produced altogether about 90 million tonnes in 1977/78. The largest producer is Eastern Coalfields, in the border area of West Bengal and Bihar, with over 26 million tonnes. The other three production subsidiaries all produced between 20 and 22 million tonnes. Bharat Coking Coal is based on the Jharia coalfield in eastern Bihar. Central Coalfields is widely spread with coalfields in Bihar, eastern Madhya Pradesh (especially Singrauli) and Orissa (especially Talcher). Western Coalfields is even more widely spread, with fields in Madhya Pradesh, Orissa and Maharashtra. Coal India headquarters exercises direct control over the very small Assam coalfield, which produces altogether well under 1 million tonnes a year.

2.1.4 The Central Mine Planning and Design Institute, formerly a division of the Coal Mines Authority, is responsible for the planning and design of all the mines and related products of the other Coal India subsidiaries. It is based in Ranchi, Bihar, but has regional institutes located near and closely associated with the other subsidiary companies.

2.1.5 Singareni Collieries Co was owned by the Nizam of Hyderabad before independence in 1947. Unlike Coal India which is fully owned by the Central Government, Singareni is jointly owned by the Centre and by the State of Andhra Pradesh, in which all its mines lie. Its output has risen fast since 1974 and its share of total output is now over 8%, almost 9 million tonnes in 1977/78.

2.1.6 The captive mines of Tata Iron and Steel Co (private sector) and Indian Iron and Steel Co (public sector) still account for about 3% of total output.

2.1.7 In 1977 further organisational changes were made in Coal India to decentralise decision-making and give the subsidiary companies greater autonomy. Each company is now headed by its own Chairman-cum-Managing Director rather than, as previously, by the Chairman of Coal India. The companies have a three-tier structure with areas, sub-areas and collieries, although there has been some shift to a two-tier system, particularly in Bharat Coking Coal, as the collieries have become larger. Each company is divided into 8-13 areas, with 80-120 collieries. An average area comprising 7-10 collieries produces about 3 million tonnes a year.

2.1.8 The subsidiary companies, not surprisingly, welcomed the recent organisational changes, though they found it too early to make an assessment for the Mission of their impact. The Mission felt that there might well be a case for further decentralisation of decision-making. The subsidiary companies still have to seek authority before spending relatively small sums of money. The same is true of Singareni Collieries.

2.1.9 Another major reorganisation of Coal India and its subsidiaries would probably be undesirable for the moment. But looking further ahead, the Mission believes that consideration could usefully be given to reducing the size and increasing the number of the subsidiary companies. The production of each company is now at least 20 million tonnes a year, and this figure is due to increase by the end of the Sixth Plan period (1982/83) to around 30 million tonnes, and in some cases to nearer 40 million tonnes. Moreover, some of the companies cover a very wide geographical area, which inevitably presents considerable administrative problems. The optimum production figure for a single company might be in the range of 10-15 million tonnes a year though this would naturally vary according to geographical and other circumstances.

2.2 Analysis of Output Growth

2.2.1 Coal production has only grown modestly in the four years to 1977/78 following nationalisation in 1973/74. Table 1 shows that the average annual growth rate in the period has been 7.0%. The period breaks down into two years of very fast growth - 1974/75 and 1975/76 - and two years of relative stagnation.

2.2.2 The growth in output was at a fairly even rate in the various subsidiary companies of Coal India but substantially above average in Singareni Collieries. The captive mines of the steel plants have only achieved below average growth.

2.2.3 Table 2 shows that, of the total increase in output during the 4 years period of about 25 million tonnes, about 20% will probably have been produced in the coalfields of West Bengal and about 40% each in the coalfields of Bihar and in the outlying coalfields respectively. These proportions apply at least in the first three years of the period. They show the continuing preponderance (66%) of the coalfields of Eastern India in total output. Despite the increase of one third in total output and despite the relative preference of the industry's planners for production in the outlying fields which are closer to consumers in the South and West and where rail congestion is less, there has been almost no loss of output share by Eastern India. This is hardly surprising since West Bengal and Bihar contain 68% of India's proven coal reserves.

2.2.4 Table 3 shows what types of coal have featured most prominently in the growth in output. The picture is incomplete because Coal India alone publishes the grade of the coal which it produces. It emerges that the share of coking coal in total output has risen from 20% to 30% over the four year period but that it is the high ash content coking coals whose output has increased most. In non-coking coal the pattern is different: Coal India's high grade coals have maintained their share of total output and have increased their share of Coal India output; Grade III coals, whose output the Government is seeking to promote for conservation reasons, are currently being produced at a lower rate than at the beginning of the period.

2.2.5 The output performance in the first two years of the period displayed a remarkable vigour on the part of the coal industry. The failure to sustain the high rate of growth was due, in 1976/77 to an unexpected demand recession, and in 1977/78 to a combination of the reduction in targets consequent on the rise in stocks in the previous year and of supply side restraints, particularly in the supply of explosives and at times also in the provision of railway wagons for the removal of

coal. In the early months of 1978/79 coal production has suffered from deficient power supplies in Eastern India, a continuing wagon shortage and a spell of industrial action at Singareni Collieries.

2.2.6 There is no easily quantifiable explanation of the vigorous growth in the years 1974/75 and 1975/76. The period after nationalisation was a time of reorganisation accompanied by some rise in employment and a rapid rise in the wage bill. Table 4 shows that there was a drastic reduction in the numbers of mines in the Coal India companies following reorganisation and reconstruction. Adjacent mines under separate ownership were amalgamated for more profitable and effective working. In Singareni Collieries, 75% of the increase in output achieved can be attributed to the increase in the labour force; the remaining 25% is due to higher labour productivity. A number of new mines were opened. By contrast in Coal India where the labour force, after an initial increase, has been reduced as a matter of policy, virtually the whole of the increase in output must be attributed to higher labour productivity. This in turn is associated with investment in plant and equipment, new or improved methods of mining, and better training and supervision. Table 4 shows that output per man shift, on average labour productivity, rose by 31% over four years in Coal India and by 16% in Singareni.

2.2.7 From Table 4 it can be seen that investment expenditure rose rapidly in the first two years of the period but stagnated or fell in real terms in the final two years in Coal India. In Singareni the acceleration in expenditure at the outset was slower and the momentum has been better maintained. Coal India's investment followed the same pattern through time as output, ie it was extremely quick-yielding. There was little investment at the beginning of the period in new mines except those already under development. Instead the emphasis was on installing quickly procured equipment to relieve production and coal handling bottlenecks. Output was also assisted by improved power supplies and the more timely provision of wagons by the railways. Coal India also arranged the "blind" procurement of Rs200 crores of equipment, some of it, including coal cutters from the UK, imported, the allocation of which to specific mines was only to be decided later. It is not altogether clear how productively these equipments have been used in practice: the exceptionally rapid increases in Coal India's stock of "Stores and Spares" suggests that 20-30% of them may have remained in stock:

Year end stock of
Stores and Spares
(Rs crores)

1973/74	36
1974/75	62
1975/76	83
1976/77	101

2.2.8 Opencast mining presents various advantages: the development time of mines is less, labour productivity is higher and the costs of production, at least in financial terms, are lower. It is certainly Coal India's policy to increase the share of opencast in total production and Singareni are developing opencast sites. However developments in this field have not contributed a great deal to the increase in output over the last four years. Opencast production has only risen from 16 million tonnes in 1973/74 to 18 million in 1977/78. Longwall mining underground is due to develop in the coming years but this too has contributed comparatively little so far. At present there are only 28 longwall faces in India. The bulk of increased production has therefore come from improved productivity in underground mines, through improved supervision in and the incipient mechanisation of traditional "bord and pillar" mining methods.

2.2.9 Improvements in manpower skills have undoubtedly had something to do with the higher rates of productivity which have been achieved. Coal India's policy on recruitment is to recruit only trained personnel who can be expected to learn a craft.

For the management grades there is a training institute run by Coal India at Ranchi and an advanced training establishment at Calcutta. New recruits to Coal India are generally expected already to be graduates of an Indian Training Institute. In the view of the Mission, however, labour skills and discipline remains some way from those required for highly mechanised mining methods. The emphasis in training in Coal India has been on mechanisation and the changes in mining methods which it entails. As mechanisation has so far only been limited and rather unsystematic the benefits of investment in training are as yet far from fully realised. On the other hand, the rate of mechanisation appears to have out-paced the availability of labour and supervisory skills required for maintenance. The Mission found evidence that machine utilisation rates were low and down-times excessive.

2.2.10 External circumstances have also helped in some measure with the increase in coal output. At the time of the 1974 ODM Coal Mission various shortages were mentioned as restraining coal output, including railway wagons, power, sand for stowing and spare parts for machinery. These factors still preoccupy colliery managers and, in the summer of 1978, the power shortage in Eastern India is once again impeding coal production. However, they have not of themselves materially depressed output in the period under review below the levels justified by demand. In 1977/78 industrial action at the works of the two indigenous manufacturers of explosives caused a temporary shortfall in coal output. This occurred in late 1977 but vigorous efforts on the part of colliery managers to make good the shortfall in the early months of 1978 prevented output for the year from falling below the level fixed for it at the beginning of the year.

2.2.11 In summary, the remarkable production performance of the first two years of the period was achieved through the more effective application of traditional methods in existing mines. The very considerable interest in mechanisation, especially in Coal India, has so far contributed little to output. It has, however, led to a certain accumulation of machinery and spares which have added materially to the financing charges borne by the coal companies and in particular to the burden of working capital (see section 2.4 below).

Table 1 Coal Output by Company

	Million tonnes					
	1973/74	1974/75	1975/76	1976/77	1977/78 (provi- sional)	Average annual increase
Eastern Coalfields Ltd	21.06	23.16	26.18	26.47	26.26	5.7%
Central Coalfields Ltd	15.55	18.31	20.69	20.72	20.20	6.8%
Western Coalfields Ltd	16.44	19.26	21.46	21.04	21.67	7.2%
Bharat Coking Coal Ltd	16.34	17.74	20.09	20.68	21.20	6.8%
North Eastern Coalfields (Assam)	0.42	0.53	0.56	0.57	0.62	10.3%
Singareni Collieries Ltd	5.31	6.18	7.36	8.30	8.91	13.8%
TISCO, IISCO and others	3.05	3.23	3.35	3.25	3.50	3.5%
Total	78.17	88.41	99.69	101.03	102.36	7.0%

Sources: Department of Coal; Singareni Collieries Ltd; Coal India Operational Statistics 1974/75 to 1977/78

Table 2 Coal Output by Region

	Million tonnes			
	1973/74	1974/75	1975/76	1976/77
West Bengal	19.39	21.14	23.72	24.01
Bihar	33.54	37.01	41.76	42.63
Outlying coalfields	25.24	30.26	34.20	34.63

Source: Department of Coal, annual reports

Table 3 Coal Production by Grade

	Thousand tonnes				
	1973/74	1974/75	1975/76	1976/77	1977/78 (provi- sional)
<u>Coking Coal</u>					
Ash content: - below 15%	na	685	722	728	(11,507
- 15-20%	na	9,915	11,063	11,568	(16,358
- above 20%	na	7,742	12,823	14,083	3,500
- ungraded (TISCO etc)	na	3,058	3,012	2,971	31,365
Total Coking	<u>15,770</u>	<u>21,400</u>	<u>27,620</u>	<u>29,350</u>	<u>31,365</u>
<u>Non-Coking Coal</u>					
Grade: - I and above (5940kcal/kg and above)	na	37,891	41,620	41,303	38,482
- II (5340-5940kcal/kg)	na	7,944	8,565	9,100	9,091
- III and below (below 5340kcal/kg)	na	14,818	14,185	12,706	13,976
- Singareni and others (ungraded)	na	6,357	7,687	8,581	9,446
Total non-coking	<u>62,400</u>	<u>67,010</u>	<u>72,060</u>	<u>71,690</u>	<u>70,995</u>
Total coal	78,170	88,410	99,680	101,040	102,360

Source: Department of Coal Annual Reports, Coal India Operational Statistics 1974/75 to 1977/78

Table 4 Factors increasing Coal Output

	1973/74	1974/75	1975/76	1976/77	1977/78 est
1. Number of mines^a					
- Eastern Coalfields Ltd (of which opencast)				117 (9)	117 (9)
- Central Coalfields Ltd (of which opencast)				60 (21)	56 (17)
- Western Coalfields Ltd (of which opencast)				70 (6)	75 (7)
- Bharat Coking Coal Ltd (of which opencast)				91 (na)	91 (na)
- North Eastern Coalfield				(na)	(na)
- Singareni Collieries Ltd (of which opencast)				44 (1)	47 (1)
Total excluding TISCO and HISCO and NEC (of which opencast)	610 (129)			382 (na)	386 (na)
2. Year end Manpower: (thousands)					
- CIL (and predecessors) ^a	670	585 ^e	605	586	586
- SCCL ^c	37	42	48	54	57
3. Output per man shift^a (tonnes)					
- ECL	0.52	0.53	0.58	0.60	0.58 0.51
- CCL	0.45	0.66	0.75	0.80	0.84 0.86
- WCL	0.64	0.82	0.85	0.83	0.85 0.89
- BCCL	0.43	0.45	0.54	0.56	0.56 0.56
- NEC	0.37	0.44	0.48	0.51	0.55
Total CIL (and predecessors)	0.51	0.59	0.65	0.67	0.68 0.67
SCCL ^c	0.62	0.65	0.69	0.72	0.72 0.70
4. Investment in Fixed Assets (Rs crores)					
CIL ^b Total		114	180	192	174
(of which:- plant and machinery		(84)	(136)	(132)	(105)
- development and exploration)		(19)	(22)	(26)	(29)
SCCL ^c Total	1.3	3.5	9.0	13.5	17.0
(of which:- plant and machinery			(5.5)	(6.8)	(na)
- development and exploration)			(1.8)	(3.3)	(na)
5. Annual Plan outlays on Coal and Lignite^d					
	44	141	237	226	240

Sources: ^aDepartment of Coal; ^bCoal India; ^cSingareni Annual Reports;
^dPlan Budgets; ^eInferred from Annual Report on Working of
Industrial and Commercial Undertakings of the Central Government.

Note: Complete data for this table were not available for 1977/78.

2.3 Demand

2.3.1 Two important industries dominate the demand for coal: the bulk of coking coal is destined for the steel industry and approximately 45% of non-coking coal goes to thermal power plants. In the last four years these two consuming sectors have accounted for most of the growth in demand for coal - 18 million tonnes out of an estimated increase in consumption of 28 million tonnes.

2.3.2 Table 5a reproduces figures presented to the Mission by the Department of Coal for consumption by different sectors; they vary somewhat from those given in the Department of Coal's annual reports. They show growth, albeit somewhat uneven, in the use of coal by thermal power stations, and steadier, though declining, growth in the consumption of coal in the steel industry and coke ovens. In power the indicated coal consumption correlates well with output showing steady growth in the first two years, a particularly rapid increase in 1976/77 followed by virtual stagnation in 1977/78. Hot metal output grew at an accelerating rate from 7 million tonnes in 1973/74 to 10 million tonnes in 1976/77 but stagnated in 1977/78. Consumption of coking coal in the steel industry followed this pattern roughly though, curiously, at a decelerating rate. The estimate of consumption in 1977/78 which shows a continuing rise may in the event prove to be over-optimistic.

2.3.3 Overall, in the Fifth Plan period the growth of coal consumption decelerated steadily over the four years. The deceleration was responsible for the build up of stocks in 1975/76 and 1976/77 at a rate which alarmed the industry's planners and caused them to reduce development outlays for the coal industry in 1976/77. Steel and power contributed to the deceleration in 1977/78 but in the previous year responsibility lay with the railways and "other industries", whose demand actually fell. Railways demand has tended to fall for some time because of dieselisation. "Other industries" consumption is much harder to explain. It appears to have risen sharply in 1974/75 when the index of manufacturing output was stagnant and to have stagnated or declined in the years thereafter when manufacturing output was rising. This was despite official efforts by the Government of India to promote the substitution of coal for oil in industrial boilers.

2.3.4 The Government has established a committee to license the installation by industry of new oil-fired boilers and it has surveyed energy-conserving sectors to determine substitution possibilities. It considers that it has already achieved considerable success in persuading those consumers which could change to coal at only small cost in additional investment to do so. It now faces the task of weaning the textile industry away from oil, which will be harder because of the poor financial position of many textile firms. These efforts have had no noticeable effect on the consumption of coal by "other industries".

2.3.5 Equally, if not more, surprising is the stagnant consumption of coal in the fertiliser industry although output of nitrogenous fertiliser has more than doubled in the period. The coal-based urea plants are yet to be commissioned but it is official policy that even plants using petroleum feedstocks should as far as possible burn coal for steam raising.

2.3.6 There are, finally, two small uses for coal which have contributed little so far to total consumption but which show some promise for the future. These are the production of soft coke from non-coking coal, and exports. The production of soft coke is still the preserve of small-scale burning methods which waste the by-product chemical distillates and tars, making the coke costly to the consumer. Singareni is however constructing a small modern low-temperature carbonisation plant at Ramakrishnapur in Andhra Pradesh and Coal India is preparing to build another in West Bengal. With cheaper coke available, Coal India will launch a drive to market soft coke as a domestic fuel, where demand is thought to be very responsive to price.

As for exports, India has traditionally sold coal only to neighbouring countries, principally Bangladesh and Nepal. New markets are now being sought out in Western Europe and Japan.

2.3.7 Research on the use of coal as a fuel is under way, principally at the Central Fuel Research Institute in Dhanbad. Apart from soft coke production where industrial scale technology is now under implementation using techniques which are well tried in Western Europe and elsewhere, research is being conducted into producing formed coke for metallurgical purposes, from non-coking coal, and briquettes and into coal gasification. These lines of research, unlike low-temperature carbonisation, have not increased the market for coal hitherto and seem unlikely to do so significantly in the Sixth Plan. A very promising line of research into coal utilisation, where Bharat Heavy Electricals Ltd are now active, is fluidised bed combustion (see section 4.8 below).

2.3.8 Table 5b shows that year-end stocks in the hands of the coal companies have only ever reached a little over 7 weeks' consumption. Consumers typically work with very slender margins of stocks on hand. There is at present no national policy favouring the holding of prudential stocks; in fact the increase in stocks in 1975/76 caused output targets for 1976/77 to be scaled down. There has thus been a very limited buffer to protect consumers from unexpected supply shortfalls.

Table 5a Patterns of Coal Consumption 1973/74 to 1977/78

	/ Million tonnes					
	1973/74 actual	1974/75 actual	1975/76 actual	1976/77 actual	1977/78 estimated	Annual growth rate %
1. Steel and metallurgical coke ^a	na	18.51	20.93	22.60	23.97	9.0 ^e
2. Power ^b	18.64	20.04	23.44	28.90	29.90	12.5
3. Railways	13.92	13.31	14.30	13.10	13.20	- 1.3
4. Cement	3.65	3.62	4.44	4.90	5.10	8.7
5. Soft Coke	na	3.72	3.64	4.30	4.00	2.5 ^e
6. Brick and other industries)	21.36 ^d	24.29	24.82	22.70	23.39	- 1.3 ^e
7. Fertiliser)		0.95	0.93	0.70	1.00	1.7 ^e
8. Colliery consumption	1.95 ^c	2.26	2.46	3.40	3.30	14.0
9. Export	0.62	0.54	0.44	0.60	0.80	6.5
10. Total Consumption	76.53 ^c	87.14	94.40	99.70	104.60	8.2

Notes: a - including semi-coking coal for blending with high grade coking coal
 b - including washery middlings
 c - estimate
 d - includes some coke ovens consumption
 e - calculated over 3 years 1974/75 to 1977/78

Sources: for 1973/74: CIL; for other years: Department of Coal

Table 5b End of Year Pithead Stocks

	Million tonnes				
	1973/74	1974/75	1975/76	1976/77	1977/78 (Dec)
1. Coking Coal	0.85	1.34	3.85	4.89	2.73
2. Non-coking coal	5.80	5.64	7.79	9.62	7.17
3. Total	6.65	6.98	11.84	14.51	9.90

Source: Department of Coal Annual Reports

2.4 Financial Performance

2.4.1 Coal mining in India was not a profitable business in the main during the Fifth Plan period. The price of coal is fixed by the Government and has remained unchanged for the producer since August 1975 when increases averaging some 30% were made. Consumers pay an excise tax, since the 1978 budget fixed at about Rs.5/tonne for non-coking coal and Rs.10/tonne for coking coal, in addition to the producer price. Meanwhile, costs have continued to rise particularly due to the wage cost increases of about 45% over the four years. These were especially fast in 1975/76 and 1977/78. Of the other operating costs of production, the price of electricity increased fast (50%) but that of explosives more slowly (28%).

2.4.2 Table 6 shows that the financial performance of Singareni Collieries was, until 1976/77, in sharp contrast with that of the Coal India companies. Singareni has benefited from a consistently higher average price per tonne for its coal than that received by Coal India so that, despite costs which rose rather more rapidly than those of Coal India, the company was highly profitable in the first two years of the Plan period. Sales realisations were boosted temporarily in 1975/76 when the company enjoyed momentary freedom from price controls. Controls were reimposed and some contracts had to be renegotiated leading to a decline in sales realisations the following year. The continuing rise in costs, particularly of financing charges, has put the company into a loss making position in 1976/77 and 1977/78. In 1977/78 losses of Rs.7-8 crores are expected.

2.4.3 The performance of the industry as a whole is dominated by the losses of Coal India which has suffered from the price fixing formula of the Government, which has never allowed it to cover costs. This is despite the evident efforts to control the rise in costs and improve profitability in 1975/76 and after. The loss for 1977/78 is reported to be Rs.88 crores compared with Rs.59 crores in 1976/77. Coal India's income has never been sufficient even to cover interest payments and the Government has made good the strongly negative cash flow with new loans. These new loans at a time of high interest rate account for the enormous rise in interest charges in the years under review from Rs.7.6 crores in 1973/74 to Rs.46.9 crores in 1976/77.

2.4.4 It follows from the financial predicament of Coal India that all finance for development has to be external to the enterprise. In Singareni, on the other hand, internal generation of cash in 1974/75 and 1975/76 covered nearly 40% of increases in gross fixed capital and working capital.

2.4.5 With a regime of fixed prices and an obligation to meet such demands for coal as consumers may make at these prices, financial management in the coal sector has as its principal task to control costs. The cost structure is dominated by labour costs which account for between 55% and 70% of total production costs.

In the Central Coalfields, where over 45% of coal comes from opencast mines, labour costs are only 55% or so of total costs. Singareni Collieries, with their relatively higher labour productivity in underground mines, and Western Coalfields occupy an intermediate position where labour accounts for about 60% of costs. At Bharat Coking Coal and Eastern Coalfields, with a large number of small, old-fashioned mines, labour costs are as much as 70% of total costs. Labour costs have been comparatively well controlled in the middle two years of the Fifth Plan period. As already seen in section 2.2 above, the Coal India companies reduced their workforce and increased productivity, thus reducing the share of labour in production costs. Singareni has been less successful in this respect: the share of labour in costs was reduced in the three years to 1976/77 but increased sharply in 1977/78 as external restraints restricted production.

2.4.6 Cost control appears to have been less effective as regards working capital which increased in Coal India from 10 weeks' sales in 1973/74 to 22 weeks' in 1975/76, falling back to 16 weeks' in the following year. This, as explained above, is not the main reason for rising interest charges but is an important contributory factor. Control over working capital has been less successful still in Singareni, which was not able greatly to reduce in 1976/77 the exceptionally large requirements built up in 1975/76 and still had working capital amounting to 20 weeks' sales in March 1977. These requirements were only in part due to the involuntary accumulation of stocks of coal. Stocks of stores and spares exceeded those of coal in value in both companies throughout the period with Singareni experiencing a particularly large accumulation of stores. As coal mining becomes more capital intensive and has a larger requirement of spare parts, explosives, etc, it will be necessary to impose stricter stores control discipline.

2.4.7 Since nationalisation, coal companies have had to pay considerably greater attention to the welfare of their employees than previously. This includes the provision of housing and other social facilities, giving rise to the need for capital outlays and certain running expenses which increase production costs. At present about a third of miners have company housing.

2.4.8 It is helpful in understanding the Government's reluctance to increase the price of coal beyond the levels set in 1975 to see coal prices in the context of the general level of wholesale prices. The following figures show that coal prices have risen faster in the years since 1973/74 than the prices of manufactured goods, than the wholesale price index and than the GDP inflator. As noted in paragraph 2.2.4, however, there has been a shift in the output mix towards high value coals which account for about 7% out of the 62% price rise over the four years. In the early months of 1978 coal prices have been under investigation by the Baveja Committee, which is understood by the Mission to have recommended that the coal companies should improve their profitability by further measures of cost control. Doubtless the rising relative price of coal has influenced this opinion.

Wholesale Price Indices

	<u>All</u> <u>commodities</u>	<u>Manu-</u> <u>factures</u>	<u>Fuel and</u> <u>Power</u>	<u>Coal</u>	<u>Implicit</u> <u>GDP</u> <u>Inflator</u>
1973/74	100	100	100	100	100
1974/75	125	121	151	118	117
1975/76	124	122	167	151	111
1976/77	126	125	176	162	116
1977/78 (9 months provisional)	133	129	178	162	na

Source: Economic Survey

2.4.9 Despite its rising relative price in India, Indian coal is priced very cheaply in comparison with coal traded internationally. The fob prices of coal of 6,000 kcal/kg calorific value from Australia and Poland in early 1978, compared with the cost of similar Indian coal on an fob basis, are:

	<u>\$/tonne</u>	
India	15.5	(ie \$8.5 at pit head price plus \$7 freight and handling)
Australia	25	
Poland	30	

It would require only a small percentage increase - well below 10% - on the Indian fob cost to enable the collieries to cover their costs including full provision for depreciation at replacement cost.

Table 6 Extract from Working Results of CIL and SCCL

Coal India Ltd (and predecessors)

	<u>1973/74</u>	<u>1974/75</u>	<u>1975/76</u>	<u>Rs Lakhs</u> <u>1976/77</u>
1. Sales	28,019	39,716	53,544	58,311
2. Operating costs	30,579	43,528	55,788	57,982
3. Stock changes (- = increase)	- 1,383	- 1,038	- 4,492	- 1,234
4. Interest	757	1,559	2,857	4,686
5. Profit before depreciation ^a	- 1,967	- 4,360	- 609	- 3,176
6. Depreciation ^a	1,309	2,014	2,617	2,727
7. Profit after depreciation and interest	- 3,276	- 6,374	- 3,226	- 5,903
8. Net Fixed assets	14,643	19,553	34,589	46,228
9. Working capital	6,053	10,475	22,539	17,463
10. Capital works in progress	8,155	10,070	2,695	8,225
11. Capital employed	20,696	30,028	57,128	63,721
12. Rate of return on capital employed ^b	- 12.2%	- 16.0%	- 0.6%	- 1.9%
13. Despatches (tonnes M)	67.2	78.2	84.3	87.0
14. Average cost of sales (Rs/tonne) ^c	46.5	59.0	67.4	73.7
15. Average price per tonne sold (Rs)	41.7	50.8	63.5	67.0

Singareni Collieries Ltd

	<u>1973/74</u>	<u>1974/75</u>	<u>1975/76</u>	<u>1976/77</u>
1. Sales	2,343	3,792	5,258	5,408
2. Operating Costs	2,097	3,323	4,243	5,019
3. Stock changes (- = increase)	1	- 96	- 143	- 157
4. Interest	74	103	225	366
5. Profit before depreciation	171	462	933	180
6. Depreciation ^d and DRE write off	164	204	355	518
7. Profit after depreciation and interest	7	258	578	- 338
8. Net Fixed assets	1,243	1,411	1,999	2,912
9. Working capital	- 49	684	2,336	2,096
10. Capital works in progress	165	233	546	1,032
11. Capital employed	1,194	2,095	4,334	5,008
12. Rate of return on capital employed ^b	6.8%	17.2%	18.5%	0.6%
13. Despatches (tonnes M)	5.18	5.90	6.95	7.82
14. Average cost of sales (Rs/tonne)	44.8	59.6	66.8	72.0
15. Average price per tonne sold (Rs)	45.2	64.3	75.6	69.2

Source: Annual Reports on Working of Industrial and Commercial Undertakings of the Central Government

Notes: See overleaf

- Notes to Table 6:
- a. Profit before depreciation takes account of minor items of income and expenditure which are not shown in the Table. It measures the internal generation of funds within the company.
 - b. Profit after depreciation, plus interest paid as a percentage of capital employed.
 - c. Cost of sales = costs of production + interest + depreciation - stock increases divided by volume of despatches.
 - d. Depreciation is calculated on a straight line basis by CIL and by the reducing balance method by SCCL. New investment by the latter therefore shows up as a higher depreciation charge in the following years than in the case of the former. Depreciation is on a historic cost basis. One estimate given to the Mission was that were depreciation to be calculated on a replacement cost basis the cost per tonne of coal sold would increase by approximately Rs. 4.

2.5 Mining Plans and Technical Advances

2.5.1 The 1974 Coal Mission was able to examine and analyse the production plans of the major mining companies, at that time comprising the Coal Mines Authority and Bharat Coking Coal (now united in Coal India) and the Singareni Collieries. The companies' production plans, to achieve an output of 142 million tonnes by 1978/79, exceeded by a substantial margin the estimates of demand made by the Planning Commission (135 million tonnes by 1978/79 - including 4.5 million tonnes from the captive mines of TISCO and IISCO) and by an even greater margin, those made by the Mission itself (115 million tonnes, by 1978/79 - possibly increasing to 125 million tonnes if more coal exports and more substitution of oil by coal were achieved).

2.5.2 The detailed analysis of the companies production plans was included on the 1974 Mission's Report at Appendix B, but is here reproduced in abbreviated form and amended to include the plans of TISCO and IISCO - Table 7a. It can be seen that the planned expansion of output was to be achieved by increases of about 20 million annual tonnes each from existing underground mines, new underground mines and new opencast mines, and rather under 6 million tonnes from existing opencast mines. This plan was, in the circumstances then prevailing, well conceived. The Mission's only reservation, and this was generally accepted by the mining companies, was that more opencast production might have been planned at the expense of the costlier new underground mines. Increases in output during the Plan period from existing opencast mines were, of course, relatively small; the lives of opencast mines are normally short in relation to those of underground mines so that increased output from existing opencast mines not only shorten their lives, but does little more than compensate for others which are closing through exhaustion of reserves.

2.5.3 The planned output increase in the Fifth Plan of 88% (an average increase per year of 18% on the base year) has not been achieved, and the remarkable efforts of the first two years, when the plan was nearly met - 13% increase in 1974/75 and 15% increase in 1975/76 - were not sustained. As has been made clear in section 2.2 above, there is no easily quantifiable explanation for the rapid increase in output, but it is clear that the steps taken prior to the inception of the Fifth Plan must have been effective in producing the increases in output experienced during its first two years.

2.5.4 The Fifth Plan was being developed during a hiatus in the industry when it was reorganising after two major changes - nationalisation of the coking coal mines, late in 1971, and nationalisation of the remaining mines in mid-1973. At that time

the planning wing of the National Coal Development Corporation was being reorganised as the planning wing of the new Coal Mines Authority, but even that body was in the throes of being reorganised as the Central Mine Planning and Design Institute. It was quite clear that the problems of reorganisation, a severe backlog of geological exploration, and an equally severe backlog of feasibility studies and project submissions, was bound to delay the initiation and subsequent completion of the major projects needed to achieve the planned expansion of capacity. But it had been demonstrated that there was a great deal of spare capacity in existing mines, particularly in existing underground mines, which could be utilised for a fairly rapid, if modest, increase in production, provided that action was taken to secure equipment and other essential materials.

2.5.5 It is difficult to state categorically exactly how much of the increase was due to more production from new mines. Table 7b shows that of the increase of about 24 million tonnes in annual output between 1973/74 and 1977/78, almost all came from underground mines with only about 1 million tonnes coming from opencast mines. Because of the very rapid increase in production in the first two years of the Fifth Plan, it is almost certain that the bulk of the increase came from existing mines. The major exception is Singareni where expansion was achieved by the rapid development of new drift mines which have accounted for their 4.5 million tonnes increase in annual output.

2.5.6 This is not altogether surprising. The sharp drop in the growth in demand during the second year of the Five Year Plan resulted in a hurried revision of production strategy. Despite a cut-back in the third year to a level of production only 1.35 million tonnes higher than in the previous year, coal stocks rose by 2.63 million tonnes to an all-time high of 14.51 million tonnes. In that year and in the following year, 1977/78 (the fourth year of the Plan), the cut-back in production affected the long term plans. Planning of new projects has continued; indeed the long lead time required for new projects demands that it should be so, but the implementation of the projects has been deferred. They cannot be too long delayed, for there is a limit to the extent to which capacity can be increased from existing underground sources.

2.5.7 During 1973/74 'advance action' was taken for the purchase of equipment, including imported equipment of a conventional type, which could be rapidly introduced into the mines without the need for the time-taking absorption of new techniques and the other preparations necessary for the adoption of new methods of working. Without any dramatic changes the introduction of more coal cutters and drills enabled many of the bord and pillar working places to be mechanised, but perhaps the most significant contribution to the increase in output from the underground mines was the introduction and rapid spread of solid blasting which breaks the coal without the need for its being pre-cut by coal-cutter.

2.5.8 The companies' production plans did provide for the introduction of new mining techniques, in particular longwall working. Longwall mining has been practiced in certain Indian mines for some years but never on any large scale. The 28 longwall faces now operating employ a wide variety of methods but by far the most common is solid blasting. Of the four longwall faces operating in the Eastern Coalfields one is a solid-stowed face equipped with a shearer producing 450 tonnes per day and the other three are solid blasted and produce between 200-350 tonnes per day each. Two of these faces are solid-stowed and the third is caved. In the Jharia coalfield of Bharat Coking Coal, there are nine longwall faces all employing the solid blasting technique. Friction props give temporary support and four of the faces are solid-stowed. A coal plough is to be used on a tenth face. Details of longwall installations were not obtained from other companies, but it is known that they generally follow the pattern of the two companies mentioned above and rely heavily upon solid blasting. There is as yet no fully mechanised longwall face in operation, despite the provision of one or more having been included in the Plan. The first such installation will be at Monidih where a package of UK equipment

is about to be installed. This package, a product of the 1974 Mission's recommendations, has taken three years to reach its present stage.

2.5.9 In summary, it appears that the short term plans to increase production by utilising existing capacity to the full, and of course by taking all the necessary measures to ensure that this was possible, have been highly successful. Less obvious has been the effect of long term planning, but the curtailment of the Fifth Plan, as well as enforced delay in long-term plan implementation, makes it difficult to assess the effectiveness of long term planning during the period. However, examination of the Sixth Plan does suggest that there is a lag somewhat longer than the enforced delay merits, and this will be discussed in section 3 below.

Table 7a Production Plan 1973/74 to 1978/79 (Fifth Plan)

	Annual Production (million tonnes)		
	Deep Mines	Opencast	Total
Actual 1973/74	61.6	16.6	78.2
Increase from Existing Mines	22.7	5.7	28.4
Increase from New Mines	19.8	20.3	40.1
Planned 1978/79	104.1	42.6	146.7

Source: Department of Coal

Table 7b Progress of Production 1973/74 to 1977/78

	Annual Production (million tonnes)		
	Deep Mines	Opencast	Total
Actual 1973/74	61.6	16.6	78.2
Increase	28.1	1.1	29.2
Actual 1977/78 (estimated)	84.7	17.7	102.4

Source: Department of Coal; Coal India Operational Statistics

Note: Complete data for 1977/78 for this Table were not available to the Mission; some figures are therefore estimates by the Mission.

Year	CL	Opencast	Total
74/75	52.22 6.18 64.40 2.73 67.13	20.77	85.17
78/79	60.27 9.65 69.92 2.30 72.22	29.86 29.36 50 3	90.13
79/8			

13.49
2.46 opencast

73.8
23.7
183%

OUTLOOK FOR THE SIXTH PLAN PERIOD 1978/79 to 1982/83

3.1 Demand and Supply Prospects

3.1.1 The draft of the Sixth Plan projects the rate of growth of the economy as a whole at 4.7% pa and the growth of output in industry at 7% pa. Major objectives in the Plan are to accelerate agricultural growth and alleviate rural poverty through rural development and to relieve bottlenecks in the energy sector by increasing power generation by almost 11% pa and by according high priority to the coal sector in the attribution of development funds. Apart from power, the growth targets are of the same order of magnitude in percentage terms as achievements over the last three years. It is not surprising therefore that demand for coal is projected to rise at the same comparatively modest rate of about 7.5% in the coming five years as it did in the four years of the Fifth Plan, leading to a demand for coal in 1982/83 of 150.5 million tonnes.

3.1.2 Table 8 presents the official forecasts of coal demand for both the Sixth and Seventh Plans. In the latter period demand growth is expected to drop below the Sixth Plan rate to 6.6% pa thanks to a general deceleration in the growth of demand, notably in the power sector. At first sight this is paradoxical because the economy as a whole is planned to be expanding faster in the mid-1980s than in the early years of the decade. The explanation for the expected slowing down of demand growth in the Seventh Plan lies in the expectation that, by then, the current shortfall of power generation will have been made up and in the fact that the long run rate of growth of coal requirements is expected to be only a little higher than the rate of growth of national income.

3.1.3 The demand for coal is forecast in Coal India and in the Department of Coal on the basis of their understanding of customers' requirements. However it is in the Planning Commission that the expectations of interlocking industries are reconciled into a consistent picture of future inter-industry flows so the Planning Commission figures command the greatest authority. In the early months of 1978 the Planning Commission completed their forecast for the Sixth Plan period and their preliminary view of the Seventh Plan. Their figures are reproduced in Table 8.

3.1.4 In forecasting the demand for coal by the steel industry the principal variable is the forecast production of hot metal which in turn is based on the economy's demand for steel and the steel industry's capacity to produce. Hot metal output is expected to rise from approximately 10 million tonnes in 1977/78 to 14 million tonnes in 1982/83. Expected improvements in the coke required per tonne of pig iron diminish the forecast growth of coal requirements below that of hot metal production but the higher ash content of the coking coal to be mined in the future has also been borne in mind in the forecast consumption of coking coal by the steel mills and coke ovens of 34 million tonnes in 1982/83. Experiments are to be conducted in 1978/79 into the blending of high grade imported coking coal with Indian coking coal with a much higher ash content. One million tonnes is to be imported this year. If the experiment is successful in reducing the overall cost of blast furnace charge imports will be continued and allowance has provisionally been made for 1 million tonnes of imports pa throughout the Plan period. The Mission considers this approach to forecast coal requirements in the steel industry to be sound. Two factors lead to the conclusion that the steel output target is within reach: firstly, no major new scheme is envisaged and as much as 80% of Plan expenditure in the nationalised sector of the industry (covering 5 out of the 6 major steelworks) is on continuing schemes for the enlargement of existing plants and for replacement investments; secondly

there is now a 20% margin of spare capacity in the industry, the planned elimination of which, through minor balancing investment, will account for half of the increase in output during the Plan period. Progress in capacity utilisation has been made in the recent past and the prospects for continued improvement appear encouraging.

3.1.5 It is expected that, as in the recent past, the power sector will again make the biggest single contribution to coal consumption: its share in total utilisation will, as planned, rise from 28.5% of the total to nearly 36% by 1982/83. The planned rate of growth, both of overall generation (10.8% pa) and of coal consumption (12.6% pa) is very close to the average for the last three years. This lends credibility to the forecasts in the Plan. The coal requirement for 1982/83 has been carefully deduced from information on the commissioning of new thermal power stations and from assumptions about the plant factors which they are likely to achieve in the early years of operation and about their thermal efficiency. At the time of the Mission, however, there was not complete unanimity on the forecast of thermal generation in 1982/83 (114m GWh or 95m GWh) nor on the quantity of coal needed to meet these generation requirements. The Department of Power mentioned the figures, based on a consumption norm of 0.61kg of coal per KWh of power generated, of 58 million tonnes of coal corresponding to the lower forecast and 88 million tonnes corresponding to the higher forecast. The consumption norm itself is lower than the present-day average despite the expectation that the percentage of ash content in the coal fed to power stations will rise in the Sixth Plan. The electricity supply industry hopes to improve its coal consumption per unit generated by using washed and blended coals to provide a higher and more uniform quality of boiler feed. This will however not necessarily reduce the requirement of raw coal per unit generated. The figure of coal demand in the Plan of 54 million tonnes in 1982/83 may therefore be an underestimate in relation to the overall target for power generation.

3.1.6 Installed thermal capacity is due to expand by 14,000mw in the 6 years 1976/77 to 1982/83, ie to more than double. All the projects required for this have been authorised by the Central Government but the Plan assumes a very quick construction period for new thermal units of only 4½ years (or four years for extensions to existing stations). This implies an acceleration in plant construction from the present average of 5 years which is, of itself, quite possible, but which may prove difficult at a time when the volume of thermal plant construction work is increasing rapidly. Some shortfall in commissioning of new capacity is not inconceivable. However, it ought to be possible to accommodate the planned growth of thermal energy generation (40m GWh) even if there is up to one year's slippage in the commissioning timetable for thermal plant because the figures in the Plan imply a low plant factor on new thermal capacity - even allowing for post-commissioning teething troubles. There is therefore no reason to abate the forecast of coal requirements on account of construction slippage.

3.1.7 The Mission considers that the coal requirements of the power sector have been forecast rather conservatively compared with forecasts of thermal energy requirements and that the coal companies should make provision, if need be, to meet a rather higher demand. This is made particularly important by the system of linkages by which particular coal mines are designated to provide coal to particular power stations. This procedure is kept under review by a Standing Linkage Committee with a view to making day-to-day adjustments in the pattern of coal supply to power stations. The Mission was informed by the Railway Ministry that the detailed pattern of coal despatches for future years was not yet clear so that the pattern of rail movements for the later years of the Sixth Plan was not yet determined. The system has a number of virtues. It assists the co-ordination of coal production plans in mines with the power generation programmes of the stations with which the mines are linked; it gives power stations some idea of the quality of coal they can expect to receive; and

it helps to ensure the regular provision of railway wagons. However it involves a measure of rigidity in planning coal despatches and can lead to localised shortages even when overall coal output is adequate. These can be avoided either by holding larger stocks at pithead or at the power stations or by having a measure of spare capacity in the mines sufficient to tide over periods of production difficulty.

3.1.8 In other consuming sectors demand for coal has been forecast on the basis of their expected output taking account of any technical changes which are likely to affect fuel requirements and of the compulsion under which industries have been placed to use coal as a boiler fuel wherever possible. In the fertiliser industry for example 2.2 million tonnes is expected to be used in 1982/83 as feedstock for ammonia production in the two coal based plants at present under commissioning while 2.5 million tonnes will be consumed in the industry at large as boiler fuel - a 150% increase on consumption in 1977/78. The Planning Commission has been conservative in forecasting the output of the fertiliser industry so there should be a good chance of achieving forecast sales of coal for steam raising; the untried technology of the coal-based fertiliser plants leaves rather more doubt over the feedstock component of sales.

3.1.9 The expected growth of sales of coal for soft coke-making represents a departure from the stagnant pattern of the past. This is based on hopes that the low temperature carbonisation plant under construction at Ramagundam and the planned plant at Dhankuni will be commissioned and prove to be commercially successful.

3.1.10 For brick burning and other industries the forecasting methods used have been less thorough. The rate of growth indicated represents the hope that some further substitution of coal for oil will occur - although further progress with this is acknowledged to be likely to be harder than hitherto. In view of the disappointing past consumption of coal by these residual consumers (discussed in section 2.2) it may be unwise to expect much growth in the market in the coming years.

3.1.11 The export volume forecast is exceedingly modest. It reflects the rather disappointing progress hitherto in extending sales outside the South Asia region, the fact that only high grade coals (5800kcal/kg) are exported and a concern for conservation in view of the comparatively low reserves of these grades of coal. Coal exports have also been less profitable than they might have been because draught limitations in Indian ports - even in the new port at Haldia - make it necessary to ship exports in small, high-cost vessels. The Minerals and Metals Trading Corporation, which handles coal exports, does not expect India ever to be a major coal exporter and will wish to commit itself only to supplying about 0.5 million tonnes pa on long-term contracts. However, it feels that there is a growing world market for coal in Western Europe and Japan, that prices are likely to rise, and that India could easily sell 1 million tonnes pa or more on short-term contracts or in the spot market. Trial exports to France and Belgium have raised the possibility of continuing orders and Japan has made recent enquiries. The upper limit of the range of possible export levels might be as high as 4.5 million tonnes pa. A rough calculation by the Mission is based on a CIF price in North Europe of coal of 5800 kcal/kg of \$28.50/tonne. After allowing for shipping and ocean freight costs of \$13/tonne and rail freight and port handling costs of \$7/tonne this yields a pithead value of exported coal of \$8.50/tonne (= Rs72.25) which is slightly more than the domestic price of such coal but not necessarily more than its marginal production costs. India would probably not wish to expand exports to remote destinations greatly until international prices rise or shipping facilities improve.

3.1.12 In the light of the foregoing a moderately conservative view of the uses for coal in 1982/83 might be as follows:

	<u>M tonnes</u>
Steel	34.0
Power	54.0
Rail	11.8
Cement	7.2
Fertiliser	3.6
Soft Coke	5.5
Brick and other industries	24.0
Colliery consumption	3.5
Export	<u>1.5</u>
Total	<u>145.1</u>

Of the total of 145 million tonnes the equivalent of 1.5 million tonnes of coking coal will be met, on present assumptions, by importing 1 million tonnes of high grade coal, leaving a total market for indigenously produced coal of all grades of 143.5 million tonnes approximately.

3.1.13 As regards the supply of coal the Sixth Plan provides for the production of 149 million tonnes in 1982/83, which is consistent with its demand forecast, to be produced as follows by the different coal companies:

Coal India Ltd	129 million tonnes
Singareni Collieries	15 " "
Captive mines of TISCO and IISCO	5 " "

In absolute terms the largest contributions to higher output will come from Central Coalfields (17.4 million additional tonnes) followed by Eastern Coalfields (11.5 million tonnes) and Western Coalfields (11.3 million tonnes). The crude figures for output increase mask an expected deterioration in the average quality of the coal produced. The share of non-coking coal of grade II and below in total production will rise in Eastern Coalfields from 31% to 38%, in Central Coalfields from 38% to 51% and in Western Coalfields from 31% to 47%. In Bharat Coking Coal, on the other hand, the share of prime coking coal will rise. In India as a whole, however, the calorific value of the average tonne of coal will fall by 1982/83.

3.1.14 In percentage terms the annual rate of increase in output is to be no higher in the Sixth Plan than in the four years of the Fifth. The question of whether the target will be achieved and what measures in detail are to be taken will be discussed in full in subsequent sections. The following paragraphs introduce this discussion with some comments on investment outlays and on the state of planning for expansion in the industry.

3.1.15 Government policy, as explained to the Mission, is that the coal sector should have all the resources it can use efficiently to achieve the required level of output. Investment outlays in the Sixth Plan period are planned to amount to Rs1,655 crores in 1976/77 prices. It would appear from estimates given in the

Plan that this figure, while including investment in mines exploration, washeries, coal utilisation, training and infrastructure, excludes social welfare which has amounted in recent years to 10% of capital outlays.

3.1.16 As the gestation period for new mines is 5 to 7 years it would not be correct to draw firm conclusions from the relationship between capital expenditure and additional output during the Plan periods. The comparison of the crude ratios of capital investment to incremental output in the Fifth and Sixth Plan periods, however, seems to indicate that the level of investments planned for the Sixth Plan may be on the low side:

	Fifth Plan 1974/75 to 1977/78 (Actual)		Sixth Plan 1978/79 to 1982/83 ^b (Projected)	
	CIL	SCCL	CIL	SCCL ^c
Investment outlays M Rs	6600 ^a	747 ^a	15440 ^d	1110 ^d
Increase in output M tonnes	19	3.8	40	6
Investment per incremental tonne Rs	347 ^a	197 ^a	386 ^d	185 ^d

Notes: a Current prices; b Source: Draft Sixth Plan; c The Plan figure for investment in Singareni is much lower than the SCCL figure of Rs1710m; d Constant 1976/77 prices.

This impression is reinforced by impressions received by the Mission about the movement of investment costs per annual tonne at the individual mine level. As the opportunities for "marginal" projects needing only small investment outlays to achieve significant increases in output are exhausted capital costs are rising to as much as Rs150 per annual tonne in mine reconstruction projects, Rs200 in new underground mines and Rs150 in new open cast mines. Bharat Coking Coal, which produces high value coal, is spending even higher amounts in investment per tonne. These figures exclude infrastructure, welfare and other overhead costs. At the beginning of the Fifth Plan some "marginal" schemes were as cheap as Rs10 per annual tonne. The present very low proportion of output produced by mechanised means is due to rise considerably in the Sixth Plan period, entailing expenditure on plant and equipment amounting to an estimated 65-75% of total investment expenditure. Some colliery company managers state that they would like to raise the share of mechanised mining from 5-10% of output today to 25% by 1982/83 though this may be frustrated by delayed procurement or implementation problems.

3.1.17 The Mission found that investment planning for the Sixth Plan period in the Coal India companies was not yet complete. A 10-year plan (Project Black Diamond) drawn up in 1976/77 had assumed a much faster rate of growth of demand than now envisaged and its subsequent abandonment had caused some disruption to the planning process. In the last two years there has been a deliberate slowdown of the programme of equipment procurement although long-gestation mine development schemes have been exempted from expenditure cuts. As a consequence the equipment expenditure programme (65-75% of total expenditure) has had to be revised and a procurement plan covering the three years 1978/79 to 1980/81 had just been submitted by Coal India to the Department of Coal for approval at the time of the Mission's visit. Procurement action was in hand in advance of approval of this plan but its delayed consideration must be having some detrimental effect on the implementation of Sixth Plan activities. The management of Singareni had expenditure plans in some detail for the Sixth

Plan period and, in common with some other companies, a "shopping list" of equipment requirements. However they anticipated procurement and financing difficulties and were unable to plan with certainty. There also appeared to be some evidence of a backlog in the approval by the Central Government of new mine development schemes, perhaps due to a recent acceleration in the production of project reports by CMPDI which may previously have been a little slow in working up projects. Although the mining companies told the Mission they had plans for projects which would enable them to meet Plan targets, one company claimed that projects approved were sufficient only to produce 35% of the intended increase in output. It is possible for companies in this situation to take "advance action" and begin work on the project without formal approval. This practice is apparently quite common. However there is no guarantee with this procedure that there will be full funding of project costs. In some companies there may be some imprecision in management thinking about their Sixth Plan investment activities.

3.1.18 The mining companies have developed production plans which aim for an output of 158 million tonnes in 1982/83 - 9 million tonnes more than the Planning Commission's estimate of 149 million tonnes. Although the planned rate of growth of output is not outside the range of past achievement the Mission feels that, in view of the pause in the development effort occurring in 1976/77, the evidence of some unpreparedness in management for handling the Sixth Plan investments and the possible insufficient provision of finance, the chances of attaining the mining companies' output target for the Sixth Plan, or even the lower Planning Commission target, should be viewed with some caution. Much will depend on how far expenditure in the last two years of stagnant output has increased effective capacity beyond current production levels and on management ability to achieve productivity improvements in the coming years.

Table 8 Demand for Coal in Sixth and Seventh Plan Periods

	Million Tonnes						
	1976/77	1977/78	1978/79	1982/83	1987/88	Annual growth rates	
	actual	estimate	forecast	forecast	forecast	6 FYP	7 FYP
1. Steel (including foundries and metallurgical coke)	22.6	23.97	25.00	34.0	46.0	7.2%	6.2%
2. Power	28.9	29.80	33.80	54.0	84.0	12.6%	9.3%
3. Railways	13.10	13.20	13.10	11.8	10.3	-2.2%	-2.7%
4. Cement	4.90	5.10	5.25	7.2	10.0	7.2%	6.7%
5. Fertiliser	0.7	1.00	1.50	4.7	7.3	36.0%	9.2%
6. Soft Coke	4.30	4.00	4.55	6.5	9.0	10.2%	6.7%
7. Brick and other industries	22.60	23.39	22.55	27.8	35.4	3.5%	5.0%
8. Colliery consumption	3.4	3.3	3.35	3.5	3.5	1.2%	nil
9. Export	0.6	0.8	1.00	1.0	1.0	4.5%	nil
10. Total	99.7	104.66	111.90	150.5	206.5	7.5%	6.6%

Sources:

- 1976/77, 1977/78, 1978/79 Department of Coal
- 1982/83, 1987/88 Draft Sixth Five Year Plan and Planning Commission

3.2 Output in the Sixth Plan

3.2.1 This section describes the mining companies' plans before their processing by the Planning Commission, whose plans were considered in the preceding section.

3.2.2 The production plans designed to achieve the coal outputs required in the Sixth Plan retain many of the features of the production plans of the Fifth Plan. Indeed, it is in some senses an extension in time of the Fifth Plan, for total production expected by the mining companies at the end of the new plan is only about 11 million tonnes pa higher than that planned for the end of the old one (see Table 9). The small increase represents only one year's incremental increase in production. From a base of 78.2 million tonnes in 1973/74 the companies were planning to produce 146.7 million tonnes in 1978/79 - an increase of 88%. From a base of 102.4 million tonnes in 1977/78 the companies are planning to produce 158.1 million tonnes in 1982/83 - an increase of 54%.

3.2.3 The companies' coal production forecasts for the Sixth Plan are obviously much more realistic than those for the Fifth Plan. Not only do the new plans require a somewhat slower rate of expansion but they are much closer to the new estimates of demand. The latter in turn provide for lower increases than those of the previous Plan. The Fifth Plan estimated that demand would increase from 78 million to 135 million tonnes pa (73% in 5 years), whereas planned production at 147 million tonnes was 12 million tonnes pa higher still. The Sixth Plan estimates that demand will increase from 104.7 million to 150.5 million tonnes (44% in 5 years), whereas planned production at 158 million tonnes is only 7.5 million tonnes pa above the demand forecasts.

3.2.4 Table 10 shows that out of the annual additional output required during the Sixth Plan over 30 million tonnes, 55% of the total, is expected to come from opencast mining. This is a far higher proportion than that in the Fifth Plan where the comparable figures were 20 million tonnes, 38% of the total increase. The proportion of extra output expected from new mines (both opencast and underground) is 37 million annual tonnes, 67% of the total. The comparable Fifth Plan figures were 40 million tonnes, 58% of the total increase.

3.2.5 The new proportions do not necessarily indicate a change in strategy but rather a means of recouping the ground lost during the Fifth Plan. Table 11 shows a combination of the results achieved since 1973/74 and the Sixth Plan forecasts. Treated as a single plan, extending from the last year of the Fourth Plan (1973/74) to the last year of the Sixth Plan (1982/83), the increase from 78 million to 158 million tonnes pa in 9 years represents a doubling of output at a steady annual increase of 5.6%. Compared with the Fifth Plan, the expected output from existing opencast and from new underground mines is virtually unchanged and that from existing underground mines and new opencast mines has been increased in similar proportions.

3.2.6 The extra increases from existing mines and from new opencast mines, provided for in the Sixth Plan, are welcome and are, indeed, in accord with the 1974 Mission's view that more output from those two sources could have been accommodated. After marginal increases taking up spare capacity have been achieved, and these were largely responsible for the early increases in the Fifth Plan, increases from existing mines (by their reconstruction) and from new opencast mines are the cheapest ways of providing increased capacity.

3.2.7 In summary, the Sixth Plan for production is effectively the Fifth Plan extended to provide a further 5 million tonnes per annum from existing mines and a further 6 million tonnes per annum from new opencast mines.

3.2.8 The main sources for the increase in opencast output are Eastern Coalfields, Bharat Coking Coal and Singareni. These companies did not contribute any substantial amounts of opencast coal to the Fifth Plan, but their combined contribution to the increase by the end of the Sixth Plan of 12.6 million tonnes pa comprises nearly half the total increase from opencast mines and one quarter of total opencast production. Those same companies will continue to make the largest contribution towards the increased output from underground mines in the Sixth Plan, whilst the Central and Western Coalfields will continue to provide the bulk of opencast output. Of its total output of 38 million tonnes Central Coalfields will produce 25 million tonnes (66%) from opencast mines. Of its total output of 33 million tonnes Western Coalfields will produce 9 million tonnes (27%) from opencast mines.

3.2.9 The main techniques to be employed in increasing output are quite specific. In opencast mining, the extension of the use of walking draglines will enable higher outputs to be achieved from a single site but will also enable each site to be more productive in that greater overburden/coal ratios can be managed, so increasing the coal reserves amenable to opencast mining. In Coal India the utilisation of draglines will increase from the 12 currently in use, by a further 6 being currently assembled, and then by a further 5 to be ordered. Singareni is also intending to use a walking dragline in its first major essay into opencast mining.

3.2.10 The main contribution to the substantial increase in underground output derives from the introduction of longwall mining. Both Singareni and TISCO intend to adopt the method, but the greatest expansion in the use of the technique is that by Coal India. In the Sixth Plan it intends to increase output from that expected in 1978/79, 3.4 million tonnes, to a planned output in 1982/83 of 20.4 million tonnes. As Table 12 shows, current methods of longwall mining provide a fairly even spread of output between solid blasting, flight loading and shearing, although the lower levels of output from solid blasted faces means that there are more of that type of face than there are of the others. But at 5% of total underground output longwall mining is clearly not playing a very significant role at present. By 1982/83 however that percentage is expected to increase to 23% of all underground output with the contribution from mechanised loader faces rising from 3% to 18% of all underground output. A further increase in longwall mining to 32% of all underground output is expected by 1985/86, so that this is clearly the road along which Coal India intends to go. (But see also 3.3.2.4.) It is significant that virtually the whole of the increase in underground output is to come from longwall mining, with bord and pillar, India's traditional method of working, remaining virtually static at between 67.5 million and 70 million tonnes pa throughout the period up to 1985/86. However, there is one very important change expected in bord and pillar working. Mechanised loading is planned to increase from its present very low level of 4% of bord and pillar working to a level of 26% by 1982/83, and to a level of 36% by 1985/86. As a percentage of all underground mining, mechanised bord and pillar is expected to be 4% in 1978/79, 16% in 1982/83 and 18% in 1985/86, which means that it will be slipping further and further behind longwall mining.

3.2.11 Hand in hand with the adoption and extension of longwall mining goes the introduction of powered supports. Bharat Coking Coal is currently installing at Monidih Colliery in the Jharia Coalfield the first set of powered supports and intends to provide three more sets there within the Sixth Plan period. Additionally Eastern Coalfields intend to install a set, within the next three years, possibly at Seatalpur Colliery and Western Coalfields intend to install two sets within the next three years in locations which have not yet been decided. Singareni also intend to install a set of powered supports in the near future.

3.2.12 The case for and against movement into longwall mining was detailed in the 1974 Mission report and the economics of longwall working is again referred to below (4.2.1.9). Its inherent advantage of high output concentrated at one point brings other advantages which Indian mining engineers have been quick to realise. Costs between face and shaft can be drastically reduced as fewer districts need to be serviced, better supervision and management can be concentrated at one point, there is an improvement in working environment, including ventilation standards, and a marked improvement in safety standards. But there is a new higher technology to be mastered and this is extremely demanding. It was noticeable that none of the plans for movement into longwall mining showed sufficient appreciation of two fundamental issues - coal transport and face development.

3.2.13 There is a distinct difference between the work pattern at a coal face where intense activity fluctuates with periods when no coal is being produced and the work pattern at a shaft or drift where a steady activity rate by the cages in the shaft or by the conveyor in the drift is demanded. To ensure clearance of coal from the face it is necessary to have coal conveyors nearly matching the capability of the face machine to produce coal when it is working. This means that the capacity of the coal conveyors near the face is far higher than is needed to sustain a steady average output such as is required in the shaft or drift. To overcome this requires either a transport system throughout the mine having a higher capacity than is necessary, and this is extremely costly, or some form of bunkering, inserted between the high capacity face system and the lower capacity shaft/drift system. Neither of these alternatives is being catered for in current plans but must be given very careful consideration before longwall faces having outputs of up to 5,000 tonnes/day - and this is well within the capability of the equipment being installed in Indian mines - are designed and brought into production.

3.2.14 The replacement of retreat longwall faces demands a high level of development activity. Depending upon the output, time taken to install equipment and a number of other factors associated with the face, the rate of drivage for a single development machine can range from 5 to 10 times the speed at which the face to be replaced is travelling. A face producing 3,000 tonnes/day might well consume 10 yards of roadway per week in each of its two roadways, and its replacement must be developed leaving adequate time for preparation, drivage, withdrawal of drivage equipment, and installation of face equipment, main conveyors and bunkers. The machine developing the replacement face, in the circumstances quoted, might well have to drive 60-100 yards of roadway per week. Such rates exceed those normally achieved in Indian coal mines.

3.2.15 The techniques being adopted to produce the required increase in output are well tried. The problems for the Indian mining engineers are those involved in adopting the new styles of planning, operation and management required to ensure the speedy transition from the traditional bord and pillar working to the much more demanding, but much more productive, longwall method of mining.

Table 9 Comparison of Fifth and Sixth Coal Production Plans

Company	Coal Output (millions tonnes)			
	Actual 1973/74	5th Plan in 1978/79	6th Plan in 1982/83	Increase % 5th-6th
North Eastern	0.4	1.0	1.0	-
Eastern Coalfields	21.1	34.0	36.8	+ 8.2
Central Coalfields	15.5	34.8	38.1	+ 9.5
Western Coalfields	16.5	31.3	32.8	+ 4.7
Bharat Coalfields	16.3	29.1	28.4	- 2.4
Coal India	69.8	130.2	137.1	+ 5.3
Singareni	5.3	12.0	16.0	+33.3
TISCO & IISCO	3.1	4.5	5.0	+11.0
All India	78.2	146.7	158.1	7.8

Source: Department of Coal

Table 10 Production Plan 1977/78 to 1982/83 (Sixth Plan)

	Annual Production (millions tonnes)		
	Deep Mines	Opencast	Total
Actual 1977/78	84.7	17.7	102.4
Increase from existing mines	15.2	3.5	18.7
Increase from new mines	10.1	26.9	37.0
Planned 1982/83	110.0	48.1	158.1

35% underground CIL
66 " " TISCO
85 " " SCL

Source: Department of Coal; Coal India Operational Statistics.

Note: Complete data for this table were not available to the Mission; some figures are therefore estimates by the Mission.

Table 11 Production (Actual and Planned) 1973/74 to 1982/83

	Annual Production (millions tonnes)		
	Deep Mines	Opencast	Total
Actual 1973/74	62	16	78
Increase from existing mines	28	5	33
Increase from new mines	20	27	47
Planned 1982/83	110	48	158

Table 12 Planned Progress of Longwall Mining in Coal India

Method of Working	1978/79			1982/83			1985/86		
	Output	% L/W	% U/G	Output	% L/W	% U/G	Output	% L/W	% U/G
L/W Solid Blasting Faces	.9	26.5	1.2	4.8	23.5	5.4	6.7	20.9	6.6
L/W Flight Loader Faces	1.4	41.2	1.9	7.9	38.7	9.0	9.3	29.1	9.1
L/W Shearer Faces	1.1	32.3	1.5	7.7	37.8	8.8	16.0	50.0	15.8
Total Longwall	3.4	100	4.6	20.4	100	23.2	32.0	100	31.5
Total Bord & Pillar	69.9	-	95.4	67.6	-	78.8	69.5	-	68.5
Total Underground	73.3	100	100	88.0	100	100	101.5	100	100

3.3 Inputs to the Sixth Plan

3.3.1 Capital Investment, the key input to the Plan, has already been identified as an area which is being subjected to a great deal of revision. In broad terms it appears that Rs1,655 crores are to be invested in the industry and that Rs1,376 crores will be invested directly in mines. Rs375 crores will be needed for continuing schemes and existing mines, Rs276 crores for projects already approved and a further Rs725 crores for new projects still at the proposal or formative stage. The balance of the Rs1,655 crores will be spent on washeries (Rs114 crores) and on coal utilisation projects, infrastructure, exploration and other activities (Rs165 crores). Of the investment in mines of Rs1,376 crores, 65-75% will be for plant and equipment.

3.3.2 Equipment requirements, which represent such a large proportion of the total investment, are being re-evaluated. At the time of the Mission's visit the costings had not been completed so that it is impossible to say how closely the new values agree with the original estimates which went to make up the total sum referred to above.

3.3.2.1 As in the Fifth Plan "advance action" is being taken to purchase equipment which will permit an important feature of the plan, further output from existing mines, to be achieved as quickly as possible. The advance action taken so far by Coal India has been to list the equipment required for underground and opencast expansion. Although uncosted, the lists seen by the Mission have been developed in great detail. They have taken into account what equipment is required for production from existing mines, for approved projects, for projects yet to be approved and of course replacement equipment. It has been made clear that the list of requirements for the next 3 years excludes items already ordered, being manufactured or in stock. Although, because of these exclusions, the list does not give a complete picture of all the equipment that is required to achieve the Sixth Plan outputs, in fact the inevitable lag in delivery will make the list fairly representative of total requirements.

3.3.2.2 The major items of opencast equipment, walking draglines, have an increasingly long delivery date and it is estimated that order, manufacture, delivery and erection is now taking as long as 4 to 5 years. In the programme are listed 4 draglines of 15 cubic metres capacity, 2 for Eastern Coalfields in 1979/80 and 2 for Central Coalfields in 1980/81. Another dragline of 10 cubic metres capacity is listed for Central Coalfields in 1978/79. It would appear that none of this equipment could be delivered in time. On the other hand, delays in deliveries during the Fifth Plan have created a situation where 6 draglines are currently under erection and all should be operational within the next twelve months. Whilst walking draglines are an important feature of many of the bigger and deeper opencast sites many more of the smaller mines continue to produce coal using the more traditional shovels, loaders and dumpers, with the overburden being broken by drilling and blasting. This equipment will still predominate for many years to come and the Coal India list makes adequate provision for its supply. With much shorter delivery times, and because the bulk of this equipment can be manufactured in India, it could be available to recoup some of the shortfall in output resulting from the inevitable delayed delivery of the walking draglines. The Coal India list is summarised in Table 13.

3.3.2.3 The other companies' plans for expansion of opencast mining are relatively modest, as are therefore their equipment demands. Singareni expected shortly to place an order for a single dragline to develop an opencast mine at Ramagundam. The extended delivery times could inhibit its application by the end of the Sixth Plan when it is expected to produce 2.4 million tonnes per annum.

TISCO has plans to expand its output from its opencast mine at West Bokaro from 1 to 1.8 million tonnes but again the modest scale makes no great demands on imported equipment.

3.3.2.4 The Coal India list of underground equipment reflects the philosophy of extending the technique of longwall working. The abstracts from the list, recompiled as Table 13, show the face equipment required to achieve the increase in output from longwall faces, and the stage loaders and conveyors required to transport the coal from the face. Also included are coal cutters which, although basic to longwall working, are more likely to have been listed for use in bord and pillar working. Attention was drawn in 3.2.13 and 3.2.14 to the need for high capacity conveying systems and high speed development equipment. It appeared that with only 16 conveyors of capacity 450/500 tonnes per hour and only 23 road headers in the list of equipment, the 55 flight loader and shearer faces expected to be working by 1982/83 will be neither adequately served by good transport systems nor replaced in time to ensure continuity of output from the next face in sequence. It could be, of course, that high outputs are not expected from the new generation of longwall faces and that both the outby transport capacity and the face development equipment do match the face performance. If this is so, then the whole philosophy of movement into longwall working, as opposed to remaining in bord and pillar working, is brought into question. It is doubtful if high cost longwall working can ever compete on cost grounds with bord and pillar working unless the output from the former is appreciably in excess of current norms so as to counteract the highly manpower intensive but low cost system which the latter represents.

3.3.2.5 Whilst provision of spares remains a problem in India, this Mission was less conscious than the 1974 Mission of its being an inhibiting factor. During the Fifth Plan expansion of output was mainly attributable to the extension of methods in which there is both an indigenous capability and capacity, and for which a fairly effective spares service has been developed. The policy for the Sixth Plan is to try to manufacture in India itself more of the equipment being currently imported. Only then can the manufacture of spares be expanded. Until that time there will still be a heavy reliance on a programme of imported spares matching up with imported equipment. Unfortunately, the Mission was unable to identify specific problem areas since the equipment lists dealt in whole items of equipment and not in spares for them. The development of quality control by the mining companies would merit consideration. A common complaint was that some indigenously manufactured spares were made of inferior materials which at the end of the day exacerbated rather than solved the problem.

3.3.2.6 Repairs of equipment, and the manufacturing of certain items of spares are increasingly being undertaken by the mining companies. The establishment of unit, area and regional workshops has proceeded apace in each of the companies of Coal India. Singareni will also be developing and expanding workshops facilities during the course of the Sixth Plan.

3.3.3 Other Supplies are of equal importance to equipment and in many areas it was clear that provision made in the Fifth Plan was considered adequate to take care of the requirements of the Sixth Plan. In others it was clear that mining plans had been changed to accommodate what was recognised as an insuperable shortage.

3.3.3.1 A lack of the supply of sand featured as a major constraint in the Fifth Plan. In the Sixth Plan, the increase in opencast mining from the Jharia and Raniganj fields, and the consequent decrease in output from underground sources, offsets to some extent the effect of these shortages, since these were the coalfields most seriously affected by the need to solid stow underground workings. Research is also being undertaken to find suitable alternatives to sand for underground

stowing, but the greatest impact is likely to be made by adopting methods of working underground which do not require that the void should be stowed. Where subsidence is not a factor the retreat system of longwall mining can be safely worked without recourse to stowing. The roof is permitted to fall behind the face (ie the goaf is "caved") and although the roadways may be destroyed behind the face, they are no longer needed. By a combination of these factors, the provision of sand is unlikely to be the major constraint that it was in the Fifth Plan.

3.3.3.2 Explosives are as important an input to the Sixth Plan as they were to the Fifth. Unfortunately at its onset, the Sixth Plan has experienced a shortage and both Coal India and Singareni have had to seek emergency supplies from outside India. It was known that problems could arise by the end of the Fifth Plan because of shortage of manufacturing capacity. The lower levels of output would have sufficed to meet the lower demand arising from the depressed coal production levels but for a serious strike in the main supplier's factory during 1977. The sharp increase in consumption of explosives, arising from the extension of solid blasting, will soon be reaching its peak. The commissioning of the long delayed new explosives factory at Bhandara should give the extra output to guard against the possibility of shortages. Much will depend upon the success of mechanised longwall working. If the 7.7 million tonnes expected from shearer faces is not achieved, then more explosives will be required with consequent pressure on the suppliers, possibly beyond their ability to meet the extra requirements.

3.3.3.3 Steel was thought to be a constraint at the time the Fifth Plan was being prepared but the stated determination of the Government of India to ensure that the mining industry received priority for its supply appears to have carried over into the Sixth Plan.

3.3.3.4 Power supply failure was frequently referred to at the time of the last Mission's visit, and although now less often mentioned this clearly remains a problem for the moment. However, the wish expressed by many of the companies in 1974 to have their own independent power generation facilities is heard less often now.

3.3.3.5 Railway wagon supplies was another constraining factor at the time of the last Mission's visit. However the expansion of the railways kept pace with that of the mining industry during the Fifth Plan: an average 7,398 wagons a day were loaded during 1973/74 rising to 9,447 during 1976/77. The railways express confidence that they will be able to meet the demand for loading of 13,000 wagons in 1982/83. The position has been helped by the mining companies' own efforts to improve turn-round at collieries by rationalising loading arrangements, encouraging bulk loading at fewer points and replacing manual by mechanical loading. These improvements will be continued into the Sixth Plan. By 1982/83 the railways expect to have to transport 40 million tonnes pa more coal than at present. This is rather less than the increase in coal output because an increased proportion of coal will be consumed at pit-head power stations. Line capacity, it is known, will need increasing to meet the needs of consumers in the Northern and Western regions; however, going east from the coal fields to Calcutta and Haldia the Railway Ministry feels that there is sufficient line capacity. The planning of investments in railway line capacity is being inhibited, according to the Railway Ministry, because Coal India has not yet reported the geographical pattern of despatches of coal expected at the end of the Sixth Plan period. There seems some risk that, despite the railways' efforts to keep pace with the mining

industry's demands, wagon supply, particularly in the congested areas of Bihar and West Bengal, may remain erratic. The Mission learned that wagon supplies to the mines had been adversely affected since the end of 1977 by the Andhra Pradesh cyclone and the pressing need to transport large amounts of domestically procured grain and imported fertiliser.

3.3.3.6 Coal India is now examining ways of effecting future colliery power station transport linkages so as to reduce their cost and ensure continuity of coal supplies. In all but the most exceptional cases, modern power stations require supplies from a number of collieries. Even if those collieries closest to a power station can be linked by conveyor systems, it is inevitable that large quantities of coal from other supplying collieries must travel by rail transport. For those, the majority of cases, Coal India is contemplating using merry-go-round (MGR) systems, so called because the locomotive and its rake of wagons are not separated but run continuously between colliery and power station, with only one rake of wagons needed to effect the linkage. The normal alternative to MGR systems is for a locomotive to deliver an empty rake of wagons to a colliery and leave with a recently filled rake of full wagons. If the link is direct between power station and colliery and a similar arrangement obtains at the power station, ie a full rake is delivered and a different empty rake is taken away, then up to three rakes of wagons are required to keep the system operational.

3.3.3.7 Introduction of the MGR system would reduce the total demand for wagons and speed up coal deliveries. It does require high-speed loading equipment at the colliery and high-speed unloading equipment at the power station, both of which are expensive to install. It also requires careful co-ordination if there is more than one supplying colliery. Where distances are relatively short, say up to ten miles from the most distant colliery, the alternative of a belt conveyor system might well be examined. The ideal project for the introduction of an MGR system would be a purpose-linked new colliery and new power station, some distance apart, with each designed from the outset to handle MGR wagons. In such a case the full benefits of the system could materialise.

3.3.3.8 Much of the optimism regarding inputs other than equipment arises from the ability of the companies concerned in supplying these inputs to meet the demands of the Fifth Plan. But it must not be forgotten that the Fifth Plan target of 147 million tonnes of coal by 1978/79 was not met by a considerable margin. What supplies would have been like had this target been met is a matter for conjecture. The Mission feels that if the plans being laid to meet the Sixth Plan output objectives are followed, then there will be considerable difficulty in ensuring that all the required inputs, outside the control of the mining industry, will be available.

3.3.4 Manpower which currently is about 590,000 in Coal India and 55,000 in Singareni, is unlikely to be a problem during the period of the plan.

3.3.4.1 Recruitment is not difficult since mining offers far better job opportunities than those normally available to the agricultural worker, the main source of supply for Indian mines. Coal India, which has considerably reduced the labour force during the Fifth Plan by mergers and increased mechanisation, will continue to do this during the Sixth Plan. However, the new mines will require manning so that the net effect will be to increase total manpower. It is estimated that Coal India will require almost 100,000 men more to raise its current output level of 90 million tonnes to 137 million tonnes while Singareni will require 30,000 to raise output from 9 million tonnes to 16 million tonnes. Should these prognostications materialise, Coal India will be improving output per man-year from 152 tonnes to 196 tonnes and Singareni will be improving from 164 tonnes per man-year to 188 tonnes per man-year during the Plan period.

3.3.4.2 Training could be a factor influencing the plans of the mining companies to a far higher degree than in past years. In an industry largely confined to manual methods little more than rudimentary vocational training was required. With the advent of mechanisation, a more thorough grounding is needed. The mining companies are well aware of this and will be putting into effect, during the Sixth Plan, the recommendations of the Committee on Training and Executive Development of Technical Personnel. A Training Board has been established charged with organising Training Institutes in each company to cover vocational training for new recruits, mining training for supervisors, training to upgrade skills, and management training for junior and middle management. Other specialised training institutes will cover equipment, washery technology, longwall mechanisation, advanced supervision and most essential of all, training for trainers. Of particular importance is the training in longwall mining in which the National Coal Board of the United Kingdom and Messrs Dowty, the British mining equipment manufacturers, have been prominent. The Mission believes that during the course of the Sixth Plan the United Kingdom could play a significant part in the training programmes designed to ease the familiarisation of the Indian mining industry with longwall techniques, and with its own well-established training programmes the National Coal Board could do much to help in the training of the future trainers.

3.3.4.3 The problems must not be minimised. Provision of training facilities, and ample supplies of recruits to use them, will not necessarily produce trained technicians. The Indian mining industry is taking a huge leap from pick and shovel to a sophisticated technology. It follows that a third element - careful selection of trainers and those to be trained - will be essential to the success of the massive training programme in years to come.

3.3.5 Management of the mining industry lies mainly in the hands of mining engineers, but there are of course a large number of management posts which need to be filled by other disciplines.

3.3.5.1 The recruitment of mining engineers is mainly via the established universities, mining schools, and technical colleges. Not untypical of these institutes is the Indian School of Mines (ISM) at Dhanbad where the Mission repeated the visit of its 1974 predecessor. It found that the plans for increasing mining engineering graduates were largely unchanged. The Fifth Plan provided for an increase in entrants for the whole country from 160 to 260 a year, 80 of whom were to be taken by the ISM; the higher figures will remain for the Sixth Plan. Bearing in mind the relatively small change between the two Plans this should not be surprising. What struck the Mission was how much better equipped to face this task the ISM is now compared with 1974. Buildings to the value of £1 million, with £750,000 of equipment, are under construction and the same amounts are to be spent to complete the expansion programme. There are now 14 post-graduate courses available, but most are under-subscribed, because of the fear of lost job opportunities after graduation or upon return to the ISM after having started a mining career. It would appear that the plan to maintain the level of graduates during the Sixth Plan is adequate to meet the needs of the mining industry.

3.3.5.2 The training of managers to equip them for the specialised work of the mining industry and to face future change is rightly the affair of the mining industry itself and not of the universities. In the past, scant attention has been paid to this need, but in future the training institutes will be used for the training of management, as well as of men, in the new mining technology. Staff colleges at Ranchi and Calcutta will cater for administrative training and for training in general management of the more senior staff.

3.3.6 Research and Development, fundamental to any industry in the process of extending its technological limits, are of even greater importance to the Indian mining industry into which so many new techniques are to be introduced. Research now being undertaken is unlikely to be of value during the Sixth Plan, but applied research and development - particularly of the type undertaken at the main research centres - could make its impact during the next five years. In India research and development in the mining industry tends to be fragmented. There is an obvious case for the separation of research into fuel utilisation on the one hand, and research into mining technology on the other, and this is done in so far as Central Fuel Research Institute (CFRI) is under a different management and under a different Ministry from the Central Mining Research Station (CMRS). But the Central Mine Planning and Design Institute (CMPDI) (running its own Research and Development Organisation) is working in the same field as the CMRS. (So will be the research team intended to be set up by the major mining machinery manufacturer.)

3.3.6.1 The CFRI is working in the energy field and researches into oil and gas as well as into coal utilisation. Its role is discussed in section 4.8 below.

3.3.6.2 The CMRS commits 70% of its resources to the coal mining industry. It acts as a testing station and nearly 20% of its income comes from that part of its work. The efficiency of the Station as a profit centre has greatly increased from 1970, when its project earnings were Rs0.5 million and its recurrent costs Rs3.0 million, to 1977 when project earnings were Rs5.4 million and recurrent costs Rs6.2 million. Much of the increase stems from the time of nationalisation, after which much more work was directed the way of the Station. The mining research on its own behalf tends to be fundamental research, but the Station also undertakes applied research sent its way by the CMPDI pending completion of the latter's own laboratories. The work of the Station is not geared directly to the requirements of the Sixth Plan except that its clients require work to be done which is so related. A quarter of the staff of the Station is working on long-term projects.

3.3.6.3 The Research and Development Wing of the CMPDI has been developed to pursue lines of applied research. It is an interesting development to link long-term planning with research and because of this it must be possible for the Institute to apply itself directly to problems related to the Sixth, and because research has long-term objectives, Seventh and subsequent Plans. The bulk of the work now being done is focussed on lines of applied research. More often than not these involve investigations into methods of working common to other countries, but not easily transferable to Indian mining conditions; safety and safety equipment; environmental problems; strata control; minimisation of production costs; and finally, and somewhat surprisingly, utilisation of coal and coal products. The last of these appears to duplicate the work being done by the CFRI.

3.3.6.4 The CMPDI's work at Ranchi is being pursued with vigour and enthusiasm but much appeared to be directed at problems which have been solved in other parts of the world. It is appreciated how absolutely essential it is to ensure that research done elsewhere is applicable to India, but this carries with it some risk of unnecessary duplication and, more importantly, the wasteful use of scarce technical resources. There also appears to be some risk of duplication within India itself of research work at a variety of companies and institutions. Although not yet established, the Mining and Allied Machinery Corporation intends to set up a research and development wing for investigations into new mining equipment suitable for Indian conditions, a subject which will

naturally develop from the work at Ranchi. The best mining machinery has been developed through the mining engineer's knowledge of the conditions under which equipment works rather than from the mechanical engineer's knowledge of how equipment works.

3.3.6.5 The last Mission commented on the need for co-ordinated effort in the research and development field. Since that visit tremendous strides have been made in extending the variety of research undertaken, making co-ordination even more difficult. It appeared to the Mission that if more specific terms of reference were given to each research institute, the risk of unnecessary duplication would be eliminated. If, for example, the CMRS concentrated on research into the environment and mine safety this would relate well to its other function of testing materials and equipment to rigid safety standards. If the CMPDI concentrated on methods of mining, strata behaviour and subjects associated with the getting of coal, including the design of equipment for that purpose, that would relate well to the Institute's long-term planning function. If the Mining and Allied Machinery Corporation were there to support the development work of both Institutes, a function admirably undertaken by mining machinery manufacturers in the UK in relation to the National Coal Board's research establishments, it too would be performing the role for which it will be best equipped. Rationalisation of research effort in the way described would have little or no impact on the Sixth Plan but would surely pay dividends in later Five Year Plans.

3.3.7 Exploration is clearly an essential requirement for the mining industry. Without adequate strategic and tactical drilling the industry could not develop. The work is carried out by a number of agencies including the Geological Survey of India, the Mineral Exploration Corporation, State Governments, the CMPDI and the mining companies.

3.3.7.1 The Geological Survey of India undertake regional drilling associated with their general role of assessing the country's mineral wealth but, when they have spare capacity available, are willing to engage in tactical drilling on behalf of, and under the direction of, the CMPDI.

3.3.7.2 The CMPDI is the prime mover in developing new capacity on behalf of Coal India, a task taken over from the now defunct National Coal Development Corporation. In that capacity, it is clearly heavily involved in every one of the exploration programmes, each of which is a necessary precursor to any new mining project. The Institute has its own drilling capacity but can call upon any of the agencies offering similar facilities. In the last four years the work supervised and directed by the CMPDI comprises:

<u>Year</u>	<u>Length Drilled</u> (metres)	<u>No of Drills</u>	<u>Metres/Drill/Year</u>
1974/75	62,659	61	1027
1975/76	106,370	102	1039
1976/77	159,155	139	1145
1977/78 (to Dec)	135,154	154	1169

The average annual capacity of drills is steadily increasing, but is unlikely to rise by very much more until newer techniques of down-hole logging, and other methods which can reduce the time absorbing need to core through coal seams, are more widely adopted. Of the total of 152 drill rigs deployed in 1977/78, the

CMPDI operated 51. The total amount of drilling required during the Sixth Plan amounts to 900,000 metres, or 180,000 metres/year. With the same number of drills deployed as in 1977/78, and with the same average annual length drilled per machine, the target is achievable and there is therefore no reason to doubt that the requirement will be met.

3.3.7.3 Besides Coal India the other mining companies are also involved in drilling before developing new projects. They too have their own drilling capacity but call upon the services of other agencies when that is required. There are a further 56 drills available between the other companies, which is proportionate to their share of the output expansion and to their share of the exploration programme. There is no reason to doubt that the capacity is adequate to fill their requirements during the Sixth Plan.

3.3.8 Planning, as is clear from the previous paragraphs, is the responsibility of the CMPDI at Ranchi and its four Regional Institutes at Asansol, Dhanbad, Ranchi and Nagpur.

3.3.8.1 Each of the Regional Institutes works directly with the Coal India company in the area in which it is situated. Each operates in an identical way following the pattern laid down by the Central Institute. The detailed planning is done in the Regional Institutes but obviously under the control of the Central Institute which directs resources, lays down policy, specifies standards and supplies specialist services as required.

3.3.8.2 The CMPDI's main function is to develop the perspective plans for Coal India, taking into account market demands, and the resources available to fulfil the plans. Arising from that function, and its work on exploration, project preparation then becomes a major part of its activities. In this respect the Institute is well experienced and extremely competent, having built on the work of its predecessor the National Coal Development Corporation which, founded in 1956, was involved in the development of all new mines since that date, apart from those developed by Singareni. The CMPDI would be perfectly competent to carry out the task assigned to it, were not the backlog of projects so great and the time-span for their anticipated completion so short. While doubts have been noted above about the likely availability of some of the inputs to the Sixth Plan in the quantities required at the time they are required, the production plans appear to assume that all inputs will be available as they are required.

3.3.8.3 Singareni Collieries is the only large mining company which carries out its own planning. In some respects the planning task is simplified by the adoption of a "standard" type of drift mine, in the construction of which the company has developed a great deal of expertise over the years. Planning, provisioning and operations are all simplified by this method of approach. It has one basic disadvantage in that the small units cannot so easily improve their productivity since the scope for increasing capacity of individual mines is clearly limited. In the four years of the curtailed Fifth Plan the company was able to come close to its revised programme and was able to increase output from 5.5 million to 9 million tonnes pa. This increase of 1 million tonnes pa will need to rise by a further 0.4 million tonnes pa if the Sixth Plan target is to be achieved. To increase output by 1.4 million tonnes pa, particularly when a high proportion of it is to be met from opencast mining for which the availability of equipment is suspect, is perhaps too ambitious.

3.3.8.4 In conclusion, the Mission found that plans exist sufficient to meet Sixth Plan targets, but feels that factors both within and outside the control of the management of the coal industry will conspire to prevent their full achievement. Of these factors it feels that those which are external to the industry are probably more deep-seated than those which are internal to it.

Table 13 Coal India: 3-Year List of Major Items of Mining Equipment

Surface Mining Equipment	1978/79	1979/80	1980/81	Total
Draglines	1	2	2	5
Shovels	23	29	31	83
Loaders	8	10	8	26
Scrapers	28	18	16	62
Dumpers	137	175	219	531
Dozers and Graders	59	83	76	218
Drills	27	34	26	87
Cranes	9	12	4	25

TABLE

Underground Mining Equipment	1978/79	1979/80	1980/81	Total
Coal Cutters	78	102	118	298
Flight Loaders	8	11	17	36
Shearers	4	2	8	14
Powered Support Faces	1	3	1	5
Friction Props 40 t.	4,400	4,900	4,100	13,400
Hydraulic Props 40 t.	10,825	9,600	19,800	40,225
Friction & Hydraulic 20 t.	2,400	4,000	4,000	10,400
Link Bars	14,400	14,200	23,150	51,750
AFCS 450/500 TPH	6	2	8	16
AFCS 150/200 TPH	20	28	38	86
Stage Loaders 300 TPH	6	2	8	10
Stage Loader 150 TPH	20	30	39	89
Trunk/Gate Conveyors	72	79	94	245

Source: Coal India

4. COMMENT AND REVIEW

4.1 Organisation and Management

4.1.1 The years after nationalisation were a time of organisational change in the Coal India companies. The technical and managerial skills present in the nationalised private companies may sometimes have been passed over in favour of public sector managers from the erstwhile National Coal Development Corporation. Initially also, there was probably excessive centralisation which gave individual colliery managers too little power and initiative. The Mission was however glad to note that communications between senior company management and colliery managers are now being systematised and strengthened.

4.1.2 The most fruitful context in which this is happening is the system of cost control which is being set up in the Coal India companies. Production plans and costs are discussed in detail with each colliery manager. Annual budgets are drawn up with monthly subdivisions. These are based on standard costs derived from past performance adjusted for productivity improvements. They cover all aspects of the costs of production including labour, productivity, machine utilisation, stores, stocks and demurrage charges on rail wagons. The budgets are recorded on standard proformas and, at monthly reviews, actual performance is compared with budgeted performance according to "flexible budget" procedures. The Mission found these developments very encouraging. They will help to make management at the colliery level more purposive and will contribute to controlling costs during a period in which other factors will tend to increase the real costs of production.

4.1.3 In investment planning, too, consultation between company management and colliery management has improved as the development possibilities of each colliery have been systematically assessed. For small investments colliery managers have the initiative. For larger schemes, however, it is the central management of the companies, assisted by the CMPDI, which takes the initiative of proposing projects to be undertaken to meet output targets. The Mission was assured that, once identified, projects were fully discussed with local management before assuming the shape in which they would be submitted for board approval. The importance is evident of fully involving line management in the planning of projects which it will later have to implement and control.

4.1.4 It was in the area of project control that the Mission detected some weakness. Senior management is well aware of the information services available and understands the use and value of action programmes and such project control techniques as network analysis, but simply to install the systems without ensuring that they are effectively utilised is of little value. At one major project, key networks were twelve months old and had never been revised to take account of shortcomings in performance which could never be recouped, and it appeared that line management paid little regard to these systems.

4.1.5 Senior management may face a dilemma during this period of the industry's development. With the restructuring of Coal India and a major construction programme in progress, the planning organisations and the company headquarters must have creamed off a great deal of the available talent, inevitably weakening line management. An acute shortage of high quality operators might well result from this policy; if so this would present serious problems. If as a result of lowering the numbers and standards of the "doers", at a time when more of even better quality will be required, the plans cannot be met, then the planners and top supporting staff at company level will not have been effectively utilised. Fortunately, the new training institutes should go some way to strengthening line management's capability, but numbers could be a problem during the Sixth Plan period.

4.1.6 Coal India's employment policy has been to restrict recruitment to skilled apprentices, to hold down or reduce the size of the work force, to reduce the incidence of absenteeism, which is still high in the summer months, and to eliminate casual labour. The latter objective has been achieved with the exception of workers employed on the surface for the manual loading of railway wagons. Coal India's policy now is to introduce a measured day work system with incentive bonuses for productivity, but progress in introducing a uniform system has so far been limited. In view of the size and diversity of India it may not be necessary to have the same system in each area of each company. Individual area managers may be the best judges of the form of incentive scheme best suited to achieving its productivity targets. As for the objective of restraining the growth of the labour force, Coal India are hoping for a continuing rise in productivity at 5% pa to reach an OMS of 0.86 tonnes in 1982/83, which would imply, if achieved, an increase in the labour force from 590,000 to 680,000 by the end of the Sixth Plan. As progress in opencast mining is expected to be considerable, one may be fairly optimistic that this sort of productivity increase can be achieved.

4.1.7 The Mission felt some disquiet, in discussing their expansion plans with company managements, about their state of preapredness for the investment programmes which they are to undertake in the Sixth Plan. All companies have a general philosophy for the technical development of their mines - though some are considerably more optimistic about the speed with which mechanised mining projects can be introduced than others - and in general they are clear which developments they intend to introduce in which mines at what time. There is however a lack of confidence in their ability to proceed as they desire, either because projects have not been approved or because procurement difficulties are expected. It is symptomatic of this that plans for investment are usually not fully itemised and prospective annual outlays are subject to variation. There is similar uncertainty about the progression of other costs of production. This might in fact be a reflection on the system which makes the companies responsible for meeting output targets while making the CMPDI and its regional institutes associated with the companies responsible for preparing and implementing the plans needed to achieve the targets. In part also it may be due to the way in which sanction for expenditure is given on a project-by-project basis rather than on a rolling programme basis, thus leaving company managements at all times with a measure of uncertainty about what they will and will not be allowed to do. The fulfilment of the physical investment targets of the Sixth Plan requires confidence about the means as well as knowledge of the ends on the part of all involved.

4.1.8 Finally, the Mission noted that company managements paid relatively little attention to financial targets. One company mentioned the objective of achieving a 10% return on capital employed but it was clear that all companies regarded this as quite out of reach so long as average sales prices are less than production costs. However, there are certain aspects of allocative efficiency in management decisions which cannot adequately be monitored by production budgets and targets for average productivity. The Mission considers that it would be useful if company-wide financial targets could be devised to measure their overall performance. These could be based on notional output prices if actual sales prices were thought inappropriate.

4.2 Economic Issues

4.2.1 Employment, wage rates and the choice of mine technology

4.2.1.1 Indian mining is labour-intensive. Wages and salaries accounted for 73% of the financial costs of production in Coal India in 1973/74 (though today this has declined to around 60%) and in Singareni Collieries wages and salaries account

for 55-57% of production costs. The industry employs about 645,000 men and women (590,000 in Coal India and 55,000 in Singareni), of which nearly 90% are permanent mineworkers, a little over 1% are company officials, and the remainder casual labourers engaged for the most part in coal loading on the surface.

4.2.1.2 In the Bengal/Bihar coalfield of Eastern India the coal mining communities are already more than a generation old. Miners' families originally came, in many cases, from North Bihar or Uttar Pradesh and settled in the coalfields when the mines were opened. A recent survey by the personnel department of Bharat Coking Coal is reported as showing that 50% of the workers in that company's mines were from the Scheduled castes. 38% of all workers remit money to their villages. In other coalfields miners are recruited locally from the predominantly rural labour force. The policy of Coal India is to restrict the size of its payroll and to concentrate on improving the productivity of its existing workforce. In Singareni Collieries the rapid growth of coal output has been achieved both by increasing the workforce and by productivity increases. The pattern of the past has been to recruit able-bodied but unskilled labour, to provide limited formal training (3-6 weeks) and then to rely on experience to improve miners' skills. The present labour force in the mines has for the most part learned its trade in this way. With mechanisation, however, the coal companies are having to recruit labour with formal crafts training and to devote resources to the retraining of their existing employees.

4.2.1.3 Although still mostly lacking in formal training mine workers earn a wage which is similar to the wages of skilled workers in other industries. Following nationalisation the coal companies entered into a national wage agreement with the miners. As a consequence, a relatively inexperienced miner can expect a monthly wage of a minimum of Rs450 or about Rs18 per day worked, and incentives and bonuses can increase the take-home pay of the more experienced miner to around Rs25 or more per day. Even casual labourers may earn Rs16-17 per day. The average wage and salary cost to the coal companies per employee is somewhat higher than this at Rs30-32 because of housing, provident fund and other welfare benefits, which are provided to miners and their families as a matter of policy since nationalisation.

4.2.1.4 The daily wages of agricultural or other unskilled workers outside mining in the mining areas are very much lower than those of miners at Rs4-5 per day. This may be taken as a rough indication of the opportunity cost of mine labour though during times of year of intensive agricultural activity absenteeism in the mines increases, suggesting a higher opportunity cost at these times. The Planning Commission advised the Mission that miners should largely be considered as coming from the ranks of the employed rural labour force rather than from the unemployed and that the value of output forgone could be reckoned at Rs3 per man-day.

4.2.1.5 The wide gap between the apparent opportunity cost of mine labour and its average wage cost suggests that the relative costs of different techniques of mining should alter considerably according to whether labour is valued at its cost to the colliery companies or at its shadow wage. The ratio of the opportunity cost of mine labour to the starting wage of the inexperienced miner is as low as 1: 5; the Planning Commission however advised the Mission that the shadow wage at domestic prices should be approximately 50% when account is taken of the premium on savings.

4.2.1.6 It is hard to generalise about the choice of techniques in the coal industry because of the variety of geological conditions found in different mines. The Mission however observed that techniques ranging from the entirely manual to the highly mechanised were employed or being introduced in underground mining, open cast mining and in coal handling on the surface.

4.2.1.7 In coal handling and wagon loading on the surface the costs of mechanical systems per tonne of coal handled decline sharply as the capacity of systems increases. Mechanical handling is less wasteful of coal and more reliable than manual loading and, because quicker, confers some saving in demurrage payments to the railways in respect of coal wagons. However, if decisions are taken on the basis of the shadow cost of manual labour the threshold above which mechanical loading will be considered economically viable will be higher than when the cost comparison is done on the basis of actual wage costs.

4.2.1.8 The large new opencast mines in India are designed for fully mechanised extraction methods. Smaller workings may only be partially mechanised eg with mechanical removal of the overburden and the manual winning and loading of coal into lorries. If decisions are taken on the basis of the shadow cost of labour the scale of operations at which full mechanisation becomes economically attractive would probably rise.

4.2.1.9 For underground mining the Mission benefitted from an illustrative analysis by the CMPDI, based on costs associated with average conditions, of the relative district costs of mining with different techniques. At present with a preponderance of conventional bord and pillar mining with manual loading some 80% of the work force works underground with half the underground workers at the face. At the new mine at Monidih designed for longwall working there is a lower proportion of workers underground (60%) and a lower proportion of these (40%) at the face. Table 14 shows how labour costs may vary from 90% of the district costs per tonne to as little as 10% according to the technique of mining used. The Mission learned that in some mines labour costs were so high that they exceeded the sale price of the coal. The figures in Table 14 show that, in financial prices, longwall working with shearers operating at average productivity levels is likely to be significantly cheaper than bord and pillar working whether fully manual or partially mechanised. However, when labour is costed at a shadow wage of 50% of its market price the advantage of longwall working as demonstrated in the figures is eroded. (If the comparison were made at international prices the comparison would swing again in favour of longwall because of the relatively high internal price of mining equipment in India.) It is not possible to prove by this illustrative example that either one or other of the systems of mining is more economically attractive in particular mines, district cost comparisons ignore the fact that a single high output face can confer considerable economies in outby costs. There will however be many projects in which the use of the shadow wage rate could make a material difference to decision on mining technique.

4.2.2 Pricing Policy

4.2.2.1 The Mission considered pricing policies from the point of view of the overall level of prices and from that of the price differences for different grades of coal. The following remarks relate primarily to non-coking coal.

4.2.2.2 Coal prices in India have remained fixed since August 1975 when they were increased by approximately 30%. This was not sufficient to cover production costs which now exceed sales realisations by approximately Rs10 per tonne. In the delivered price of coal, however, the pit-head price of coal is frequently a smaller element than transport costs; the average length of haul for non-coking coal delivered by rail is of the order of 600-800 km, on which rail freight is about Rs50/tonnes. The prices of different grades of non-coking coals are now fixed so that, at the pit-head, they are proportionate to the calorific content of the coal.

4.2.2.3 There are various considerations which would normally govern the pricing of coal, including the need to:

- a. signal correctly to consumers the cost of the fuel which they consume;
- b. signal accurately to managers in the coal companies the profitability of their operations;
- c. reflect the depletion of a wasting natural resource;
- d. reflect in domestic prices the value of Indian coal in export markets or, alternatively the value to India of oil imports saved thanks to the use of coal;
- e. promote the use of coal in substitution for oil following the oil price rise;
- f. help contain industrial and retail costs as part of a counter-inflationary policy.

While appreciating that pricing policy is a sensitive topic and that objectives can often conflict with each other, the Mission feels that the present pricing policy might take greater account of economic considerations.

4.2.2.4 Because price differentials for different grades of non-coking coal are fixed at the pit-head rather than on the delivered price the latter does not reflect differences in the calorific value of the coal. Prices do not therefore act as a signal to consumers, enabling them to choose rationally the grade of coal which they wish to buy. Consumers are allocated coal of the grade which is thought appropriate to them by administrative action. The Indian authorities argue with justification that to use the price mechanism would lead to enormous and unrealistic price differentials at the pit-head between high and low grade coal. The disadvantage with the present arrangement, however, is that commercial relations between the coal companies and their customers tend to be poor and payments by the latter for coal consumed tend to be slow. The increasing restrictions which the authorities are placing on new uses of grade I non-coking coal imply that they value high grade coal much more highly than its price would suggest. In a broad sense this is rational economically because the reserves of high grade coal will be depleted much sooner, on present consumption patterns than those of lower grades. However the policy of administrative allocation runs the risk of involving the economy as a whole in higher extraction, transport and coal utilisation costs per calorie of useful energy than would probably be incurred in a system where allocation was based on economic pricing principles.

4.2.2.5 If an energy source such as coal is sold at less than its costs of production (or its opportunity cost to the economy) there is a risk that it will be wastefully used by consumers. As shown in Table 6, and allowing for depreciation on the basis of replacement costs, average costs in Coal India now exceed the unit value of sales by at least Rs10 per tonne. The risk is diminished insofar as the freight cost outweighs the costs of producing coal in the delivered price. However, by the same token, the control of coal prices per se has only a limited effect on the general level of industrial costs. The counter-inflationary motive for controlling coal costs is no longer a major consideration because the 1978 Central budget imposed an excise tax of Rs5 per tonne on non-coking coal (and Rs10 per tonne on coking coal) in addition to the royalty and cess payments amounting to about Rs7 per tonne. This new tax will help to make consumers more aware of the true cost of coal though without making a contribution to the profitability of the coal companies.

4.2.2.6 The Mission found that the coal companies were becoming increasingly cost conscious but that because of unremunerative prices they placed little emphasis on profitability. Coal is a heterogeneous product both because of grade differences and because coal fields are at varying distances from consumption centres. Cost comparisons are therefore not sufficient to guarantee the efficient operation of the companies as a whole. As the price mechanism is not permitted to function so as to show economic costs and values the companies are deprived of a simple yardstick for measuring the relative performance of their different units.

Table 14 Techniques of Underground Mining: Comparison of Costs^a
in Financial Terms and with a Shadow wage rate

Technique	Output per day ^b (tonnes)	Output per man shift ^b (tonnes)	Wage Cost per ton (Rs)	Total Direct Cost per tonne ^c	
				Financial (Rs)	With Shadow wage of O (Rs)
1. Bord and Pillar with Manual loading	260	1.1	32	43	27
2. Bord and Pillar: Development with Scraper	460	2.4	14	31	24
3. Bord and Pillar: Depillaring with Scraper	460	2.5	14	31	24
4. Bord and Pillar: Depillaring with Side-Loader	600	3.0	11	32	27
5. Longwall with solid blasting and friction props	432	1.7	20	41	31
6. Longwall with shearer and friction props	768	3.6	13	29	23
7. Longwall with shearer and hydraulic props	800	3.9	9.5	28	25
8. Longwall with shearer and self advancing supports	1240-1780	12-18	2.2-3.3	28-35	27-34

Source: CMPDI

- Notes: a. Direct cost up to outby of panel on June 1976 basis under average conditions.
b. Inclusive of development drivages for longwall mining; assumes seam thickness of 2.5m and longwall faces of 150m for non-powered support techniques and of 120m when powered supports are used.
c. Costs per tonne include, besides wages, depreciation and interest at 12% on plant and equipment, development drivages, housing (for 40% of workers), colony roads and water supply.

4.3 Technical Considerations

4.3.1 New opencast mines in the Sixth, as in the Fifth, Plan are to be one of the main sources of increased output. Opencast mining is a system ideally suited to India, where thick coal seams lie close to the surface in many parts of the major coalfields. Furthermore, the social dislocation brought about by this method of working coal is not much of a problem in the more sparsely populated areas of Madhya Pradesh and Bihar, which is where the greatest scope for opencast mining lies. In expanding opencast output, the industry is to rely heavily upon the use of walking draglines, a number of which were imported during the Fifth Plan, though not put to use, and a number of which are included in the provisioning lists prepared for 'advance action' at the beginning of the Sixth Plan. Walking draglines, having the dual advantage of increasing output and a capacity to increase the over-burden/coal ratio thereby permitting economical working at greater depths, are the preferred equipment for most of the larger sites.

4.3.2 Output increases from opencast mining were disappointingly small during the course of the Fifth Plan. This probably resulted from delays in delivery and assembling of equipment. However the delays have resulted in the accumulation of equipment which can be put to work on planned opencast sites within the immediate future. This means that, while the early increases in output during the Fifth Plan came from existing underground mines, the early increases in the Sixth Plan are likely to come from new or extended opencast mines.

4.3.3 One of the means suggested for transporting coal in future opencast sites is by means of inclined skip hoists. This technique has been used in the UK but mainly where the site is restricted, and the output is relatively low. In normal circumstances, high capacity loaders would be the preferred method of delivering coal from large opencast sites. Equipment of the size required for this specialised purpose is not immediately available in the UK but no doubt those companies specialising in shaft transport could readily design and manufacture to specified requirements.

4.3.4 Underground mining plays a less important part in increasing output in the Sixth Plan than it did in the Fifth, when it accounted for 95% of the increase in total output. This reflects the fact that many of the easily implemented schemes for increasing underground output have already been undertaken and there is now less scope for these cheaper methods of expanding output. Nevertheless, the expected annual increase of 25 million tonnes from underground mines, even if less than the 30 million tonnes expected from opencast mines, is still a formidable target.

4.3.5 The ways in which output is to be increased from underground sources was considered in section 3.2. There is little change expected in output from bord and pillar working and the greatest change is likely to be in method, with mechanised bord and pillar working gradually replacing manual loading, although right through the Sixth Plan manual loading will continue to be the predominant method of bord and pillar working. The main, and most important change, will be in longwall working and it is clear that by far the greater part of the expected increase in underground output is to come from that method.

4.3.6 The Mission was less clear exactly how the expansion into longwall working was to take place. Coal India is likely to develop its mechanised longwall faces as retreating faces. In the method known as longwall retreating, roadways are driven in coal to the full extent of the area to be worked by the face, the face is established at the furthestmost point and is then worked back or "retreated" to the starting point, leaving used roadways and collapsed goaf behind itself. The method has a number of advantages but its main one is that because the roadways have been pre-formed, the machinery on the face is able to work unhindered by the need for the slower

process of roadway formation to maintain pace with the face. In advancing longwall working, where roadways are formed behind the face as it moves forward, the process of making the roadways immediately behind the face often retards the progress of coal production. There are safety factors associated with retreat mining, particularly if the seam is liable to spontaneous combustion, since the goaf areas in which fires most frequently occur are left behind the roadways instead of being retained between the roadways, as is the case with an advancing face. In the process of working coal, stresses created in the strata can often result in serious roadway deformation which can hinder production and if they are left unrepaired (and repair is a most costly process) this increases immeasurably the time taken to retrieve valuable equipment from the face. By retreating, the stressed roadways are left behind, repair costs are saved and the equipment, now close to the main transport roads to which the face has retreated, can be quickly and cheaply recovered at the end of the life of the face. One further advantage, particularly applicable to geologically disturbed coal or coal of variable quality, is that drivage of the roadways before the face is worked gives a great deal of advance information leading to better operational planning.

4.3.7 The disadvantage of the system is that it is extremely demanding requiring, to maintain continuity of faces, a rate of development drivage far in excess of that normally required for roadway drivages and indeed, until recent years, far in excess of the capacity of standard drivage equipment to achieve the required rates. Development, as an operational function, begins to absorb a great deal more planning and management time and effort than does the face itself.

4.3.8 Curiously enough the transition from bord and pillar working to longwall retreating is perhaps as easily made as is the transition from longwall advancing to longwall retreating. Bord and pillar working also calls for a concentration on development drivage, although normally at a much slower pace than is required for development of retreating longwall faces, so that the change in management attitudes is less abrupt than the "advance to retreat" change. In most respects the Indian mining industry, if it is to adopt longwall mining, should opt for retreating longwall. It is the system most likely to give the required results, as well as being that to which Indian mining engineers should most easily adapt. However expectations of high outputs from retreat faces will not be met unless high capacity conveyor systems, integrated with adequate coal bunkers, are installed (see paragraph 3.2.13).

4.3.9 Materials transport is another area where a change in approach is required. Normally the main materials required for a working advancing longwall face are those needed to line and support the newly formed roadways, and the slow pace of advance means that supplies do not require a high capacity system for their transport. During the production phase of an operating retreat face, because the roadways are pre-formed, very few supplies are required at all; but during the development phase, because roadways need to be driven at fast rates, the daily consumption of supplies is very high indeed. Where powered supports are used on either longwall advancing or retreating faces materials-handling systems need to be designed for heavy duties and not for speedy delivery of light equipment. Transport of men can be integrated into the materials transport system, but it is also possible to use the coal-carrying conveyors for man-riding from the face.

4.3.10 The adoption of longwall mining will open up an entirely new concept of mine planning. Face design and district design will need to be part of a total design embracing coal transport, materials transport and carriage of men to work. These are matters which the CMPDI must be examining with some urgency. Longwall mining will demand an entirely different approach by management, and the training to be undertaken in the technique must lay stress on attitudes as well

as on technical development. Supervision at the face will be a more important factor than it is in bord and pillar working and will call for foremen of high calibre. New problems arising from different patterns of strata behaviour will inevitably tax the research wing of the CMPDI.

4.3.11 The British mining industry in general, and equipment manufacturers in particular, could do much to help the advancement of the Indian mining industry. The new techniques to be employed underground follow closely those traditionally used in British mines. Although not producing quite as much opencast coal as does India, the National Coal Board has a lot of experience in that type of mining and is supported by a British manufacturing capability which can supply the whole range of opencast mining equipment.

4.4 Demand Forecasting, Stocks and Customer Relations

4.4.1 Section 3.1 above discussed the demand forecasts made for the Sixth Plan and concluded that, on the assumption that overall economic growth targets will be achieved, moderately conservative estimates of indigenous requirements in 1982/83 would be of the order of 143-144 million tonnes, compared with the Plan forecast, based on average estimates, of 149 million tonnes. The Mission feels that the "end use" method of forecasting used in the preparation of the Plan as regards the major consuming sectors is sound and that the Plan forecast has been prepared with all due caution.

4.4.2 However, the forecasts may in the event prove wrong because of unexpected shifts in demand or, more likely, because the growth pattern of consumer sectors, individually or collectively, may be different from that depicted in the Plan. It is therefore important for the coal companies to monitor carefully indicators of demand growth and to make regular adjustments to their forecasts. In the Coal India companies output targets are revised at six-monthly intervals. It would not be sensible to try to attune output too closely to demand over short periods of time because of the disruptive effect of this on output planning and costs but over the longer period demand prospects should affect decisions on whether to advance or delay investment expenditure. The Mission found that the coal companies individually, and Coal India at the apex level, made estimates of the pattern of demand and tried to keep abreast of factors affecting demand levels but that they did not always have faith in their forecasts.

4.4.3 Coal stocks in India have traditionally been low. Both producers and consumers seek to keep stock levels down to economise on working capital and there is no policy of holding strategic stocks. As shown in Table 5b, at the end of 1977 the coal industry was holding only 5 weeks' stocks and in March 1977 was holding 7-8 weeks' stocks - a level which was considered by the authorities as excessive. Consumers hold much lower stocks. In the weeks following the departure of the Mission from India there were numerous reports of power stations with only a few days' coal in stock following fairly shortlived disruptions to coal supply resulting from industrial action in Singareni and the power shortage in Eastern India. Such disruptions must be expected to occur from time to time and they can be guarded against by the holding of larger stocks. In view of the size of India, the distance and difficulty of communication between supplier and customer, and the cost to the economy of disruption due to coal shortages, it appears sensible to hold stocks of at least 3 months' consumption. Some of this could, if need be, be held by a Government-financed agency other than the coal companies or the consumers of coal. The cost of adding 2 months' stocks to the level of the coal companies' stocks at the end of 1977 would, in 1978/79, be of the order of Rs130 crores, which would increase the approximate level of Plan

outlays on coal in the current year by about 60%. It would, of course, only be possible to move slowly to the optimum level of stocks in view of restraints on higher production. Stocks of coal might be located at strategic points in the country ready to meet requirements in the event of disruption to production or unexpectedly higher demand.

4.4.4 Finally, the Mission feels that the coal industry's relations with some of its customers might be improved. The power sector in particular believes that the coal delivered to power stations does not always conform to guaranteed specification. The Department of Power informed the Mission that it thought the solution to the problem of the declining calorific value and variable quality of the coal sent to the power stations would lie in washing power coal and in judicious blending. The Mission suggests that consideration might also be given to the adoption in India of the system in force in the UK whereby each cargo of coal for the power stations is subject to agreed testing procedures by the National Coal Board. Prices are fixed for a quarter and any variation in quality results in the prices being adjusted for the following quarter. This system has the virtue of providing collieries with a financial incentive to supply coal of at least the grade contracted for while avoiding delays in payment and costly disagreement.

4.5 Investment Planning

4.5.1 The planning of projects in the Coal India companies is the responsibility of the Central Mine Planning and Design Institute in Ranchi (CMPDI). The CMPDI has a professional staff of 3000 with technical expertise from exploration and the evaluation of reserves, through mine planning, to the design of coal handling and beneficiation installations. It is involved with all projects for new mines and for the reconstruction of old mines. Only in the case of minor schemes for mine investment does the initiative usually come from colliery or area managers. For all other schemes, the CMPDI, operating through its Regional Institutes which it has established to work in co-operation with each of the subsidiary companies, takes the lead in identifying new projects and in designing and implementing them.

4.5.2 In the period since the nationalisation of coal mining in 1971/73 the CMPDI, following on and extending the work of its predecessor, the National Coal Development Corporation, has surveyed all Coal India mines with a view to identifying reconstruction and development possibilities and has planned a large number of new mines. It has also identified in detail the equipment requirements of the expansion plan of the industry. The fruit of this industry-wide planning exercise is known as Project Black Diamond which was completed in 1976/77 and which presented a fully-costed 10-year plan of mine and ancillary development, colliery by colliery. The plan, which envisaged a demand for coal in excess of 200 million tonnes pa by 1983/84 was very ambitious and probably beyond the physical and financial resources of the industry to achieve. In the event targets have been scaled down because of a slower growth of expected demand.

4.5.3 The CMPDI follows a procedure in project preparation involving continuous consultation with the managements of Coal India's subsidiaries, in which projects are considered at the pre-feasibility and feasibility stages before receiving approval. The Institute, through experience, is evolving norms for costing proposals, though these norms are not yet completely identified. The Mission was able to see the comparisons made by the CMPDI of the costs of underground mining using different mechanised and non-mechanised techniques under average conditions (see 4.2.1.9). CMPDI officials and managers in

colliery companies are, thanks to this activity, aware of the order of magnitude of investment costs financial tonne of planned development. The CMPDI also lays down norms for labour and machine productivities under different conditions as yardsticks against which to judge performance.

4.5.4 Projects up to a value of Rs2 crores can be approved by the managements of the subsidiary companies of Coal India on the basis of project feasibility reports prepared by the CMPDI's Regional Institutes. Projects costing between Rs2 crores and Rs5 crores require the assent of the Coal India management. Those which cost more than Rs5 crores require the approval of Central Government's Public Investment Board and are vetted in Delhi by the Department of Coal, the Planning Commission and the Bureau of Public Enterprises. Expenditure on projects is controlled on an annual basis in the content of the Plan Budget. The realism of the colliery companies' demands for funds is assessed by the Central Government. The expected operating losses of the companies are taken into account in this assessment, usually by adjusting the interest due to the Government from the companies in respect of past loan finance. Unexpectedly high losses may however lead to a temporary cash flow shortfall.

4.5.5 Singareni Collieries has its own planning department which fulfils functions similar to those of the CMPDI though with less formalised procedures. Singareni is allowed to take investment decisions only up to Rs1 crore without reference to the Central Government. The company has a recent record of quickly and efficiently executed projects for new mines in which it has been greatly assisted by favourable mining conditions in some of its coalfields. The company has however found that shortfalls in internal fund generation has eaten into the resources available for investment expenditure.

4.5.6 The Mission was concerned that the number of schemes planned and approved might be insufficient to meet Sixth Plan output targets given the development lead times involved. Although it was not possible to gather comprehensive data about the approval status of projects it was learned from Western Coalfields that existing mines and approved projects were sufficient to increase output only from 21.5 million tonnes (1977/78) to 25-26 million tonnes as compared with the target output level for 1982/83 of nearly 33 million tonnes. The Mission learned that a two-step procedure was in force for major mining projects whereby "advance action" could be taken on projects eg for the opening of opencast sites or the sinking of new mines shafts before the eventual mine configuration or techniques of mining were finally decided. Construction activity could reach a fairly advanced stage before final approval was given. Such actions will give the Sixth Plan period a flying start. But it remains a fact that the volume of new project proposals is not such as to allow the authorities at coal company or Government level to pick and choose among projects and that in the 1976/77 down-turn in demand it was felt imprudent to delay the execution of long-gestation projects. The slow-down in the rate of projects approved in that year was, with the benefit of hindsight, perhaps a mistake. Output is still in danger of being restrained because the volume of investment planning and project preparation work has been insufficient. The volume of proposals submitted to the Planning Commission has substantially increased in the recent past.

4.5.7 One advantage in the building-up of a pipeline of new schemes is that it will present the planners with more options from which to choose and thus improve the probability that the decisions taken have the highest economic returns. The Mission felt that it had not been possible hitherto to ensure that new demands would be met at least economic cost (including the cost of transport) or that the planned pattern of coal utilisation would necessarily maximise net national economic

benefits (which could only be directly measured through the correct valuation of different grades of coal). New coal mining developments are to be undertaken which have a widely varying capital cost per annual tonne ranging between Rs120 per tonne for the further development of existing mines to Rs250 per tonne for new mines. The expected development cost of the Monidih mine of Bharat Coking Coal, in which British longwall face equipment is being installed, will probably be over Rs300 per tonne at full development. These figures are an indication - though not a conclusive demonstration - that costs of production at the margin in new schemes are far from uniform.

4.5.8 The Mission learned that the current costs of investment quoted are already considerably in excess of those in Project Black Diamond, which was drawn up two years ago and which showed, for formulated projects, an average cost of new underground mines of Rs150 per tonne, of new opencast mines Rs125 per tonne and costs of reconstruction projects to be even less. Some of the increase in costs since these estimates were made may be attributable to inflation - though inflation rates have been low on average in the last two years in India - but it is probable also that, with growing experiences, the coal industry's planners find it necessary to allow for higher real costs. The Planning Commission confirmed to the Mission that the marginal costs of production in new schemes were higher than present average costs.

4.5.9 As regards steps to ensure that the demand for coal is met as efficiently as possible, the Mission learned from the Planning Commission that two measures were envisaged to improve investment planning. Firstly, it was hoped, in the course of time, to build up a "shelf" of projects from which the most cost-effective set of projects could be chosen in each period. This would involve a considerable amount of work in project preparation and the Mission fully appreciated that it would never be possible to generate a wide-ranging menu of projects from which to choose. The second procedure envisaged by the Planning Commission was a mathematical programming exercise designed to identify the best pattern of "linkages" between coal fields and power stations and other large coal users given the regional pattern of demand for coal of different grades and the known reserves of exploitable coal. Once instituted this exercise should give a better idea about priorities for development between different coal fields.

4.5.10 Because of the very limited range of choice open to the planners of the coal industry hitherto there has been little attention paid so far to the question of criteria for project acceptability. Although the CMPDI, in the course of preparing feasibility studies, shows the financial implications of new mine developments and calculates an internal rate of return there is no clear financial - let alone economic - criterion for project choice. Virtually all projects have to be chosen if output targets are to be met. In the larger projects which are submitted to it the Planning Commission tries, to a limited extent, to influence the choice of technique but has hitherto been more concerned to influence the sequence in which neighbouring seams of coal are mined so as to maximise economic benefits. There are, however, as pointed out in section 4.2 above, some notable price distortions affecting decisions about the mining of coal, with labour rates considerably in excess of the opportunity cost of labour and some excess of domestic equipment prices over import prices. In view of these, it would be as well if the costs used in investment planning were expressed in shadow prices at all stages of the consideration of a project except where showing the impact of projects on company profitability. In the same way the cost objectives of managers could be expressed in shadow price terms.

4.6 Plan Inputs

4.6.1 Section 3 above concluded that there were likely to be shortfalls in the supply of some Sixth Plan inputs. There are a number of these, outside the

control of the mining companies, which by their non-availability could produce some disruption of the Plan. However, it is within the companies' powers to modify the means of achieving the Plan sufficiently to overcome some of the likely causes of disruption. As for those inputs within the companies' control, some action can be taken at quite short notice in some cases, but other inputs, requiring long lead-times to ensure their effective contribution to the Plan, cannot be materially changed by any company action in the Sixth Plan period. Generally, the following comment is restricted to those Plan inputs which the Mission feels might be in short supply, or might otherwise affect the Plan's achievement.

4.6.2 Presuming that availability of capital for investment will not be a constraint, equipment becomes the most critical input. The Mission feels that the "advance action", planned to cater for the increase in output from opencast mines by purchasing walking draglines, is too late. It understood that no orders had been placed for any of the new dragline equipment. Singareni, in inviting tenders for the single dragline provided for in their production plans, had probably made most progress, but even they are unlikely to get the equipment soon enough to make the impact in the Sixth Plan that they intended. Faced with the real possibility of shortfalls in opencast output by the end of the Plan, the mining companies might well consider contingency arrangements which would include examination of the scope for increased output from other opencast sites. This would cover, of course, those new sites for which dragline equipment is currently being assembled, and those new sites planned to operate with conventional shovels which do not have long delivery times. Such increases in output need only be for the period covering late delivery and not for the whole period of the Plan.

4.6.3 The underground equipment, supply of which is likely to be most critical, is that associated with longwall working. The Mission, whilst hopeful that the new techniques involved in fully mechanised longwall working will be mastered quickly, recognises that there are a number of potential problems. Substantial equipment inputs are required and furthermore, because of the diversity of equipment being employed during this "learning" period, spares holdings will need to be exceptionally high. Should there be delays in delivery or installation of equipment, and in the Mission's view this is highly likely, the lost output will be difficult to recoup. The problem of expanding underground output is rather more difficult than that of expanding opencast output. In the latter case output can at times be expanded by an injection of more equipment; but underground, the extension of shaft or drift capacity is required, in addition to the provision of more equipment and more face room, and that is often a long-term process. The Mission feels that there should be an attempt to standardise on at most two or three types of each major form of mining equipment. Some experimentation must take place so that the mining engineers can be assured that the best types are being adopted as standards, but this should be kept to a sensible minimum.

4.6.4 Concomitant with the mining companies' problems on equipment supply, indigenous manufacturers are likely to have difficulties with inputs. There could be some difficulty for those developing new lines, often in conjunction with overseas manufacturers. The difficulties will arise during the learning processes and while the production systems for the new mines are being developed. Much will depend upon the partners with whom the companies will be collaborating. The Mission was pleased to learn that the Indian mining machinery manufacturers seem to be developing closer links with UK manufacturers of mining equipment. The Mining and Allied Machinery Corporation is intending to manufacture Dowty powered supports, Jessop & Co hope to produce Gullick-Dobson powered supports, and the Heavy Engineering Corporation may collaborate on the manufacture of draglines. These are important developments, and every encouragement should be given to the Indian manufacturers to develop cost-effective production.

4.6.5 Most of the other Plan inputs from external sources have received adequate comment in section 3.3 above. It is doubtful if the mining companies can do a great deal to alleviate their effects other than to plan to cater for the possible consequences of lack of supply.² In the case of sand and explosives, potential shortages can be overcome by change in method of working. In the case of the sand needed for stowing, the solution is simply to move away from the methods of mining which require the goaf to be stowed. It is less simple to say this in the case of explosives, since movement away from their use would place higher demands on face equipment. Should it transpire that, despite imports, a shortage of explosives is foreseen, reduction in solid blasting could produce savings, although this would mean reversion to earlier techniques of slotting the coal by coal-cutter before blasting it with much lower charges than those demanded by solid blasting. Many of the coal cutters, operating at quite low productivity on bord and pillar work, were designed for cutting coal on longwall faces. If explosives shortages appeared imminent, some of these could be transferred to longwall work; the need for solid blasting, and therefore explosives, would be reduced.

4.6.6 Of the inputs controlled by the companies one of the most important is training, on all aspects of which - the training of workmen, technicians, and management at all levels - a welcome emphasis is being placed. The Mission feels that the strengthening of management at colliery level by training, and by increasing the skilled staff available to line management, is a special priority.

4.6.7 Finally, the CMPDI, with its triple function of exploration, planning and research, must be regarded as a key input. In exploration it is following in the well established traditions of the Geological Survey of India with its acknowledged experience in this field, while in research it has barely begun its work. The Mission considers that, apart from some of the applied research associated with methods of working coal, which is reaching or has reached the development stage, the research wing will make little impact on the Sixth Plan. In the view of the Mission, lines of research should be redefined and rationalised so that each of the Indian research establishments can make a full and unique contribution to present and future plans. The Mission felt that while the preparation of projects occupied so much of the total input, work on detailed face design, operational planning and action programming was perhaps not receiving all the attention it merited. These aspects of the planning function could be strengthened, partly by redeployment of planning staff, but more importantly by bringing mine management into the planning process and involving them from the outset. A fully mechanised longwall face can represent an investment of Rs50 million, and its effective planning operation and control requires its effective management. The Mission feels that in the Sixth Plan and further ahead, if the Indian mining industry continues to increase its longwall faces, day-to-day planning and management will be the most important issues to be faced.

4.7 Efficiency of Equipment Manufacturers

4.7.1 The Mission visited four engineering companies associated with the manufacture of machinery and equipment for the coal industry: the giant Heavy Engineering Corporation (HEC) with sales of the order of £50 million, which is interested in diversifying into the manufacture of low temperature carbonisation plant and washery and dragline equipment; Jessop & Co Ltd, a Calcutta engineering company with an annual turnover of the order of £30 million, 60% of which is in heavy structural fabrication, and with an interest in diversifying into self-advancing roof support equipment in collaboration with Gullick-Dobson of the UK; Mining and Allied Machinery Corporation (MAMC), a company specialised in mining machinery with a turnover of £20 million, which has recently had to diversify into other fields to sustain a flow of orders; and the very much smaller Meameco Ltd, part of the private sector Jardine Henderson group, which manufactures coal cutters and coal drills.

4.7.2 At the time of the Mission's visit the sections of these companies devoted to the manufacture of coal equipment were suffering from a lack of orders and from cancellations consequent on the revision of Coal India's development and procurement plans after 1976/77. MAMC had been particularly badly hit with turnover declining drastically from Rs28 crores in 1976/77 to Rs18 crores in 1977/78. In Meameco the financial results in 1977/78 were expected to show a deterioration. Order books were thin. In March 1977 MAMC reported firm sales orders amounting to 2 years' production. About a third of these orders were subsequently cancelled with the result that, at the time of the Mission's visit, orders amounted to only 10 months' output. At Meameco orders for coal cutters were only 3-4 months' production. The position was expected to improve in the course of the year when Coal India's new 3-year procurement plan was approved by the Central Government. The performance indicators discussed below relate to the years prior to the cutback in orders, when financial results were better than they will have been in 1977/78.

4.7.3 In the years 1974/75 to 1976/77 the public sector engineering companies HEC, MAMC and Jessops were marginally profitable in historic cost terms. The companies made small net profits and rates of return in 1976/77 (after depreciation) on capital employed (at historic cost) were: Jessops: 11% HEC: 6.7% and MAMC: 5.1%. At replacement cost the companies would in all probability have been making substantial losses with no return to capital employed. Profitability depends importantly on the prices of goods sold which, because both suppliers and customers are in the public sector, have been Government-controlled; the Government as a rule sets prices at a level which is rather below the landed cost (inclusive of 40% import duty) of equivalent imports. It also depends on the prices of important cost items; the engineering industry has benefitted from the stability, since 1974, of the wholesale price of ferrous raw materials and foundry products. Profitability has been enhanced by the practice whereby the Government permits public sector companies to capitalise part of the interest due on debts to the Government. 1976/77 was the first year in which HEC did not have to resort to this.

4.7.4 One reason why the engineering companies were able to show financial results from 1974/75 to 1976/77, which were better than previously, was that these were years of slow growth in capital employed, with limited additions to fixed assets. HEC was adding to its fixed capital stock at 2% pa and MAMC by about 3% pa. Jessops, on the other hand, has been investing more and has increased the (very low) historic value of its fixed assets by over 20% pa with the installation of new machine tools to assist with its diversification programme. The commutation of over half of its debts to the Government into equity was needed to make this financially possible.

4.7.5 Capacity utilisation can only be measured rather arbitrarily in general engineering companies where the product mix alters according to the pattern of orders. Production to individual order or in small batches has made it very difficult to achieve high rates of loading on the sophisticated machinery installed in these companies' shops. In HEC's heavy machine building plant, where it is hoped to build walking draglines, capacity utilisation at present is 60-70% (though in the foundry-forge plant it is much lower at 30-40%). MAMC were working close to their installed capacity in terms of tonnage in 1976/77 but, from the fall in the value of output subsequently, must have been operating below 60% of capacity in 1977/78. The heavy structurals shops at Jessops were operating at rather over 90% of installed capacity in 1976/77 but the other shops were much less heavily loaded.

4.7.6 One indicator of economic efficiency in heavy engineering where fabrication times tend to be long is the volume of stocks held in relationship to production. There is great variation between the three public sector corporations in this regard. The most efficient is Jessops where (in 1976/77) finished goods and work in progress only amounted to 3½ months' sales and where raw material stocks were only 6 months' consumption. In MAMC the corresponding figures were 9 months and about 1 year. In HEC, where the product mix contains very much heavier items, stocks of finished goods and work in progress amounted to a year's sales and raw materials stocks to rather more than one year. The very much smaller and less sophisticated Meameco holds total stocks of only 4½ months' sales. By international standards the Indian heavy engineering industry holds large stocks and thus has a high requirement of working capital. MAMC and HEC exceed the norm for the Indian engineering industry.

4.7.7 Productive efficiency in engineering companies calls for the organisation of the flow of materials in a manner which is consistent with the output mix determined by commercial policy and the nature of the orders on hand and which at the same time optimises machine utilisation. If production is planned scientifically there can be economies in the fixed asset, working capital and other overhead costs per unit of output. With the aid of such a system of production planning it is also much easier to determine the cost of individual items and the cost to the company of executing particular orders. The Mission noted that a computerised stock control and materials flow system, of a kind known to exist in other large engineering companies in India, was only just about to be introduced in MAMC. Hitherto all job costing has been done manually on the basis of standard costs of groups of items, taking into account shop managers' assessments of machine loading rates. At a time of low capacity utilisation there is little pressure to optimise machine loading. However the Mission formed the impression that there was considerable scope for rationalising materials flows through the fabrication and assembly shops of MAMC and that the new data processing system would improve management control in this respect and achieve economies in stocks of raw materials and work in progress.

4.7.8 Of the efficiency indicators mentioned so far the profitability criterion is the most satisfactory because it subsumes and summarises the effects of the others. Financial profitability is, however, itself distorted by the effects of domestic pricing policy, taxes and subsidies. In order to assess financial profitability objectively it is helpful to see if it would be improved or worsened if inputs into production and output are valued at "border prices" i.e. at the prices at which they could be imported or exported. If value added is higher at border prices than at the domestic prices faced by the firm the effective rate of protection is negative; conversely, if value added is lower at border prices the effective rate of protection is positive.

4.7.9 The effective rate of protection test has only been applied in the case of MAMC because it is by far the most important manufacturer of equipment for the coal industry with mining machinery accounting for 50% of turnover. Table 15 shows that MAMC benefits from a modest positive effective rate of protection of 30-40%. An index of the average share of different cost items in domestic prices is converted into border prices by factors representing the approximate ratio of domestic to border prices. These ratios are derived from indications given to the Mission in the course of its visit about the level of domestic prices of indigenous materials and components and about the rate of import duty. Where no indications are available it is assumed that the effect of domestic taxation is to raise prices some 20% above cost. As for the value of output, it was learned that MAMC products were in general sold somewhat below the landed price of imported equivalents but not as cheaply as the c.i.f. price.

4.7.10 The conclusion from the effective rate of protection analysis is that value added in MAMC would be lower by about 30% in a regime of border prices than it is with the domestic prices which it enjoys. With border prices it would

not be able to show the marginal profitability at historic costs of the years 1974/75 to 1976/77. A fortiori there would be a negative return on capital employed if inputs and outputs were valued at border prices with capital valued at replacement costs. Costs of production at MAMC seem therefore not yet to be fully competitive in international price terms.

4.7.11 This conclusion points to the need for special care if the programme which is envisaged for the manufacture of fully mechanised longwall mining equipment at MAMC is not to involve the Indian economy in higher costs than need be. This equipment calls for the manufacture of powered supports for which MAMC considers that some additional capital expenditure in its shops is required. The number of longwall mining sets to be ordered is rather uncertain, which makes it difficult for MAMC to plan a regular production line. Furthermore, Jessops envisage the production of self-advancing hydraulic supports manufactured to another design. The smaller the production run and the more erratic the ordering pattern the higher the unit costs of each set of equipment are likely to be. The Mission considers that it would be unwise for equipment manufacturers to commit themselves too far to the production of sophisticated new types of mining machinery until the coal industry has completed its trials and decided on which machinery to standardise. Thereafter the coal industry and the equipment manufacturers should consult closely to determine how to keep to a minimum the costs to the Indian economy of equipment procurement. If the initial rate of ordering is to be low it may be sensible to allow for a high import content in the equipment supplied. This would only fall significantly when the rate of ordering was such as to permit the requisite scale economies in indigenous manufacture.

Table 15 Effective Rate of Protection of Mining and Allied Machinery Corporation

Cost Items	Index of Costs in domestic prices (1)	Ratio of Domestic prices to resource costs at border prices (2)	Index of Costs at border prices (=1/2) (3)
1. Value of Production	100	1.2 - 1.25 ^a	80-83
2. Raw Materials consumed	29.4	1.155	25.1
(alloy steel)	(6.1)	(1.08) ^b	(5.6)
(mild steel)	(5.4)	(0.9)	(6.0)
(foundry materials)	(2.9)	(1.1)	(2.6)
(pipes)	(1.2)	(1.0)	(1.2)
(other indigenous)	(3.9)	(1.1)	(3.5)
(other imported)	(9.9)	(1.6) ^c	(6.2)
3. Bought out components	6.6	1.245	5.3
(indigenous)	(3.6)	(1.1)	(3.3)
(imported)	(3.0)	(1.5) ^c	(2.0)
4. Subcontractors	12	1.2	10.0
5. Excise duty	1	-	-
6. Manufacturing expenses	11	0.99	11.1
(utilities)	(4)	(0.77) ^d	(5.2)
(tools and spares)	(2)	(1.2)	(1.7)
(other incl admin)	(5)	(1.2)	(4.2)
7. Value Added [= 1 - (2+3+4+5+6)]	40	1.27 - 1.40 ^e	28.5 - 31.5

- Notes: a. Sales prices lie between the landed price (1.4) and the border (cif) price (1.0).
b. Alloy steel imports attract a duty of 80%. The indigenous price of alloy steel is said to be 60% of the landed price.
c. Duty on imports of unspecified raw materials and components is said to range from 40% to 70%.
d. Allows for a subsidy element in the cost of utilities.
e. Value added at domestic prices is 27% to 40% higher than at border prices; the Effective Rate of Protection is thus of the order of 27% to 40%.

4.8 Utilisation of Coal

4.8.1 Coal utilisation is a central issue for India. Not only is coal the largest energy resource there, but the size of the reserves places India among the most important coal-producing nations. There is, however, a singular lack of good quality coal.

4.8.2 It is thought that the Gondwana coals, to which the bulk of India's coal reserves belong, were formed by allochthonous processes during which high amounts of matter extraneous to the coal were introduced in the course of deposition. This is evidenced from the high propensity of the coals to have frequent alternations of coarse and fine beds and, of course, high ash contents often excessive to the point of being more ash than coal and at times containing high amounts of silica.

4.8.3 Coal utilisation research is concentrated in two main areas, both of supreme importance to the Indian economy. One is the beneficiation of coking coals so as to produce the best possible blends from the available production and at the same time to conserve the relatively small reserves of coking coal available for exploitation. The other is the treatment of the high ash thermal coal and, more importantly, investigations into new methods of using it.

4.8.4 Significant work in the field of fuel utilisation research is being undertaken by the Central Fuel Research Institute (CFRI) and by Regional Research Laboratories at Hyderabad and Jorhat. Coal Survey Laboratories also contribute to the general research effort, whilst in the industrial sector companies such as Bharat Heavy Electricals Limited (BHEL) concentrate on applying the research results to new installations. The Mission visited the CFRI laboratories where, as well as plants investigating uses of oil and gas, there are pilot plants to investigate better utilisation of coal. The Mission again noted that much of the research work is devoted to applying the findings of research elsewhere to Indian coal, and nothing was seen suggesting that new techniques might emerge from the work being carried out. This is as it should be as so much work in these fields has already been done in Europe and the USA that to modify and apply the findings to the unusual Indian coals must be the correct approach.

4.8.5 Two projects of particular importance to the steel industry were being investigated at the CFRI. One involved the pre-heating of the coal charge to coke ovens to produce a better quality coke and the other involved the formation of an artificial coke by the pelletisation of non-coking coal to form a premier coke equivalent. A demonstration plant for the latter process is to be built at Talcher so as to produce formed coke in sufficient quantities to carry out demonstrations in blast furnaces.

4.8.6 Standard furnace design studies are being carried out at the CFRI, but the most interesting work is that concerning fluidised bed combustion, a technique developed in the UK to burn high ash or high sulphur coals and of particular relevance to India. So far a small pilot plant has been built, in conjunction with BHEL, which has a capacity of 2 tons/hour and has successfully coped with coal having 30% ash. BHEL have gone further. They are operating a 10 tons/hour capacity fluidised bed combustion boiler at Tirunichirapalli and are manufacturing a 300 kg/hr pressurised fluidised bed combustor which will be test operated at Hardwar. This is the most important area of work and there appeared to the Mission to be good prospects for collaboration between UK and Indian companies.

4.8.7 In common with the rest of the world, India has worked for a number of years on gasification and liquefaction of coal. At the CFRI, Lurgi and Kopper

processes of gasification are being investigated in pilot plants, using Indian coal. Interest was expressed in the liquid solvent extraction method and super-critical pressure gas extraction method, both of which are being developed in the United Kingdom at the Coal Research Establishment of the National Coal Board.

4.8.8 Improved coal preparation is an area in which the CFRI is working with the Research and Development section of the CMPDI. Coal preparation has been largely concentrated on coking coals where ash is critical, but it is being extended in future years to some of the thermal coals because, on occasion, the nature of the ash as well as its proportion causes damage to power station boilers.

4.8.9 Methods of using coal more efficiently are of great importance to India. There has been a noticeable deterioration in average quality as output has expanded. This results from the exploitation of the vast reserves of higher ash coals and is already posing problems. While more coal preparation plants will help produce better qualities for selected markets, the residual output will continue to depreciate in quality. The new combustion technology could be of great value, particularly if it can be developed on the scale that will permit fluidised bed combustion to be applied in power generation. There is a great deal of scope for the United Kingdom to join in developing this technology in India.

5. UK AID FOR THE COAL SECTOR

5.1 Capital Aid

5.1.1 Until 1975 UK capital aid for the coal sector took a variety of forms depending on whether it was required for a major project, for capital investment or for maintenance purposes. Following the report of the 1974 ODM Coal Mission, a grant of £10 million for the coal sector was signed in December 1975. This new grant was designed to provide for the supply of the whole range of imports required for the sector that were available from the UK. The Government of India was given full discretion over allocations from the grant for maintenance purposes (covering the supply of industrial materials, components and spare parts), and also over smaller allocations for capital equipment. Large allocations for capital investment have been subject to the prior approval of the Ministry of Overseas Development.

5.1.2 Up to the end of 1977 about £3.4 million had been allocated by the Government of India from the 1975 coal sector grant. The largest allocation, of £1.65 million, was to Bharat Coking Coal for mechanised longwall mining equipment, including self-advancing props. Other major allocations have been to Coal India for flameproof switchgear (£487,000), 32 side discharge loaders (£427,000), air circuit breakers (£186,000), two shearers (£151,000) and methanometers (two allocations totalling £113,000), and to Bharat Coking Coal for a winder (£106,000). The main recipients of allocations have been Bharat Coking Coal with a total of £1.78 million, Coal India (excluding Bharat Coking Coal) with £1.54 million, the Central Coal Mines Rescue Stations Committee with £105,000, and Singareni Collieries with £44,000. Other recipients have been the Central Fuel Research Institute, the Directorate General of Mines Safety, Neyveli Lignite Corporation and Reyrolle Burns Co.

5.1.3 The coal industry's future equipment requirements are at present being re-evaluated (see section 3.3.2 above). It was not possible, therefore, for the Mission to arrive at a firm estimate of the extent and nature of the requirement for equipment and materials from the UK, and hence the requirement for UK aid. However the Department of Coal considered that from 1978/79 the rate of utilisation of UK aid was likely to accelerate and that, on a rough estimate, the balance of the 1975 UK coal sector grant should be allocated by around the end of 1978/79.

5.1.4 The Department of Coal told the Mission that among the items of equipment which it was proposed to procure in the near future and which could be financed from UK aid were two sets of mechanised longwall face equipment and two walking draglines. It was also proposed to place orders for nine long haul dumpers, nine road headers or dint headers, and a large number of methanometers. Orders for a single set of longwall equipment and a single dragline would alone take up most or all of the balance of the 1975 coal sector grant.

5.1.5 There will also certainly continue to be a substantial requirement for supply from the UK of many smaller items of equipment and for components and spare parts. There may in addition very well be a requirement for major items of equipment besides those listed by the Department of Coal. As is noted in section 3.3.2 above, the industry will require during the Fifth Plan, and later, a substantial number of sets of longwall equipment and several walking draglines of various sizes. While both categories of equipment will increasingly be manufactured within India, there will continue for some time yet to be a significant demand for imported components.

5.1.6 It is expected that a decision will be taken quite shortly on a foreign collaboration agreement for the Heavy Engineering Corporation for the production of

draglines; UK firms have been involved in discussions about this with HEC. Several collaboration agreements between the Mining and Allied Machinery Corporation (MAMC) and UK firms have already been concluded or approved. These agreements cover the production of hydraulic pit props, self-advancing roof supports, Desford chocks and rams (all Dowty Mining Equipment Co), shearers (Anderson Strathclyde Ltd), heavy duty armoured face conveyors and other haulage equipment (National Coal Board) and trolley wire locomotives (Messrs Greenbat). MAMC have in addition identified the following areas where there might be collaboration with UK firms:

- a. Roof bolting machinery for bord and pillar mining (metal as well as coal);
- b. underground air cooling;
- c. dense medium bath and flotation cell for washing of coal;
- d. briquetting machinery;
- e. Burnside borers.

MAMC also gave the Mission a list of orders for a variety of equipment totalling about £500,000, which had recently been or would shortly be placed with UK companies. Jessop & Co Ltd are another company with agreements with UK firms. They are at present in particular interested in collaborating with Gullick-Dobson Ltd in the production of self-advancing roof supports. Meameco Ltd would also be interested in collaboration with UK companies. Most such collaboration agreements between UK and Indian manufacturers of mining machinery would involve the continuing supply for some years of components and spare parts from the UK.

5.1.7 In the course of its tour the Mission also received from the coal mining companies indications of possible requirements for imported equipment which might be supplied from the UK. Besides the items listed by the Department of Coal, requirements of equipment at present not readily available from indigenous manufacturers will include shearers, armoured face conveyors, side dump loaders, coal drills and in-line coal breakers. As noted above, most of these types of equipment are the possible subject of collaboration agreements between UK and Indian manufacturers. Coal India estimated that expenditure on them might be roughly of the order of Rs. 75 crores (£50 million) during the Fifth Plan, but noted that the extent to which the equipment would be imported would depend on a number of factors, including the pace at which new technologies were introduced and at which indigenous manufacturing capacity developed.

5.1.8 Interest was expressed to the Mission not only in coal mining and handling but also in preparation equipment. In particular, Tata Iron and Steel Co were considering the procurement of UK engineering services and equipment for the proposed coal washery at West Bokaro; orders here might be worth approaching £1 million.

5.1.9 In the light of its review of the development of the coal sector, of the sector's continuing economic priority and of the sector's continuing need for inputs from the UK, the Mission recommends that a further allocation of UK aid should be made to the coal sector when required. It would clearly be premature to recommend now a specific amount when the existing sector grant is not yet fully allocated and when likely requirements are still being assessed. The amount of the grant should be a matter for discussion between the two Governments, probably towards the end of 1978/79, when the present grant is expected to be fully allocated and when the extent of future requirements is likely to be clearer. However the Mission considers that the amount of the new grant will probably need to be in the range of £15-25 million. It should be designed to meet requirements in the related fields of coal exploration, mining, handling and preparation for 3-4 years from 1979/80 until towards the end of the Fifth Plan in 1982/83.

5.1.10 The Mission further recommends that the Government of India should be given full discretion over the allocation of the new sector grant. Under the existing grant this discretion is limited, as noted earlier, and excludes large allocations for capital investment.

5.2. Technical Co-operation

5.2.1 Over the past two years an important programme of training for Indian managers, trainers and engineers has been started under the UK/India technical co-operation programme. Following visits to India by British consultants in 1976 and 1977, senior training managers and training officers from both Coal India and Singareni have attended courses in Britain specially designed by the National Coal Board. Engineers and trainers from Coal India and the Mining and Allied Machinery Corporation have also received training in Britain from Dowty and Anderson Strathclyde in the use of self-advancing props and shearers on longwall faces. The training in Britain has been complemented by visits to India by British consultants and training officers to provide general advice on training requirements and more specifically to assist with the introduction of mechanised longwall face equipment.

5.2.2 The current training programmes will continue and there is likely to be a requirement for a longwall mining training gallery which the Mission recommends should be supplied under the technical co-operation programme, if requested by the Government of India. There are, however, likely to be other areas where British assistance could also be valuable. Coal India gave the Mission a list of areas where it was thought that the UK might be able to assist with training. The areas included underground transport systems; rapid shaft sinking; equipment planning; maintenance, etc (especially for longwall faces); major mine reconstruction; and washery operations. The full list is at Appendix B. The Mission recommends that consideration should be given to assisting in any of the areas listed, where the UK has the appropriate expertise and capacity, if requested by the Government of India.

5.2.3 The Department of Coal expressed interest in possible British co-operation in a number of areas, including seismic surveying, project planning, coal preparation, low temperature carbonisation, the transport of coal from mines to power stations and fluidised bed combustion. Again, consideration should be given to assisting in any area requested by the Government of India.

5.2.4 The Mission considers that Britain could also assist, under the technical co-operation programme, with some of the research and development work being undertaken in India. The 1974 ODM Mission recommended that consideration should be given to supplying certain items of equipment required by the Central Mining Research Station, if so requested by the Government of India. The present Mission learnt on its visit to the CMRS that much of the equipment listed in 1974 was still required by the station; it also recommends that consideration should be given to any request for assistance.

5.2.5 The Central Fuel Research Institute discussed with the Mission a number of areas in which it would welcome collaboration with the UK, in particular coal gasification and fluidised bed combustion. In both these latter processes much work has been done in Britain, and the Mission believes that collaboration could make a useful contribution to the development of the technologies in India. It recommends that a consultant from the Coal Research Station of the National Coal Board should visit the CFRI to consider further possible areas and ways of collaboration. Bharat Heavy Electricals Ltd are also very actively involved in research in fluidised bed combustion and have an experimental boiler operating. BHEL would be interested in collaboration with the UK in this very important area and the Mission recommends that this should be given consideration.

5.2.6 Finally, in the context of the UK/India technical co-operation programme as a whole, the Mission recommends that priority should continue to be given to the needs of the coal sector.

COAL INDIA TRAINING REQUIREMENTS
AREAS OF POSSIBLE TECHNICAL CO-OPERATION WITH THE UK

- | | | |
|----|---|---|
| 1. | Systems of transport underground including man-riding arrangements and material supply. | 1 Mining Engineer
1 Mechanical
1 Electrical |
| 2. | Rapid sinking and deepening of shafts, widening of shafts, high speed drifting including detailed designing for head frames, winding gear, skips, skip pockets etc. | 2 Mining Engineers
1 Mechanical
1 Civil |
| 3. | Dry mechanical stowing. | 1 Mining Engineer
1 Mechanical |
| 4. | Equipment planning, installation, operation and maintenance of longwall equipment. | 2 Mining Engineers
2 Mechanical
2 Electrical |
| 5. | Major mine reconstruction. | 2 Mining Engineers
1 Mechanical
1 Electrical
1 Civil |
| 6. | Training in NCB Plant Pool and Central Workshop on equipment planning, standardisation and control. | 1 Mining Engineer
2 Mechanical
2 Electrical |
| 7. | Design of new mine installations. | 2 Mining Engineers
1 Mechanical
1 Electrical
1 Civil |
| 8. | Washery operations. | 2 Mining Engineers
2 Mechanical
2 Electrical |
| 9. | Coal movement by railway transportation. | GM (Sales) level |

Source: Coal India

