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REPORT
OF THE
COMMITTEE ON CONSERVATION
OF
METALLURGICAL COAL

May 1950



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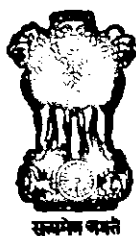
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OF THE GIPE-PUNE-213369
COMMITTEE ON CONSERVATION
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Interim Report

ON

Conservation of Metallurgical Coal.

1. The Committee on Conservation of Metallurgical Coal was appointed by the Government of India, Ministry of Industry and Supply, *vide* their Office Memorandum No. Coal II-7(16)/49, dated the 25th April 1949, which is reproduced below:—

“ No. Coal II-7(16)/49.

GOVERNMENT OF INDIA,

MINISTRY OF INDUSTRY & SUPPLY.

New Delhi, the 25th April '49.

OFFICE MEMORANDUM.

The Government of India are pleased to constitute a Committee to advise them on the measures to be taken in regard to conservation of metallurgical coal with particular reference to the recent reports on coal washing and coal blending and other ancillary matters.

2. The Committee will consist of—

Dr. M. S. Krishnan (Director, Indian Bureau of Mines),
Chairman.

Dr. J. W. Whitaker (Director, Fuel Research Institute), Member.

Dr. D. R. Malhotra (Representative of Railway Board),
Member.

Mr. C. S. N. Raju (Representative of Central Electricity Com-
mission), Member.

Mr. S. K. Sen (Ministry of Finance), Member.

Mr. A. Farquhar } (Representatives of the Coal Consumers'
Mr. W. M. Wallace } Association of India), Members.

Mr. W. H. S. Michelmores } (Representing Colliery Interests),
Mr. B. L. Agarwalla } Members.

Mr. A. B. Guha (Colliery Superintendent, Giridih—Coal Com-
missioner's representative), Member.

Mr. A. B. Guha will act as the Secretary of the Committee.

3. The terms of reference of the Committee will be as follow:—

“To review the publications and recommendations of Fuel Research Committee, Fuel Research Institute and other Research Organisations and to recommend to Government what legal or executive action should be taken to implement such of the findings of the research bodies as in the opinion of the Committee are considered desirable for adoption and in particular—

- (i) to consider and recommend what results can be achieved through blending and washing of coal and what measures are needed and the extent of the compulsion which is to be applied both at the producers' and consumers' ends for conservation of metallurgical coal with suggestions for revision of price structure of coal to make washing and blending economically feasible ;
- (ii) to ascertain what the existing difficulties mainly arising out of transport limitations are of increasing the production of good quality metallurgical coal and how to overcome them ; and
- (iii) to estimate the increase in requirements of the Country for good quality metallurgical coal within the next few years.

The Committee is to submit its report by the 15th June 1949.

(Sd.) P. R. DAS GUPTA,
Dy. Secretary, Government of India.”

2. The terms of reference were later amended to read as under, *vide* the Government of India, Ministry of Industry and Supply's Corrigendum No. Coal II-7(16)/49, dated the 3rd May 1949.

“The following Corrigendum is issued to this Ministry's Office Memorandum No. Coal II-7(16)/49, dated the 25th April 1949:—

In para. 3 of the Office Memorandum, for sub-item (ii), *substitute* the following, *viz.*—

- (ii) to ascertain what the existing difficulties mainly arising out of transport limitations are of increasing the production of good quality non-metallurgical coal and how to overcome them, and”

(Sd.) P. R. DAS GUPTA,
Deputy Secretary to the Government of India.

3. Later on Sri B. P. Sinha, Secretary, Bihar Khan Mazdoor Federation, Dhanbad, was appointed as a Member of the Committee as per the Government of India, Ministry of Industry and Supply's Office Memorandum No. Coal II-7(16)/49, dated the 10th May 1949.

4. Before making final recommendations we felt it essential to redetermine the total amount of good and feebly coking coal, but in view of the urgency of the position we are submitting these interim observations. As the survey is only at its early stage, our provisional observations are based generally on the report of the Indian Coalfields Committee, 1946 for the total availability of coal which may be suitable for metallurgical purposes. There have been many estimated reserves of good coking coal based on incomplete data. The estimates showed wide variation. The Coal Mining Committee, 1937 gave reserves of good coking coal to be 1,436 million tons at the end of 1936. At the end of 1944, Gee of the Geological Survey of India estimated the total reserves of this coal to be in the region of 1,165 million tons. In this connection we quote from the Report of the Coalfields Committee:—

“ We are advised that good coking coal can be strictly said to occur only in seams 12 to 18 of the Jharia field, in the Giridih field and in the Ramnagar seam and in a portion of Laikdih seam of the Raniganj field, but the Giridih field is nearing exhaustion and may be left out of consideration. We have shown earlier that the present reserves in seams 13 to 18 of the Jharia field are probably in the neighbourhood of 730 million tons. The reserves in seam No. 12 have not been readily available from the Geological Survey of India's Memoirs, but the details we have collected give a figure of 167 million tons. The total for seams 12 to 18 may, therefore, be put in the neighbourhood of 900 million tons. But there is an important reservation to be made in regard to this total. The Jharia seams mentioned are not of uniform quality throughout, from Katrasgarh westwards, quality definitely deteriorates and it would be most unsafe to treat all the 900 million tons of coal in these seams as good coking coal. What proportion of the total cannot be so classified it is difficult to say ; but it is probably appreciable. As regards the Ramnagar and Laikdih seams of the Raniganj field, we have estimated the present reserves at about 42 million tons. The total reserves of good coking coal are, therefore, undoubtedly much below 1,000 million tons, and may well be in the neighbourhood of about 700 to 750 million tons only, after allowing for the inferior coal in certain parts of seams 12 to 18 of the Jharia field.

If we were to rely on the figures reported to us by the collieries, we would have to revise our estimates of the reserves of good coking coal. We have been told that such coal is found in the following seams:—

12, 12A, 13, 13A, 13B, 14, 14A, 15, 15A, 16, 16A, 17, 17A, 17B, 18, 18A in the Jharia field and Laikdih seams of the Raniganj field.

The total reserves in these seams, as reported to us, are as follow :

	<i>Million tons</i>
Reserves in seams as now being worked .	597
Additional reserves if the full seams are worked	242
Reserves in virgin areas proved and thought workable	310
	<hr/>
	1,149
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On this basis, the reserves appear to be much larger, but there is again an important reservation to be made. We have classified the collieries which have reported reserves to us in the Jharia field according to the quality of the coal as determined by the Indian Coal Grading Board and we find that many of the reporting collieries have resources of inferior grade coal only which cannot obviously be described as good coking coal, even though it comes from seams 12 to 18. The total is, therefore, not a safe guide to the Country's reserves of good coking coal."

5. It will thus be seen that the Indian Coalfields Committee did not consider the figures of total reserves as a safe guide. It soon became clear to this Committee that a detailed resurvey of the coalfields containing metallurgical coal was necessary.

6. We have, therefore, sent out questionnaires, *vide* Appendix I, later amended by Appendix II, to (a) all the Collieries producing metallurgical coal, (b) Collieries producing semi-coking or feebly coking coal, (c) Collieries producing coking coal with high ash and (d) Collieries producing non-coking coal in the Provinces of Bengal, Bihar, Orissa and some Collieries in the C. P. including Pench Valley.

7. We requested the Collieries to furnish not only the total quantity available of each category or class of coal but also the average annual production, the estimated reserves and the future possibilities from each mine. This information was necessary for the Committee when they came to consider the replacement of metallurgical coal. It is important to know whether the Collieries producing non-coking coal can increase their output substantially.

8. Realising that the questionnaire might meet with the same fate as the questionnaires that were circulated by the Indian Coalfields Committee, we felt that if we left it to the individual collieries it was likely that we would not receive replies from all the Collieries as some of them might find it difficult to answer the questions in detail. It was then decided that we should take full advantage of the Coal Commissioner's Organisation.

9. The Coal Commissioner and the Chief Mining Engineer, Railway Board, very kindly agreed to place the Coal Superintendent

together with 5 Asstt. Coal Superintendents and 25 Inspectors at the disposal of the Member-Secretary, Conservation of Metallurgical Coal Committee, to enable them to contact the collieries personally and obtain the replies to our questionnaire. This was a more direct approach. The procedure adopted was that each Asstt. Coal Superintendent in his division visited a particular colliery along with the Inspectors and had a personal discussion with the Managerial staff, and worked out the total quantity of coal at the Colliery after going through all the records. In some of the bigger groups of Collieries, the Chief Mining Engineers of the particular group preferred to work out the details themselves and send the replies together with the plans and data to the Member-Secretary. The Member-Secretary, in consultation with the Chief Mining Engineers of various Companies, arranged that the data supplied by these Companies were checked up and correct assessment made by the Assistant Coal Superintendent with the Colliery staff. This enabled the Coal Superintendent's staff to assess the actual quantity available from each mine.

10. This checking will take a long time as the data are to be checked from each individual colliery and actual quantity determined. We are receiving and hope we shall continue to receive full co-operation from the Mining Industry.

11. While making this assessment, differences of opinion as regards the total availability of metallurgical coal and what portion of it can be extracted, arose between the Colliery staff and Coal Superintendent's staff. The Member-Secretary at this stage approached the Chief Inspector of Mines with a request to throw in his knowledge and that of his staff to the aid of the Coal Superintendent and his Officers to ascertain as to what extent the figures of reserves submitted by the Collieries should be accepted as a true guide of total reserves. At the invitation of the Committee, the Chief Inspector of Mines attended one of the meetings of the Committee. After comprehensive discussion of all the aspects, the members were of the opinion that a joint survey under the auspices of the Geological Survey of India, Chief Inspector of Mines and the Coal Superintendent, Dhanbad, should be made.

12. The Ministry of Industry and Supply in their Memorandum No. Coal-II(16)/49, dated the 8th August 1949, appointed Mr. N. G. Chatterjee, Deputy Chief Inspector of Mines in India, as a Member of this Committee and the Ministry of Works, Mines and Power requested the Director, Geological Survey of India, to place an Officer from his department to assist the Member-Secretary in the assessment of the reserves of metallurgical coal.

13. This Survey will require a few months for its completion. Meanwhile the Committee are issuing these interim observations which are subject to modification later, in order to show the trend of the evidence now before them which is alarming in the case of the higher grade coking coal of the Jharia coalfields, and the available evidence so far would appear to confirm the remarks made by the Indian Coalfields Committee in 1946

14. A questionnaire has also been sent out to Messrs. Tata Iron & Steel Company, Indian Iron & Steel Company and Mysore Iron & Steel Company requesting them to indicate the minimum standard for metallurgical coal and coke and whether the standard shown in the Indian Coalfields Committee's Report should be adhered to.

15. Messrs. Tata Iron & Steel Company have indicated to the Indian Coalfields Committee that caking index should be 15 (Tata's Index*) and the ash content below 17 per cent. We have thought it worthwhile to ascertain the current specification of metallurgical coal from Iron and Steel Producers in other countries for comparative purposes. Certain foreign firms like Koppers maintain that they have been able to use low grade weakly coking, high oxygen content coals for metallurgical coke production. They state that the entire Western Steel Industry in the United States, which now produces approximately 3 million tons of Steel Products per year, is based upon Utah coal which had been hitherto considered to be of no use for metallurgical purposes. Koppers developed a design of coke ovens and a method of operating these ovens which resulted in the production of satisfactory metallurgical coke from the Utah coals.

16. It devolved upon Koppers to develop plant and practice which would produce an usable metallurgical coke from these Western coals for the reason that they were the only coals available and if they could not be properly coked, there would be no Steel Industry in the West. If they had used the normal oven design current in the Eastern Industrial area of the United States in England and in Germany, the Western American coals simply would not coke.

17. Mr. Carvlin, Vice-President of the Koppers Company, states that with the proper design of Coke Ovens and with the proper operating technique, blast furnace practice can be achieved in India which will be equal or even superior to present practice, with a substantial proportion of low grade coking coals in the blend charged to the coke ovens. He further maintains that their type of coke ovens would give substantially higher yield of by-products (ammonium sulphate, tar and benzols) than the ovens which are commonly used in India. It seems to us that actual tests should be carried out in India with Indian coals for deciding whether this claim can be sustained.

18. In the meantime, we shall accept the definition of metallurgical coal as indicated in the Indian Coalfields Committee's Report, 1946. The definition of metallurgical coal as given by the Tata Iron & Steel Company to the Indian Coalfields Committee is reproduced below:--

"Detailed specifications of suitable coking coal (relating to samples dried at 105° C.).

- (a) Swelling Properties . . . must be non-swelling.
- (b) Phosphorus below 0.15 per cent.

* British Standard Index is 1.5 times Tata's Index, e.g., Tata's Index of 15 is equal to British Standard Index 21.

- (c) Sulphur below 0.6 per cent.
- (d) Caking Index 15 and above.
- (e) Ash below 17 per cent.
- (f) Volatile matter 26 per cent.
- (g) Fixed Carbon 57 to 58 per cent."

Explaining the specifications further, they have stated that the coal should—

- “(i) not swell on being carbonised, as otherwise the walls of the coke ovens will be injured ;
- (ii) not be too high in phosphorus content in view of technical difficulties in its removal to an extent that will yield a steel with a sufficiently low phosphorus content ;
- (iii) not be too high in sulphur content, as otherwise a vicious circle of more limestone and more heat to remove the sulphur in the blast furnace and thus more coke and more sulphur input is created ;
- (iv) have coking properties ;
- (v) have the ability to make a coke of certain physical characteristics, viz., strength, hardness, size and porosity, which for good coke are fixed by the following recognised standards:—

Shatter Index	Over 82/92.
Haven's stability	Over 50.0 per cent.
Breslau's Hardness	Over 80.0 per cent. (over 40 mm. indicating hard coke).
Porosity	Over 42.0 per cent.
Size over 3"	50 to 60 per cent.
Size 2" to 3"	35 to 45 per cent.

- (vi) have a carbon content high enough to give a coke with at least 75 per cent. of carbon ; and
- (vii) have an ash content as low and as uniform as possible, the higher the ash the more limestone is needed which in turn calls for more heat, more coke and more ash. The maximum ash that can be tolerated in the coke is 22.5 per cent. and if there is an increase over this figure difficulties in operation are encountered.”*

High Quality Coking Coal—

19. *Jharia.*—The Steel Industry in India was relying upon the high quality coking coal available from the following seams of Jharia Coalfield:—

12, 13, 14, 14A, 15, 17 and 18.

* Further revised specification of coking coal and coke which has just been received jointly from Tata Iron & Steel and Indian Iron & Steel Companies, will be considered in our final report.

Later, as the supply of slack coal from these seams dwindled, the Steel Industry gradually switched over to 16, 16A, 11 and 10 seams of the Jharia Coalfields. On some occasions both Tata Iron & Steel Co. Ltd. and Indian Iron & Steel Company Ltd. have accepted Kargali slack coal from Bokaro Colliery. It seems that the seams of Laikdih Series* conform to the true characteristics of coking coal and the Steel Industries have liberally accepted supplies from collieries mining this coal.

20. Coal seams of selected grade in Jharia Coalfields between 12 and 18 can definitely be used for purposes of manufacturing good metallurgical coke as also certain sections of No. 11 and No. 10 seams in a restricted area. The No. 10 seam is rather high in ash but contains large potential reserves of good quality coking coal. If modern Coal Washeries can reduce the ash sufficiently it will be found a most valuable reserve. This appears probable.

21. *Giridih*.—The coal from Giridih Coalfields, especially from the Upper and Lower Kurhurbaree Seams, is one of the best coking coals available in India with low ash and low phosphorus. (The seams of the Laikdih Series are generally low in phosphorus.) There is still a reserve of approximately 13 to 16 million tons of selected grades coking coal available in Giridih Colliery after allowing for losses. Further there is reason to believe that if deep borings are carried out in the Giridih Coalfield it may lead to the discovery of increased reserve.

22. Dishergarh, Poniati, Sanctoria and Tropsi Seams cannot be used by themselves for the manufacture of metallurgical coke but they can definitely be used in blends with low volatile coking coal of high caking index of the Jharia Coalfields.

East and West Bokaro Coalfields—

23. Recent tests have proved that certain seams of the East and West Bokaro Coalfields are capable of beneficiation and will yield coal of good metallurgical quality which will be acceptable to the Steel Industry. The East Bokaro Coalfield which is being worked by the Railway Group of Collieries and Messrs. Anderson, Wright & Co. has also been proved and there are known reserves in this area. Messrs. Anderson, Wright & Co. with the help of the Geological Survey of India have carried out detailed survey of the West Bokaro Coalfield which is expected to yield promising results.

24. Reports have been received that the coal available from Damua and Kalichapa in the PENCH Coalfields in C. P. shows fairly good coking properties but the analytical results which we have seen so far, indicate that it can be used only if blended with superior coking coal of the Jharia Coalfields. There is a vast reserve of coking coal in Assam and in the new Coalfields in the Garo Hills, but the sulphur content of these coals is generally high and the coke is only of moderate strength. It is not possible to consider them in our report until a method can be found for desulphurisation of the Assam coal.

* Laikdih Series includes Ramnagar, Laikdih and Begunia seams.

The long lead alone may make it uneconomical for use in the existing steel plants.

Reserves of Coking Coal—

25. In 1946 the Indian Coalfields Committee estimated a reserve of 750 million tons coking coal in the Jharia and Raniganj fields. The Indian Coalfields Committee, however, did not indicate whether this reserve had been accepted after allowing for inevitable losses on extraction. We are of the opinion that this reserve of 750 million tons can only be considered as coal now existing either on pillars or in virgin areas and does not allow for extraction losses. Our recent inspections of the Mines and detailed knowledge which we have gained during our course of enquiry have shown that the major portion of this coal is standing on pillars. Where these pillars are of adequate size and galleries have been driven in conformity with the present regulations there is no need for apprehension that the coal will be lost, especially if suitable stowing methods are adopted. Some of the old mines, especially those producing high grade coking coal, had been developed many years ago before the Indian Coal Mines Regulation No. 77 came into being when there was practically no control or supervision about the size of pillars and height of galleries. The result is that there are some old mines in which the workings do not conform to the modern standards of development. It is, therefore, likely that a substantial part of the reserves shown in the Indian Coalfields Committee's Report, 1946, will not be available. Attempt to extract these pillars in some of the old workings has resulted and is likely to result in the loss of adjacent pillars due to over-riding. There are certain cases where stabilisation by sand stowing is so uneconomic that it cannot be recommended. The actual tonnage of available metallurgical coal, in our opinion, is likely to be less than the figure of 750 million tons in the Jharia and Raniganj Coalfields as shown in the Indian Coalfields Committee's Report.

26. The report issued by the Fuel Research Committee, Council of Scientific and Industrial Research, on blending of coal for coking has shown that it is possible to blend feebly coking and non-coking coal with good coking coal and produce sound metallurgical coke. The Indian Coalfields Committee's Report (1946) estimated the reserves at 750 million tons for good coking coal in the Jharia and Raniganj Coalfields. Some of these, as already shown, are not recoverable and some 50 million tons have been extracted during the last three or four years. At present it is not possible to give the precise figures about the reserves but it has been shown in the Report mentioned above that these reserves will be increased by 30 per cent. if suitable coal is blended with them. The reserves of blendable coal are ample as compared to the reserves of parent coking coal.

27. The quality of the coking coal available from Jharia No. 10 and 11 seams and Kargali Seam of the East Bokaro Coalfield has been determined and if washed, these coals will, no doubt, add to the total reserves of coking coal considerably.

28. We understand that Steel Companies prefer slack to run-of-mine because—

- (a) Run-of-Mine coal generally is approximately 2 per cent. higher in ash than slack coal and
- (b) The Receiving Bunkers are not designed to receive coal more than 4" size.

29. The Steel Companies are prepared to accept Run-of-Mine coal not exceeding 4" in size, provided the coal conforms to specification.

30. *Coal Washing*.—Randall, in 1924 and 1925, carried out certain froth flotation tests with selected grade coals of Jharia Coalfields. Mr. Farquhar in his Foreword to the Report on the Washability of Indian Coals by Forrester and Mazumdar states that these early investigations did not yield promising results. He remarks, "the Industry too readily concluded that Indian coals in general were not amenable to coal beneficiation and this unfortunately led to the discouragement of further research and probably retarded progress for two decades. Credit is due to those who did not concur in the popular conclusions of the industry and who consistently pursued their enquiries and have now established that Indian coals, although more difficult, are amenable to treatment and that it is only a question of selection of Plant, Comparative losses, and costs of beneficiation".

31. With the exhaustion of the seams containing better grades of coking coal and the adoption of mechanical mining methods of production, it is becoming more and more necessary to clean the inferior grades of coal so that the raw coal may be freed from the associated mineral impurities, largely shale. In the Indian Coalfields, except those in Assam and the parts of the Himalayas, the Gondwana coals are difficult to wash because much of the shaly matter is intergrown with the coal substance. By contrast, in most American and British coals, the shale and the other impurities occur largely as distinct as separable lumps or layers.

32. Forrester and Mazumdar, whose work is summarised in the Report of Washability of Indian Coals (1947) stated that 141 samples were taken and 196 tests were carried out on those samples. They concentrated their attention largely on the high ash coking coals of the Jharia Coalfield which had not been investigated by Randall. A Plan indicating the places from where samples have been drawn with brief results can be seen in Appendix No. III to this Report.

33. A few extracts from the Report on the Washability of Indian Coals are given below:—

"One of the most significant points that emerge from those investigations is one to which attention has been drawn from time to time in recent years, namely, the essential difference between the Gondwana coals and the bituminous coals of Britain. In general, the high-ash portions of

British coals are less intimately mixed with the rest of the coal substance than is the case with the Gondwana coals, occurring, as they often do (in the British coals), as separate lenticular masses, or layers or bands of varying thicknesses, of what the miner calls shale and containing upwards of 65 per cent. of ash forming minerals. As the coal breaks up in the ordinary course of mining and subsequent handling, many of these pieces of 'shale' separate out and accumulate among the smaller screen sizes. These latter are, in consequence, of much poorer quality (as measured by ash content) than is the run-of-mine coal and much more so, in consequence, than coal of the intermediate screen sizes.

On the other hand, it is the exception, rather than the rule, to find isolated lenticular masses or even smaller pieces of very high-ash 'shale' inter-calated in the Gondwana coals of India. The counterpart in India, of the 'shale' of British coals is the relatively high-ash stony coal. As there is, in most cases, a gradation from low-ash to high-ash coal and *vice versa* throughout the seams, there cannot be such a hard and fast differentiation between the 'clean coal' and the dirt. As a further consequence, the dirt or shale separable from these Indian coals is not of such a high ash content as is its counterpart in the British bituminous coals. That means, of course, that in the dirt in the Indian coals there is a much greater amount of carbonaceous substance—potential fuel—than in the dirt of the British coals. Much of the 'dirt' of the Indian coals, would, therefore, be too valuable to throw away."

34. The separation of coal from its impurities, in all ordinary coal washing, primarily depends on the difference of density of coal on the one hand and that of the mineral impurities on the other. The size and the shape of coal particles to be washed, however, decides to some extent the type of washeries to be employed. The commonest coal washeries are of the Jig type but modern trends, especially for large and difficult coals, are towards the development of heavy-medium washeries generally known as Gravity Washers. The principle of these Gravity Washers is that the required effective gravity (apparent) of liquid is maintained by keeping fine particles of sand or other solids in suspension. There are several dense-medium cleaning processes now in use, such as the Barvoys, Chance, Tromp, Simon-Carves, American Cynamide, etc., and of course numerous Jig Washers.

35. In washing Indian coal it is sometime possible to obtain from 50 to 60 per cent. of washed coal with an ash content of 16 or 17 per cent. These yields are not uneconomic. Where, however, the yield is small, the rejects or middlings should be saleable, i.e., ash content should not exceed 35 per cent. or so. Assessment of the best procedure can be made only after careful study of the washability of the coals. The needs of the market have at the same time to be

remembered. In this respect the education of the Consumers is vital. Future steam Power Plants near the Washeries should, as far as possible, be designed to consume washery middlings and/or rejects.

36. We consider, therefore, that the investigations into washability and blending have proved that (1) Indian coals are amenable to washing and (2) the life of the coking coal can be increased considerably by washing and by suitable blending. There are large potential reserves in No. 10 and 11 Seams of the Jharia field and in the seams in the East and West Bokaro Coalfields. These coals are high in ash and should be washed.

37. In a written Memorandum submitted to the Committee, concurring with the opinion of many others, Dr. Lahiri states that "the investigations on washability and blending of coals have given hope for fuller and more extensive utilisation of Jharia coals which are almost entirely of coking quality. It has been shown that many of the seams are capable of yielding fractions suitable for manufacture of coke and production of clean coal for other purposes. The quality of blending give a definite promise of extension of life of our coking coal resources. It would be rash to predict, but the life of our coking coal reserves could be doubled if the results of these investigations were utilised in practice and steps were taken to avoid waste. If, however, the results are not rapidly implemented then the promises are only of academic interest. If the good coking coals are wasted and exhausted then obviously there will be little to blend with. Similarly if the inferior grades of coals are not washed now the better qualities of other types of coals will also approach rapid exhaustion."

38. No Coal Washeries are yet in operation in India. Two Washeries are under erection, one of which should be in operation by the end of 1950 and the other early in 1951.

39. We have been told that the manufacturers of these Plants have guaranteed the performance of the Washeries. We have been in touch with various makers of Coal Washery Plants. As the details of all the coals to be washed and cuts which would be made for the clean coal could not be indicated to these firms, it was not possible for them to give firm quotations. The choice and performance of a Coal Washery depends on the washability characteristics of the coal and the sizes of the coal to be washed. Further they have given the approximate cost of Plants of 100 tons, 200 tons and 300 tons capacity per hour, as shown below. The cost appended below is exclusive of civil works in some cases and Screening Plants for screening and sizing the coal and Blending Plant which may have to be put up in connection with the Washery.

	100 Tons.	200 Tons.	300 Tons.
<i>Coppee Company.</i>			
Coal handling	{ £8,500	{ £17,000	{ £25,000
	{ Rs. 1,14,750	{ Rs. 2,29,500	{ Rs. 3,37,500
Building (steel & asbestos sheeting)	{ £17,500	{ £30,000	{ £45,000
	{ Rs. 2,36,250	{ Rs. 4,05,000	{ Rs. 6,07,500
Washery apparatus	{ £39,000	{ £55,000	{ £70,000
	{ Rs. 5,26,500	{ Rs. 7,42,500	{ Rs. 9,45,000
Motors & Controllers	{ £2,000	{ £5,000	{ £8,000
	{ Rs. 27,000	{ Rs. 67,500	{ Rs. 1,08,000
Crushing, Mixing & Bunkers	{ £29,000	{ £44,000	{ £60,000
	{ Rs. 3,91,500	{ Rs. 5,94,000	{ Rs. 8,10,000
Total	{ £96,000	{ £1,51,000	{ £2,08,000
	{ Rs.12,96,000	{ Rs. 20,38,500	{ Rs. 28,08,000

(Figures are liable to vary widely according to local considerations.)

1. The prices are for Baum Washeries if they were erected in England.

2. Assuming that the coal treated would be 4" to 0.

3. There will be no re-washing provided, considering that it is intended to use the rejects for power generation.

	100 Tons.	200 Tons.	300 Tons.
<i>Fraser & Chalmers Engineering Works.</i>			
Raw Coal handling and Bunkers. Washery Plant to handle all sizes + $\frac{1}{4}$ " Steel Framed Building, Refuse Disposal Conveyor, Electrical Equipment, Civil work, Foundations, Lighting & Cablework—			
Total cost installed, say	Rs. 19,00,000	Rs. 27,00,000	Rs. 33,00,000
Total cost per ton/Hr. capacity	19,000	13,500	11,000
<i>Annual Charges.</i>			
Capital Int. & Depr. @ 15% per Annum	Rs. 2,85,000	Rs. 4,05,000	Rs. 5,00,000
Total Input per Annum 20 hrs. for 350 days tons	700,000	1,400,000	2,100,000
Annual Capital Charge say As/Ton	6.5	4.6	3.8
Operating labour, Sand, Power, Maintenance, Insurance and Administration say As/Ton.	5	4	3
	11.8	8.6	6.8
<i>Colliery Engineering Ltd.</i>			
Approximate total capital cost	{ £80,000	{ £1,50,000	{ £1,85,000
	{ Rs.10,80,000	{ Rs.20,25,000	{ Rs.24,97,500

(The approximate prices may give an indication of the total cost of coal washing plants, having the usual type of buildings and inclusive of electrical equipment, completely erected on the site, and inclusive of the normal mechanical handling plant required to deliver the raw coal to the plant and for the disposal of the washed coal, including breaking same.)

	100 Tons.	200 Tons.	300 Tons.
<i>Simon-Carves Ltd.</i>			
Raw Coal Handling. Coal Washing Plant to handle 1'-0" Steel framed buildings, brick panelled or sheeted Foundations. Electrical Equipment.			
Approximate installed cost	Rs. 19,00,000	Rs. 28,00,000	Rs. 32,50,000
Operating costs As/Per ton	4.5	3.5	2.8
<i>Woodall-Duckham Co.</i>			
Total prices of Coal Handling, Blending and Crushing Plant	{ £2,00,000	{ £2,85,000	{ £3,75,000
	{ Rs.27,00,000	{ Rs. 38,47,500	{ Rs. 50,62,500
Prices for the Blending Bunker with associa- ted conveyors and equipment, as included in the above totals	{ £65,000	{ £90,000	{ £1,25,000
	{ Rs. 8,77,500	{ Rs. 12,15,000	{ Rs. 16,87,500

(The prices have been prepared on the basis of plant manufactured and erected in England, and are extremely approximate. The scheme adopted in each case commences at railway sidings where track hoppers are situated, arranged for emptying of the wagons by bottom outlet doors. Tipplers are included to deal with any wagons which may not be equipped for bottom dumping.)

40. It is the considered opinion of this Committee that Washing Plants should be installed as soon as possible to treat all coking coals high in ash but with high caking index which can be economically washed. The size and the location of these Washeries will depend on the amount of coal and the sources of the coal to be washed. The Committee also considers that proper facilities for large scale research on the washability of Indian coals should be provided in the Fuel Research Institute.

41. It will thus be seen from the figures we have quoted that the capital cost of Washeries is considerable. We have given careful consideration to the method by which Washeries should be financed and who should be responsible for installing and operating them. Four principal suggestions as to the interests by whom Washeries should be erected have received our consideration—

- (a) Producers.
- (b) Consumers.
- (c) Government.
- (d) Public financed Co-operations to be specially floated for the purpose.

(a) *Producers.*—In the majority of cases, the Producers of raw materials and commodities treat them in such a way as to make them fit for use or consumption. As far as our information goes, in other Countries of the World Coal Washeries have been installed at the expense of Producers and not of Consumers. As far as we can ascertain, however, there is little or no prospect that, in the present depressed state of the capital market, it will be possible for colliery owners to raise additional finance for Washeries. It may be expected, however, that these conditions will not last long, and in due course there may be some Colliery Owners who will be prepared to construct Washeries, provided there is sufficient financial inducement to encourage such enterprise. We suggest that the best method would be a sliding scale of bonus based upon the ash percentage of the various grades of washed coal. We shall make definite proposals on this subject in our final Report.

(b) *Consumers.*—Certain of the Producers' Interests are emphatic that as coal washing is solely for the benefit of the Consumers it is incumbent upon the latter to instal and operate Washeries either at the Steel Works or in the Colliery area. Consumers, on the other hand, strongly resist this argument and maintain that beneficiation is in the national interest as well as that of Consumers, and that in conformity with the practice in vogue in the world, washing is the responsibility of the Producers. Here again there is the difficulty regarding finance.

(c) *Government.*—It has also been argued before us that in the interest of the national economy Government are even more vitally concerned than Producers or Consumers in the proper conservation and utilisation of the Country's fuel resources. It has, therefore, been suggested that Government should take upon themselves the responsibility for financing and operating Central Washeries in the Coalfields. It may be pointed out in this connection that the larger the Washery the more economic it is both in capital and in operating cost. With the comparatively small coal producing units in this Country, Central Washeries will be more economic than smaller washeries at individual collieries.

(d) *Washing Corporation.*—It has been suggested that a Corporation might be floated with public money to instal and operate Washeries. There are such Corporations in existence in other Countries and *primâ facie*, there is no reason why they should not be formed in this Country, but here again the financial difficulty arises to which reference has already been made, and obviously satisfactory financial inducement as indicated above [in item (a)] would also be necessary.

42. As this is a controversial issue we content ourselves at this stage with putting forward, for the consideration of the Government, the various alternatives which have been proposed.

43. In our final Report we propose to make specific recommendations separately for the three categories of metallurgical coal. *viz*

(1) Parent coal which will make good metallurgical coke without

recourse to washing or blending, (2) Washable coal which after washing could yield a sufficient quantity of good parent metallurgical coal and (c) Blendable coal, i.e., coal which could be used only for blending in varying proportions with parent metallurgical coal.

44. In the present Report we are confining our recommendations to only category (1) above for the obvious reason that measures for conservation could be started at once with this category of coal which does not require any beneficiation, and the amount of blending that could be done will be wholly dependent on the available reserves of parent coking coal.

45. *Blending.*—Blending of non-coking or feebly coking coals with good coking coals is regarded as a means for extension of lease of life for the coking coal reserves of our Country. To this end, investigations were carried out on blending of coals and a report has recently been published.

46. According to the Coal Blending Report, coals of a (Tatas) caking index of 13 or 14 may be used to the extent of 30 to 40 per cent. with a good coking coal of caking index 15 and over and the blend will yield sound metallurgical coke. Coals of caking index 8 to 12 can be mixed to the extent of 20 to 30 per cent. and coal of caking index below 8 to the extent of 10 to 20 per cent. with the good coking coal. * (See foot note.) The high ash content of some of the coals below 10 seam of the Jharia field precludes their immediate utilisation for coke manufacture unless they are used in blends with other coals of sufficiently low ash content.

47. These high ash coking coals may be washed to reduce their ash content and thus render them suitable as parent coking coal.

48. The Caking Index of Seams of the Jharia Coalfield below No. 10 Seam has been tabulated in the Report together with their analysis in the coal blending report and it is seen that the caking index of these coals varies widely and there is a general loss of caking power with increase in the ash content.

49. It is clear, therefore, that the fundamental issue involved is that of the quantity of parent coal which will eventually be available. The exact figures for the reserves of such parent coal cannot be given until the Fuel Research Institute completes the survey of the physical and chemical properties of Indian coals together with the washability tests. This work should be accelerated and necessary finance and staff made available, at the earliest opportunity.

50. In a previous paragraph it has been stated that it is quite feasible to blend semi-coking coals with parent coal. The Committee feel it desirable to recommend that the Steel Companies undertake blending of coals and use such blends for coke manufacture. At the same time the Committee is of opinion that until the use of good

* The good coking coal with caking index of 15 (Tatas) and above will, for the present purpose, be referred to as Parent coking coal. The coal that can be blended with this is called Blendable coal. The reserves of blendable coal are of course very much greater than the parent coal. The ash content also is an important bearing in lowering coke strength.

coking coal, *i.e.*, parent coal, for purposes other than the manufacture of metallurgical coke is stopped, no very useful purpose will be served by expecting the Steel Industry to do this.

51. *Conservation.*—In the absence of Coal Washeries the Steel Industry will have to rely on 'Selected Grades' coking coals for their source of supply, as they will not be able to utilise high ash coking coal without beneficiation. We may, therefore, for all purposes, confine ourselves to the total production of Selected 'A' and 'B' of the Jharia, Ramnagar and Laikdih and Giridih (Kurhurbaree Seams). The total production of the Selected Grades for the year 1948 will be approximately 6.82 million tons. The Steel Industries are utilising approximately 2.5 million tons per annum. We are informed that the Steel Industry may require another one million tons when on full production. The Coal Commissioner informs the Member-Secretary that approximately 3 million tons of coking coal and 240,000 tons of coking coal will be required respectively for the proposed two new Steel Plants and the Sindri Fertiliser Factory. The immediate demand will, therefore, be 2.5 plus 1 million tons for the operating Steel Industries, 0.24 million tons for Sindri and 1.5 million tons for the proposed two new Steel Plants of half a million ton unit each, thus making a total of 5.24 million tons. There is nothing definite about the two proposed Steel Plants. We may, for the purpose of this Interim Report, ignore them and consider the demand to be 3.74 million tons. If the demand for Rolling Mills, Cupolas and other Consumers of hard coke are taken into consideration, the total demand will then come to about 4 million tons. It will, therefore, be necessary to suggest conservation (restriction in use and production) of approximately 2.82 million tons of only Selected Grades, and 7.98 million tons of all grades up to and including Grade II.

52. The Indian Coalfields Committee in its Report suggested that the first step in the conservation of coking coal was primarily to restrict the use of good coking coal for the Iron and Steel Industry only by the cessation of supplies of such coal to (a) Railways, (b) Bunkers and exports and (c) Consumers other than bore Ovens. We concur. We are of the opinion that the use of good coking coal should be restricted and at the first stage the supply to the Railways and for shipment and Bunkering should be curtailed. The Coal Commissioner in his Note to the Member-Secretary has stated that 403,500 tons of coking coal per month (Selected A to Grade II) and 66,000 tons of coking coal per month (Selected A to Grade II) are now being supplied to the Railways and to the Docks for shipment, respectively. Out of these, approximately 159,500 tons of Selected A and B are being supplied to the Railways, and approximately 53,000 tons of Selected 'A' and 'B' grades to the Docks for shipment, making a total of 212,500 tons (say 213,000 tons) a month.

53. The problem is to effect a replacement of this 2.8 million tons of good coking coal by suitable non-coking coal as far as practicable. To effect this in the course of two years it would be necessary to make provision for the replacement of about 120,000 tons of such coal per

month in the first year and a further 120,000 tons per month in the second year, which would mean a replacement of about 200 wagons per day during the first year and 400 wagons per day during the second year. The replacement by non-coking coal will have to be made from the various coalfields, keeping in view the requirement of the Railways and the necessity of shipping only very good quality of coal for bunkering and export. Coal necessary for replacement, for other Industries, may be obtained from the following fields:

Raniganj, Karanpura, Pench, Central India Coalfields and Jharia (lower grade coals).

54. In this connection we wish to emphasise that the replacement should not be made from coking coals of Grade I and Grade II particularly of the Jharia and Bokaro fields.

55. Conservation will not be effective unless Steel Industries are enabled to utilise all Selected 'A' and 'B' grades coking coals which are produced by the Mines, but much of this coal is of a large size and the Steel Companies have, in the past, preferred to take only slack. We understand they are now prepared to take run-of-mine coal provided it is not more than 4" in size and conforms to specification. It will be necessary to compensate the Producers for breaking charges.

56. Though the Coal Mining Committee, the Indian Coalfields Committee and various other Committees have, from time to time, stressed the necessity of using lower grade fuels for stationary boilers, nothing tangible appears to have been done.

57. The cleaning of Indian coals cannot be a Commercial success unless steps are taken to utilise rejects and/or middlings from Washeries. Large Thermal Power Stations may be erected adjacent to the Washery Plants to serve the needs of the Collieries and the electric grid. Unless large scale power generation is undertaken from the high ash rejects from the Washeries and also from the high ash coal of the Jharia lower coal seams, the conservation of high grade metallurgical coal becomes almost impossible.

58. In this connection it may be worthwhile to quote a typical case in Europe of a generating station producing 100 mega-watts from pulverised fuel in the Pas-de-Calais coalfields of France, where inferior coal containing 30 to 35 per cent. ash with approximately 10 per cent. of moisture is employed and high thermal efficiency is being obtained.

59. In future, stationary Boiler Plants should not be permitted to use superior grades of coking coal for steam raising. The railways should be encouraged to use the lowest grades of coal compatible with sound economy of running.

60. The attention of the Government is drawn to the fact that many collieries are using high grade metallurgical coal for steam raising in stationary boilers. The ideal action, perhaps, will be for those collieries to take electricity from a Power Supply Co., failing which to produce their own electricity by using inferior grades of coal. We quite appreciate that at present it may not be possible to

give effect to these recommendations immediately, but wherever possible inferior coal should be used for steam raising. The competent authority may be given statutory powers to enforce any order that may be promulgated in this connection.

61. *Stowing*.—In pursuance of the Coal Mines Safety Stowing Act, a Coal Mine Stowing Board was created in 1st November 1939. This Board has authority to grant assistance for the following purposes only:—

- (a) For stowing or other protective measures which are required to be undertaken by an order issued by the Chief Inspector of Mines in India under Section 9(3) of the Act, (b) for any protective measures essential for the effective prevention of the spread of fire to or inundation by water of, any coal mine from an area adjacent to it, (c) for stowing operations voluntarily undertaken in the interests of safety and (d) for research connected with safety in mines.

62. We thus observe that the Act is limited in its scope in that stowing can be enforced by the Chief Inspector of Mines only for purpose of safety and not for conservation. We feel that the time has come for enforcing stowing for conservation also. It may be possible in our final report to indicate the Collieries which should receive attention in this respect. Meanwhile we recommend that grant of assistance for stowing for the purpose of conservation should be given and the Chief Inspector of Mines, after taking competent advice, should be empowered to order stowing for conservation. In other words, the Coal Mines Safety Stowing Act should be enlarged to cover stowing for conservation as well. In some cases it may be uneconomical, to start stowing as stabilisation of underground workings in some old mines will not be feasible nor remunerative. The Chief Inspector of Mines may again be consulted in such cases. But in all cases he should instruct the Stowing Board to compel certain collieries to stow all underground workings where coking coal is being recovered. Financial assistance should be given to the collieries compelled to stow for conservation purpose. It is suggested that this assistance should be on a tonnage basis so that a clear picture of profit and loss and whether stowing is economical for conservation can be obtained within a reasonable period.

63. Doubts have been expressed in some quarters about the sufficiency of supplies of sand and the adequacy of the transport of sand from the river to the Colliery sand Bunkers. Certain collieries have successfully used surface and other rocks after crushing and boiler ashes with some admixture of sand. The sand Stowing Board, Research Department should investigate this matter thoroughly and suggest alternative stowing materials wherever there is a shortage of sand. Priority should be given to those collieries which have been directed to stow for conservation of coking coal. Compulsory sand stowing, in many cases, will in itself reduce the output of collieries considerably.

64. We are informed that the Coal Commissioner does not at present sanction the opening of new collieries in virgin coalfields possessing high grade metallurgical coal. It is desirable also that permission to open old collieries which have been closed and which contain high grade metallurgical coal should generally be refused.

65. We have recommended a reduction of 120,000 tons per month of Selected 'A' & 'B' grades metallurgical coal during the first year. This reduction should be effected equitably amongst all the collieries producing this class of coal and on the basis of their production during the last two years. Additional considerations suggested are:—

- (1) Collieries which supply coal solely for the purpose of coking should receive favourable consideration in restriction of output.
- (2) Collieries where restriction may involve total loss of coals standing in pillars will also have to receive special consideration. This will arise in cases of those collieries whose life is short and where shutting down the mine may mean total loss.
- (3) Collieries producing washed coal should receive special consideration.

66. The Government of India may set up a small Committee to examine and report on all special cases in order to determine the restriction of output that will have to be enforced. The Committee may consist of the Chief Inspector of Mines, a representative of the Coal Commissioner and the Director, Fuel Research Institute. It may be empowered to take other expert advice, if necessary.

67. Summarising we feel that the success of the policy of conservation depends on how soon arrangements can be made for replacing high grade coking coal by non-coking coal. Long-term planning is necessary both on the part of the Mines and on the part of the Railways. Active co-operation of the Railways will be necessary.

68. *Conclusions and Recommendations—*

(1) Recent experiments have proved that some Indian coals are amenable to washing and the reserve of good quality coking coal can definitely be increased by beneficiation. Steps should be immediately taken for installation of Coal Washeries.

From some figures we have received from Manufacturers of Coal Washing Plants it would appear that something like 35 to 50 lakhs of rupees will be necessary for erection of a Plant of 300 tons per hour capacity. Installation of Coal Washeries may be done by (a) Producers, (b) Consumers, (c) Government or (d) Public financed Washing Corporation.

From figures we have been able to gather it is likely that the cost of washing will amount to about Re. 1 per ton excluding handling and transport and loss on rejects. The up-grading which will result from washing, may not be sufficient under the present grading structure to cover the total cost of washing and an increased price will, therefore, have to be paid for washed coal.

(2) Blending of semi-coking coal with parent coking coal can be carried out and approximately 30 per cent. increase in the reserve of the coking coal can be expected by correct blending.

(3) We suggest that the production of Selected 'A' and 'B' grades of coking coal should be restricted to the extent of 1.4 million tons in the first year and a further 1.4 million tons in the second year. This would mean a replacement of about 200 wagons per day of coking coal by other coal in the first year. It should be possible to restrict the supply of the coking coal to the Railways, to the Docks (for shipment) and other Consumers, probably in the above order. Steps should be taken at once to increase production of non-coking coal. It will be necessary to effect replacement of coking coal by non-coking coal from various fields.

(4) The Government should encourage Collieries producing non-coking coal to increase their output so that the restriction of coking coal to the manufacture of metallurgical coke will be effected within a reasonable time.

Meanwhile there should be no increase in output of grade I and grade II coking coal, but for the time being there need not be any restriction on the output of grade III, so far as conservation aspect is concerned.

(5) Active co-operation and goodwill of the Ministry of Railways are necessary to carry this out successfully.

(6) Compulsory stowing for conservation of metallurgical coal should immediately be undertaken in order to achieve conservation in extraction and to minimise losses.

(7) Early steps should be taken to utilise middlings and rejects from Washeries in large Thermal Power Stations and Stationary Boilers.

(8) An Advisory Committee consisting of the Chief Inspector of Mines, Representative of Coal Commissioner and the Director, Fuel Research Institute, should be constituted to advise upon special cases concerning the restriction of output of coking coal.

(9) The Committee recommends that Steel Companies should accept run-of-mine coal, provided that it is up to specification both in regard to ash content and size.

(10) The restriction of output of Selected 'A' and 'B' grades of coking coal may affect labour employed in collieries producing those classes of coal. It is recommended that suitable alternative employment should be found for the displaced labour. In matter of compensation Government may take action in accordance with the decisions reached on the Report of the Surplus Labour Committee, in this matter.

(11) (a) The Committee feels that proper facilities for large scale research on Coal Washing should be provided in the Fuel Research Institute including research on the beneficiation of fine coal fractions and their recovery from slurry.

(b) The Committee also feels that the intensive physical and chemical survey of the coals of India should be accelerated.

APPENDIX I.*(Questionnaire to be sent to all Collieries.)***FORM.**

Province and Coalfield.....

Name of Colliery.....

Owners.....

Address.....

Item:

1. Seam or Seams worked or may be worked.
2. Thickness and section of each seam, dip of the seam indicating the section worked.
Analysis of each seam section by section, if possible.
3. Plan of the property on the scale of 4" = 1 mile showing latitude and longitude.
4. Tonnage already recovered in each seam.
5. Estimated amount that can be extracted economically (i.e., reserves)—in each seam, stating the maximum depth to which it is expecting to work.
6. Estimated loss in future working, with stowing and without stowing.
7. State which seams are caking.
8. (a) What seams are used or have been used, if any, for making hard coke.
(b) which seams if any that you are working, have been tested for washability.
Do you consider washing possible, if not, why?
9. Please give your suggestion for the location of Washeries in your area, bearing in mind transport and water supplies and the desirability of utilising the washery middlings and rejections.

(Sd.) A. B. GUHA,

Member-Secretary.

APPENDIX II.

(Questionnaire to be sent to all Collieries.)

FORM.

Province and Coalfield.....

Name of Colliery.....

Owners.....

Address.....

Item:

1. Seam or Seams worked or may be worked.
2. Thickness and section of each seam, dip of the seam indicating the section worked.
Analysis of each seam section by section, if possible.
3. Plan of the property on the scale of 4" = 1 mile showing latitude and longitude.
4. Tonnage already recovered in each seam.
5. Estimated amount that can be extracted economically (i.e., reserves)—in each seam, stating the maximum depth to which it is expecting to work.

Details may please be furnished in the following form.

Total quantity available in the property.	Quantity virgin coal still available.	Quantity on Pillars.	Quantity locked under.		Total quantity still available.
			Rlys*.	Public Road, buildings, etc.	
1	2	3	4		5

6. Estimated loss in future working, with stowing and without stowing.
7. State which seams are caking.
8. (a) What seams are used or have been used, if any, for making hard coke.
(b) which seams if any that you are working, have been tested for washability.
Do you consider washing possible, if not, why?
Please indicate reasons in either case.
9. Please give your suggestion for the location of Washeries in your area, bearing in mind transport and water supplies and the desirability of utilising the washery middlings and rejections.
10. State the percentage of slack in freshly raised R. O. M. coal (1" size and below).

N. B.—In calculating the estimated amount of coal that can be extracted economically as asked for under item 5, the total thickness of stone band may please be excluded while submitting the figure of total availability of coal.

(Sd.) A. B. GUHA,

Member-Secretary.

Copy of letter No. CMC/44/17, dated the 13th December 1949 from the Coal Department Manager, Indian Iron and Steel Co. Ltd. to the Member-Secretary, Conservation of Metallurgical Coal Committee, giving his comments on the Interim Report.

I have signed the Interim Report, as I agree generally with the conclusions and recommendations, but would like to record (1) that I am not fully in agreement with all that has been said in relation to Washing of Indian Coals (2) I cannot approve of Jharia lower grade coal being taken to replace good coking coal, unless they are beneficiated to give a consistent and workable Ash Content.

(Sd.) W. WALLACE,

Coal Department Manager.

Copy of Dr. D. R. Malhotra's letter of Consent to the Interim Report.

Re Interim Report on Conservation of Metallurgical Coal.

Your No. CMCC/I.R./5, dated 18.10.49.

I have much pleasure in acknowledging receipt of a copy of the above report and agree with the recommendations made therein.

Yours faithfully,

(Sd.) D. R. MALHOTRA.

Copy of letter dated 22nd November 1949 from Dr. D. R. Malhotra, to Mr. A. B. Guha, Member-Secretary, Conservation of Metallurgical Coal Committee.

Interim Report on Conservation of Metallurgical Coal.

I regret it will not be possible for me to attend the Conservation of Metallurgical Coal Committee meeting on the 25th instant.

As I told you at our last meeting I have no modifications to suggest in the Interim Report which has already been prepared but you will remember that this meeting was simply convened to satisfy some of the members who were anxious to have another meeting for personal discussion with Dr. Krishnan.

Will you kindly express my regrets to the Chairman and other members of the Committee for my inability to attend this meeting.

Yours faithfully,

(Sd.) D. R. MALHOTRA.

NOTES ON CONSERVATION OF METALLURGICAL COAL COMMITTEE'S
INTERIM REPORT BY B. L. AGARWALLA.

It is to be observed that the recommendations that are now being made regarding conservation of good metallurgical coal have been made by various committees set up by the Government from time to time. Conservation of parent coking coal as the term is applied in the Interim Report requires no further comment. It has been suggested by almost everybody who has some knowledge of our reserves of coking coal for the last 20 years and even if any scheme of conservation of good coking coal is now enforced it will perhaps be late by at least 20 years. Its urgency cannot be over-emphasised. It will, however, not be out of place to add a few words about the washability of Indian coal. In India at present no coal washery is in operation. All our knowledge of washability comes from tests carried out in float and sink machines in a liquid mixture of carbon tetrachloride and benzene. The specific gravity of the mixture is varied to suit the requirement. It is to be remembered such a uniform mixture will not be available in large scale washing where the medium employed will be quite different. It is an admitted fact that in Indian coal there is more inherent ash than adherent that is to say the foreign impurities are finely disseminated throughout the mass of the coal rather than adhering to the mass of coal thus rendering their separation difficult. It follows, therefore, that what is achieved by washing is not so much the removal of those impurities as separation of naturally good coal with lesser percentage of foreign impurities from the coal with high percentage of impurities. Of course where shale bands exist they are also separated. Thus we have usually 3 products from washing Indian coals (i) clean coal, (ii) middlings, (iii) rejections. So far as higher seams are concerned where the natural impurities in the mass of the coal is low and distinct and separate bands of shale impurities exist washing may be both profitable and desirable. Coals with higher percentage of inherent impurities present a practical difficulty to which all the attention it deserves has not been paid. These coals when subjected to washing will produce a very large percentage of high ash middlings whose ash content will naturally be much higher than in the original coal and the percentage of clean coal produced will be comparatively low. It follows, therefore, that unless a suitable use for this high ash middlings is found washing of such coals will not be practical or economical. Obviously such high ash coal cannot economically be transported to long distances and, therefore, it must be used near about the washeries themselves. It has been suggested that large Thermal Power Station should be established near washeries to consume these washery middlings. Even the washery rejects of Indian coal will generally contain a high percentage of combustible material admittedly too valuable to be thrown away.

It becomes, therefore, doubtful if it will be practicable to find use for these in the near future and it is equally doubtful that even if large Thermal Power Stations are established near the washeries they will be able to use all or even a major portion of the washery middlings and rejects. We have to remember that large water power generation is contemplated near the coalfield under Damodar Valley scheme. The washery middlings and rejects will, therefore, present a practical problem the solution of which is not in slight and will render washing of high ash coals uneconomical and impracticable. The restriction on Grade II coal, therefore, seems not only superfluous but harmful inasmuch as immediate replacement of good coking coal by other coals will not be possible unless some portion of it is taken from Jharia field lower grade coal the reserves of which are ample.

Messrs. Tata Iron & Steel Co. Ltd. and Indian Iron & Steel Co. Ltd. in a Joint Memorandum submitted to the Committee have admitted at page 8. Part I of their Memorandum that a decrease of 2* per cent. of coal that is to say reduction of 2 per cent. ash from their present average of 17 per cent. to 15 per cent. will enable them to effect an economy of 26 lakhs of rupees in expenditure on coal, 2.94 lakhs on the expenditure on lime stone, 29.54 lakhs on

* 2 per cent. of ash in the coking coal that is to say reduction of 2 per cent.

the expenditure on raw materials. They go on to say "whilst the increase or decrease of expenditure for raw materials might only be of interest for economics of the steel works themselves. The increase or decrease of output of finished steel, is a question which has to be looked upon from national point of view. A reduction of 2 per cent. in ash of coking coal against our present average, would allow an average increase of steel output in the vicinity of 82,400 tons per annum. Taking a price of about Rs. 360 per ton for imported steel this quantity is equivalent to Rs. 3 crores. At the present stage when still considerable quantities of steel have to be imported from abroad a saving of 3 crores per year for consumer goods would have a notable bearing on our foreign trade balance". If above facts are true it must be admitted that steel companies have been acting very negligently in not establishing coal washeries so far. It is gratifying to note Messrs. Tata Iron & Steel Co. Ltd. are erecting two coal washeries. Indian Iron & Steel Co. Ltd. should do the same. In face of their own admission that a 2 per cent. reduction in ash in coking coal will enable them to effect a saving of 58.49 lakhs per annum on the expenditure on raw materials apart from a national saving of 3 crores a year there seems little ground left for arguing as to who should establish coal washeries and where as far as washing of coking coals is concerned.

Mr. W. H. S. Michelmore's Note of dissent on the Interim Report.

(1) While I am in general agreement with the main conclusions of this Report on the subjects of coal washing and blending (although we have no practical experience of them on a commercial scale) and on the introduction of compulsory stowing for conservation, I find myself unable to accept either the indications given of the reserves of metallurgical coal or the proposals in regard to conservation.

(2) Dealing first with the question of reserves, I would remark that, as admitted in paras. 4 and 10, the survey in progress is at present far from complete; at the time of writing no firm figures have even been presented to the Committee by our team of investigators, and it is therefore premature to form any conclusions. While I do not, at this interim stage, deprecate the desirability of conservation, I feel that the indications so far available tend to prove that washing, blending, and the hitherto unrecognised reserves now being brought to light in the East and West Bokaro coalfields will establish a much greater reserve of metallurgical coal than has previously been thought possible. There is, therefore, no justification for the reference to the 'alarming trend of evidence' which appears in para. 13 of the interim report.

(3) Turning now to the subject of conservation, the report, in my opinion, approaches this problem from the wrong angle, that of consumption. If conservation be found to be desirable the only method likely to achieve any success is restriction of production, not restriction of use; for if use be restricted in one direction the coal will always find an outlet elsewhere, unless and until output is controlled at source. The restriction of output raises a host of problems of which it will suffice to mention only a few; whether whole coalfields or districts should be closed down; whether individual collieries should be closed; whether the Government and Steel Works' collieries should be forced to shut down; whether an over-all percentage reduction should be imposed; how safety can be secured in closed or restricted collieries, how the owners of such collieries should be compensated and so on. A deep study of these problems is inescapable for the Committee, and the final report should endeavour to indicate a solution.

(4) The attempted diversion of 200 wagons of coking coal a day, as suggested in this report, is, as I have indicated, a wrong approach, as if this coal is not despatched to railways or the docks, it will, as long as it is produced, be despatched to some other consumer instead. Moreover the report is silent

on the all-important question of compensation ; it is a fundamental principle of law that compensation shall be paid for any loss occasioned by Governmental interference with the liberty of the individual ; any restriction or cessation of coal output imposed by Government on a colliery owner will involve the latter at least in loss of profit, if not in absolute loss. Some means must be devised for compensating these losses.

(5) I am unable to understand why it is suggested (in paras. 59 and 60 of the interim report) that both stationary boilers and railways should be compelled to use inferior coal. A part altogether from the question of coking coal, all the evidence that has been amassed in the past, as well as that so far available to us, indicates that the country has almost inexhaustible reserves of good quality non-coking coal. Conservation of this coal is therefore not only unnecessary but also highly uneconomic, as the utilisation of good coal produces greater thermal efficiency, reduces labour costs, and above all eliminates the transportation of high percentages of non-combustible material—a most important consideration in a country of great distances, such as India.

(6) It is suggested in paras. 29 and 55 that the Steel Works should be compelled to use Run-of-Mine coal in their coke ovens. This recommendation is no doubt sound, but the vital question of price has been entirely overlooked. Under the present price structure the controlled selling price of Run-of-Mine coal is no less than Re. 1-1 per ton lower than the controlled price of steam (lump) coal. In my view it is quite unreasonable that this, the most valuable coal in the country, should be delivered to the Steel Works at this substantial discount. I consider that the selling price for Run-of-Mine coking coal should be *at least* equal to the controlled price for steam coal of equivalent grade, and it may well be argued that this coal which is so expensive to produce should even carry a premium. In this connection it is relevant to invite a reference to para. 12 of the Indian Tariff Board's report on Fair Retention Prices of Steel (1949) in which the Tata Iron and Steel Co. Ltd. is awarded no less a sum than Rs. 10 lakhs a year to cover the extra cost of raising its own coal. 'Market' collieries, where working conditions are similar, receive no such consideration, but on the contrary are expected to sell their Run-of-Mine coal to the Steel Works at a price of Re. 1-1 per ton, lower than that considered reasonable for the despatch of their steam coal to other consumers.

(Sd.) W. H. S. MICHELMORE,

29-11-49.

Copy of letter No. Col./262-A/5614, dated 29th November 1949 from Mr. A. Farquhar to the Member-Secretary, Conservation of Metallurgical Coal Committee, giving his comments on Interim Report.

Re. Meeting held on Friday, the 25th November 1949 in Calcutta to clarify and modify the *Interim Report* in accordance with *Members' comments*.

The meeting, in my opinion, resulted chiefly in change of wording in certain respects, which left the issues raised with materially the same sense. The only point, in my opinion, which was fundamentally altered was para. 29, page 12, and which corrected an obvious statement, which would not lend itself to conservation. I did not bring up the points I had recorded in my letters Col./94/5120 of the 3rd November 1949 and Col./262-A/5456 of the 21st November respectively, since they were matters of fundamental difference on which a measure of agreement could not have been arrived at without delaying the submission of the Interim Report. In view of the necessity of

submission to Government at the earliest possible date, I prefer to postpone these fundamental issues for a later report, when developments and additional information may be available to enable other members to bring their views more into accordance with mine. I agree generally with the recommendations arrived at on pages 27-29 of the Report and am endorsing it subject to certain reservations and comments, which, I trust, will be forwarded with the Report. These are as follows:

- (a) I do not fully agree with the interpretations placed on the opinions of the various Members and on the data available. Since, in my opinion, the interpretations are not strictly technically correct, regarding washing, the nature of coking coals and the nature of hard coke for metallurgical purposes.
- (b) I also do not approve of compensating the producers for loss of Steam Coal when despatching Run-of-Mine coal for metallurgical purposes. The higher rate for Steam Coal was sanctioned by the Coal Commissioner on the inauguration of Control of Production and Distribution for the special purpose of coal preparation for consumers. In other words, additional rate for Steam Coal was sanctioned for separating the Slack Coal from the Steam Coal. Since the despatch of Run-of-Mine coal does not involve this separation, the expense for which the higher rate for Steam Coal was granted does not arise.
- (c) I am also of the opinion that Government is liable to misinterpret the recommendations made in the Report regarding the production of inferior grade coal and encourage its production. This is in conflict with the attitude I have adopted over a long period of years. I am of the opinion that the production and utilisation of the inferior grade coal should be discouraged in the interests of consumers and traffic, unless coal beneficiation is adopted.

Yours faithfully,
(Sd.) A. FARQUHAR,
Member.

FINAL REPORT
OF THE
COMMITTEE ON CONSERVATION
OF
METALLURGICAL COAL

May 1950

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Report of the Committee

ON

Conservation of Metallurgical Coal.

I.—Appointment of Committee and Terms of Reference.

1. The Committee on Conservation of Metallurgical Coal was constituted by the Government of India, Ministry of Industry and Supply, in accordance with their Memorandum No. Coal II-7(16)/49, dated the 25th April, 1949 (as modified by Corrigendum No. Coal II-7(16)/49, dated the 3rd May, 1949) which is reproduced below :—

OFFICE MEMORANDUM.

The Government of India are pleased to constitute a Committee to advise them on the measures to be taken in regard to conservation of metallurgical coal with particular reference to the recent reports on coal washing and coal blending and other ancilliary matters.

The Committee will consist of :—

CHAIRMAN.

Dr. M. S. Krishnan . . . Director, Indian Bureau of Mines.

MEMBER.

Dr. J. W. Whitaker . . . Director, Fuel Research Institute.

Dr. D. R. Malhotra . . . Representative, Railway Board.

Mr. C. S. N. Raju . . . Representative, Central Electricity Commission.

Mr. S. K. Sen . . . Ministry of Finance.

Mr. A. Farquhar . . . } Representatives of the Coal Con-
Mr. W. M. Wallace . . . } sumers' Association of India.

Mr. W. H. S. Michelmore . . . } Representing Colliery Interests.

Mr. B. L. Agarwalla . . . }

Mr. A. B. Guha . . . Colliery Superintendent, Giridih,
Coal Commissioner's Represent-
ative.

Mr. A. B. Guha will act as the Secretary of the Committee.

2. The terms of reference of the Committee will be as follows :—

To review the publications and recommendations of Fuel Research Committee, Fuel Research Institute and other Research Organisations and to recommend to Government what legal or executive action should be taken to implement such of the findings of the research

bodies as in the opinion of the Committee are considered desirable for adoption and in particular :—

- (i) to consider and recommend what results can be achieved through blending and washing of coal and what measures are needed and the extent of the compulsion which is to be applied both at the producers' and consumers' ends for conservation of metallurgical coal with suggestions for revision of price structure of coal to make washing and blending economically feasible ;
- (ii) to ascertain what the existing difficulties mainly arising out of transport limitations are of increasing the production of good quality non-metallurgical coal and how to overcome them ; and
- (iii) to estimate the increase in requirements of the Country for good quality metallurgical coal within the next few years.

The Committee is to submit its report by the 15th June, 1949.

(Sd.) P. R. DAS GUPTA,
Deputy Secretary, Government of India.

2. Later on, Sri B. P. Sinha, Secretary, Bihar Khan Mazdoor Federation, Dhanbad, Sri N. G. Chatterjee, Deputy Chief Inspector of Mines and Sri V. P. Sondhi, Deputy Director, Geological Survey of India, were appointed as Members of the Committee [*vide* Government of India, Ministry of Industry and Supply, Office Memo. No. Coal II-7(16)/49, dated the 10th May, 1949, 8th August and 23rd November, 1949 respectively].

II.—Issue of Questionnaires.

3. At the first meeting at Calcutta in May, 1949 the Committee drafted questionnaires to be sent to various collieries in the Provinces (States) of Bengal, Bihar, Orissa and C. P. (Madhya Pradesh). The Committee also drafted questionnaires for the iron and steel-making firms (Appendix B), the business organisations representing coal mining and trade (Appendix D), the Chief Government Organisations dealing with some aspect of the coal industry, and a certain number of experienced mining engineers (Appendix C) whose opinions were likely to be of help to the Committee in their task.

4. The questionnaire to the collieries, as finally amended is given in Appendix A. The addressees included :—

- (a) All collieries producing good coking coal ;
- (b) Collieries producing semi-coking or feebly coking coal ;
- (c) Collieries producing coking coal with high ash ; and
- (d) Collieries producing non-caking coal.

in the Provinces of Bengal, Bihar and Orissa and a few in Madhya Pradesh, including the Pench Valley. All these collieries were requested to furnish figures of reserves of each category or class

of coal in the areas held by them on lease ; the average annual production ; future possibilities ; and other details which, in the opinion of the Committee, were necessary to assess the reserves and to help them in considering increase or decrease of output from the different areas.

5. Realising that the questionnaires might not meet with better response than that accorded to the questionnaire issued by the Indian Coalfields' Committee (1946), partly because several of the collieries might find it difficult to answer some items, we decided to enlist the help of the Coal Commissioner's organisations, through the Government of India. The Coal Commissioner and the Chief Mining Engineer of the Government Railway collieries kindly agreed to place at our disposal, the Coal Superintendent, with 5 Assistant Coal Superintendents and 25 Inspectors, in order that they might contact each individual colliery and obtain replies to the questionnaire. The procedure proposed was that the Coal Superintendent's staff would visit each colliery and, after going through the relevant records, discuss the reserves of coal with the managerial staff and obtain other details in answer to the questionnaire. The Chief Mining Engineers of some of the larger groups of collieries preferred to work out the details themselves and send the replies to the Member-Secretary, together with data and plans of the collieries. In making assessments of reserves, differences of opinion occasionally arose between the colliery staff and the Coal Superintendent's staff in matters relating to the total reserves and the percentage which constituted recoverable reserves. At this stage, the Chief Inspector of Mines was requested to help the enquiry with the knowledge and experience of his organisation, so that the data finally adopted would be on a uniform basis and agreed to by the parties concerned.

6. The question of proper assessment of reserves was discussed at a meeting of the Committee attended by the Chief Inspector of Mines, by invitation. It was decided that a joint survey should be conducted with the help of the Geological Survey of India, the Chief Inspector of Mines and the Coal Commissioner. This decision was approved by Government. A definite procedure was adopted for calculating the reserves and forms were drawn up for recording the data. Where there was a difference of opinion between the colliery staff and the Survey staff, the Deputy Chief Inspector of Mines met the parties and after examining all the relevant materials, gave his decision, which was accepted by the mine officials. As such a survey would take several months to complete, Government directed the Committee to submit an Interim Report on the basis of the figures given in the Report of the Indian Coalfields' Committee (1946) and in conformity with the trend of evidence collected by that time. Accordingly, an Interim Report was submitted to Government on the 14th December, 1949.

III.—Coking coals and their properties.

7. Only certain types of coal are convertible on carbonisation into metallurgical coke.

Carbonisation of coal can be accomplished at any temperature between 400° and 1,300° C., the nature, composition and yield of the products depending largely on the range of temperature of carbonisation, whether low (400°—750° C.), medium (750°—900° C.), or high (900°—1,300° C.) metallurgical coke is made by high temperature carbonisation. The physical properties of the coke depend upon the type of coal used, the time taken and the temperature attained in the carbonisation process and also on the shape, size and type of the oven in which the carbonisation is carried out. It is not generally possible to predict, from the chemical analysis only, the kind of coke which will result from carbonising any particular coal in coke oven plant, but the following certainly play important part: the rank of the coal, its composition (moisture, volatile matter, fixed carbon, ash and its fusion temperature, sulphur and phosphorus) and especially the Caking Index.

8. The Ovens used in India for manufacturing metallurgical coke, comprise 'country', 'bee-hive' and 'by-product' types. In modern practice, coke is manufactured in by-product ovens to recover the volatile constituents and by-products, i.e., tar, benzol, ammonia, and surplus gas. The chief properties of coke which influence its value for metallurgical purposes are the following:—size, hardness, shatter strength, resistance to abrasion, porosity, percentage of fixed carbon, volatiles and ash, fluxing property of the ash, and the sulphur and phosphorus content. Hardness and toughness are particularly important as the coke has to withstand the weight (and movement) of a superincumbent burden of ore, coke, and flux in the blast furnace. The coke should be free from dust and fines, and should not contain an appreciable proportion of sizes below 1 inch. The usual tests applied to coke to evaluate its strength are Abrasion and Shatter Tests. From the point of view of India's economy, it is desirable that all coke should be produced in by-product coke ovens. Even in by-product ovens, recovery of by-products should be done to the fullest extent possible. We have noticed that in a modern Coke Oven plant lately installed no provision has been made for recovery of Benzol. Heavy excise duty and high railway freight act as impediments to recovery of Benzol and Government should examine to what extent it is desirable to remove the impediments.

9. According to the Indian Coalfields Committee Report (Vol I, p. 82, 1946), the Tata Iron and Steel Company, Limited have adopted the following specification for coal suitable for making metallurgical coke. These properties are determined on coal samples dried at 105° C.

(a) Swelling properties	. Non-swelling.
(b) Phosphorus	. . Below 0.15 per cent.
(c) Sulphur	. . Below 0.6 per cent.
(d) Caking Index	. . 15 and above.
(e) Ash	. . Below 17 per cent.
(f) Volatile matter	. . 26 per cent.
(g) Fixed Carbon	. . 57 to 58 per cent.

Regarding the coke they have stated that it should conform to the following standards:—

Shatter Index	Over 82/92.
Haven's stability test	Over 50 per cent.
Breslau's Hardness	Over 80 per cent. (over 40 mm. indicating hard coke).
Porosity	Over 42 per cent.
Size over 3"	50 to 60 per cent.
Size 2" to 3"	35 to 45 per cent.

The coal should have a high enough carbon content to give a coke with at least 75 per cent. carbon. The coke should have an ash content as low and uniform as possible. The higher the ash the more limestone is needed, which in turn calls for more heat, more coke, and thus more ash. The maximum ash that can be tolerated in the coke is 22.5 per cent. and, if there is an increase over this figure, difficulties in operation are encountered.

10. The Steel Companies have recently (1949) revised their specifications and made some alterations. The following summary is taken from a joint memorandum (Appendix H) submitted to us by the Tata Iron and Steel Company and Indian Iron and Steel Company. The document contains much valuable information.

I.—SPECIFICATION FOR COKE.

A.—*Chemical analysis.*

Ash	About 20 per cent.
Phosphorus	Below 0.20 per cent.
Sulphur	Below 0.60 per cent (Assuming that 25 per cent. of the sulphur in the coal volatilises on carbonisation).

B.—*Physical properties.*

These remain the same as given to the Indian Coalfields' Committee (1946).

With regard to size, it should preferably be in the following proportions:—

1½" to 3"	40 per cent.
3" to 6"	60 per cent.

II.—SPECIFICATIONS FOR COAL (ALL DATA ON DRY BASIS).

Ash	Should not exceed 15 per cent. for coals having 30 per cent. volatile matter on ash-free basis.
Volatile matter	Around 30 per cent. on ash-free basis, and 26 per cent. in coal having 15 per cent. ash.

- Fixed carbon . . . Will depend on ash and volatiles.
- Phosphorus . . . Not more than 0.15 per cent.
- Sulphur . . . Not more than 0.60 per cent., but a slightly higher sulphur may be tolerated if ash content is much lower than specified above.
- Caking Index . . . 15 minimum (Tata Index), i.e., roughly 22.8 British Standard Index. Experiments show that Tata Index multiplied by 1.5 is roughly equal to the British Standard Index, if the Tata Index is above 10.
- Swelling properties . . . Not of much importance as the coals specified are free from harmful swelling properties.

11. In connection with the stipulation that the ash in coal to be used for coking should not exceed 15 per cent., some extracts from the Steel Companies' Memorandum are given below:—

“The calculation of the heat and material balance of our blast furnaces indicates that under identical operating conditions, with each increment of ash in coking coal by one per cent., blast furnace performance is affected as follows:—

- (a) Decrease of production by 3 to 6 per cent ;
- (b) Increase of coke consumption by 4 to 5 per cent ;
- (c) Increase of limestone consumption by about 5 per cent.

On the basis of the data available in the Coal Washing Report, a study of the average cleaning characteristics of the Jharia coals of 16, 16A, 13 11 and 10 seam was made, which revealed that washing of these coals to an ash content of about 15.0 per cent. at a yield of 77.5 per cent. is practicable in spite of their comparatively difficult cleaning characteristics.

By co-relating the washing data of these coals with the coking coal consumption per ton of pig iron in the blast furnace for different ash contents, it becomes evident that due to the reduction of coking coal rate with decreasing ash content, washing of these coals to 15 per cent. ash does not increase the raw coal requirements. For the original untreated coal with 20.62 per cent. ash the coking coal rate per ton of pig iron is 1.590 tons, whereas for 15 per cent. ash coal the coking coal rate is only 1.247 tons. Since 1.247 tons are approximately 78.0 per cent. of 1.590 tons (which nearly corresponds with the average yield figure 77.5 per cent. for coal washed to 15 per cent. ash), washing of these coals does not involve increased drawing on the reserves.

It is estimated that the total reserves of coking coal contained in seams above 10 seam are in the vicinity of 700 million tons. If it is assumed that two-thirds of this quantity is contained in 16, 16A, 13, 11 and 10 seams, the total pig iron producing capacity of these high ash coking coals works out to 220 million tons of pig iron which, at a rate of production of 4 million tons per year, would last approximately for 55 years. As a result of washing and blending, the pig iron producing capacity of these reserves could be increased to 280 million tons which would mean an increase in the life-time of these reserves by a minimum of 15 years.

Utilisation of high ash coals for iron making invariably involves a waste of carbon for the fusing of coke ash in blast furnace and the metallurgical industries have therefore to insist in future, in the very interest of conservation, on a reduction of the present ash standards in coking coals. This is the more so since even the high ash coking coals can satisfactorily be washed to 15 per cent. ash, without involving increased drawing on their reserves.

In view of the above, washing of all coking coals to an ash content of 15 per cent. maximum should be enforced by legislative measures at the earliest possible date. This should be co-ordinated with measures on restriction of output and consumption of coking coal for other than metallurgical purposes. A time limit of say 5 years should be given for the implementation of the scheme, after which output of metallurgical coal should be adjusted to the absolute necessary requirements of the metallurgical industry."

The representatives of the two Steel Companies, who were examined by us, held that for reasons given in the Memorandum it was necessary for them to limit the ash content of coking coal to 15 per cent. and that the coal should have a (Tata) caking index of 15. We have tried to compare the characteristics of Indian coke with those used in England and America but, on account of many different and varying factors, *e.g.*, quality of iron ore and ash in the coal, we can find no basis for comparison.

12. Mr. P. V. Martin of Koppers Co. Inc. told us (see APPENDIX G) that Indian coke now being used is definitely stronger than the average of American coke used in similar large blast furnaces of 300 to 1,200 tons capacity, and he thought it possible to use somewhat weaker coke in India. Mr. Martin also stated that the weakly caking coals of Utah (some 3 million tons per year) were being successfully coked by his company in specially designed ovens and that such coke was being used in blast furnaces.

In the carbonisation, the weakly caking coal was generally first given a 'thermal shock' and then coked in the normal way; sometimes a certain amount of low volatile 'eastern' coal was blended with Utah coal to improve the coke; or a 'char' or semi-coke with

about 15 per cent. volatile matter was first made from Utah coal and the char then blended with raw coal before coking the blend. By these means they had largely succeeded in producing metallurgical coke from coal formerly considered unsuitable. Mr. Martin also mentioned that weakly caking coal could often be made to yield better coke by adding a small quantity of pitch or crude oil to it before coking. *He particularly emphasised the importance of careful preparation and sizing of all raw materials for the blast furnace burden.* With care in the above items the coke consumption, even with weak coke, had been reduced considerably.

13. We have seen a summary of a paper* by Dr. F. H. Reed and others of the Illinois State Geological Survey based on experimental work carried out in their laboratory in a specially designed coke oven and checked satisfactorily in commercial ovens. The Illinois coals are weakly caking with high volatiles (30-33 per cent.). In 1947 such Illinois coal was said to have been coked in commercial ovens of modified design for use in blast furnaces. The tests show that the coke is inferior in strength to that used by Indian blast furnaces. Illinois coals have, however, been successfully blended with 25 per cent. to 40 per cent. Eastern (W. Virginia) coals containing 17 per cent. to 23 per cent. volatile matter. Good coke has also been produced by blending Illinois coal with 15 per cent. to 25 per cent. char (containing 17 per cent. to 19.5 per cent. volatile matter made from the same coal) derived from the State of Colorado. The coke produced has the following characteristics:

Stability (+1 inch)	. . . . .	55
Hardness (+ $\frac{1}{4}$ inch)	. . . . .	68-70
Shatter (% of +2")	. . . . .	64-68
Shatter (% of +1 $\frac{1}{2}$")	. . . . .	87-89

14. In view of the results achieved in America by the Illinois Geological Survey, Koppers Co., Inland Steel Co., Kaiser Co., and the U.S. Bureau of Mines, we recommend the undertaking of a programme of research on similar lines by the Fuel Research Institute on the weakly caking coals of India.

In another section we have discussed the results obtained in India by blending strongly caking with weakly caking coals. The results obtained so far indicate that on an average, in the ovens now in use in India, 20 per cent. to 30 per cent. of the blend could be weakly caking coal. This means that the life of strongly caking coals can be prolonged by about one-third (33 per cent.). Moreover, washing of coking coal and the reduction of ash thereby, usually improves the strength of coke produced, which may permit further blending. Finally, researches on the lines of those undertaken for western coal in the United States of America, from which new designs of coking oven and new techniques of coking may emerge, will

* F. H. Reed, H. W. Jackman, O. W. Rees, G. R. Yoke, and P. W. Henline:
 "Use of Illinois coal in the production of metallurgical coke."
 Amer. Inst. Min. Eng. Techn.-Publ. 2491, 1948;
 Also, Illinois Geol. Surv. Bull. 71. 1947.

also appreciably lengthen the life of coking coal reserves and bring more of the weakly caking coals of India and even some present-day non-caking coals within the category of coals usable in the coking process.

15. The Steel Companies in India have always preferred slack coal to run-of-mine coal because it has been found by experience that the slack is generally about 2 per cent. lower in ash than the run-of-mine coal. This may be due to the fact that the slack coal of the seams now exploited, is usually richer in vitrain (brights) than is the run-of-mine coal in which there is usually much durain (hards). The ash of durain is commonly higher than that of vitrain. Another reason for the preference for slack is that the receiving bunkers for coal at the steel works are not designed to take sizes larger than 4-inch. The companies, however, state that they will be prepared to accept run-of-mine provided it is broken down to 4-inch size and otherwise conforms to specification.

IV.—Specification Recommended.

16. The Iron and Steel Companies have made out a case for limiting the ash to 15 per cent. in the coal used for making metallurgical coke. They have also stated that the volatile content of the coal should be around 25 per cent. in the blend, and that the caking index should not be below 15 (Tata index). As already pointed out, these requirements are more rigid than those submitted by the Steel Companies to the Indian Coalfields' Committee (1946).

17. After carefully reviewing the position, we think that the Indian Steel Industry can relax their requirements so as to include certain coals containing up to 17 per cent. ash. In reality, the criterion is not the ash of the coal, but rather that of the coke; and when the volatile matter of the coal is low, a higher percentage of ash in the coal is tolerable without unduly raising the ash content of the resultant coke. Until such time as coal washing is generally adopted in this country and coal with 15 per cent. ash is made available in sufficient quantities, we feel that the Steel Companies should accept for coking certain coals whose ash content may be up to 17 per cent.

There is often an appreciable difference in the yield of washed coal for cuts at 15 per cent. ash and at 17 per cent. ash. Taking No. 10 seam—Jharia as an example, the results of washing show that the yield of cleaned coal will be less than 50 per cent. with an ash content of 15 per cent., whereas if the ash in the cleaned coal is allowed to be 17 per cent., the yield will be about 66 per cent. The difference in the yield of clean coal constitutes an important reason for raising the ash limit in coking coal to 17 per cent. We may also add that, if the limit of ash is fixed at 15 per cent., only coals of selected A grade, the reserves of which are very limited, can be used for coke-making at the present moment, and indeed not all of these.

V—Chief Coalfields for Coking Coal.

18. Coking coals of the quality required by the iron and steel works are found in the Jharia, Raniganj, Giridih, and the East and West Bokaro coalfields, while semi-coking coals are found in these as well as in the Karanpura and Kanhan Valley fields.

19. *Jharia Coalfield*.—Until recently the Steel Industry in India relied largely on the good quality coking coals available in seams 12, 13, 14, 14A, 15, 17 and 18 all of which used to yield selected A Grade coal. Slack coal was preferred to run-of-mine since the slack contained less ash as already stated. As the supply of good slack from these seams began to dwindle, the steel industry began to take coal from seams 10, 11, 16 and 16A also, since these seams were found to contain satisfactory coking coal in restricted areas. Seams 12-18 (except 16) are suitable for coking and are often of good quality, especially if hand picked, whereas the others mentioned above, being higher in ash, generally require more beneficiation. No. 10 seam is generally high in ash, but, as it yields a strong coke, its washability should receive full attention, more especially as the reserves in this seam are large.

20. *Raniganj field*.—Coking coals are found in the Ramnagar, Laikdih and Begunia seams which occur in the Barakar measures (locally referred to as Laikdih Series). The thickness of these seams is variable. The Laikdih seam is often low in phosphorus and therefore valuable. The well-known seams of the Raniganj field (Raniganj measures), e.g., Dishergarh, Poniati, Sanctoria and Tpsi Seams, though low in ash are weakly caking and cannot be used by themselves for manufacture of metallurgical coke. They can however be blended with strongly caking coals.

21. *Giridih*.—Coals from the Giridih coalfield, from the lower and upper Kurhurbaree seams, are amongst the good coking coals with comparatively low ash and low phosphorus. Coal made from such coals will be particularly suitable for ferro-alloys (e.g., ferromanganese) manufacture.

22. *East and West Bokaro Coalfields*.—Recent tests have shown that some seams of the East and West Bokaro coalfields, e.g., the Kargali seam can easily be beneficiated to yield good coke acceptable to the Steel Industry.

23. *Kanhan Valley Coalfield*.—Coals from Damua, Kalichappar and Rakhikal fields in the Kanhan Valley show moderate caking properties and can therefore be blended with strongly coking coals, such as those from Jharia.

24. *Assam Coalfields*.—In the Garo Hills and Makum and certain other places in Assam there are apparently good reserves of coal, which, though of Tertiary age, possess moderate good coking properties with low ash. The Assam coals, however, suffer from two disabilities—one being the long lead from the industrial markets in India and the other a high content of sulphur. Until a commercial process of de-sulphurising the Assam coals is evolved, it will not be possible to use them for metallurgical purposes.

VI.—Reserves of Coking Coal.

(a) Former Estimates.

25. In 1936 Sir Lewis Fermor published a paper entitled "Note on the necessity for conservation of coal in India" (Records, Geological Survey of India, LXIX, pages 336-352, 1935) in which he estimated the reserves of coking coal to a depth of 2,000 feet. as below :—

	Million Tons.
Giridih	38
Raniganj	241
Jharia	900
East Bokaro	515
	—
Total	1649
	—

He also pointed out that research would enable the utilisation of the semi-coking coals of Bokaro and Karanpura coalfields. He stated, that, at that time, only the Jharia and Giridih coalfields were producing good coking coal and that, with the mining methods in vogue, the recovery was only about 50 per cent. after deducting quantities which were standing in pillars and under railways, roads, buildings, etc. In his opinion the extraction from below 1,000 ft. would be almost negligible under the then conditions of mining. If the percentage of extraction were raised from 50 to 80, the life of these reserves would go up to 80 years (from 1932).

26. The Coal Mining Committee of 1937 brought the above figures of reserves up-to-date and estimated a total reserve of 1,525 million tons of coking coal at the end of 1936. This estimate was further corrected to 1,185 million tons at the end of 1944 by E. R. Gee of the Geological Survey. The Committee (1946) examined the reserves and concluded that since the coal in the Jharia field showed a tendency to deteriorate in quality to the west of Katrasgarh, only 700 to 750 million tons of good quality coking coal were available within a depth of 2,000 ft.

(b) Present Assessment of Reserves 'in situ'.

27. *Jharia Coalfield*.—Reserves of coking coal in the Jharia coalfield below 2,000 ft., mainly in the area occupied by the Barren Measures and the Raniganj Series, were estimated by E. R. Gee (Indian Minerals I, p. 71, 1947) to be of the order of 1,000 million tons even after allowing for losses by igneous intrusions and for 50 per cent. loss in extraction. There is some difference of opinion on this matter between Dr. Gee and Sir Cyril Fox. The latter

thought that igneous intrusions at depth would be responsible for a higher percentage of loss than in the first 2,000 ft. depth. Mr. A. B. Dutt of the Geological Survey of India, in his report of the survey carried out recently, refers to some deep borings put down through the Barren Measures by Tatas in the Dungri and Malkera areas and by Messrs. Bird & Co. in the Loyabad area. These borings show that most of the seams at depth are seriously burnt and the evidence obtained from them support Sir Cyril Fox's contention. It should be remembered, however, that the area between Jharia and Sijua is one which is most affected by intrusions at all levels, and that the degree of destruction of the coal by igneous rock is probably not a function of depth but a characteristic of this area. The recoverable reserves in this part of Jharia coalfield, however, may be less than the quantity estimated by Dr. Gee, possibly much less. Meanwhile we would support the recommendation of the Geological Survey of India that intensive exploration be undertaken for proving all coal available at depths between 2,000 and 5,000 ft. in the Jharia Coalfield.

A provisional figure for the total reserves of coking coal *in situ* (working and Virgin Areas) in the Jharia field is about 1,200 million tons (Selected A and B) and 760 million tons (Grades 1 and II).

28. *Raniganj Coalfield*.—Dr. Gee estimated (*vide* "Indian Minerals", Volume I, page 75) that the proved and probable reserves of coking coal in the Barakar Series of the Raniganj coalfield to a depth of 2,000 ft. were about 40 million tons. The recent survey of the lease-hold areas of this part of the field by Mr. A. N. Banerjee, Assistant Coal Superintendent and his colleagues for the Laikdih, Ramnagar and Begunia Seams, shows that the reserves are of the order of 103 million tons. In the unleased areas the seams are much burnt and faulted and there are no reliable data proving the existence of any additional reserves. Hence the figure of 103 million tons only is taken as the reserves of coking coal in this field. This may be on the conservative side, but it is thought that investigations in the unleased areas are not likely to add very appreciably to these reserves.

In the Trans-Ajai Section, the Kasta seam (from Kasta to Rasuan and up to the Ajai River and the Barakar-Ironstone shale boundary) is estimated to contain reserves of 156 million tons approximately down to a depth of 1,000 ft. from the surface. The coal from this seam yields a rather weak coke and may have to be blended with strongly caking coals. We have accordingly excluded these Trans-Ajai reserves, and taken the total for Raniganj field as 103 million tons.

29. In the *Giridih Coalfield* the total recoverable reserves of good quality coking coal have been estimated by the Colliery Superintendent and the Survey Party to be nearly 17 million tons.

30. *East Bokaro*.—In this field Mr. Dutt estimates that the unworked reserves in the Kargali and Bermo seams are 583 million tons and 220 million tons respectively. The Bermo seam contains over 27 per cent. ash and would have to be beneficiated and the reserves from this seam have been excluded.

31. **West Bokaro.**—The three main seams that have been proved in this field have total reserves of 88 million tons. The coals will generally have to be washed to bring down their ash content.

32. **South Karanpura.**—The Argada and Sirka seams have a low caking index but have an ash content below 20 per cent. They are estimated to contain reserves of 450 million tons to a depth of 1,000 ft.—but we are not considering these as coking coals.

33. **Ramgarh.**—The more important coal seams in this field are of medium quality and semi-coking. The reserves are 188 million tons to relatively shallow depths. These have also been excluded from our estimates.

34. **Kanhan Valley.**—In this field Mr. Dutt estimates that the reserves are 66 million tons of weakly caking coal with an ash content of 17 per cent., including 3 million tons standing in pillars. We have not included these reserves in our estimates.

(c) *Further Exploration of Reserves.*

35. In view of some limited knowledge of the fields other than the Jharia and Raniganj Coalfields, it will be appreciated that the estimates of the reserves in such fields are tentative, and based on rather limited knowledge. It is recommended that such fields be further explored by the Geological Survey of India on the lines of the Jharia and Raniganj fields. This will necessitate drilling and large scale mapping. The outcome of such investigations may modify our estimates of the reserves both of metallurgical and non-metallurgical coals. The fields which it is considered should be explored are :—

East and West Bokaro
 Ramgarh
 South and North Karanpura
 Surguja
 Korea
 Korba, and
 Kanhan Valley

(d) **TABULATION OF RESERVES.**

36. The following table (*vide* also Appendix K) shows in a summarised form the reserves of coking coal calculated by the present survey party—(a) for leased areas in which coal mines are being worked and (b) virgin areas, i.e., areas in which coal has not been exploited or are in early stages of development.

(A) Working Areas

Coalfield.	Workable Reserves.		Quantity Extractable.			
			With stowing.		Without stowing.	
	Sel. Grades.	Gr. I & II.	Sel. Grades.	Gr. I & II.	Sel. Grades.	Gr. I & II.
Jharia (Barakar Series)	865.9	680.6	656.7	544.7	345.0	340.4
Raniganj	102.5	—	83.6	—	30.9	—
Giridih	12.5	—	10.7	—	8.9	—
Bokaro	0.5	336.7	0.3	279.4	0.2	168.3
TOTAL	981.4	1,017.3	751.3	824.1	385.0	508.7

(B) Virgin Areas.

Coalfield.	Workable Reserves.		Quantity Extractable.			
			With stowing.		Without stowing.	
	Sel. Grades	Gr. I & II.	Sel. Grades.	Gr. I & II.	Sel. Grades.	Gr. I & II.
*Jharia	325.6	88.5	160.5	88.0	162.8	42.7
Raniganj	—	—	—	—	—	—
Giridih	4.0	—	3.2	—	2.0	—
East Bokaro	—	271.3	—	217.0	—	135.6
West Bokaro	—	87.8	—	70.3	—	43.9
TOTAL	329.6	444.6	163.7	355.3	164.8	222.2
	981.4	1,017.3	751.3	824.1	385.0	508.7
GRAND TOTAL	1,311.0	1,461.9	1,014.0	1,179.4	549.8	730.9

* Those figures include 247 m. tons of coal reserves particulars of which were supplied by Messrs. Bird & Co. (vide page 2 Appendix J.).

† (1) With stowing the losses have been estimated as follows:—

	per cent.
Loss due to barrier, outcrop coal and local causes	5
Colliery consumption	8
Shaft pillar, coal locked under important bldgs., etc.	2
Loss due to mining	5
TOTAL	20

(2) Without stowing the losses have been estimated as follows:—

	per cent.
Loss due to barrier, outcrop coal and local causes	5
Colliery consumption	8
Shaft pillar coal locked under important bldgs., etc.	2
Loss due to mining	35
TOTAL	50

Basis of Calculation of the Reserves—

In calculating the reserves, the Survey Party has taken the area of each seam as equivalent to the superficial area in the plan. As the seams generally dip at low angles (only in a few cases as much as 1 in 1) there is likely to be some difference if the area of the surface of each seam is strictly taken into account. The investigators have also assumed, for easy calculation, the round figure of 500 tons per bigha-foot which is commonly used in the coalfields. This, strictly speaking, is true only for coal with very low ash. In the case of the average coal of the Jharia Coalfield, the tonnage per bigha-foot may be 600. In dealing with the reserves these points have to be kept in mind, as the tonnage is thus likely to be some 15 to 20 per cent. more than what is given in the calculations of the survey party.

37. Under modern conditions, and especially where the seams are not unduly thick, the losses with or without stowing will be far less than the figure given above. For example, at the West Bokaro colliery where seams of 7' and 5'-6" are to be worked under modern conditions, a recovery of a much higher percentage is expected.

(e) MAINTENANCE OF REGISTERS.

38. The Survey Party has prepared five registers in 3 of which are given reserves for each colliery in the Jharia, Raniganj, Giridih and Bokaro coalfields, the two others showing the reserves gradewise and seamwise, by re-arrangement of the data in the first 3 registers. They have also submitted a consolidated statement (Appendix K) showing the reserves of good coking coal in working areas, while the Geological Survey of India has given a report on the reserves in virgin areas and in those areas where mining operations are in an early stage of development.

These registers contain valuable data which, it is suggested, should be kept up-to-date by the Departments of Government concerned.

(f) ANALYSIS OF ESTIMATES.

39. Analysing the above table, the figures of reserves *in situ* are as follows:—

	Million tons.
(A) Working Collieries.	
Selected A	404.0
Selected B	577.4
Grade I	512.9
Grade II (10 seam above)	504.4

(B) Virgin Areas—	
Selected A & B	329.6
Grade I	395.7
Grade II (10 seam above)	49.1

Expressed in another way:—

Million Tons.		Beneficiated Million Tons.
Selected A . . . 500	Coking coals with 15 per cent. ash or less.	=500
Selected B . . . 750	Coking coal with 15—17 per cent. ash or less.	=600
Grade I & II . . . 1,500	Coking coal with over 17 per cent. ash but which on beneficiation will yield coking coal roughly to the extent of $\frac{2}{3}$ i.e. 1,000 tons.	=1,000
	TOTAL	=2,100

This is the 'in situ' value. Probably we can expect a recovery with modern mining methods of 75 per cent., say, 1,600 million tons. To this we may blend $\frac{1}{4}$ of weakly caking coal, making the overall figure for coal available for coking 2,000 million tons. *This figure, however, may well be halved unless precautions (notably compulsory stowing) are taken in mining, and unless steps are taken to use blends containing weakly caking coals and to wash the inferior grades of coking coals.*

40. It will be noticed that in the case of Selected A and B the virgin areas contain about 330 million tons, of which about 264 million tons can be recovered if stowing is resorted to, but perhaps only half without stowing. In the case of working areas the total reserves of Selected A and B are nearly 1,000 million tons, of which about 765 million tons can be recovered with stowing, but again perhaps only half without stowing. These figures have been arrived at by the Survey Party after careful consideration of the conditions of working in the various areas. Selected grades comprise coals which can be used, more or less without beneficiation, for coke-making and constitute our most important reserves. Grade I coals, which in working collieries and virgin areas amount respectively to 512.9 and 395.7 million tons making up a total of 908.6 million tons, can be used for the manufacture of metallurgical coke *only after they have been beneficiated and their ash reduced sufficiently.* Though the total of all Selected A and B Grade I coals, still underground, amount to 2,259 million tons, only about 75 per cent. of this quantity can actually be recovered by efficient working and stowing where necessary. In the Jharia coalfield as much as 90 million tons of coal is standing in pillars.

41. Roughly we may take it that with washing and blending we have a coking coal reserve available of 2,000 million tons. The above estimate includes reserves in seams which have a high dip (as much as 1 in 1). Such areas are difficult to work and involve the use of modern and skilful methods of mining, including mechanisation. Under the present conditions and by the use of current methods of mining in India, a large proportion of such reserves will be lost.

(g) LIFE OF THE RESERVES.

42. The reserves of high grade iron ore in India are enormous and many times greater than those of the coking coal. The present requirement of coking coal for steel making is about 3.5 million tons per annum. Assuming that with stowing, washing and blending we have a reserve of 2,000 million tons for coking, the life of the coking coal reserves at the above rate of consumption would be nearly 600 years, but as the Country is consuming a total of about 10 million tons of coking coal per annum at present, the life becomes reduced to 200 years. If the Government programme of stepping up the steel production is implemented, the coking coal requirement will be in order of 8 million tons per annum, which will make the life about 250 years, if the coal is used for coking, and coking only. Assuming, however, that for the next period of 50 years, the steel production is stepped up ten-fold, and that the coking coal requirement is increased *pro rata* to 35 million tons per annum—and such an increase may well be called for in the industrial development of the country—the life of the coking coal reserves becomes no more than 55 years. *In each of the above cases, the life of the reserves may be halved unless stowing, washing and blending are adopted forthwith.*

VII.—Stowing for Conservation of Coking Coal.

43. In pursuance of the Coal Mines Safety Stowing Act a Coal Mines Stowing Board was created on the 1st November, 1939. This Board has authority to grant assistance for the following purposes only:—

- (a) For stowing or other protective measures which are required to be undertaken by an order issued by the Chief Inspector of Mines in India under Section 9(3) of the Act;
- (b) For any protective measures essential for the effective prevention of the spread of fire to or inundation by water of, any coal mine from an area adjacent to it;
- (c) For stowing operations voluntarily undertaken in the interests of safety; and
- (d) For research connected with safety in mines.

44. It will be apparent, therefore, that the scope of the Act is limited to stowing for safety only and not for conservation. We feel most strongly that the time has come for enforcing stowing for conservation purposes also. All our witnesses were unanimous in the opinion that the scope of stowing should include the conservation aspect. We, therefore, recommend that the Coal Mines Safety Stowing Act be enlarged to cover stowing for conservation and to include conservation of all coking falling in the Selected grades and Grade I, in the first instance. Whether mines producing Grade II (10 seam) coal should also be required to be stowed may be examined by the Committee mentioned in para. 85. The functions of the present Stowing Board should be extended and the additional funds required for giving help to collieries stowing for conservation raised by a further

cess. The Chief Inspector of Mines may be vested with powers to enforce stowing for conservation purposes, and steps should be taken to make this possible at a very early date. It is suggested that assistance for stowing may be on a tonnage basis, in order to give a clear picture of the expense involved per ton of coal raised.

45. *Sand for stowing.*—The Chairman of the Stowing Board stated in his evidence that from the data available at present, it appeared that for complete stowing there was not enough sand from the portion of the Damodar river traversing the Jharia coalfield. The 'fixed deposit' in the river from Tentangabad where the Katri joins the Damodar river to Kalhajar amounted to 120 million tons; but, from the western boundary of the area leased to the Coal Mines Stowing Board (about 1 mile east of the B. N. Rly. bridge at Sudamdih), to Tentangabad, the fixed deposits would amount to only 48 million tons. The present output of coking coal in the Jharia field was 8 million tons per year, and the sand in the area leased to the Stowing Board would last only 4 years, since $1\frac{1}{2}$ tons of sand were required to replace 1 ton of coal in the mine. If the Panchet Dam were built by the Damodar Valley Corporation, there would be 10 ft. of water in the river at the Sudamdih bridge, and the sand in the river bed more than 1 mile east of the bridge would be difficult to extract except at a time when the water level was low.

46. According to the Geological Survey of India [Indian Minerals, Vol. I, No. 2, P. 71 (1947)] there are 140 million tons of sand available in the Damodar river in the Jharia coalfield area as 'fixed' deposit. The rate of replenishment of the sand every year is not known with any degree of accuracy, but it is said to be of the order of 11 million tons. It is also not known if the annual replenishment would increase if sand were removed steadily from the river. For this purpose it will be necessary to collect reliable data by actual experiments. In addition, it is stated that there are 25 to 30 million tons of alluvial material as well as an unknown but fairly large quantity of rock in dumps, clinker, etc., which can be used for stowing.

47. It should be possible, in future, to arrange for the removal of the sand and silt deposited in the reservoirs when the dams are built across the Damodar. The dredging of the sand and its distribution to the collieries may be done on a co-operative basis between the Damodar Valley Corporation and the Stowing Board, so that both organisations will benefit by such co-operative effort. Such action will prolong the life of the reservoirs and will also directly help the conservation of coal. It is, therefore, recommended that data should be collected on the amount of sand deposited at the head of the reservoirs (formed by dams) in or near the Jharia coalfield. Where practicable, coal washery rejects may also be used to supplement the stowing, dangers from spontaneous combustion being guarded against.

48. *Raniganj Coalfield.*—The Geological Survey of India has estimated that 990 million tons of sand containing about 15 to 20 per cent. clay are available in the rivers traversing the Raniganj

coalfield. This is considered to be enough for stowing purposes in this field.

49. Before leaving the subject of sand stowing we wish to point out that such stowing tends to reduce the annual output of coal from the mine. It thus has the double benefit of reducing the present excessive output of coking coal, and of conserving it to allow of maximum extraction in due course.

VIII.—Review of publications of the Fuel Research Organisations.

A. BLENDING OF COALS FOR COKING.

50. The reports issued by the Fuel Research Committee of the Council of Scientific and Industrial Research on the Blending of Coal for Coking show that it is possible to blend weakly caking and non-caking coal with good coking coal, roughly in the proportion of 20 to 30 per cent. of the former with 80 to 70 per cent. of the latter. Coals from the Jharia, Raniganj, Bokaro and C. P. fields have been used in the experiments. The proportion for blending varies with different coals and with the strength required in the resultant coke. From the results of blending tests it is apparent that, by careful blending the life of the reserves of good quality metallurgical coal can be increased by 30 to 40 per cent. *The Indian Iron & Steel Co., have taken steps to instal a plant at Hirapur for coal blending and we visited this plant near Asansol, where a new battery of 72 coke ovens had just been installed for making coke from blends of a number of coals. So far, however, blending is practised not with weakly caking coal, but only to preserve a balance among the various kinds of coking coal, and to give a volatile matter yield from the blend of about 26 per cent. The incorporation of weakly caking coals should be inaugurated forthwith at all large coke oven plant, notably at Jamshedpur and at Burnpur.

51. Regarding the cost of blending plant we have received the following quotation from Messrs. Woodall-Duekham in U. K.

—	100 tons pr. hr.	200 tons pr. hr.	300 tons pr. hr.
Woodall Duekhan Co.— Total prices of coal Handling, Blending & Crushing Plant.	£ 200,000	£ 285,000	£ 375,000
Prices for the Blending Bunkers with associated conveyors and equipment as included in the above.	Rs. 27,00,000	Rs. 38,47,000	Rs. 50,92,500
	£ 95,000	£ 90,000	£ 125,000
	(Rs. 8,77,500)	Rs. 12,15,000	Rs. 16,87,500

(The prices have been prepared on the basis of plant manufactured and erected in England, and are approximate. The scheme adopted in each case commences at railway sidings where track hoppers are situated, arranged for emptying of the wagons by bottom outlet doors. Tumbler are included to deal with any wagons which may not be equipped for bottom dumping.)

* It should be observed that if a blend will carry 50 per cent. of non-coking or weakly caking coal, the life of the coking coal is increased by 100 per cent.; while with blends containing 25 per cent. of weakly caking coal, the life of the coking coal becomes increased by approximately 33 per cent.

52. There is no doubt that transport difficulties stand in the way of regular and uninterrupted supply of the different types of coals in requisite amounts required for blending. We have, therefore, to recommend that the Ministry of Railways, take steps to ensure transport for regular supplies of coal from the various collieries to the steel works so that the latter do not run short of the grades required whether of coking or semi-coking coal for correct blending. We also recommend that in order to expedite quick loading and unloading, the wagons shall be of a uniform and open type. We are informed that the B. N. Railway already supplies in large numbers such wagons for coal going to the Tata Iron & Steel Works. The E. I. Railway should also ensure a sufficient supply of such wagons for transport of coal to coke ovens and to washing and blending plant.

53. In view of the results obtained in the United States of America, we feel that the Fuel Research Institute in India should be requested to undertake researches of a similar nature into the uses of weakly caking Indian coals for the manufacture of metallurgical coke; the Institute must be provided with the necessary funds, staff and facilities for this work.

B. COAL WASHING.

54. In 1924 and 1925, Mr. Randall carried out forth flotation tests with certain Selected Grade Coals of the Jharia Coalfield. In his 'Foreword' to the 'Report on the Washability of Indian Coals' by Prof. Forrester and Mr. Mazumdar, Mr. Farquhar stated that these early investigations did not yield promising result and added:

"The Industry too readily concluded that Indian coals in general were not amenable to beneficiation and this unfortunately led to the discouragement of further research and probably retarded progress for two decades. Credit is due to those who did not concur in the popular conclusions of the industry and who consistently pursued their enquiries, who have now established that Indian coals, although more difficult, are amenable to treatment, and that it is only a question of selection of plant, comparative losses and cost of beneficiation."

With the exhaustion of the seams containing the better grades of coking coal and the adoption of mechanical mining methods, it is becoming more and more necessary to clean the inferior grades of coal in order to reduce the percentage of ash. Indian (Gondwana) coals are difficult to wash because the bulk of the ash-forming constituents (shaley matter) in them is intimately mixed with the coal substance. By contrast, in most American and British coals the ash-forming matter occurs largely as distinct and separate lumps or layers, the inherent ash being much less than in Indian coal.

55. Forrester and Mazumdar, whose work is summarised in the Report on Washability of Indian Coals (1947), stated that 196 tests were carried out by them on 141 samples. They concentrated their attention largely on coking coals containing high ash from the Jharia

coalfield. A plan indicating the sources of the samples and some of the results obtained forms Appendix I to this Report.

56. Some extracts from the Report on Washability of Indian Coals are given below :—

“One of the most significant points that emerge from these investigations is one to which attention has been drawn from time to time in recent years, namely, the essential difference between the Gondwana coals and the bituminous coals of Britain. In general, the high-ash portions of British coals are less intimately mixed with the rest of the coal substance than is the case with the Gondwana coals, occurring, as they often do (in the British coals), as separate lenticular masses, or layers or bands of various thicknesses, of what the miner calls ‘shale’ and containing upwards of 65 per cent. of ash forming minerals. As the coal breaks up in the ordinary course of mining and subsequent handling, many of these pieces of ‘shale’ separate out and accumulate among the smaller screen sizes. These latter are in consequence (in British coals) of much poorer quality (as measured by ash content) than is the run-of-mine coal and much more so, in consequence, than coal of the intermediate screen sizes.”

“On the other hand, it is the exception, rather than the rule, to find isolated lenticular masses, or even smaller pieces of very high-ash (shale intercalated in the Gondwana coals of India). The counterpart in India of ‘shale’ of British coals is the relatively high ash stony coal. As there is, in most cases, a gradation from low-ash to high-ash coal and *vice versa* throughout the seams there cannot be such a hard and fast differentiation between the ‘clean coal’ and the dirt. As a further consequence, the dirt or shale separable from these Indian coals is not of such a high-ash content as its counterpart in the British bituminous coals. That means of course, that in the dirt in the Indian coals there is a much greater amount of carbonaceous substance—potential fuel—than in the dirt of the British coals. Much of the dirt of the Indian coals, would, therefore, be too valuable to throw away.”

57. The separation of coal from its impurities, in ordinary coal washing, primarily depends on the difference of density of clean coal on the one hand and that of the mineral impurities on the other. The washeries still mostly in use are of the jig type but the general development is towards the installation of heavy-medium washeries, generally known as Gravity Washers. The principle of these Gravity Washers is that the required effective gravity of separation is maintained by the suspension in water fine particles of sand, magnetite, or other solids. There are several heavy-medium cleaning processes now in vogue, such as the Barvoys, Chance Tromp, Simon-Carves, American Cyanamide, etc.

58. In a written Memorandum submitted to the Committee, Dr. A. Lahiri of the Fuel Research Institute states that:—

“The investigations on washability and blending of coals have given hope for fuller and more extensive utilisation of Jharia coals which are almost entirely of coking quality. It has been shown that many of the seams are capable of yielding a fraction suitable for manufacture of coke and production of another fraction useful for other purposes. The results of blending give a definite promise of extension of life of our coking coal resources. It would be rash to predict, but the life of our coking coal reserves could be doubled if the results of these investigations were utilised in practice and steps were taken to avoid waste. If, however, the results are not rapidly implemented, then the promises are only of academic interest. If the good coking coals are wasted and exhausted, then obviously there will be little to blend with. Similarly if the inferior grades of coals are not washed now the better qualities of other types of coals will also approach rapid exhaustion.”

59. Since submitting our Interim Report we have had the opportunity of discussing this matter with persons who have installed washery plant in different parts of the world, and their evidence has confirmed the opinion that the problem of coal washing in India is difficult chiefly because the ash in the Gondwana coals is intimately mixed with the coal while the ash in the bituminous coals of Europe and U. S. A. occurs largely in the form of distinct layers. The process of cleaning coal in America or in England is in general a simpler problem than the one we have to face in India.

60. Mr. Martin of Koppers Co. Inc. informed us that from the experiments carried out by his firm on some samples sent to them by the Government of India, one coal, *viz.*, the Kargali Seam from E. Bokaro, yielded promising results. In the other two samples, the percentage of recovery of the clean fraction was such that, in his opinion, it might not be economical to wash them. This view was supported by Prof. N. N. Chatterjee, Professor of Geology in the Calcutta University. Prof. Chatterjee, in his evidence before the Committee gave details of certain experiments conducted by him recently in Imperial College, London. He too was of the opinion that practical testing should be carried out in Pilot Plant in order to determine the process or processes best suited for the coals in question. We concur with these recommendations, and support them.

MIDDLEINGS.

61. The Fuel Research Institute has carried out further washability tests on Indian coals and has submitted a progress report. From the tests carried out in the past year on many samples of some promising results have been achieved from the washing of the coal of No. 10 seam, in certain areas. From the evidence given to us and an examination of the experimental results, we find that the above seam can

yield 60 per cent. clean product with 16 to 17 per cent. ash, the rest (40 per cent.) containing 30 per cent. ash. Even better results have been obtained with coal from the Kargali seam. The products left after removal of the clean product, which we may refer to as 'middlings', are likely to contain 28 to 30 per cent. of ash according to the nature of the coal washed and the degree reduction of ash in the cleaner product required, e.g., for coking. The disposal of the middlings with 28 to 35 per cent. ash is a problem which has to be tackled. One outlet is obvious; large thermal power stations near the washeries could consume these middlings on the spot and thus prevent a glut in the market for high-ash coal. But other outlets should also be found to improve the economic of coal washing.

62. Two coal washeries are at present under erection in India, one of which should be in operation by the end of 1950 and the other early in 1951. We had the pleasure of visiting the Tata Iron and Steel Company's Washery's (Chance Process) under erection at West Bokaro. The results obtained in these washeries, such as working costs, percentage yield of clean coal, and amount and disposal of middlings etc., will be of great importance and assistance in the solution of the problem of coal washing.

IX.—Cost of Washing Plants.

63. We have written to various makers of Coal Washery Plant in U. K. for estimate showing the approximate cost of washing plant of capacities 100, 200 and 300 tons per hour input. Their estimates are given in the tables below. In certain cases the estimate is inclusive of civil works or storage bunker plant, or of plant for screening and sizing, while in other cases some or all of these items have been omitted. Probably the major difference in cost are attributable to these differences in tendering. In any case, it will be understood that the figures are only approximate and largely based on prevailing prices in U. K. On an average the cost appears to be as follows:—

	Rs.
For 100 tons per hour washery	15 lakhs.
For 200 tons per hour washery	24 "
For 300 tons per hour washery	30 "

	100 tons per hour	200 tons per hour	300 tons per hour
<i>A. Coppee Company—</i>			
Coal handling	{ Rs. £ 8,500	Rs. £ 17,900	Rs. £ 25,000
Building (steel and asbestos sheeting).	{ Rs. £ 17,500	Rs. £ 30,000	Rs. £ 45,000
Washery Apparatus	{ Rs. £ 2,36,250	Rs. £ 4,05,000	Rs. £ 6,07,000
	{ Rs. £ 39,000	Rs. £ 55,000	Rs. £ 70,000
	{ Rs. £ 5,26,500	Rs. £ 7,42,500	Rs. £ 9,45,000
Motors and Controllers	{ Rs. £ 2,000	Rs. £ 5,000	Rs. £ 8,000
	{ Rs. £ 27,000	Rs. £ 67,500	Rs. £ 1,08,000
Crushing, Mixing and Bunkers.	{ Rs. £ 29,000	Rs. £ 44,000	Rs. £ 80,000
	{ Rs. £ 3,91,500	Rs. £ 5,94,000	Rs. £ 8,10,000
Total	{ Rs. £ 96,000	Rs. £ 151,000	Rs. £ 208,000
	{ Rs. £ 12,96,000	Rs. £ 20,38,500	Rs. £ 28,08,000

(Figures are liable to vary widely according to local considerations.)

1. The prices are for Baum Washeries erected in England.
2. Assuming that the coal treated would 4" to 0".
3. There will be no re-washing provided, if it is intended to use the rejects for power generation.

—	100 tons per hour.	200 tons per hour.	300 tons per hour.
<i>B. Fraser and Chalmers Engineering Works—</i>			
Raw coal handling and Bunkers. Washery Plant to handle all sizes $\frac{1}{2}$ " steel framed Building. Refuse Disposal Conveyor, Electrical Equipment, Civil work, Foundations, Lighting and Cablework—			
Total cost installed say	Rs. 19,00,000	Rs. 27,00,000	Rs. 33,00,000
Total cost per ton hr capacity.	" 19,000	" 13,500	" 11,000
<i>Annual Charges—</i>			
Capacity Int. and Depr. @ 15% annum.	" 2,85,000	" 4,05,000	" 5,00,000
Total Input per annum 20 hours for 350 days tons.	" 7,00,000	" 14,00,000	" 21,00,000
Annual Capital Charge say As/ton	6.5	4.6	3.8
Operating labour, Sand Power, Maintenance, Insurance and Administration say As/ton	5	4	3
	11.5	8.6	6.8
<i>C. Colliery Engineering Ltd.</i>			
Approximate total	{ £ 80,000 Rs. 10,80,000	{ £ 1,50,000 Rs. 20,25,000	{ £ 1,85,000 Rs. 24,97,500

(The approximate prices give an indication of the total cost of coal washing plants, having the usual type of buildings and inclusive of electrical equipment completely erected on the site, and inclusive of the normal mechanical handling plant required to deliver the raw coal to the plant and for the disposal of the washed coal, including the breaking of same.)

<i>D. Simon-carves Ltd.</i>			
Raw Coal Handling. Coal Washing Plant to handle 1'-0" steel framed building, brick pannelled or sheeted. Foundations Electrical equipment. Approximate installed cost.	Rs. 19,00,000	Rs. 28,00,000	Rs. 32,50,000
Operating costs As ton.	4.5	3.5	2.8

64. The representatives of the coal producing industries in their evidence before us were generally of the opinion that more information and more data were needed before they would consider it reliable to instal coal washing plant on a large scale. Many of them were not satisfied that it was economically feasible.

65. The availability of several different processes for coal cleaning makes it imperative to study the economics, performances, and the relative advantages of each process before final adoption. Coal samples have already been sent to Europe and America to firms specialising in coal washing, but the coal often breaks down and suffers other changes during transit, so that, the results of the tests are liable to be inaccurate, and indeed misleading. Hence facilities for testing coals in the different types of washer box (on a sufficiently large scale) should be created in India as soon as possible. Pilot plant should be installed for coal washing at the Fuel Research Institute. It will then be possible to obtain valuable data for the coal producers in the direction they have requested.

X.—Economics of Coal Washing.

66. The present prices of coals from the Jharia coalfield (which are practically all coking) are as follows:—

Grade.	Ash content.	Prices (Run-of-mine)	
		Rs.	A.
Selected A	Below 15	15	3
Selected B	15-17	14	3
Grade I	17-20	13	8
Grade II	20-24	12	15
Grade IIIA	24-28	11	12
Grade IIIB	28-35	10	9

Coal with more than 35 per cent. ash does not come under the coal control order.

67. We are informed that the following are the *approximate* proportions of total rejects, middlings and clean coal which would be obtained in modern coal washeries, from Indian coals of various grades—if washed to 15 per cent. ash.

Grade	Rejects per cent.	Middlings per cent.	Clean coal per cent.
Selected A	0	0	100
Selected B	0	15	85
Grade I	10	20	70
Grade II	15	25	60

On the basis of the above average proportions (which admittedly are only approximate) we have made certain calculations in which we assume that 100 tons of a particular grade of coal is washed and compare the prices of unwashed coal with that of the different fractions got after washing, taking the value of the middlings at Rs 10 per ton.

Value of coal after washing 100 tons input.

Grade	Total rejects (over 35% ash)		Middlings (28%, 35% ash)		Clean coal (15% ash)		Total value of fractions	
	Tons.	Value. Rs.	Tons.	Value @ Rs. 10	Tons.	Value @ Rs. 15/3	Rs.	as.
Selected A . . .	Nil	Nil	Nil	Nil	100	1,518 12	1,518	12
Selected B . . .	Nil	Nil	15	150	85	1,291 0	1,441	0
Grade I . . .	10	Nil	20	200	70	1,063 2	1,263	2
Grade II . . .	16	Nil	25	250	60	911 4	1,161	4

Comparison of values of 100 tons of unwashed coals and of washed coals got therefrom.

Grade	Unwashed Value	Washed (all fractions) Value	Loss or gain Total	per ton
	Rs. as.	Rs. as.		
Selected A . . .	1,518 12	1,518 12	Nil	Nil
Selected B . . .	1,418 12	1,441 0	+ 22—4	+ 3.56 as.
Grade I . . .	1,331 4	1,263 2	—68—2	—10.9 as.
Grade II . . .	1,293 12	1,161 4	—132—8	—21.2 as.

68. In the quotations obtained from manufacturers of washeries we find that, for a washery handling 100 tons per hour, the cost of operation will be 5 annas and the charges against depreciation of plant will be about 6 annas, making up a total of 11 annas per ton of coal put through the washery. The cost will be respectively 3 annas and 5 annas per ton less, if plants of 200 and 300 tons per hour capacity are installed. If therefore only 100 tons per hour capacity plants are installed, the cost of washing including depreciation, per ton of coal, will be about 11 annas. Adding this to the difference in value between raw coal and washed coal, we get the following figures in respect of the different grades of coal washed. It will be clear that certain assumptions regarding recovery have been made.

	Difference Annas	Cost of washing Annas	Total Annas
Selected B . . .	+ 3.5	—11	— 7.5
Grade I . . .	—11	—11	—22
Grade II . . .	—21	—11	—32

The above figures do not include the cost of transport and handling of coal which might be heavy for instance if central washeries were adopted.

69. At present, practically all collieries, except a few who have installed labour-saving devices, are spending about Re. 1 per ton for hand-picking, and hand-screening and hand loading into wagons, involving the employment of a large amount of labour whose maintenance involves, in addition to wages, some indirect charges such as the extra cost of food grains, housings, bonus, etc. Most of this expenditure will be saved if the coal is fed straight from the mines to the washeries. It will be seen that for the Grade I sample shown above the difference in cost between beneficiation by hand (hand-screening and hand-picking) and beneficiation by washing is only about 6 annas per ton. The above figures thus show that for washing Selected B and Grade I coking coals, the producer may incur very little loss. It is essential however that the Railway minimum freight-charge for coal washeries, etc. now Rs. 1-12 per ton be lowered.

70. The disposal of middlings is important. They will have an ash content of about 30 per cent. and will therefore compete with Grade III coal if no special arrangements are made for their use. Thermal Power Stations if established near central washeries in the coalfield may be supplied with these middlings at about Rs. 10 per ton (or less if possible).

71. If the rejects are too high in ash to be used as fuel, it may be possible to use them as stowing materials.

72. We are of the opinion that any legal or executive action to compel producers to put up coal washeries at the moment is premature. The present price structure for coal does not encourage coal washing financially, and although a revision of the price structure for coking coal desirable, it does not appear to be immediately feasible. If it is found from experience gathered in the operation of the washeries that it is necessary to give revised prices for washed coal the matter should be reviewed by Government at a suitable opportunity in consultation with the producing and consuming parties and the Railway authorities.

XI.—Results that can be achieved through Blending and Washing of Coal.

A. BLENDING.

73. We feel that if blending with weakly caking coals is practised to the maximum extent possible without weakening unduly the strength of the coke produced, it should be possible to incorporate into all blends of coking coals now in use approximately 25 per cent. of weakly caking coal with 75 per cent. of strongly coking coal. By these means the effective life of the coking coal reserves will be increased by 33 per cent. We recommend that such blending with weakly caking coals be immediately put into practice by the large manufacturers of metallurgical coke. If researches are undertaken for the purpose of utilisation of the weakly coking coals for the manufacture of metallurgical coke and for the conversion of non-coking coal into coking coal, they may lead to a considerable increase in the quantity of coal which can be used for coking. The work

carried out on the Utah and Illinois coals in America promises to be of great importance in this connection.

B. WASHING.

74. We are of the opinion that it can be taken as an accepted fact that Indian Coals are amenable to washing, but in view of the comparatively slight differences in specific gravity of the various constituents, the coals in general may be considered as coming under the category of "coals difficult to wash".

75. Recent tests have proved that certain seams of the East and West Bokaro coalfield can be beneficiated to yield excellent metallurgical quality coal. Of these the Kargali seam appears to be very suitable for washing.

By beneficiation it is possible to draw upon coking coal reserves in a large number of seams which are, at present moment, excluded by the steel works as coking coal, chiefly on the score of high and variable ash. The steel works have asked for rather rigid specifications in their coking coal, and for many seams this will necessitate coal washing. Hand beneficiation hitherto adopted has not proved satisfactory even in the past and will be increasingly unsatisfactory as the better seams become exhausted and as mechanised mining increases.

XII.—Estimate of India's requirements of good quality Coking Coal in the next few years.

76. Figures of the present and estimated future demands of coking coal are given below:—

Name of consumer.	Present demand in tons (per annum)	Estimated future demand (after 5 years) per annum
1. Tata Iron & Steel Co.	1,560,000	1,845,000
2. Indian Iron & Steel Co.	1,332,000	1,800,000
3. B. P. Hard Coke—for other consumers, viz.—		
(a) Bararee Coke Co.		
(b) Burrakar Coal Co.	426,000	468,000
(c) Lodna Colly. (1920)		
(d) Bhowra Coke Co.	72,000	360,000
4. Coke Ovens Giridih	—	3,000,000
5. Proposed two steel Plants	97,000	270,000
6. Sindri		
	3,487,000	7,743,000
II. Other Hard Coke—		
(a) Beehive Ovens	175,796	175,796
(b) Country Ovens	60,156	60,156
	235,952	235,952
GRAND TOTAL	3,722,952	7,978,952

The Sindri Fertiliser Plant may not require metallurgical coke, as its needs can be met from Weaker Coke.

77. The present consumption of coking coal is thus about 3·7 million tons and it will rise to about 4·9 million tons in a year or two when the present steel companies have completed their expansion programme. If the proposed two new steel plants are constructed by Government in the course of the next 3 to 5 years, the consumption of coking coal will rise by another 3 million tons, to nearly 8 million tons per year, as shown above.

XIII.—Reduction of Output of Coking Coal.

78. At present the total annual output of coking coal of all grades is about 12·6 million tons (1949), made up as follows:—

Selected A	2,216,082 tons.
Selected B	5,048,370 „
Grade I	2,840,208 „
Grade II	2,496,647 „

Total . 12,601,307 tons.

79. Leaving out Grade II, the output is 10·1 million tons. In order to minimise dislocation of the industry in the coming few years we propose that the reduction of output should be gradual, at the rate of 10 per cent. each year calculated on the output of the previous year. The following table shows the output and reduction up to 1953 if this programme be followed for 5 years.

Year	Output (million tons)	Reduction (million tons)	Year	After reduction net output (million tons)
1949	10·11	1·0	1950	9·0
1950	9·00	0·9	1951	8·1
1951	8·11	0·81	1952	7·29
1952	7·29	0·73	1953	6·56
1953	6·56	0·66	1954	5·90

80. At the end of 5 years therefore there would result a reduction of 4·2 million tons, which we think will be the limit to which output could be reduced without actually closing down many mines and causing serious dislocation. But we recommend that the position be reviewed annually and that the programme be adjusted in the light of the developments and actual requirements more especially of the new Iron & Steel Works.

81. As already stated there are enormous reserves of good quality iron ore in India easily and cheaply workable. If the country's future industrialisation plans involve the production of 10 million tons of

iron and steel per year, a vastly increased production of coking coal will be necessary. Meanwhile, the programme proposed above may be initiated.

82. One of the difficulties that will be encountered in enforcing reduction in the output of metallurgical coal, will be the retrenchment of labour. To a large extent labour can be transferred to collieries working non-coking coal where the output will have to be increased. We are informed that mining labour often objects to being transferred from one coalfield to another and even from one colliery to another. This difficulty will have to be faced. Labour when retrenched should, if possible, be given alternative employment in the same locality.

To deal with the problems arising from the retrenchment of labour, e.g., rehabilitation, compensation, transfer and re-employment, an *Ad Hoc* Committee should be formed in which the Labour Unions should be adequately represented.

83. About the manner of reduction of output of coking coal various opinions have been expressed, e.g., that the Railways should shut down their collieries and take their requirements from private collieries; that the steel companies should similarly shut down their collieries and take metallurgical coal from the private collieries. It has also been suggested that as the reserves of coking coal, as found by the Survey Party, are not so alarmingly low as was thought at first, and as there is every likelihood of two new steel plants being constructed within the next few years, there is no need to curtail production at all beyond what may be expected to meet from compulsory sand-stowing. The last argument has also been supported on the grounds that there will be a good deal of unnecessary dislocation in industry, labour, etc., if production is reduced for a few years after which it might have to be increased and that the traffic arrangements involved in providing more transport from non-coking coal areas will be difficult of achievement in a short time, and involve much expense, and so on.

84. After giving the matter consideration, we are of the opinion that our reserves of coking coal are not so large as to permit of the indefinite postponement of the enforcement of a measure of conservation. It is not reasonable and prudent to continue to use good coking coal for non-coking purposes, even if there are future possibilities of technological improvements in the use of non-coking coal for metallurgical work. The reserves of coking coal are not sufficiently great to allow of extravagance. We would, therefore, urge that immediate steps be taken to curtail production over a period of years as recommended above. It is desired to cause as little dislocation of industry as possible. We think that except in the case of collieries where a restriction of output will seriously affect the safety of the mine, the reduction may be made *pro-rata* on all collieries, in order that the disadvantages accruing therefrom will fall more or less equally on all the producers. We recommend, however, that the following

principles be observed in the curtailment of production of coking coal:—

- (i) The condition of the workings in each individual mine should be carefully taken into account. Where curtailment of output will lead to loss of coal, the loss must be guarded against, and the collieries allowed to continue the working by the competent authority.
- (ii) Special consideration should be given to collieries or companies installing washeries to provide uniform quality coal for coke manufacture.
- (iii) Collieries which are worked solely for supply of coal for coking should receive favourable consideration; and
- (iv) Permission to open new collieries and re-open old collieries (which have been shut down for some years) for the production of metallurgical coal should be refused.

85. We further recommend that an Executive Committee be set up by Government for carrying out the above programme of reduction. The Executive Committee will allot output quotas to each individual colliery, after hearing any special representations which the management may wish to make. They should have power to call for all relevant information from the collieries to help them to decide each case satisfactorily. This Committee should be advised by a small Advisory Committee composed of the representatives of the following:—

- (1) Consumers,
- (2) Producers;
- (3) Labour;
- (4) Railway;
- (5) Fuel Research Institute;
- (6) Department of Mines, if not already included in the Executive Committee.

XIV.—Transport difficulties in the way of increasing the production of good quality non-metallurgical coal.

86. If the output of metallurgical coal be curtailed by about 4·2 million tons per annum in the coming 5 years, this amount will have to be made up by production elsewhere of non-metallurgical coal. This may be done to some extent from the Raniganj coalfield but mainly we consider from the fields west of Jharia, particularly Karanpura and the coalfields of Madhya Pradesh, Wardha Godavari and Mahanadi Valleys. Any non-coking coals of suitable quality from the Jharia coalfields may be drawn upon.

87. We are informed that, based upon our recommendation in the Interim Report, the Railways (*vide* Appendix J) have already arranged to replace coking coal by 29 wagons per day from the Karanpura area served by the B. N. Railway and 27 wagons per

day from the Jharia field. The Railway representatives informed us that they could make arrangements for the movement of some 50 wagons, daily, from the Asansol area in the Raniganj field and a further 50 wagons loaded by the B. N. Railway *via* Gomoh. This would till leave about 57 wagons of metallurgical coal to be replaced daily by non-metallurgical coal as part of the first year's programme of replacement of 213 wagons. We are also informed that any further transfer of traffic to the Raniganj or any other field will involve the provision of more locomotives. If most of the replacement beyond the above programme is made from coalfields west of Jharia, it should not be difficult to arrange.

88. The mining engineers with whom we discussed this question stated that it should not be difficult to develop the Karanpura and other fields to the required extent, but quick replacement would require help from Government in the matter of machinery, colliery equipment and sidings. They also stated that for some years past it had been exceedingly difficult for them to persuade the Railways to give facilities for construction of sidings to collieries. This difficulty should be removed if the programme of replacement were to be effective. Government should give every facility for the opening up of new collieries and the provision of sidings, procurement of equipment, etc. If these facilities are made available no serious difficulties are anticipated in carrying out the programme of replacement of coking coal with non-coking coal during the coming few years. The Committee charged with the duty of enforcing reduction of output of coking coal may also allocate the increase of output of non-coking coal to the various coalfields and collieries, and recommend the construction of railway sidings and other facilities.

XV.—Use of low-grade coal by

(a) RAILWAYS AND (b) POWER GENERATION.

89. *Railways*.—The largest consumers of coal in India are the railways. Their consumption amounts to about 12 million tons per annum and includes some 4 million tons of coking coal of grades down to and including Grade II. The engineering and research staff of the railways have gone to considerable trouble to redesign locomotives with the result that the modern designs with models WP and WG are capable of giving excellent performance on non-coking coal or even on low grade coking coal as long as the ash content does not exceed 24 per cent. The railways state that they are not in a position to consume coal of lower grade than Grade II (ash content 24 per cent.).

We wish to place on record our appreciation of the good work done by the Railways and recommend that steps be taken to implement the work fully by complete utilisation in due course of non-coking coal.

90. Most steam locomotives have an efficiency of about 5 per cent. whereas electric locomotives traction systems show an overall

efficiency of about 15 per cent. Still more important, low grade fuel and slack can be utilised for the generation of the electrical energy, or hydroelectric power may be available. Consequently electrification of railways directly effects conservation of coal and of the higher grades of coal. We would recommend that electrification be given the fullest consideration from this point of view and that the extension of such electrification be fully explored. In our opinion there is an excellent case for electrification of the railways in and around Calcutta and in other areas not remote from the coalfields. In districts where hydroelectric power is not available, low grade non-coking coals can be utilised for power generation at Thermal Stations including middlings from washeries. The middlings ought to be available at a comparatively lower price.

91. *Power Generation.*—Thermal Power Stations at present should be compelled to take non-coking coal and in future such power plants should be designed to be capable of consuming coal containing 30 per cent. of ash or more. We have already pointed out that there is much to be said for the erection of Thermal Power Stations alongside the coal washeries. Thermal Power Stations will of course be linked with hydroelectric grid in order to help in the adjustment of seasonal fluctuation to which the hydroelectric sources are subject.

XVI.—Compensation.

92. In connection with the proposed reduction of output, the Representatives of the Colliery Companies (The Indian Mining Association; Indian Mining Federation; the Indian Colliery Owners' Association; and most of the Mining Engineers) raised the question of compensation. In their opinion the colliery owners should be compensated for loss of profit. They admitted that it was possible that natural causes might intervene and necessitate reduction of output, but that was different from artificial reduction enforced by Government in the national interest. They argued that if there were reduction of output in the national interest, the Nation should compensate them for loss as incurred through such interference, the earnings being calculated as under normal conditions of supply and demand over a period of 3 to 5 years prior to such artificial enforcement. The cost of working and profits earned would depend upon the capitalisation, overhead charges, and output. Another argument advanced by the private interests in respect of compensation is that if the supply goes down due to natural causes, the demand remaining the same, the price will go up and thus a rough and ready compensation would be achieved.

93. We discussed this question at some length both with the witnesses and amongst ourselves, but could not agree upon any kind of helpful formula. Some of the arguments against compensation are that the restriction of output does not mean an actual loss so long as the company is able to meet interest on capital, depreciation on machinery installed and overhead expenses; that there is no means by which efficiency of operation of different companies can be

measured and that in any case the coal which is not raised is still in the ground and is thus able to earn a profit at a future date when restrictions are removed. We therefore think that Government should treat the coal industry on the same basis as other industries in which a similar restriction of output has been imposed in the past, and examine the question of compensation if and when necessary. There are many factors which will have to be taken into consideration, for instance, a mine which is just being developed has been spending a large amount of money in sinking shafts, installing machinery and developing the mine for production, and therefore it has incurred heavy expenditure and not made any profit. On the other hand, a well developed mine in full production has made appreciable profits which, it is true, may be reduced by restriction of output, but which may not actually be turned into a loss unless the output is curtailed to a low figure.

XVII.—Fuel Research.

94. In the course of this Report we have pointed out the necessity and urgency for undertaking investigations by the Fuel Research Institute on the following subjects:—

- (i) Production of metallurgical coke from weakly caking coals and non-caking coals ;
- (ii) Design of coke ovens to coke weakly caking coal ;
- (iii) Methods and economics of washing of the various seams containing metallurgical coal.

95. It is imperative that the Fuel Research Institute should be provided with necessary funds for the above researches.

ACKNOWLEDGMENTS.

96. We wish to tender our thanks to the Coal Superintendent and his Assistants and to the other members of the Survey Party (including the Surveyor at Giridih Colliery) who have worked diligently to complete the survey of the reserves in the restricted time available. We are also indebted to the Coal Commissioner, Chief Inspector of Mines, Director of the Geological Survey of India and the Director of the Fuel Research Institute for giving the valued co-operation of their organisations, and to Messrs. Tata Iron & Steel Company and Messrs. Indian Iron & Steel Company for their co-operation in numerous directions. Finally we have to thank other organisations and individuals too numerous to mention for coming forward and submitting evidence to assist in our deliberations.

We wish also to place on record our appreciation of the energy and enthusiasm displayed by our Member-Secretary—Mr. A. B. Guha.

XVIII.—Conclusions and Recommendations.

(A) Conclusions.

1. If correct and prudent mining practice be adopted in mining, and if the blending and washing of coking coals is practised at an

early date, we may regard the country's reserve of coal serviceable for carbonisation to metallurgical coke as 2,000 million tons from all sources. (Para. 42.)

2. The above figure must be reduced—possibly halved unless proper mining methods (including especially sand stowing) are adopted forthwith. (Para. 42.)

3. Coking blends containing the maximum proportion of weakly caking coal should be introduced as soon as possible. (Paras. 73, 50 and 39.)

4. Coal washing is essential not only in the interests of producing coal of consistent and low ash content, but also in the very interests of coking coal conservation. If beneficiation or washing be not adopted, the estimate of coal suitable for coking must be considerably reduced. (Paras. 75 and 39.)

5. A reduction in the output of coking coal is desirable, much of which reduction can be achieved by sand stowing, which will also have the additional advantage of effecting maximum extraction from the mine. (Paras. 79 and 80.)

(B) *Recommendations.*

1. In the Mining of Coking Coal stowing should be carried out not only for safety as at present, but also to effect maximum recovery of coking coal. Legislation to this end is immediately necessary. (Paras. 44 and 79.)

2. The sand stowing of all mines working coking coal, of Selected Grades, and of coking coals of Grades I and II if they can be beneficiated to give large yields of low ash coal should be made compulsory forthwith, unless the competent authority permits their exemption. (Para. 44.)

3. The resources not only of sand but also of other suitable stowing materials in and around the (coking) coalfields should be investigated. The utilisation of dredgings from the reservoirs in the Damodar Valley should be kept in view. (Para. 47.)

4. The selective mining of parts of seams should not be allowed except with the permission of the competent authority.

5. Prompt steps should be taken by Steel Companies to arrange for the incorporation of the maximum amount of semi-coking coals in the coal blends fed to the ovens. The Railways on their part must provide the necessary transport facilities to enable regular supplies in open wagons of semi-coking coals (as well as of coking coals) to be sent in the requisite proportions to the coal washeries or to the coal handling plant of the Coke Ovens. The co-operation of the operating Heads of the Railways is essential. (Para. 52.)

6. It is recommended that the steel companies may change their

coking blend as long as the coke produced from the blend is up to the specification for the following reasons. We would point out that—(Para. 17)—

- (i) A 15 per cent. limit of ash would mean that only Selected A coal could be used at present. The reserves of such coal are small.
- (ii) The Steel Companies are already using coal with up to 17 per cent. ash ; and, where the volatiles are low, such coal does not give excessive ash in the coke.
- (iii) By relaxing the limit to 17 per cent. an appreciable extra yield of clean coal will be got by washing certain coals.

7. The Fuel Research Institute may be requested to undertake a research work on the following:—(Para. 94.)—

- (i) Coking of weakly caking coals on the lines of work done on Utah, Colorado and Illinois coals in the U. S. A.
- (ii) Carbonisation of such coals in modified Coke Ovens.
- (iii) Extensive washing tests in pilot plant of all seams containing good coking coal.

The Government should provide the necessary funds.

8. Thermal Power Stations near the Washeries should as far as possible consume 'Middlings' produced which should be supplied at a reasonably low price. The rejects should, if possible, be utilised for stowing, dangers from spontaneous combustion (especially of certain coals) being guarded against. (Paras. 70, 61 and 47.)

9. A revision of the prices of coking coals at present, though desirable from certain points of view, is not considered feasible. A general revision of prices of the various grades of coking coal, and especially of washed coal, may be undertaken after actual data on the economics of washing coals in India are available. Meanwhile, the price of washed coal may be fixed by Government in consultation with producers and consumers, and the Railway Authorities. (Para. 72.)

10. For the coming few years the output of coking of Selected A, B and Grade I quality coals should be reduced by 10 per cent. per annum of the previous years output. We advise, however, that the position be reviewed annually by the competent authority in the light of developments and the needs of the time. (Para. 79.)

11. A small Executive Committee should be set up to determine the allocation of reduction of output of coking coal and the increase of output of non-coking coal. This Committee should be advised by a competent Advisory Committee who will take into consideration all relevant matters. (Paras. 84 and 85.)

12. Railway facilities must be given for supplying additional non-coking coal from Raniganj, Karanpura—and other non-coking areas to

the general consumers in order that metallurgical coal now in use for non-coking purposes may be adequately replaced. Sufficient power and wagons, etc., for the rearrangement of the transport must be made available. At the same time the progressive opening up of collieries in non-coking areas should be undertaken so that the present supplies of coking coal to the Railways and other consumers, may be replaced at an early date. (Paras. 86 and 88.)

13. The possibilities in electrification of the Railways as a means of conserving high grade coal should be explored further with special reference to the areas not too distant from the coalfields. (Para. 90.)

14. Thermal Power and other Plants now using coking coal for steam raising should be supplied with non-coking coal of the same grade as soon as possible. (Para. 91.)

15. Steps should be taken to prove the reserves below the depth of 2,000 feet in the area underlying the Barren Measures and the Raniganj series in the Jharia coalfield. (Para. 27.)

In addition, the Geological Survey of India should explore fully by drilling and large scale mapping the following coalfields. (Para. 35.)

- (1) East and West Bokaro ;
- (2) Ramgarh ;
- (3) South and North Karanpura ;
- (4) Surguja ;
- (5) Korba ;
- (6) Kanhan Valley.

16. The necessary equipments must be provided. Certain coking coals low in phosphorus, e.g., Kurhurbaree seams at Giridih and the Laikdih seam of the Raniganj coalfield, may be reserved in part for the manufacture of ferro-manganese and for blending.

17. Where Coke making is done in By-product Plant, it is essential that no impediments should be put in the way of economic recovery of the By-products. (Para. 8.)

18. If the reduction in the output of collieries producing coking coal results in a serious loss to the owners each case for compensation should be judged on its merits. (Paras. 92 and 93.)

19. To deal with the problems arising from the retrenchment labour, e.g., rehabilitation, compensation, transfer and re-employment, an *Ad Hoc* Committee should be formed on which the Labour Unions should be adequately represented. (Para. 82.)

(MEMBERS' SIGNATURE.)

1. (Sd.) M. S. Krishnan,
Dr. M. S. Krishnan, Chairman.
2. (Sd.) J. W. Whitakar,
Dr. J. W. Whitakar, Member.
3. (Sd.) D. R. Malhotra,
Dr. D. R. Malhotra, Member.
4. (Sd.) C. S. N. Raju,
Mr. C. S. N. Raju, Member.
5. Subject to my note of dissent in para. 82
of the Report.
(Sd.) S. K. Sen,
Mr. S. K. Sen, Member.
6. (Sd.) A. Farquhar, 30-5-50,
Mr. A. Farquhar, Member..
7. (Sd.) W. M. Wallace, 30-5-50,
Mr. W. M. Wallace, Member.
8.
Mr. W. H. S. Michelsmore, Member.
9. I agree generally with the conclusions and
recommendations but I differ with a few
suggestions in the main body of the report
for which I intend to submit a note.

(Sd.) B. L. Agarwalla, 30-5-50,
Mr. B. L. Agarwalla, Member.
10. (Sd.) B. P. Sinha, 30-5-50,
Mr. B. P. Sinha, Member.
11. (Sd.) N. G. Chatterjee, 30-5-50,
Mr. N. G. Chatterjee, Member.
12. (Sd.) V. P. Sondhi,
Mr. V. P. Sondhi, Member.
13. (Sd.) A. B. Guha,
Mr. A. B. Guha, Member-Secretary.

Note of Dissent on para. 82 by Mr. S. K. Sen.

It has been stated that it should be possible to absorb the surplus labour thrown up as a result of reduction in the output of metallurgical coal in collieries producing non-metallurgical coal the production of which will have to be stepped up. If alternative appointment is offered to the surplus labour which they do not accept for reasons of their own, the question of payment of any compensation should not arise. At any rate, the question of surplus labour in the coalfields was considered by an *Ad Hoc* Committee appointed by the Government for the purpose—in 1948 and in the matter of retrenchment, rehabilitation, compensation and re-employment, etc., the questions should be governed by the decisions reached by Government on the Report of the Coal Mines Surplus Labour Committee. It seems hardly necessary to appoint any *Ad Hoc* Committee for this purpose as recommended in this para.

(Sd.) S. K. SEN—2-6-50.

**A minute of dissent submitted by Mr. W. H. S. Michelmore, Member,
Committee on Conservation of Metallurgical Coal
on the Final Report of the Committee.**

1. I am in agreement with other Members of the Committee on much of the Report, but there are issues of major importance on which I differ and upon which I feel bound to submit a separate minute.

RESERVES OF METALLURGICAL COAL.

2. In my opinion the reserves have, in many respects, been calculated on a basis which is so conservative as to be deemed unjustifiably pessimistic. Maximum losses in working have been anticipated; seams not actually proved in detail, although known to exist, have in many cases been ignored; in cases where there is a difference of opinion as to the workable thickness of a seam, minima have been taken; no figures have been included for certain potential (though as yet unproved) reserves such as seams Nos. 1 to 7 in the West Bokaro Coalfield; and lastly, even in fully electrified collieries substantial deductions have been made to cover colliery consumption, which of course would in such cases be negligible. It is my considered opinion therefore that both the total reserves and the ultimate recovery are likely to be appreciably greater than has been anticipated.

3. It should be remembered that India is fortunate not only in possessing large reserves of iron ore, but also that this ore is of high quality; it is therefore possible for blast furnaces to work, even if at a somewhat lower efficiency—with coke of higher ash content.

Some other countries are less favourably placed in this respect, and as a result have already been forced to make considerable progress in the direction of devising alternative processes for steel-making. Reference is made in the Report to the use of weakly coking coals, and there are good grounds for confidence that scientific research and invention will find a means of modifying present practice adequately for the use of these ores. Nevertheless the reserves of good metallurgical coal are not unlimited; and although the position now revealed is very much less alarming than had previously been believed and there is no fear of imminent or early exhaustion, I agree that proper planning is necessary to ensure that this coal is conserved and utilised to the best advantage if the country is to maintain and expand its industrial development.

4. In considering the reserves as now established, it is necessary that proper importance should be attached to the unworked areas, which form such a substantial percentage of the total reserves. These are lying fallow, cannot be worked without the permission of Government, and never *will* be worked (assuming control is maintained) until such time and in such manner and in such quantities as Government may direct. To pursue this point further by quoting a single instance, we have the reserves in the Kathhara property of no less than 231½ million tons; assuming the necessary development and facilities there reserves alone would supply the estimated requirements of the two proposed new Government Steel Works, amounting to 3 million tons per annum, for no less than 77 years. Moreover the necessary output could be produced from this property at a few years' notice at any time, whether active operations be commenced to-morrow, or a hundred years from now. If therefore the 774 million tons of virgin coal be strictly reserved for steel-making, this alone will provide a hundred years' reserve for a steel industry of more than double the size of the existing one.

DEMAND.

5. The figures which have been produced to us and which are embodied in the Report show that the present demand for metallurgical coal is, in round figures, 4 million tons per annum and in say five years' time, when the Government's two new projected steel plants may be expected to be in operation, will be of the order of 8 million tons per annum. It is well known that there is a time lag of several years in getting a decent sized colliery into full production, and that is particularly so in modern times when procurement of machinery is so difficult, and sidings, weighbridges and other facilities take so long to provide. Almost the same considerations apply to the re-opening of a colliery which has been closed or restricted as to the opening out of a new one, and it seems therefore that it would be most imprudent to attempt to regulate output now to a figure less than the demand anticipated five years hence. For, if output be drastically restricted to the nett consumption of to-day, there is every likelihood that the increased demand of five years hence will not then be met

CONSERVATION.

6. If the necessity of proper planning of output and utilisation be accepted, it then falls to consider what form such planning should take. A plan for reduction of output may be either arbitrary and immediate as proposed by the Committee, or practical and orderly. I shall discuss in greater detail in later paragraphs some of the difficulties inherent in the Committee's proposals, but at this stage it will suffice to record that in my opinion they are not practical. I have already drawn attention to the importance of the reserves of metallurgical coal in the virgin areas, and my opinion is that they should be immediately conserved by Government and earmarked for use in due course for metallurgical purposes only.

7. As regards the working collieries, our aim should be to achieve conservation in its widest sense, that is that there should be no avoidable waste in mining, while at the same time ensuring that there is no violent upheaval or dislocation. Experience in our Indian coalfields has shown that sand-stowing is the best means of conserving coal and on the whole it has been fairly successful. I therefore support the view that compulsory sand-stowing for conservation should be enforced wherever the losses without such stowing are likely to be excessive. It must be appreciated, however, that the *universal* enforcement of sand-stowing in metallurgical coal mines is not practicable because the sand itself and the facilities for moving it are not adequately available, and there are also a number of mines where the percentage of recovery without stowing is so satisfactory that the additional recovery with stowing would by no means justify the very substantial increase in cost which would be involved. While agreeing, therefore, that there should be statutory powers for the enforcement of compulsory stowing for conservation, I cannot agree that such stowing should be universal; in my opinion the discretion should rest with a Technical Advisory Committee to decide whether individual collieries should be compelled to stow or not. Where compulsory stowing is enforced the cost should be met in full.

8. The quantum of assistance now being granted to Collieries by the Coal Mines Stowing Board for voluntary stowing does not meet the actual cost of such stowing; with compulsory stowing the expenditure of the Board will obviously be much increased, and as its funds are already inadequate to cover existing and projected grants and schemes the enhancement of the Stowing cess appears inescapable.

9. It is difficult to estimate the reduction of output which will be brought about by the introduction of stowing for conservation, but it seems likely to be appreciable, particularly as time goes on and gallery driving in existing mines draws to a close. At the same time the prohibition of the normal development of new collieries will also result in a decline in output, and the production of metallurgical coal will then be brought down to a level more commensurate with the actual requirements of the steel industry. An orderly equating of supply and demand will thus be achieved, without acute dislocation and, above all, without the need for very heavy

compensation which would inevitably result from a compulsory restriction on the lines proposed.

RESTRICTION.

10. I have endeavoured to put forward an alternative to arbitrary universal restriction, but as this latter proposition appears to be accepted by my colleagues as indispensable, I cannot but make a few observations on the subject.

11. The Report does not seem to appreciate that coal production costs vary inversely with the output and directly with the standard of mining efficiency. Any mining engineer knows that even a small reduction in output puts his raising cost up appreciably, and a reduction of the magnitude envisaged in the Report would produce an astronomic rise in cost such as to put a colliery completely out of business. Again, any increase in mining or marketing efficiency, whether it be mechanisation, sand-stowing, or coal washing, must, on an unchanged output, reflect itself in a rising cost of production. The sharp increase in cost which arbitrary restriction would bring about would, unless there is to be gross injustice, have to be met either by subsidies or compensation, or else by an increase in selling price; the amount of this assistance is moreover likely to be very substantial. But without it the producer will be forced by economic necessity to close his mine. And there are many collieries—especially among those producing metallurgical coal—where conditions are such owing to mining difficulties, proximity of fire or heavy percolation of water that if they were once closed they could never be re-opened. So the result of their enforced closure would be not Conservation but destruction of metallurgical coal.

12. The Report suggests that there will be special cases, such as where coal washing is being practised, where collieries should be exempt from restriction. Among these must surely be included, and if anything with an even stronger claim, those where heavy capital expenditure has been incurred in the installation of sand getting and stowing equipment and in the maintenance of production for war and post-war purposes. Many of these projects have been undertaken under strong Government pressure, and it is generally agreed, as has already been pointed out, that sand-stowing is the best and most efficient single avenue for conservation and the avoidance of wasteful mining. There would, therefore, appear to be an unanswerable case for allowing such collieries to continue to operate to their full installed capacity.

13. Another, and a most important, aspect of the restriction problem is the traffic aspect. This question has been given most inadequate attention by the Committee, although we have seen from the evidence given before us by representatives of the two principal coal loading railways, the E. I. R. and the B. N. R., and by the Coal Transport Officer that very little progress has yet been made, or is indeed practicable, in the replacement of metallurgical by non-metallurgical coal for steam raising purposes. The fact is that the Jharia Coalfield has been the principal source of the country's coal

supplies for many decades past, and the transport system has been built up to serve this traffic; to replace these supplies from other coalfields would require a major reorganisation of the railways, besides very heavy capital expenditure which has not yet been estimated. Only if this be undertaken can the recommendations of the Committee be put into effect without creating chaotic conditions.

14. The Committee, while posing the problem of where the impact of restriction should fall, have cut the knot by suggesting that all collieries, whatever their ownership, should carry the burden equally. To my mind this proposal is quite unjustifiable, for, after all, we should ask ourselves, who will benefit by the adoption of a policy of restriction and conservation. The answer must surely be, first the Steel Works, whose supplies of coal the policy is intended to secure, and secondly, the nation, partly as custodian of the interests of posterity and partly as the future owners of any new Steel Works that may be erected. It therefore seems to me quite indefensible, as long as the principle of private ownership is maintained, that the "captive" collieries should be allowed to exhaust their reserves *pari passu* with collieries under private ownership. I suggest therefore that, subject always to mining considerations which must be paramount (by which I mean that no closure likely to involve destruction of coal reserves should be ordered) the impact of any restriction which may be deemed to be necessary should fall first on the collieries belonging to the Steel Works and second on the Government owned collieries. I am particularly impressed with the urgency of closing or restricting the national owned coal quarry at Bokaro. This coal has been satisfactorily used by the Steel Works in large quantities for coke making, the closing of a quarry raises no mining problems such as arise in deep mines, and—whatever views one may hold on the rights or wrongs of the Government owning their own collieries—there can surely be no justification for Government (whose example should be the best) to raise and despatch this valuable metallurgical coal at the rate of millions of tons a year for steam raising in locomotives. I may also mention, although the fact is not strictly relevant to the immediate issue, that this has always been and still should be the nation's great flexible strategic reserve of ready coal which can be immediately drawn upon in the event of war or other national emergency. Again, I am quite unable to see the justification of one of the Steel Works being permitted at this juncture to open up, a large new colliery in a virgin area to produce nearly a million tons of metallurgical coal a year—even if the coal is to be washed. Surely operations at this colliery could be suspended and the washery re-erected elsewhere at a working colliery.

15. If restriction is to be imposed at all on privately-owned collieries, sufficient elasticity should be provided to enable restriction collieries, as well as groups of collieries under the same ownership or management, and greater efficiency and economy could undoubtedly be achieved by enforcing restriction on the group as a whole to be effected by groups. There are companies owning several rather than imposing a *pro rata* cut on every individual colliery.

COMPENSATION.

16. The question of compensation is touched upon all too lightly in the Report, and the suggestion that this subject should be examined by Government "if and when necessary" is manifestly inadequate. The fundamental right of an individual (or Company) to compensation in the event of Government interference with his property has been accepted in the Constitution, and it is, I suggest, indispensable that the basis of compensation for any restriction in output that may be imposed in the national interest should be carefully examined and determined *before* compulsion is introduced rather than by haphazard subsequent enquiry, when it may well be that substantial losses have already been incurred. I have already touched in para. (11) above on the effect of restriction on cost of production, and obviously a 40 per cent. cut as envisaged by the Committee would bring ruin to many Companies and their shareholders, as there is no possibility of adjusting or pruning costs to meet so severe an imposition. I therefore consider it essential, whether restriction be enforced by legislation or by executive action, for the basis of compensation to be settled in advance. This indeed is a matter of urgency as the sale by collieries of metallurgical coal is already being restricted by Government, with no decision as to how they should be compensated.

17. The basis of compensation is a difficult problem, as indeed is recognised in the Report. I, however, strongly disassociate myself from the suggestion which I feel is implied in the wording that actual nett loss should be the only criterion, and loss of profit should be ignored. For if a colliery has by efficient management and good organisation been making a profit for its shareholders, and then the possibility of making that profit is destroyed by Government restricting the output to an uneconomic level, that will be a serious financial blow to the shareholders—even if no actual loss be incurred—and they are obviously entitled to be compensated for this interference with their liberty. It may be argued that the coal is still in the ground and will be able to be profitably worked at some future date, but the shareholder is entitled to expect some return on his investment during his own lifetime and not to sacrifice it to posterity. The repercussions of such a policy would be far wider than on the Coal industry alone.

18. I have suggested in para. (6) that the proper way to safeguard the future is for Government to conserve the virgin areas containing metallurgical coal, but here again it is not reasonable to expect shareholders to stand out of their property indefinitely, and in my view the Government should acquire these areas outright. Here again the question of compensation will arise, and the measure of this should be, if not current value, at least the actual cost of property to the company, including purchase price as well as minimum royalty, interest on capital, and other holding and service charges up to the date of acquisition. In acquiring these virgin areas proper care must be taken to ensure that working collieries are left with adequate reserves of solid coal for future development adjacent to their existing workings.

19. If the principle of compensation for reduction of output be accepted, then we have to determine the measure of it. It is extremely difficult to assess accurately the financial effect of partial restriction on any particular colliery ; moreover, even if the scheme be applied generally there will, owing to special circumstances, be some collieries completely closed, others partially restricted, and yet others continuing in full operation. For the colliery which has been in existence for some time and is partially restricted probably the fairest method would be for the Government to guarantee to the shareholders a profit not less than their average profit from the colliery over, say, the last five years, the balance being made good out of the Compensation Fund (*vide* para. 20 below). Coal mining is, as is well known, a fluctuating and very hazardous industry which has its ups and downs, resulting not only from trade cycles, but also from mining, geological and other physical causes. There may then be cases where there are no past profits as a yard-stick to measure compensation, but yet it cannot be denied that restriction imposes undue interference and hardship ; it therefore seems reasonable that shareholders in a colliery which is restricted should be entitled as a minimum to a fixed percentage (say 8 per cent.) return on the capital employed in their business, the basis of this computation being perhaps the basis lately in force for Excess Profits Tax. Some such calculation would also have to be employed to compensate newly opened collieries which were restricted. The case of a working colliery completely closed is somewhat simpler to this extent that it is possible to ascertain the financial impact with reasonable certainty ; moreover the wasting asset of the coal is being fully preserved ; if the colliery is likely to be re-opened in the fairly near future it would perhaps be reasonable in such a case for the Compensation Fund to pay the shareholders the care and maintenance cost, plus a fixed percentage on the capital employed ; if on the other hand long-term closure is visualised, then acquisition by Government would be the fairer course. The assessment of fair compensation in each case will be a long and complicated business which will occupy much time which would be better spent on true conservation on the lines I have advocated.

COMPENSATION FUND.

20. Even if arbitrary restriction be enforced to only a comparatively small extent the cost will, as I have tried to show, fall heavily on a considerable number of collieries, and it is therefore necessary that a sizeable Compensation Fund be built up. Here again it is a question of where the burden should fall ; on the general revenues, as representing the nation and posterity, who are the principal beneficiaries of a restriction policy ; on the Steel Works, who are the particular gainers ; on all coal producers ; or again on all coal consumers. It is for consideration whether the fairest method would not be to impose a special general cess for the purpose on all coal despatches, payable by consumers, and with an appreciably higher rate of cess on despatches to the Steel Works than on despatches to other consumers.

COAL WASHING AND THE PRICE STRUCTURE.

21. The majority of technical opinion seems to be that further pioneering and research work will be necessary before the washing of Indian coals can be widely adopted. There is little doubt however that washing of these coals, if successful on a commercial scale, has very great potentialities in the direction both of securing improved coal utilisation at the Steel Works and elsewhere, and of bettering the quality of despatches from poorer grade collieries so as to make their coal acceptable to a wider range of consumers. In the circumstances it is surely desirable to adopt a much more positive price policy to encourage washing than is suggested in the Report. The installation of washing plant will involve heavy capital expenditure, not unaccompanied by an appreciable element of risk. Many collieries producing metallurgical coal are already working at a loss, or at best at a narrow margin of profit, and in these circumstances it will be fruitless to expect them to instal washeries unless there is some substantial and attractive inducement offered to them to do so. The figures quoted in the Report illustrate the difficulties inherent in arriving at a formula, but a careful study of the data furnished by the Steel Companies in their Memorandum (in particular, Table 3) will reveal that the financial and operational benefit to them of receiving a homogenous coal of a lower ash content would more than outweigh a sharp increase in price for such coal. I am of opinion therefore that very serious consideration must be given to the suggestion made to us by the representative of the Indian Mining Association that the price structure should be amended *now* so that washed coal should earn a substantial bonus based on ash percentage.

(Sd.) W. H. S. MICHELMORE.

**Supplementary Note by Sri B. L. Agarwalla on the Final Report
by the Committee on Conservation of Metallurgical coal.**

On the question of urgent necessity of conservation of metallurgical coal there was not only complete unanimity among the members of the Committee but all the witnesses who appeared before us were also of the same opinion. Therefore, this question requires no further emphasis.

While I am of opinion that the figures of reserve estimated includes many doubtful and many figures of coal unsuitable for metallurgical purposes and, therefore, is high and will not be available I do not intend to go into details of same since it is an admitted fact that even if same were available it will fall far short of our requirements. This can be judged from the fact if we started producing steel at the rate U. S. A. is producing even this estimated reserves of metallurgical coal will last less than 10 years. Our deposits of iron ore are one of the richest in the world and there is no reason why we should not

produce, in course of time, as much steel as some of the advanced countries in the world are doing to-day. Our industrial development and, therefore, the prosperity of the nation will depend on this very fact.

Any scheme of conservation to be effective must be practical. I, therefore, intend to examine some of the recommendations regarding their practicability. The first recommendation made by the Committee is regarding stowing. I fully agree with this recommendation but I cannot ignore the practical difficulties that will have to be solved before this can become effective. A number of big collieries are already stowing. Compulsory stowing will require stowing material, very little of which will be available at the put-head. The chief supply of stowing material will, therefore, have to be sand which will be required to be carried to the put-head. This is being done by some collieries with the help of aerial rope-way. This seems to be the only and the cheapest method. The fitting of long rope-way with other necessary equipment, however, is a costly affair well outside the means of very large number of collieries. It is, therefore, evident that unless some arrangement for supplying of sand for stowing is made stowing cannot be practised by a large number of collieries. If, therefore, stowing is made compulsory in these circumstances these collieries will go on developing the first working and forming pillars, the extraction of which, will be deferred indefinitely. These pillars will deteriorate in course of time and will become danger to the safety of the mines and large reserves may be lost in this way. It is, therefore, absolutely necessary that suitable safeguard must be provided against such a contingency for otherwise compulsory stowing instead of being a step towards conservation will be just the opposite. I suggest that there should be a restriction on the extension of area under pillars after a certain limit and that the Stowing Board should arrange to supply sand to collieries.

There is another aspect of this question which cannot be ignored. Compulsory stowing will on the one hand restrict output on the other it will increase cost of production and large number of collieries will become uneconomic unless present price structure is revised.

I do not agree with the suggestion that a revision of the price of coking coals at present though desirable is not considered feasible. If restriction of output as suggested is to be imposed and if stowing is to be made compulsory present price structure of the coking coals has got to be revised for otherwise nothing but chaos and confusion will result from the proposed steps.

I fully agree with the recommendation that output of coking coals of selected grades and Grade I should be reduced 10 per cent. per annum of the previous years output. Nothing new is likely to happen in the next few years and, therefore, annual review of the position for a few years does not seem to be called for. Even if the erection of the proposed steel plants by the Government is undertaken they are not likely to come into production within next few years. Besides the proposed 50 per cent. cut in the output of metallurgical coal will leave enough output of same coal to meet any

likely increase in its demand. The output of good quality metallurgical coal after the proposed reduction is aimed at 5.90 million tons per annum. This can be increased by 25 per cent. by blending with non-coking coals. Thus even after the proposed reduction is implemented the available coal for coking will be nearly 7.37 million tons more than twice our present requirements. But a 50 per cent. reduction in output of metallurgical coals however desirable is not feasible unless prices of such coals are suitably raised. Very few collieries, if any, will find it possible to remain in production after 50 per cent. reduction in output is implemented unless they are compensated.

After inuinciating the principle that "except in the case of collieries where a restriction of output will seriously affect safety of the mine the reduction may be made *pro-rata* on all collieries so that disadvantages accruing therefrom will fall more or less equally on all the producers"—my colleagues on the Committee have considered it desirable to make following recommendations:—

- (i) The condition of the workings in each individual mine should be carefully taken into account. Where curtailment of output will lead to loss of coal the loss must be guarded against and the collieries allowed to continue the working by competent authorities.
- (ii) Special consideration should be given to Collieries or Companies installing washeries to provide uniform quality coal for coke manufacture.
- (iii) Collieries which are worked solely for the supply of coal for coking should receive favourable consideration and
- (iv) Permission to open new collieries and re-open old collieries (which have been shut down for some years) for the production of metallurgical coal should be refused.

I had vehemently opposed these four conditions in the Committee and I believe if these recommendations are followed the proposed restriction of output will become impractical and they will not lead to conservation of metallurgical coal.

If No. 1 of the above recommendations is followed it is evident that to achieve an overall reduction of 50 per cent. of output of metallurgical coal some collieries will have to reduce their output more than 50 per cent. which in turn will mean their complete closure.

If condition in any mine are such where 50 per cent. reduction in output will lead to loss of coal apparently such loss cannot be guarded against merely by allowing them to continue to produce at full rate of production. This will not only increase the burden of reduction on the other collieries but may encourage mine owners to create such bad conditions in their mines. Therefore, no case is made out for any preferential treatment.

Under existing circumstances and until production of selected grades of metallurgical coal alone exceeds our requirements of metallurgical coal no case is made out for a preferential treatment to a

colliery installing a washery. If, therefore, preferential treatment is to be given to a colliery with washing plant it will mean that either the washed coal or the selected grade coals which can be used unwashed for metallurgical purposes will have to be used for purposes other than metallurgical. I have shown above that without washing and with the proposed restriction fully implemented there will be more than twice our requirements of metallurgical coal available for next few years. Under the circumstances, a preferential treatment to washeries is uncalled for. It is well known fact that only two washeries are at present under erection in India and both belong to a steel company. Conservation though primarily is in the interest of the nation, the steel companies will ultimately benefit by it. Therefore, it is necessary that the steel companies should be called upon to make greater sacrifices instead of being given preferential treatment in the matter of restriction in output. I suggest that these two washing plants be converted into central washeries. One of them is situated suitably for being converted into a central washery and other may be shifted to a suitable place.

The recommendation (ii) above, therefore, is not justified in my opinion.

Only collieries that are worked solely for supply of coal for coking are those that belong to the steel companies. If there is any justification for asking others for restricting their output of metallurgical coal that same justification applies with greater force to the steel companies for ultimately they are to benefit by restriction. Besides in the case of steel companies collieries form only a small part of their undertaking and the steel companies are better able to bear the loss due to restriction than others. It follows, therefore, that the steel companies should be asked to take proportionately higher burden of restriction if not to stop completely the production of metallurgical coals from their mines to reduce the burden of restriction from others who are ill able to bear same instead of being given preferential treatment. Besides, if this recommendation is followed then steel companies by entering into contract with a few collieries for their whole output may make position of other collieries difficult and contribute to the failure of the scheme. A reduction in the output of collieries raising two thousand tons or below per month will be clear invitation to them to close down. Therefore, there should not be any reduction in such cases. Recommendation No. (iii) above, therefore, in my opinion is not justified.

If conservation of metallurgical coal is desirable in the interest of the nation the Government must come forward by not only restricting the output from State-owned mines, but completely stopping such output where conditions are ideal for such stoppage. Kargall seam forms one of the chief source of our reserves. This seam when washed will give a very large percentage of clean coal which can not only be used by itself to yield a very good coke but can be blended with non-coking coal to make good coke. Until washeries are erected much of this coal cannot be used for metallurgical purposes and, therefore, all the output from this seam will

continue to be used for non-metallurgical purposes. The present output from this seam is nearly 2 million tons per annum or 50 per cent. of the total proposed restriction. If Government are really serious about conservation they can effect a conservation of 50 per cent. of the proposed total by closing only one of their collieries. Incidentally Kargali colliery where only open cast mining is done is ideally suited for complete closure as no subsequent mining difficulties are involved.

If, however, Government must continue to misuse metallurgical coal for non-metallurgical purposes for reasons of financial investments others who have also invested large sums of money in acquiring lands should also be allowed to raise coal from their properties and until Government show the initiative in this direction, in my opinion, there is no justification for restriction on opening of new or closed mines to produce metallurgical coal subject to restrictions applicable to all other mines.

In conclusion I have to submit that transport problem is one which requires careful consideration. If 4 million tons of good metallurgical coal are to be replaced it is not only necessary to produce the other coals for replacement but to arrange transport of same from the new fields.

I am of opinion that unless a substantial portion of the replacement is aimed at from the Jharia field from poorly coking and non-coking coals transport problem alone will contribute largely to the failure of the scheme of conservation. At present the output of coal from this field is highest. This has been so all along. If, therefore, a switch over is to be made to other field considerable alteration in the existing structure of the transport arrangement will have to be made and this under existing circumstances is not practical. Besides, many seams in Karanpura field from which replacement is recommended are not only low ash coal ideal for blending but are by themselves semi-coking coals. The Dishergarh seam of Raniganj field has not only low ash but a high coking index of 13. This seam is not only ideal for blending but in the words of Director of Fuel Research Institute "by themselves fairly good coking coals". From the Report on Blending of Coals for Coking it will be seen that nearly 60 per cent. of this coal can be used in blend with Jharia coals to give good metallurgical coke. Very nearly similar though no quite as good result are obtained from Poniaty seam of Raniganj field. Incidentally these seams form the chief reserves for our future by-product recovery, chemical industries and hydrogenation, etc. These industries play an important part in the advanced countries of the world and it is, therefore, all the more imperative that they should be conserved as much as possible.

While these seams have been left out of the conservation scheme many seams from Jharia field with high ash and low coking index are not only taken in the reserve but are sited as probably reserve for the future. I regret I am unable to agree to the view of my colleagues.

It is an admitted fact that on account of inherent nature of the impurities Indian coals are difficult to wash. The washing of high ash coals to the specification of the Steel Industries will not only be difficult but uneconomic. The estimated reserves will be considerably reduced for this reason also.

With these observations, I agree with the conclusion and recommendations.

(Sd.) B. L. AGARWALLA.

APPENDIX J.

GEOLOGICAL SURVEY OF INDIA, CALCUTTA.

April 10th, 1950.

DEAR SIR,

I am sending you herewith 14 copies of a report entitled "Reserves of good quality coking and semi-coking coals in virgin areas in Indian coalfields" by Mr. A. B. Dutt, Geologist, Geological Survey of India.

Before drawing your attention to the main features of this report, and before giving my views on the other points on which your Committee have asked my opinion, it is convenient first to refer to the note written by Sir Lewis Fermor in 1933 entitled "Note on the necessity for conservation of coal in India".*

Sir Lewis Fermor's note was written after the Jharia and Raniganj coalfields had been re-surveyed by the Geological Survey of India on the 4 inches to one mile scale, and after the completion of Sir Cyril Fox's memoir on the Lower Gondwana Coalfields of India, in which the reserves of coal in the principal Gondwana coalfields were re-estimated in the light of new information. After making certain modifications in the figures given by Sir Cyril Fox, Sir Lewis Fermor estimated the total reserves of good quality coking coal down to 2,000' to be 1,694 million tons at the end of 1932, as follows:—

Giridih	. . . . .	38 million tons
Raniganj	. . . . .	241 " "
Jharia	. . . . .	900 " "
Bokaro	. . . . .	515 " "
		TOTAL
		1,694 " "

In this estimate he has included the whole of the Kargali seam in East Bokaro, but nothing from West Bokaro. He added, however, that technical research might show that, by blending, some semi-coking coals, e.g., in Karanpura, might become available to the iron and steel industry.

As the best coking coals were known to be situated in the Giridih and Jharia fields (for he showed that the manufacturers of hard coke obtained 96 per cent. of their requirements of coking coal from the Jharia field), he confined his attention primarily to those fields, particularly to Jharia. Assuming that not more than 50 per cent. of the total reserves would be won, that the coal standing in pillars would be totally lost unless stowing were resorted to, and taking the annual extraction of coking coals from the Jharia field to be 9 million tons, he estimated the reserves in the Jharia field, without stowing, and after deducting the coal standing, under railways, roads, buildings, etc., to be only 600 million tons down to 1,000', which would last for only 33 years if the mining practice then in force were not revised. As regards the coal reserves estimated to exist between 1,000' and 2,000' in the Jharia field, he considered that there would be no addition to the total reserves from these coals if only 50 per cent. of the coals above 1,000' were extracted, because under such conditions it would be economically impracticable to work the deeper coal. He therefore concluded that under the most unfavourable conditions the life of the good coking coals in the Jharia field would extend to only 33 years from 1932; but that if the percentage of extraction were improved from 50 per cent. to 80 per cent. their life would be extended to 80 years.

* *Rec. Geol. Surv. Ind.*, LXIX, pp. 336-352 (1935).

The seriousness of the position was also emphasised by Sir Cyril Fox in a speech delivered at the Annual Dinner of the Mining & Geological Institute of India in January 1936, from which I give the following extract:—

“The subject of the coking coals in India has received a great deal of attention on paper, and the seriousness of the situation has been brought forward from time to time. There is no doubt at all that the main storehouse of India's coking coal is the Jharia coalfield, and under whatever pretexts reserves are assumed in other fields, it is certain that those reserves are unattractive to our iron-masters unless mixed with an appreciable proportion of Jharia stock. Thus the fundamental importance of the Jharia reserves is evident, and yet, by the methods now in vogue, for every ton of Jharia coal despatched from the mines at least another ton has to be sacrificed in working. When we add to these considerations the prevalence of underground fires, the certainties of subsidences and the likelihood of heavier pumping charges on the arrival of the monsoon, it is clear that the situation is serious.”

Sir Lewis Fermor also followed up the matter in his Presidential Address to the Royal Asiatic Society of Bengal in February, 1936, when he expressed the opinion that the position was actually worse than his figure of 1,694 million tons might suggest. “The Jharia coalfield, as we all know, is now one vast honeycomb in the best seams, and even with stowing much coal that could otherwise have been recovered will be lost due to subsidence and fire.”

The Coal Mining Committee of 1937 brought Sir Cyril Fox's figures up to date, and estimated a total reserve of 1,425 million tons of coking coal at the end of 1936. Allowing for the production of subsequent years, Dr. Gee reduced the estimate to 1,185 tons at the end of 1944. The Indian Coalfields Committee of 1946, taking the view that much of the Bokaro and Raniganj coal included in the above estimates is not itself good coking coal, but only suitable if mixed with good coking coal, and that from Katrasgarh westwards the quality of the Jharia seams deteriorates, concluded that the total reserves of good coking coal were much below 1,000 million tons, and might well be in the neighbourhood of about 700-750 million tons.

In the present investigation the Geological Survey of India has collaborated with the Coal Commissioner's Department and with the Department of Mines in India in estimating the total reserves of coking and semi-coking coals in seams now being worked, and has been responsible alone for estimating the reserves in virgin areas. It is in connection with the latter that Mr. Dutt's report is mainly concerned. With regard to the former I am unable to make any comments, as the final figures have not yet come to hand.

As regards the Jharia coalfield, Mr. Dutt estimates the reserves in proved areas in the Barakars and close to the Barakar-Barren Measures junction as 247.5 million tons, in the unproved areas in the Barakars as 167 million tons, and in the Raniganj series as 180 million tons.

Mr. Dutt also discusses the possibility of extracting coal from seams at greater depths than 2,000 feet, the maximum figure hitherto taken in estimating reserves. There is no *a priori* reason why coal from greater depths than 2,000 feet should not be mined. But Sir Cyril Fox, in his evidence before the Indian Coalfields Committee of 1946, expressed the view that the burning of seams by igneous intrusions would be found to increase in depth, and that the destruction of the seams would be greater at greater depths. Dr. E. R. Gee contested this view in an article published in *Indian Minerals* in 1947.* He considered that there was no reason to expect a sudden increase in the effects of igneous activity at an additional depth of 2,000 to 3,000 feet (that is below the 2,000 feet level of proved reserves). He also made an estimate of the possible reserves of caking coals of the Barakar measures beneath the Barren Measures and Raniganj series of the south-western part of the Jharia field. He calculated that the over-burden covering the Barakar seams at their deepest point of burial in the south-western part of the coalfield would

* *Indian Minerals*, I, p. 71 (1947).

be of the order of 4,000 feet in the case of seam No. XVIII, and of 5,000 feet in the case of seam No. XII. After allowing for losses as a result of igneous intrusions and during the course of extraction to the extent of 50 per cent. of the original reserves he calculated the possible reserves below 2,000 feet to be of the order of 1,000 million tons.

Against this view Mr. Dutt in his report refers to some deep borings put down through the Barren Measures by Tatas in the Dungri and Malkera areas, and by Messrs. Bird & Co. in the Loyabad area. These borings have shown that most of the seams are seriously burnt, and the evidence obtained from them would appear to support Sir Cyril Fox's contention. It should be remembered, however, that the area between Jharia and Sijua comprises that part of the Jharia field that is most affected by intrusions *at all levels*, and it may be that the degree of destruction by burning is not a function of depth but (for some reason) is specially characteristic of this part of the Jharia coalfield at all depths. It is therefore most important that, as both Dr. Gee and Mr. Dutt have emphasised, a programme of deep boring should be undertaken in the centre and south-western portion of the coalfield as soon as possible, to ascertain the extent and condition of the seams between depths of 2,000 and 5,000 feet. And though at present it would be unwise to estimate even possible reserves of caking coal at depth in this part of the field, there is some hope of a substantial reserve being available.

As regards the *Raniganj* field, Mr. Dutt quotes estimates of reserves of good coking coals arrived at recently by Mr. A. N. Banerjee, Assistant Coal Superintendent, for the Laikdih, Ramnagore and Begunia seams, namely 103 million tons. This may prove to be a conservative estimate, for Mr. Banerjee has only taken into account the average height of the present workings in the Laikdih seam, i.e., 10-43 feet. It seems, therefore, that the older estimates for these seams in the *Raniganj* field may have been too low. The *Kasta* seam in the trans-Ajai section, Mr. Dutt estimates, to contain reserves of 156 million tons down to a depth of over 1,000 feet. This seam has a rather low caking index, however, and would have to be blended with better coals.

In the *Giridih* coalfield the total available reserves of good quality coking coal have been estimated by the Colliery Superintendent to be 16½ million tons.

In the *East Bokaro* coalfield Mr. Dutt estimates that the present reserves in the Kargali and Bermo seams are 583 and 220 million tons, respectively. These seams have ash contents of nearly 16 per cent. and over 27 per cent., respectively.

In the *West Bokaro* coalfield Mr. Dutt estimates that the three main seams that have so far been proved have reserves of 88 million tons, which it is expected to be able to utilise after washing.

In the *South Karanpura* coalfield the Argada and Sirka seams, with an average ash content below 20, but with a low caking index, are estimated to contain reserves of 450 million tons down to 1,000 feet.

In the *Ramgarh* coalfield the more prominent coal seams, of medium quality and said to be semi-coking, contain 188 million tons down to relatively shallow depths.

In the *Kanhan Valley* coalfield Mr. Dutt estimates reserves of 66 million tons of coal with an ash content of 17 per cent. This includes about 3 million tons in pillars.

Summarising Mr. Dutt's figures, we find that he estimates that in the Jharia, Raniganj and Giridih coalfields there are at least 329 million tons of good coking coal in the virgin areas; while in the East Bokaro, West Bokaro, South Karanpura, Ramgarh and Kanhan Valley coalfields there are approximately 1,600 million tons of semi-coking and near-coking coals, a large proportion of which may, after washing or by blending with good caking coals, be used for the manufacture of hard coke. Of these, the 583 million tons to the Kargali seam are the best. To the figure of 329 million tons of good coking coal it is necessary to add the present reserves in seams

XII to XVIII of the Jharia coalfield, which are not known to me ; while there are possibilities of being able to use the very large reserves in seam X if this coal can be utilised in whole or in part with or without treatment.

As regards the semi-coking coals, it is important to know what percentage will be available after they have been treated by washing, etc. This is a question that I am unable to answer, as sufficient data from experimental and pilot plant investigations are not yet available.

I will now attempt to answer certain questions put to me by the Conservation of Metallurgical Coal Committee.

What do you consider to be a good metallurgical coal and in what seams do they occur? What is the total availability of metallurgical coal in the Jharia, Raniganj and other coalfields?

(1) The definition of a good metallurgical coal must depend upon the requirements of the ironmaster who intends to use the coke, and on the type of blast furnace he is using. The Tata Iron and Steel Company have laid down certain stipulations for their own use, but these might be liberalised if a modified furnace were used.

For the purpose of estimating reserves of good coking coals, Sir Cyril Fox, according to the evidence he gave before the Indian Coalfields Committee (1946), defined a good coking coal as one which, when subjected to destructive distillation, yields a hard coke suitable for iron ore smelting in blast furnaces. The chief characteristics of such a coke were assumed to be a low ash content (under 21 per cent.), fine porous texture, and strength (hardness and toughness) to resist pressure. I imagine, however, that he included in his estimate of the reserves of good coking coals those coals which in actual practice had been found to yield a hard coke suitable for metallurgical use.

(2) Good metallurgical coal is known to occur in:—

- (a) Seams XII to XVIII in the Jharia coalfield. Investigations by the Fuel Research Institute are now being carried out on coals of X seam, and are proposed to be done on coals of XI seam.
- (b) The Ramnagar, Laikdih and Begunia seams in the Raniganj coalfield.
- (c) The Lower and Upper Karhabari seams in the Giridih coalfield.
- (d) The Kargali seam in the East Bokaro coalfield and certain seams in the West Bokaro field.

(3) Up-to-date estimates of available reserves of metallurgical coal in these coalfields are being worked out by the Geological Survey of India in collaboration with the Coal Commissioner's Organisation and the Department of Mines in India, while reserves in virgin areas are given in Mr. Dutt's report attached herewith.

Previous Directors of the Geological Survey of India have all apprehended the danger of exhaustion of good quality metallurgical coal. Do you concur with their views? If not, reason for the same.

Previous Directors of the Geological Survey of India have pointed out that if certain measures were not adopted a shortage of good quality metallurgical coal would arise in an alarmingly short time. I concur in that view.

If, however, certain measures were adopted, viz., restricted use (if necessary by restriction in production) of metallurgical coal, compulsory sand stowing to increase the percentage of extraction, improvement of high ash coals by washing, blending of semi-coking with coking coals, relaxation of the rather rigid specifications laid down by Indian iron smelters, and the possibility of mining to greater depths than 2,000 feet in the Jharia coalfield, then the whole position would be altered.

It has been shown by Mr. Dutt in his report that the reserves of poorly caking coals, which can be improved by treatment or utilised directly by blending, are very large, of the order of 1,600 million tons, not including the large reserves in seam X of the Jharia field. But in view of the rapid depletion of the best Jharia coking coals, it is evident that unless steps are quickly taken to utilise the poorer caking coals, and to extract the maximum amount

possible of the remaining good coking coals, the apprehensions expressed by previous Directors must continue to be felt, especially when the proposed expansion of the iron and steel industry in India is taken into account.

Do you consider compulsory stowing essential in order to achieve conservation of metallurgical coal? Is in your opinion conservation of metallurgical coal essential and how do you propose to give effect to the same?

(1) In view of the limited reserves of good metallurgical coal, and of the proposed expansion of the iron and steel industry, compulsory stowing is essential where it can be done economically. So long ago as 1919 Mr. Treharne Rees recommended the extensive introduction of hydraulic stowing in the Jharia and Raniganj coalfields, and the Coalfields' Committee (1919) which considered his report expressed the view that unless the country's resources in coking coal were strictly conserved, India would be faced at no very distant date with the loss of her metallurgical industries for want of coke. The Committee concluded that no improvement in the current wasteful methods could be expected without State interference, and that sand-stowing should be made compulsory within certain limits, with provision for compensation. Though some sand-stowing has been carried out since then, and though the possibility of using semi-coking coals in part replacement of coking coals has become more apparent, the argument for State enforcement of stowing remains as strong as it was 30 years ago.

(2) Conservation of metallurgical coal is obviously essential. The machinery to give effect to it is more open to debate. Sir Lewis Fermor in 1923 had recommended that compulsory measures of conservation should be introduced, but that they should be precluded by a practical educative period of, say, five years. In his later note of 1923 he recommended that the Government of India should create a new Conservation Department to inspect and control methods of work in coal mining. The Indian Coalfields' Committee (1946) have recommended the setting up of a much more elaborate organisation to be known as the National Coal Commission, with broad and comprehensive powers and functions, and advised by a number of Boards and Committees.

It is my experience that in general it is much easier to get something done by building up on something that is already in existence than by creating something quite new. I therefore incline to the view that in order to give effect to measures of conservation it would be best to utilise the present Department of Mines after suitable expansion. This Department is manned by experienced officers; and though the scope of their work would have to be extended to cover conservation as well as safety, the nature of their work would not be materially changed.

It is true that the Department of Mines comes under the Ministry of Labour, which is not concerned with the conservation of coal. The solution probably lies in closer collaboration between the Department of Mines and other related Departments such as the Geological Survey of India, the Indian Bureau of Mines, the Stowing Board and the Coal Grading Board, the executive functions being left to the Department of Mines.

What is the present fixed deposit of sand in the rivers adjacent to the Jharia and Raniganj coalfields? Is it possible to estimate the rate of replacement?

(1) In order to arrive at fairly definite estimates of the volume of sand in those portions of the Damodar, Barakar and Ajay rivers adjacent to the Raniganj coalfield, a drilling party in the charge of Mr. D. M. Sen, Assistant Geologist, was deputed to drill holes in the river sand at suitable intervals in the following areas:—

- (1) in the Damodar river from near Shrirampur (24° 34' : 87° 12') upstream to its junction with the Barakar river,
- (2) in the Barakar river from its junction with the Damodar river upstream to near the proposed Maithon dam site, and
- (3) in the Ajay river from the N. W. end of the trans-Ajay field near Pariarpur (23° 59' : 87° 03') to north of Madhaipur (23° 43' : 87° 21½').

The holes were put down at intervals of 1,000 feet both along and across the river beds, and altogether 321 holes were bored.

A summary of the results is given in the table on the last page, from which it will be seen that large reserves of sand are available for stowing in the Raniganj coalfield.

As regards the sand in the Damodar river adjacent to the Jharia field, it has been roughly estimated that some 140 million tons of river sand, together with 25 to 30 million tons of older alluvium of the Damodar in that area, are present as fixed deposit*. This amount is nothing like sufficient to meet the probable future requirements of the Jharia coalfield.

(2) As regards the annual replenishment of sand in the Damodar river by the Jharia coalfield, since no detailed tests have been carried out it is very difficult to give any satisfactory estimate. The question has become more complicated as a result of the proposal to construct a number of dams across the river. The matter has been discussed by Dr. J. B. Auden, Superintending Geologist, in an unpublished note, the substance of which has been published in an article by Dr. E. R. Gee in *Indian Minerals*** . He points out that even if no dams are constructed, the possible annual increment of sand and silt (based on observations made in 1924 by the Punjab Irrigation Department in the Sutlej river) falls far short of the actual annual requirements for sand stowing, the annual increment to the Damodar river in the vicinity of the Jharia coalfield being estimated at 11 million tons. It is clearly very necessary that data relating to the Damodar, Barakar and Ajay rivers should be collected as soon as possible, so that a more accurate estimate of replenishment can be arrived at.

Yours faithfully,

W. D. WEST,

Director, Geological Survey of India.

To

THE MEMBER-SECRETARY,

CONSERVATION OF METALLURGICAL COAL COMMITTEE.

* *Indian Minerals*, I, p. 78 (1947).

** *Ibid*, p. 79.

Reserves of sand in the Damodar, Barakar and Ajay rivers adjacent to the Raniganj Coalfield.

River.	Area.	Average Thickness.	Total in Million tons.
1. Damodar river . . .	Baska to Pinjrapol.	29½'	70 (10% clay)
Ditto	Baska to junction of Damodar and Barakar.	32½'	510 (10% clay)
2. Barakar river . . .	Junction of Barakar and Damodar to Maithon.	42½'	120 (20% clay)
3. Ajay river	Ramnagar to Chhatrisganda.	8' 19'	3 17 (40% clay)
Ditto	Paraipur to Chhatrisganda and Ramnagr to Madhaipur.	35½'	270 (20% clay)
		TOTAL . . .	990 Million tons.

RESERVES OF GOOD QUALITY COKING AND SEMI-COKING COALS IN VIRGIN AREAS IN INDIAN COALFIELDS.

BY

A. B. DUTT, M.Sc., GEOLOGIST, *Geological Survey of India.*

In view of the varying estimates at different times of good quality coking coals in the different coalfields of India, probably based on insufficient data, the Ministry of Industry and Supply, Government of India, in order to have more reliable figures of reserves made available for the Conservation of Metallurgical Coal Committee, decided that an investigation should be conducted by the Geological Survey of India jointly with the Coal Commissioner's Department and the Department of Mines in India, the first named being responsible for estimating reserves in virgin areas. The Geological Survey took up the investigation accordingly in different coalfields and the results obtained are given in the following pages. In this report wherever Caking Index has been mentioned it has been given in the standard B. S. S.

I. JHARIA COALFIELD.

In this coalfield there are only a few proved virgin areas in the portion of Barakar rocks from the outcrop of the XII Seam up to the Barakars-Barren Measures boundary. The small plot that has been left unworked west of Jharia is very badly burnt and is therefore useless in so far as production of coal from it is concerned. Messrs. Bird & Co. have proved by borings the Sudamdih and Sawardih areas in the south-eastern part of this coalfield as also the Aralgaria Colliery and Central Jherria areas at the Barakars-Barren Measures junction in the central part of the same field. The Sutikdih Colliery area of Messrs. Jardine Henderson Ltd. has also been similarly proved. The reserves of coal in all the above areas are given below:—

Area.	Reserves in tons.	Remarks.
Sudamdih Colliery	112,000,000	} Seams with high dips somewhat rapidly increasing towards the south. The mines will require complete mechanisation for working. Fire in some of the workings has necessitated the closing of the mines.
Sawardih Colliery	18,000,000	
Sutikdih Colliery	19,531,000	
Aralgaria Colliery	7,000,000	
Central Jherria	91,000,000	
TOTAL	247,531,000	

It may be noted that the above figures have been arrived at according to the data supplied by the private concerns and it has not

been possible to check or verify them with independent information obtained by this department. It may also be mentioned that the Geological Survey was not associated with the party carrying out boring and sampling operations in the above-mentioned areas. As regards the quality of the coal, the different grades as mentioned in the reports placed at our disposal have been taken into account. This department, however, accepts no responsibility with regard to the reserves and the quality of the seams.

In addition to the above, the data on the following area, which has not been proved, are based on the records of private companies in the neighbouring areas. The area is expected to contain the following quantity of coal:—

Area.	Reserves in tons.	Remarks.
South Katras	167,000,000.	Figures supplied by Messrs. Bird & Co., on the basis of boreholes put down in the adjoining Bholatand and Dharmaband areas. The Geological Survey accepts no responsibility with regard to the reserves and the quality of the seams underground.

Further there are three virgin areas of 250,375 and 62½ bighas south of Sitanala, east of Kalithan-Gurgaon and south of Chasnalla collieries respectively, about which no reliable information is available although presumably these may contain some coal seams. Therefore the reserves in them have not been taken into account.

In the Raniganj measures of the Jharia coalfield the Mohuda bottom and top as also the Bharungia are the seams which persist in the areas bounded by their respective outcrops. The Mohuda top and bottom seam coals have a Caking Index varying from 14 to 16 and while the Mohuda bottom and Bharungia seams are of Selected B grade, the Mohuda top seam belongs to Grade I. The reserves of the three seams in the virgin areas are as follows:—

Seam.	Area in bighas.	Average thickness in feet.	Reserves in tons.	Grade.
Mohuda bottom	17,625	8	70,500,000	Selected B
Mohuda top	16,625	10	83,125,000	Grade I
Bharungia	11,750	4½	26,437,000	Selected B
		TOTAL	180,062,000	

In the Jharia coalfield the possibility of finding coking coals beneath the higher measures, i.e., the Barren Measures and the Raniganj series, at greater depths was considered. On geological grounds it may be assumed that the seams containing good quality coking coals originally continued in thickness and in quality towards the dip under the Barren Measures and the Raniganj rocks. It is now to be considered at what depths the seams occur and what is the condition of the coal in them. So far as is known no borehole data are available for the Barakar coal-measures in this field to a depth of 2,000 feet and over under the higher measures. There have been, however, some borings by Tatas in the Dungri and Malkera areas and by Messrs. Bird & Co. in the Loyabad area through the Barren Measures close to the Barakar-Barren Measures boundary. This boundary has been proved on structural grounds, substantiated by borehole records, to be a faulted one. Tatas boreholes in the Dungri area have proved the downthrow of the fault to be about 1,000 feet, while in the Jarma ($23^{\circ} 43\frac{1}{2}' : 86^{\circ} 22'$) area the throw is nearly 1,200 feet. In the Malkera area, however the throw of one fault is found to be 750 feet, which is considered not to be the total throw due to faulting between the Barakars and the Barren Measures. In the Dungri area the boreholes have proved only *Jhama* and dyke in the XVIII Seam and no clean coal. Out of four boreholes put down in this area only the middle one, e.g., Tatas' B. H. No. 10, has proved 8 feet 9 inches of clean coal in the XVII Seam.

The boreholes put down by Messrs. Bird and Co. in the Phutaha area have proved that the fault between the Barakars and the Barren Measures has been split into two with a total downthrow of almost 1,000 feet and that excepting for a small portion of XVIII Seam and the XVI Seam all other coal seams down to the XIII Seam are burnt. Evidences in the Aralgaria area, west of Phutaha, are that the XII Seam (7 feet thick) is partially burnt, but the XI Seam (with about 20 per cent. ash) is absolutely unaffected. The Chirudih borehole (No. 2), about 2 furlongs east-north-east of Chirudih ($23^{\circ} 45\frac{1}{2}' : 86^{\circ} 20\frac{1}{2}'$), has proved 7 feet 2 inches of *Jhama* in the XVII Seam leaving only 4 feet 2 inches of coal with 4 inches of shaly band 1 foot 2 inches from top, and burning at the bottom of the XIV Seam.

The available information from boreholes leads to the conclusion that excepting the XVI Seam all seams of coal down to the XII Seam are subject to burning to a varying degree, mostly serious. It is also a fact that the area between Jharia and Sijua is most affected by intrusions.

In view, therefore, of the insufficient data available from borings made through the Barren Measures and from the history of serious burning of seams it has been felt that no attempt need be made now to calculate the reserves of the coal seams underlying the higher measures till more detailed information is available from deep boreholes. It is considered that a programme of boring to ascertain the extent and condition of the coal seams between depths of say 2,000 to 5,000 feet should be immediately drawn up and given effect to. It is anticipated from geological considerations that the thickness of over-

burden covering the Barakar coal seams from the XII to the XVIII Seams at their deepest point of burial in the centre of the Jharia coal basin will be between 4,000 feet and 5,000 feet.

2. RANIGANJ COALFIELD.

In his more recent paper on "INDIA'S RESERVES OF COAL AND RIVER-SAND" (*Indian Minerals*, Vol. 1, No. 2) Dr. E. R. Gee gives the reserves of strongly caking coals in the Raniganj coalfield as follows:—

Proved and probable reserves
to a depth of 2,000 feet . . . 40,000,000 (approxly.)

Mr. A. N. Banerjee, Assistant Coal Superintendent, on behalf of the Conservation of the Metallurgical Coal Committee, carefully investigated the collieries in the Barakar-Chanch area in which the Laikdih, Ramnagore and the Begunia seams containing good coking coals have been worked. The figures of reserves arrived at by him are given below:—

Collieries.	RESERVES IN TONS.		
	Laikdih seam.	Chanch-Begunia seam.	Ramnagore seam.
Laikdih Deep	16,092,000	—	—
New Laikdih	1,885,000	—	—
Chanch	24,216,000	7,307,000	—
Victoria	25,796,500	—	—
Victoria West	11,000,000	—	3,950,000
Begunia	500,000	5,200,000	—
Ramnagore	4,330,000	—	1,900,000
Junkundar	400,000	—	—
Total	84,189,500	12,507,000	5,850,000

The total reserves for these three seams are therefore 102,546,500 tons. The above figures have been calculated by taking into consideration the erratic nature of the seam and different thickness accepted for calculation after due deliberation. The Laikdih seam, however, is said to be 90 feet thick but none of the boreholes proved this thickness. In the New Laikdih colliery four boreholes within its area of 400 bighas have proved the thickness of the Laikdih seam as 36 feet, 19 feet, 44 feet and 76 feet. In the Laikdih Deep Colliery Pit (upcast) and in No. 3 Pit 71 feet and 24 feet respectively of the Laikdih seam have been proved; also in two boreholes in the same area 76 feet and 28 feet of the seam have been met with.

Mr. Banerjee in his calculations has taken into consideration an area of 3,863 bighas covering the leaseholds of these collieries situated in Bihar. Now, the total area of the portion south of the burnt area extending upto the junction of the Barakar river with the Damodar is about 5,808 bighas. In the part of the country on the western and northern sides of the Barakar and Damodar rivers respectively at their common junction no boreholes have been put—the presumption being that the Laikdih seam has been completely burnt out. Therefore out of the extra nearly 2,000 bighas hardly 700 bighas will be found to contain coal which also is very much faulted and difficult to extract. It will therefore be over-optimistic to expect workable coal in that area. There appears to be no virgin area containing the above seams outside the colliery holdings in Bengal.

It is also not known if the entire thickness of the Laikdih seam is of good coking coal. Unless and until the entire thickness of the seam is sampled foot by foot to ascertain the exact nature of the coal it seems reasonable to base the calculations on the average thickness of coal extracted in the workings. The calculations must, therefore, be considered as provisional.

The Kasta seam in the Trans-Ajai section has a total thickness of 29 feet 8 inches out of which coal forms only 22 feet 2 inches. The ash percentage varies from 19.5 to 20.1 and the Caking Index from 14 to 15. The available reserves of the Kasta seam from north of Kasta ($23^{\circ} 49\frac{3}{4}' : 87^{\circ} 4'$) to Rasuan ($23^{\circ} 47' : 87^{\circ} 12\frac{1}{2}'$) up to the Ajay river and the presumed Barakar-Ironstone shale boundary down to a depth of over 1,000 feet are 156,200,000 tons which are inclusive of the reserves in working collieries.

3. BOKARO COALFIELD.

The Bokaro coalfield is practically divided by the Lugu Hill ($\Delta 3200$) made up of Panchet rocks into two separate coalfields, and the East Bokaro and the West Bokaro coalfields have been so designated according to their position with reference to the above hill.

A. EAST BOKARO COALFIELD.

In East Bokaro the more important coal seams in downward succession are as follows:—

- (iii) Kargali seam.
- (ii) Bermo seam.
- (i) Karo seam.

The Kargali seam coal has an average ash content of nearly 16 per cent. and has Caking Index varying from 13 to 16. In estimating reserves, areas from which coal has already been exploited have been left out.

The reserves of the *Kargali seam* are as follows:—

Locality.	Area in bighas.	Average thickness in feet.	Reserves in tons.	REMARKS.
Dhori area— Bottom Kargali	633	34	10,760,000	Down to the Gobindpur fault.
Kargali area .	2,045	70	71,575,000	Do.
Brokaro area— Eastern . . .	1,790	90	80,550,000	Do.
Western . . .	254	100	12,700,000	Do.
Jarangdih area .	2,000	100	90,000,000	Probable reserves south of Gobindpur fault; seam encountered in a shaft 930 ft. deep and proved occurring in an area down to a depth of nearly 1,500 ft. Work abandoned, after explosion, from the middle of 1936.
Gobindpur area	1,330	40	26,600,000	Down to the Rly. line; depth nearly 2,000 ft.
Sawang area	2,300	40	46,000,000	Down to a depth of 2,600 ft.
Pipradih area	665	40	13,300,000	Ash about 25%. Down to a depth of 1,650 ft.
Kathhara area	5,445	85	231,412,500	Down to a depth of about 1,650 ft. at the Bokaro river and Borea fault.
		Total .	582,897,500	

N.B.—The figures are provisional as the survey of the Bokaro Coalfield is not yet complete and are inclusive of all working collieries in this area.

The Bermo seam coal has ash content of over 27 per cent. and has coking properties. The reserves of the *Bermo seam* are given below:—

Name of Area.	Average thickness in feet.	Average dip.	Reserves in tons.	REMARKS.
Dhori area .	30	15°	10,650,000	Down to a depth of 270 ft. at the Gobindpur fault.
Kargali area .	30	7°	65,000,000	Down to a depth of 1,000 ft. at the Gobindpur fault.
Bokaro area .	30	5°	72,450,000	Down to a depth of 725 ft. at the Gobindpur fault.
Gobindpur area .	25	15° to 20°	26,250,000	Down to a depth of 2,500 ft.
Kathhara area .	30	20° to 25°	45,600,000	Down to a depth of 2,250 ft. at the Borea fault.
		Total .	219,950,000	

N.B.—No reserves have been calculated for the Siladhar hill area as the area occupied by the seam is indefinite. For the Kargali and Bokaro areas out of a thickness of 40 feet only 30 feet is assumed by deducting shale and shaly bands contained in the seam. In the Sawang colliery area a multiple intrusion of a mica-peridotite sill is noticed in the seam which appears to be not worth working. The Bermo seam lies in an area affected by many faults in the Pipradih area where not much good coal is likely to be available.

The coal of the *Karo seam*, which has a maximum thickness of nearly 100 feet, so far has proved to be of non-coking variety. Hence the reserves have not been calculated.

B. WEST BOKARO COALFIELD.

In this coalfield several coal seams are occurring. The Tata Iron & Steel Co. are opening up their West Bokaro Colliery where they propose to work seam Nos. 10, 9 and 8. These three seams have been proved to contain coking coal, the Caking Index varying for 10 to 15 and so the Company intend to use the coal in their blast furnace after washing.

The thickness of the seams are as follows:—

10 seam	11 feet.
9 seam	5½ feet.
8 seam	9 feet.

The washing properties of the coals are good.

The Tatas are setting up a washing plant for reducing the ash percentage of the coal which is about 15.6 in the 10 seam, so as to make the coal suitable for use in smelting of iron.

The reserves of the three seams are as follows:—

Seam No.	Area in bighas.	Thickness in feet.	Reserves in tons.	REMARKS.
10	7,889	11	37,889,000	
9	7,889	5½	18,944,500	
8	7,889	9	31,001,830	
		Total	87,835,330	

No reserves of other seams are given as they still remain unproved.

4. GIRIDIH COALFIELD.

In the Giridih coalfield good quality coking coals occur in the Lower and Upper Karharbari seams of varying thickness. Two Collieries belonging to the Indian Government Railways are at present working in this area. The workable reserves of these two seams from two collieries are given below:—

Seam	Serampore Colliery.		Karharbari Colliery.	
	Thickness in feet.	Reserves in tons.	Thickness in feet.	Reserves in tons.
Upper Karharbari	5'	2,325,000	2' average	350,000
Lower Karharbari	16'—22'	3,431,000	8'—16'	6,363,336
	Total	5,756,000	Total	6,713,336

In addition to the above the only virgin property in the south-eastern portion of the Deep Pit area belonging to the Serampore Coal Co. and recently acquired by the Indian Government Railways has an area of 38.66 bighas where the Lower Karharbari seam, 16 feet thick, is present. The available reserves will be 309,280 tons. In southern continuation of the Deep Pit there is an area of 130 bighas where the reserves of the Lower Karharbari seam having a thickness of 16 feet are 1,040,000 tons.

South of the Kolimoran Pit there is an area of the Bayra Coal Co. (Proprietors—Bengal Coal Co.) in which the Lower Karharbari seam was previously worked through pits. Leaving the worked portion, the area of 150 bighas containing the seam, 8 feet thick, has reserves of 600,000 tons.

In the west-northwestern part of the field between the properties of the Bengal Coal Co. and the Indian Government Railways there is a dyke *cum* fault which has a downthrow to the south 150 feet in the northern part diminishing to 0 foot in the south. Further south there is another fault running west-northwest—east-southeast, the downthrow of which to the south is 600 feet gradually diminishing to 0 foot in the eastern portion. The areas of the properties belonging to the Bengal Coal Co. and the Railways are 350 and 384 bighas respectively.

Considering the fact that the Lower Karharbari seam outcrops at the extreme western end of the field and also taking into consideration the fact that the Bhadua seam (overlying the Upper Karharbari seam) was worked south of the 600 feet fault it can be safely presumed that the Lower Karharbari seam is still preserved in the blocks belonging to the two parties. Assuming a thickness of 12 feet of the Lower Karharbari seam in the Bengal Coal Co.'s area and 8 feet in the Railway area the reserves will be approximately 2,100,000 and 1,536,000¹ tons.

The total reserves of the Giridih Coalfield from the Lower and Upper Karharbari seams are, therefore, 16,518,616 tons. It may be noted that the above figures have been supplied by the Colliery Superintendent, Giridih and checked by this Department.

The Coal Mining Committee of 1937 gave the figures for Giridih and Jainti coalfields together as 20 million tons. The Jainti coalfield, therefore, was visited and examined. A 5-foot seam containing 1 foot thick shale band 1 foot from the bottom, that is now being worked by the Central Jainti Colliery, was sampled² after excluding the shale band. Although the results of the analysis have not yet been received, from the look of the coal it appeared to be of inferior quality and so the small reserves of coal from this field have not been taken into account.

5. KANHAN VALLEY COALFIELD.

The area consists of the Ghorawari group of collieries to the east of the Kanhan river and the Damua-Rakhikol group of collieries extending westwards from about half a mile east of the Kanhan river and is covered mainly by the Barkar rocks and the Moturs (Barren Measures). There appears to be one major seam 10 ft. 3 in. to 14 ft. 11 in. thick extending from east to west, which is cut off by parallel strike faults and subsidiary cross faults. The coal has an average

¹ Included in the Railway colliery reserves.

² Sampled jointly with Mr. J. M. Dhawan, Assistant Coal Superintendent.

ash content of 17 per cent. and its Caking Index varies from 11 to 17. Sulphur and Phosphorus in the coal do not usually exceed 0.70 per cent. and 0.20 per cent. respectively. The reserves of coal in the Kanhan Valley coalfield are as follows:—

Area.	Extent in acres.		Reserves in tons.
Damua Block	589.5	Coal in pillars	1,233,569
		Coal in virgin area	2,007,632
Kalichapar Block	1,204.66	Coal in pillars	1,768,536
		Coal in virgin area	20,174,410
Rakhikol Block	307	Coal in pillars	45,000
		Coal in virgin and in barriers	4,272,000
Ghorawari Kajan Block	99.34	Coal (in about 60 acres). . . .	650,000
East Naudora Block	106.39	Coal in pillars	40,000
Nimdhana area			Some coal may be present but the quantity is not known.
Ghorawari Khurd			Worked out
Chenkatbari-Piparia -N a n d u a area (mostly covered by Moturs) up to about $\frac{1}{2}$ a mile north of the northern-most point of Kalichapar Block (Partly proved by boreholes).		2,380 acres Virgin coal (approx.) (Average 10 ft. thick)	35,730,000
		Total	65,931,146

6. SOUTH KARANPURA COALFIELD.

The Argada top and bottom seams and the Sirka top and bottom seams in the Argada-Sirka-Religara-Bhurkunda area in this coalfield have an average ash percentage below 20 and the Caking Index of the coals usually varies between 5 and 11, rarely being 15 or 16.

The reserves of the seams are given below:—

Seam.	Average thickness in feet.	Reserves in tons down to 1,000 ft.
1. Argada-Sirka area—		
Argada top and bottom	120	90,744,000
Sirka top and bottom	50	34,151,000
2. Religara-Gidi area—		
Argada (?) seam	68	15,749,000
3. Chordhara area (eastern portion of Bhurkunda)—		
Argada seam	50	40,512,000
Sirka seam	30	20,053,440
4. Bhurkunda area (central portion)—		
Argada seam	50	20,256,000
Argada (A) seam	30	9,115,000
Argada (B) seam	40	16,207,000
5. Bhurkunda area (western portion upto Nalkari <i>nala</i>)—		
Argada seam	50	20,256,000
Argada (A) seam	30	9,115,000
Argada (B) seam	20	8,100,000
Sirka seam	20	23,632,000
6. Saunda area—		
Argada seam	50	13,504,000
Argada (A) seam	30	5,012,700
Argada (B) seam	20	2,016,600
Sirka seam	30	32,085,900
7. Porha area—		
Argada seam	50	40,512,000
Argada (A) seam	30	40,095,000
Argada (B) seam	20	8,100,000
Total .		449,216,640

7. RAMGARH COALFIELD.

In the Ramgarh coalfield the more prominent coal seams are Rauta, Sugia, Semarbera and Mael seams. The coals are of medium quality and are said to be of semi-coking variety. The reserves of the different seams are as follows:—

Seam.	Average thickness in feet.	Reserves in tons.	REMARKS.
		Tons	
1. Rauta area—			
Upper Rauta seam	20	1,080,920	Down to a depth of 120 feet up to the N. Bank of the Damodar river.
Lower Rauta seam	20	1,621,380	Down to 180 ft. depth to N. bank of Damodar river.
2. Sugia-Mahuatongri area—			
Upper Sugia seam	25	6,676,800	Down to 200 ft. depth upto N. bank of Damodar river.
Lower Sugia seam	15	4,051,200	Down to 260 ft. depth upto N. bank of Damodar river.
3. Dhanberwatoli area—			
Lodhma seam	10(proved)	1,620,480	Down to 130 ft. depth.
4. Gidhnia-Somarbera-Dhawaiya-Dhauntatanr area—			
Lower Dhawaiya seam	15	1,823,000	Down to 100 ft. depth.
Lower Somarbera seam	25	9,114,000	Down to 100 ft. depth.
Upper Somarbera seam	50	120,430,000	Down to 850 ft. depth upto axis of syncline.
Upper & Lower Mael Seam	60	15,495,750	Down to 225 ft. depth upto axis of syncline.
5. Dudhmatia-Lehritongri-Buchungdih area—			
Lower Dhawaiya seam	15	7,291,000	Down to 100 ft. depth.
Upper Dhawaiya seam	15	5,469,000	Down to 100 ft. depth.
Lehritongri seam	20	2,700,800	Down to 100 ft. depth.
Mael seam	20	9,723,000	Down to 100 ft. depth in the N. limb of syncline.
Mael seam	20	1,891,000	Down to 100 ft. depth in the S. limb of syncline.
Total		188,388,330	

RESERVES EXCLUSIVELY IN VIRGIN AREAS.

The reserves of good coking coals exclusively in virgin areas (excluding those included in working areas) in the different coalfields of India comprising of the Grades, Selected A and B, I and II are given below :—

Grades.

Coalfield.	Selected A & B	Gr. I.	Gr. II.	REMARKS.
	Tons.	Tons.	Tons.	
Jharia	325,586,000	30,534,000	49,071,000	3,340,000 tons are possibly of Gr. III and have been excluded.
Raniganj	<i>Nil</i>	<i>Nil</i>	<i>Nil</i>	
Giridih	4,049,280	—	—	
Bokaro—				
East	—	271,312,500	—	
West	—	87,835,330	—	
Total	329,635,280	395,681,830	49,071,000	

NOTES ON RESERVES.**Calculated by the Investigation Survey Party.**

The Survey Party consisting of representatives from the three Organisations—Geological Survey of India, Department of Mines and Coal Commissioner's Organisation, *viz.*, Sri A. B. Dutt, Geologist, Geological Survey of India, Sri N. G. Chatterjee, Dy. Chief Inspector of Mines and Sri D. R. Bagroy, Coal Superintendent, have submitted their report on reserves of metallurgical coal which is being placed on the table for information of all the members (Statement Nos. I to VII).

To work out the reserves following registers were prepared :—

1. Register Nos. 1, 2 and 3—showing the reserves tabulated colliery-wise in Jharia, Raniganj, Giridih and Bokaro Coalfields.
2. Register Nos. 4 and 5—showing the reserves gradewise and seamwise as taken from Registers Nos. 1, 2 and 3.

A consolidated gradewise statement showing reserves of coking coal in working areas in all coalfields, is also enclosed (Statement No. V).

Sri A. B. Dutt has submitted report about reserves estimated by him for coal in virgin areas and also for those areas where mining

operations have not made such headway. This will be seen from statement No. VI. The Director, Geological Survey of India,—Dr. W. D. West, has submitted Sri Dutt's report with a forwarding letter which is enclosed herewith.

RESERVES.

(a) *Virgin Areas*—

* (i) Sel. A and B	329.6 m. tons.
(ii) Grade I	395.7 m. tons.
(iii) Grade II	49.1 m. tons.

(b) *Working Collieries*—

(i) Selected 'A'	404.0 m. tons.
(ii) Selected 'B'	577.4 m. tons.
(iii) Grade I	512.9 m. tons.
(iv) Grade II	504.4 m. tons.

The total extractible quantities of Selected 'A' and 'B' grade coal are as follow (*vide* Statement No. VII).

A. *Working Collieries*—

	(in million tons.)
(i) Allowing for losses with stowing	750.3
(ii) Allowing for losses without stowing	385.0

B. *Virgin Areas*—

(i) Allowing for losses with stowing	263.7
(ii) Allowing for losses without stowing	164.8

Details as to how the calculation of figures in each colliery, have been made, will be found from the Note attached in each Register.

Sd./-A. B. Dutt,
(A. B. Dutt), *Geologist*,
Geological Survey of India.

Sd./N. G. Chatterjee,
(N. G. Chatterjee),
Dy. Chief Inspector of Mines.

Sd./-D. R. Bagroy,
(D. R. Bagroy),
Coal Superintendent.

Sd./- A. B. Guha,
(A. B. Guha), *Member Secretary*,
Conservation of Metallurgical
Coal Committee

* These figures include 247 m. tons of coal reserves particular of which was supplied by Messrs Bird & Co. and the Geological Survey of India was not associated during the course of the survey.

Appendix—K (1)

Statement No. I

JHARIA COAL FIELDS.

Seam.	Quantity virgin coal still available.	Quantity on Pillars.	Total quantity still available excluding under Railways, Public Roads, etc.	Estimated quantity that can be extracted economically.		Solid coal proved but unexploited.
				With stowing.	Without stowing.	
<i>Selected 'A'.</i>						
18	1,200,000	4,795,000	4,109,000	4,964,000	2,752,000	..
17A	4,664,000	521,000	5,075,000	4,148,000	..	..
17 Special	2,700,000	320,000	3,020,000	2,567,000	2,114,000	..
17	8,004,480	3,245,271	10,062,972	9,207,222	1,939,977	..
16A & 16 . . . . .	..	1,095,000	554,264	897,900	399,070	..
16	15,585,000	5,788,000	17,724,000	14,431,000	10,288,000	..

15A	2,330,000	150,000	2,265,000	2,167,000	1,812,000	..
15	2,512,000	19,226,588	16,641,299	16,918,942	4,780,149	3,860,000
14A	518,000	1,892,000	1,290,000	1,805,000	255,000	..
14	72,196,000	49,947,700	49,267,700	45,375,904	11,663,515	84,635,000
13	244,350	180,100	255,950	348,890	146,372	490,000
11 & 10	3,025,000	300,000	3,325,000	2,494,000	..	..
TOTAL	112,978,830	87,460,659	113,590,185	105,314,858	36,150,083	88,975,000
	200,439,489					
Solid coal proved but unexploited	88,975,000			77,408,250	50,715,750	..
TOTAL	289,414,489		113,590,185	182,723,108	86,865,833	..

Appendix—K (i)

Statement No. I—*contd.*

JHARIA COAL FIELDS—*contd.*

Seam.	Quantity virgin coal still available.	Quantity on Pillars.-	Total quantity still available excluding under Railways Public Roads, etc.	Estimated quantity that can be extracted economically.		Solid coal proved but unexploited.
				With Stowing.	Without Stowing.	
<i>Selected 'B'.</i>						
18	144,300	308,900	289,200	390,004	245,820	..
17A	452,250	871,800	1,324,050	1,129,867	1,081,296	..
17B	228,750	52,500	281,250	244,687	225,000	315,000
17	3,286,922	1,173,179	3,792,319	3,841,713	2,931,017	174,500
16A	4,545,625	1,869,875	5,520,500	5,509,345	4,257,800	2,241,000
16	8,120,534	17,630,180	18,845,962	21,525,473	13,343,498	11,434,000
15A	56,555	2,205	58,760	52,884	51,121	2,815,000
15	20,835,027	27,641,579	36,807,089	39,454,555	20,476,484	7,023,440
14A	4,880,000	17,000	4,897,000	4,162,000	3,428,000	..

14	25,874,981	48,926,032	58,671,509	57,897,986	13,027,496	18,488,300
13A	1,687,000	275,000	1,456,000	1,694,000	179,000	..
13B	4,279,000	1,801,000	4,698,000	5,289,000	2,721,000	275,000
13	47,729,229	34,736,973	65,346,002	66,067,564	32,383,707	13,054,640
13, 12 & 11 . . . . .	..	8,578,000	7,960,000	6,862,000	4,776,000	..
12	36,556,180	23,920,999	53,208,251	54,197,290	34,020,660	8,108,760
12 & 11	29,883,000	13,527,000	32,585,000	35,338,000	15,918,000	1,912,000
11	53,820,179	26,782,122	68,889,270	66,046,489	44,931,318	450,000
11 & 10	906,000	2,068,000	2,352,000	2,129,000	362,000	..
10	29,191,231	12,384,346	35,201,683	34,783,968	20,069,925	10,462,500
TOTAL	272,076,663	227,626,690	402,184,745	407,215,425	214,429,342	76,754,140
	499,703,353					
Solid coal proved but unexploited	76,754,140	..	66,776,101	43,749,859	..	..
TOTAL	576,457,493	402,184,745	473,991,526	259,170,201	..	..
GRAND TOTAL OF SEL. A & SEL. B	865,971,982	515,774,930	656,714,634	345,045,034	..	..

Statement No. I—contd.

Appendix—K (i)
JHARIA COAL FIELDS—contd.

Seam.	Quantity Virgin coal still available.	Quantity on pillars.	Total quantity still available excluding under Railways, Public Roads, etc.	Estimated quantity that can be extracted economically.		Solid coal proved but unexploited.
				With stowing.	Without stowing.	
<i>Grade I.</i>						
18	1,478,335	42,666	1,518,661	1,323,270	1,165,795	367,875
17	4,686,400	424,000	5,005,400	4,366,408	3,900,550	..
16A	13,953,000	352,000	11,866,000	10,188,850	7,386,750	..
16B . . . . .	..	..	..	..	..	1,350,000
16	7,522,000	2,946,334	8,437,334	8,502,080	5,637,267	..
15A . . . . .	..	..	..	..	..	1,890,000
15 . . . . .	..	..	..	..	..	1,331,000
14 . . . . .	..	..	..	..	..	1,561,250
13A	20,000	18,000	17,000	32,000	12,000	..
13B	623,000	713,000	641,000	1,138,000	480,000	..
13	18,276,000	1,171,000	17,689,400	15,592,800	11,279,880	..
12 Special . . . . .	..	..	..	..	..	378,000
12 . . . . .	..	1,241,000	401,000	1,055,000	260,000	8,248,625
12 & 11	2,481,000	1,677,000	2,500,600	3,287,000	885,640	9,862,000
11	28,124,946	10,802,372	35,303,770	31,523,444	18,174,424	25,570,810
11 & 10 . . . . .	..	..	..	..	..	1,000,000
4 ft. Spl.	18,000	46,000	43,000	58,000	35,000	..
10 Special	1,073,000	149,000	1,120,000	1,094,000	843,000	..
10	14,543,200	16,101,000	27,820,331	23,454,760	5,431,667	3,590,400
TOTAL	92,803,881	35,683,372	112,453,499	101,615,612	55,481,973	55,655,960
Solid coal proved but unexploited	128,487,253	55,655,960	..	48,420,685	31,723,897	..
TOTAL	184,143,213	..	112,453,499	150,036,297	87,205,870	..

Appendix—K (1).

Statement No. I—contd.

JHARIA COAL FIELDS—contd.

Seam.	Quantity virgin coal still available.	Quantity on Pillars.	Total quantity still available excluding under Railways, Public Roads, etc.	Estimated quantity that can be extracted economically.		Solid coal proved but unexploited.
				With Stowing.	Without Stowing.	
<i>Grade II.</i>						
18	426,720	108,468	535,188	454,909	401,301	1,080,000
16A . . . . .	..	..	..	..	..	2,700,000
15B . . . . .	..	..	..	..	..	..
15	700,650	15,120	480,870	608,404	394,313	1,800,000
14	4,950,127	2,010,825	6,277,312	5,675,521	4,320,992	2,565,000
13A . . . . .	..	..	..	..	..	1,765,000
13B . . . . .	..	..	..	..	..	4,165,500
13	8,601,934	851,730	8,329,292	8,023,574	5,591,341	916,000
12	7,992,040	509,379	7,363,792	7,233,925	5,356,464	..
12 & 11	12,067,400	4,885,300	14,754,700	14,534,220	9,608,935	1,370,000
11	12,131,749	6,543,869	15,471,144	15,607,602	10,558,977	..
11 & 10	566,000	68,000	424,000	476,000	..	60,000
4 ft. Special	233,000	49,000	249,000	244,000	188,000	..
10A	1,104,185	526,330	1,539,880	1,405,240	1,126,353	141,216,500
10	176,935,552	90,925,128	236,322,429	216,223,042	130,872,055	..
TOTAL	226,319,357	112,502,149	291,747,616	270,491,446	168,418,821	157,718,000
	338,821,506					
Solid coal proved but unexploited	157,718,000	..	..	137,214,660	89,899,200	..
TOTAL	496,539,506	..	291,747,616	407,706,106	258,318,081	..

Appendix—K (ii).

Statement No. II.

RANEEGUNGE COAL FIELD.

Seam.	Quantity virgin coal still available.	Quantity on Pillars.	Total quantity still available excluding under Railways, Public Roads, etc.	Estimated quantity that can be extracted economically.		Solid coal proved but unexploited.
				With Stowing.	Without Stowing.	
<i>Selected A.</i>						
Laikdih	18,842,000	38,231,500	56,280,500	43,000,750	9,098,200	26,716,000
Begunia	6,500,000	6,007,000	12,417,000	10,881,000	5,051,000	..
Ramnagar	2,450,000	3,400,000	4,313,700	5,089,500	1,107,000	..
TOTAL	27,792,000	47,638,500	73,011,200	58,971,340	15,347,100	26,716,000
	75,430,500					
Solid coal proved but unexploited	26,716,000		Nil.	23,242,020	15,229,120	Nil
	102,146,500		73,011,200	82,214,260	30,575,220	Nil
<i>Selected B.</i>						
Laikdih	300,000	100,000	400,000	340,000	280,000	..
	400,000					
GRAND TOTAL OF SEL. A & B.	102,546,500		73,411,200	82,554,260	30,855,220	..

Appendix—K (iii).

Statement No. III.

GIRIDIH FIELD.

Seam.	Quantity virgin coal still available.	Quantity on Pillars.	Total quantity still available excluding under Railways, Public Roads, etc.	Estimated quantity that can be extracted economically.		Solid coal proved but unexploited.
				With Stowing.	Without Stowing.	
<i>Selected A.</i>						
Upper Kurhurbareo . . . . .	..	..	..	..	..	2,675,000
Lower Kurhurbareo	3,541,200	6,253,836	9,795,036	8,325,780	7,346,277	
TOTAL .	3,541,200	6,253,836	9,795,036	8,325,780	7,346,277	2,675,000
	9,795,036					
Solid coal proved but unexploited	2,675,000		Nil	2,327,250	1,524,750	Nil
TOTAL .	12,470,036		9,795,036	10,653,030	8,871,027	Nil

Appendix—K (iv).

Statement No. IV.

BOKARO COAL FIELD.

Seam.	Quantity virgin coal still available.	Quantity on Pillars.	Total quantity still available excluding under Railways, Public Roads, etc.	Estimated quantity that can be extracted economically.		Solid coal proved but unexploited.
				With Stowing.	Without Stowing.	
<i>Selected B.</i>						
Kargali	180,816	342,957	358,865	287,803	161,480	..
	470,773					
<i>Grade I.</i>						
Kargali	282,058,126	43,034,560	283,996,286	221,272,608	42,812,729	..
12 ft.	2,105,500	1,566,125	2,052,375	2,753,710	1,771,425	..
	328,764,311					
TOTAL	284,163,626	44,600,685	286,948,061	224,026,417	44,584,154	..
<i>Grade II.</i>						
Kargali	0,854,251	1,084,487	7,038,738	5,318,954	3,572,432	..
	7,038,738					

Appendix—K (v).

Statement No. V.

WORKABLE RESERVES OF COKING COAL IN WORKING COLLIERIES (Figures in million tons)

Name of Coalfield.	Selected A. (Up to 15 per cent. ash).	Selected B. (Up to 17 per cent. ash).	Grade I. (Up to 20 per cent. ash).	Grade II. (Up to 24 per cent. ash).
Jharia	289·4	570·5	184·1	496·5
	865·0			
Raniganj (Laikdih, Begunia and Ramnagar Seams).	102·1	0·4	<i>Nil</i>	<i>Nil</i>
	102·5			
Giridih	12·5	<i>Nil</i>	<i>Nil</i>	<i>Nil</i>
	12·5			
Bokharo	<i>Nil</i>	0·5	328·8	7·9
	0·5			
TOTAL	404·0	577·4	512·0	504·4
	981·4			

Appendix—K (v):

Statement No. V.

WORKABLE RESERVES OF COKING COAL IN WORKING COLLIERIES (Figures in Million Tons).

Name of Coalfield.	Selected A. (Up to 15 per cent. ash).	Selected B. (Up to 17 per cent. ash).	Grade I. (Up to 20 per cent. ash).	Grade II. (Up to 24 per cent. ash).	Remarks.
Jharia	289·4	576·5	184·1	490·5	
	865·9				
Raniganj (Laikdih, Bogunia and Ramnagar Scemas).	102·1	0·4	<i>Nil</i>	<i>Nil</i>	
	102·5				
Giridih	12·5	<i>Nil</i>	<i>Nil</i>	<i>Nil</i>	
	12·5				
Bokharo	<i>Nil</i>	0·5	328·8	7·9	
	0·5				
TOTAL .	404·0	577·4	512·0	504·4	
	981·4				

Appendix K (vi).

Statement No. VI.

RESERVES OF COKING COAL IN VIRGIN AREAS FURNISHED BY THE GEOLOGICAL SURVEY OF INDIA.

Name of Coalfield.	Selected A and Selected B.	Grade I.	Grade II.	Remarks.
Jharia	325,536,000	30,534,000	49,071,000	
Raniganj	<i>Nil</i>	<i>Nil</i>	<i>Nil</i>	
Giridih	4,040,280	..	..
Bokaro . . . . .	..	271,312,500	..	
West Bokaro . . . . .	..	87,835,330	..	
GRAND TOTAL .	329,635,280	395,681,830	49,071,000	

APPENDIX B (VII).

Statement No. VII.

QUANTITY (in million tons) WHICH CAN BE EXTRACTED OUT OF THE SELECTED "A" AND SELECTED "B" COAL RESERVES IN WORKING COLLIERIES SHOWN IN STATEMENTS I, II, III & IV.

"A".

Name of Coalfield.	Workable reserves.	Quantity Extractible.		Remarks.
		With stowing.	Without stowing.	
Jharia (Barakar Series)	865.9	650.7	345.0	
Raniganj	102.5	82.6	30.0	
Giridih	12.5	10.7	8.9	
Bokaro	0.5	0.3	0.2	
TOTAL .	981.4	750.3	385.0	

Appendix K (vii)—contd.

Statement No. VII—contd.

QUANTITY (in million tons) WHICH MAY BE EXTRACTED OUT OF THE SELECTED "A" & SELECTED "B" COAL RESERVES IN VIRGIN AREAS SHOWN IN STATEMENT VI.
"B".

Name of Coalfield.	Workable reserves.	Quantity Extractible.		Remarks.
		With stowing.	Without stowing.	
Jharia	325.6	200.5	162.8	*(See below).
Raniganj	Nil	Nil	Nil	
Giridih	4.0	3.2	2.0	
Bokaro	Nil	Nil	Nil	
West Bokaro	Nil	Nil	Nil	
TOTAL	329.6	203.7	164.8	
GRAND TOTAL OF 'A' & 'B'	1,311.0	1,014.0	549.8	

(i) With stowing the losses have been estimated as follows:—

Loss due to barrier, outcrop coal and local causes	5
Colliery consumption	8
Shaft Pillar, coal locked under important buildings, etc.	2
Loss due to mining	5
Total	20

(ii) Without stowing the losses have been estimated as follows:—

Loss due to barrier, outcrop coal and local causes	5
Colliery consumption	8
Shaft Pillar, coal locked under important buildings, etc.	2
Loss due to mining	35
Total	50

Appendix L (i).
TOTAL OUTPUT OF METALLURGICAL COAL FOR THE YEAR 1949.
(GRADEWISE.)

—	Selected A.	Selected B.	Grade I.	Grade II.	Total all grades.
January 1949	168,798	404,464	250,903	179,043	1,003,208
February 1949	195,321	426,912	230,805	208,206	1,070,244
March 1949	195,496	436,291	244,133	206,652	1,082,572
April 1949	197,651	441,026	223,737	207,648	1,070,062
May 1949	186,131	413,054	264,941	196,915	1,061,041
June 1949	174,718	382,027	240,263	191,215	988,223
July 1949	170,510	385,378	230,751	193,914	980,553
August 1949	187,186	425,740	226,261	215,163	1,054,350
September 1949	182,498	440,216	223,730	228,391	1,074,835
October 1949	169,601	423,251	233,710	214,280	1,040,842
November 1949	183,945	414,320	233,248	211,468	1,042,981
December 1949	204,227	455,691	228,726	243,752	1,132,396
*TOTAL	2,216,082	5,048,370	2,840,208	2,496,647	12,601,307
Monthly Average	184,674	420,697	236,684	208,054	1,050,109

* This includes Jharia Coal upto 10 Seam, Giridih Coal, Kargali Seam and Ramnagar, Laikdih and Bogunia Seams of Raniganj Coal.

Appendix L (i)—*contd.*

TOTAL OUTPUT OF METALLURGICAL COAL FOR THE YEAR 1949—*contd.*

(SEAMWISE & GRADEWISE.)

	Selected A.	Selected B.	Grade I.	Grade II.	Total all grades.
Ramnagar Seam	436,927	..	..	..	436,927
M. Average	36,411	..	..	..	36,411
Laikdih Seam	145,460	9,600	..	5,138	160,204
M. Average	12,122	800	..	428	13,350
Begunia Seam	77,674	..	..	..	77,674
M. Average	6,473	..	..	..	6,473
Giridih Coal	316,783	..	..	..	316,783
M. Average	26,398	..	..	..	26,398
Kargali Seam . . . . .	..	107,503	1,917,851	..	2,025,354
M. Average . . . . .	..	8,959	159,821	..	68,780
Jharia Coal (Upto 10 Seam)	1,239,238	4,931,201	922,357	2,491,509	9,584,365
M. Average	103,270	410,938	76,863	207,626	798,697
Total All Seams	2,216,082	5,048,370	2,840,208	2,496,647	12,601,307
Monthly Average all Seams	184,674	420,697	236,684	208,054	1,050,109

Appendix L (ii).

STATEMENT SHOWING DESPATCHES OF METALLURGICAL COAL, BY GRADES TO PRINCIPAL INDUSTRIES DURING THE YEAR 1949.

Class,	Selected A.	Selected B.	Grade I,	Grade II,	Total.	Average.
Loco	567,284	1,152,150	1,830,412	819,813	4,369,659	364,198
Bunker and Export	260,471	455,512	981,681	27,339	1,125,003	93,750
Steel	483,301	1,701,993	91,576	11,966	2,288,836	190,736
Electricity	135,386	146,696	26,533	54,060	362,675	90,223
Provincial	2,250	28,784	23,454	342,032	390,520	39,043
Cotton	34,923	253,232	10,676	266,043	564,874	47,073
Paper	53,888	11,000	2,846	2,159	69,902	5,825
Miscellaneous	3,304	5,449	20,067	25,620	54,440	4,537
Coke	135,295	271,327	6,978	19,884	427,484	95,624
Pottery	4,009	13,374	489	663	18,535	1,545
Hospital	416	1,033	66	632	2,147	179
Re-rolling	2,933	15,987	997	700	20,617	1,718
Distillery	5,408	22,336	2,515	2,883	33,142	2,762
Refractory	10,013	4,049	130		14,192	1,183
Municipalities	1,553	10,196	819	1,118	13,686	1,141
Tea Gardens	5,261	25,465	1,188	734	32,648	2,721

Appendix—L (ii)—*contd.*

STATEMENT SHOWING DESPATCHES OF METALLURGICAL COAL, BY GRADES TO PRINCIPAL INDUSTRIES
DURING THE YEAR 1949—*contd.*

Class.	Selected A.	Selected B.	Grade I.	Grade II.	Total	Average.
Engineering	10,061	28,963	9,677	9,774	58,475	4,873
Glass	1,150	24,307	2,389	1,718	29,564	2,464
Cement	13,414	92,895	22,747	26,510	155,566	12,964
Jute	26,377	80,983	2,543	1,039	110,942	9,245
Tobacco	2,478	2,277	41	995	5,791	483
Chemical	3,132	33,613	3,145	18,046	57,936	4,828
Defence	1,443	5,654	1,505	12,176	20,778	1,732
Wool	1,613	3,322	651	2,331	7,917	660
Leather	2,255	1,464	..	485	4,204	350
Enamel	1,313	2,469	152	1,887	5,821	485
Oil	2,483	59,231	7,060	44,419	113,193	9,483
Soap	69	2,452	589	451	3,561	297
Ordnance	3,298	147	458	..	3,903	325
Brick	1,166	22,078	22,387	356,316	401,947	33,496
Food Stuff	340	17,484	8,213	45,109	71,146	5,929
Sugar	863	11,698	22,890	31,084	66,535	5,545

Ginning . . . . .	..	111	593	12,072	12,776	1,065
Limestone . . . . .	..	53	601	16,334	16,988	1,416
Education	23	1,744	279	922	2,968	247
Mica . . . . .	..	556	90	2,167	2,813	234
Jail . . . . .	..	2,358	82	943	3,383	282
Rubber	3,633	1,388	219	1,869	7,109	592
Tram . . . . .	..	126	..	..	126	11
Ice . . . . .	..	19,442	1,555	1,855	22,852	1,904
Gas . . . . .	..	..	..	..	..	..
Match . . . . .	..	182	..	44	226	19
Silk	41	990	..	22	1,053	88
Dairies	21	554	..	117	692	57
Starch . . . . .	..	242	..	423	665	55
Copper	1,225	..	..	..	1,225	102
TOTAL	1,782,093	4,535,375	2,508,293	2,158,754	10,984,515	915,376

NOTE.—In compiling the figures of Industry-wise despatches of Metallurgical Coals from Collieries, quantities of Bee-hive or Country Bhatta Hard-Coke despatched to the Industries have also been included, by converting the quantities of Hard-coke despatched, into quantities of Coals used in making it. Quantities of Coals used by collieries in making Bee-hive or Country Bhatta Hard-Coke are not, therefore, included in the figures of despatches under the head 'COKE'; neither are these quantities mentioned under separate heads as that would be duplication and would inflate the total. However, a separate statement showing quantities of Coals used by collieries in making Bee-hive and Country Bhatta Coke is made out for information.

Appendix L (iii).

STATEMENT SHOWING METALLURGICAL COAL* (Grade-wise) USED BY BEE-HIVE PLANTS & COUNTRY BHATTAS DURING THE YEAR 1949.

Grade.	January.	February.	March.	April.	May.	June.
Selected 'A'	Bee-hive Plants . . . . .	..	..	..	..	..
	Country Bhattas . . . . .	..	..	..	..	..
Selected 'B'	Bee-hive Plants	5,355	5,355	5,355	5,355	5,355
	Country Bhattas	1,008	1,008	1,008	1,008	1,008
Grade—I	Bee-hive Plants	1,400	1,400	1,400	1,400	1,400
	Country Bhattas	476	476	476	476	476
Grade—II	Bee-hive Plants	5,246	5,246	5,246	5,246	5,246
	Country Bhattas	1,490	1,490	1,490	1,490	1,490
TOTAL	Bee-hive Plants	12,001	12,001	12,001	12,001	12,001
	Country Bhattas	2,974	2,974	2,974	2,974	2,974
GRAND TOTAL		14,975	14,975	14,975	14,975	14,975

Appendix L (iii)—contd.

STATEMENT SHOWING METALLURGICAL COAL (Grade-wise) USED BY BEE-HIVE PLANTS & COUNTRY BHATTAS DURING THE YEAR 1949.—contd.

Grade.		July.	August.	September.	October.	November.	December.	Total.
Selected 'A'	Bee-hive Plants . . . . .	..	..	..	..	..	..	..
	Country Bhattas . . . . .	..	..	..	..	..	..	..
Selected 'B'	Bee-hive Plants	5,355	5,355	5,355	5,355	5,355	5,355	64,260
	Country Bhattas	1,008	1,008	1,008	1,008	1,008	1,008	12,096
Grade—I	Bee-hive Plants	1,400	1,400	1,400	1,400	1,400	1,400	16,800
	Country Bhattas	476	476	476	476	476	476	5,712
Grade—II	Bee-hive Plants	5,246	5,246	5,246	5,246	5,246	5,246	62,952
	Country Bhattas	1,400	1,400	1,400	1,400	1,400	1,400	17,380
TOTAL	Bee-hive Plants	12,001	12,001	12,001	12,001	12,001	12,001	144,012
	Country Bhattas	2,974	2,974	2,974	2,974	2,974	2,974	35,688
GRAND TOTAL		14,975	14,975	14,975	14,975	14,975	14,975	179,700

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* Approximate Figures.

Appendix—L (iv).

STATEMENT SHOWING DESPATCHES OF SEL. 'A' GRADE METALLURGICAL COAL TO IMPORTANT INDUSTRIES,
DURING THE YEAR 1949.

Class.	January.	February.	March.	April.	May.	June.	July.
LOCO	51,052	41,162	56,764	56,484	53,504	57,173	50,466
NX & SS	15,695	9,828	12,340	21,034	31,384	22,218	28,829
STL	14,866	20,854	38,474	44,912	47,588	46,111	48,214
ELC	20,562	9,702	10,028	8,915	12,074	10,415	10,523
PROV.	280	295	200	137	37	39	191
COT	3,125	1,991	10,380	1,570	2,353	1,598	3,129
PPR	2,385	3,230	4,995	5,224	3,465	7,340	3,710
MIS	197	366	290	286	223	62	636
COKE	10,771	10,924	12,529	14,050	11,811	11,960	10,870
POT	238	450	576	354	812	227	333
HOS	44	43	44	19	266	..	..
RRL	386	259	201	63	348	701	171
DIST	261	300	441	349	281	470	305
REF	1,331	1,173	1,416	765	950	87	471
MWW	109	90	1,029	21	41	42	64
TEA	44	1,383	1,669	132	88	401	68

Appendix—L (iv)—*contd.*

68 P&S	Class.	August.	September.	October.	November.	December.	Total.	Average.
	LOCO	39,772	43,112	41,309	36,053	40,343	567,284	47,274
	XX & SS	31,811	22,050	26,596	23,663	14,123	260,471	21,706
	STL	48,745	48,961	42,326	39,761	42,489	483,301	40,275
	ELC	10,227	12,320	7,841	10,864	11,015	135,386	11,282
	PROV	101	132	205	367	266	2,250	188
	COT	2,299	2,841	2,698	2,236	697	34,923	2,910
	PPR	5,482	4,445	4,230	5,682	3,700	53,898	4,491
	MIS	448	199	364	368	365	3,304	275
	COKE	12,837	11,646	10,478	8,884	8,535	135,296	11,275
	POT	66	325	313	218	288	4,009	4,334
	HOS . . . . .	—	..	..	..	..	416	35
	RRL	160	306	343	147	148	2,933	244
	DIST	269	638	767	1,092	235	5,408	451
	REF	698	1,500	1,204	313	105	10,013	834
	MWW	94	22	20	—	21	1,553	129
	TEA	286	356	331	398	125	5,261	438

Appendix—L (iv)—contd.

STATEMENT SHOWING DESPATCHES OF SEL. 'A' GRADE METALLURGICAL COAL TO 'IMPORTANT INDUSTRIES'
DURING THE YEAR 1949—contd.

Class.	January.	February.	March.	April.	May.	June.	July.
ENG	287	204	1,199	613	439	432	554
GLS	37	280	80	71	64	174	113
CMT	1,593	2,709	129	518	386	1,177	1,435
JCT	1,527	2,204	1,084	1,394	2,638	1,430	2,355
TOB	434	747	625	—	520	128	—
DEF	—	62	58	—	—	43	40
WOL	46	23	137	—	173	255	24
LTH	212	—	46	141	290	216	217
ENM	138	21	88	—	214	65	124
OLE	135	65	202	543	267	301	246
SOP	22	47	—	—	..	..	..
ORD	—	252	600	19	—	—	—
BRK	22	24	20	30	—	43	48
FOD	56	—	150	46	—	—	88
CHM	864	576	515	477	218	45	437
SUG	43	..	..	..	..	..	..

Appendix—L (iv)—contd.

Class.	August.	September.	October.	November	December.	Total.	Average.
ENG	727	887	1,271	1,845	1,603	10,061	838
GLS	—	179	22	46	84	1,150	96
CMT	157	1,356	1,849	593	1,512	13,414	1,118
JUT	3,099	1,760	4,028	3,436	1,422	26,377	2,198
TOB	—	—	24	—	—	2,478	207
DEF	38	346	84	374	398	1,443	120
WOL	159	412	135	45	204	1,613	134
LTH	258	88	198	391	288	2,255	188
ENM	111	91	113	260	88	1,313	109
OLE	367	21	67	346	23	2,483	207
SOP . . . . .	..	..	..	..	..	69	6
ORD	84	84	—	408	1,851	3,298	275
BRK	422	297	192	24	44	1,166	97
FOD . . . . .	—	—	..	..	..	340	28
CHM . . . . .	—	—	..	..	..	3,132	261
SUG . . . . .	..	400	109	232	439	863	72

~~Appendix—L (iv)—concl~~

STATEMENT SHOWING DESPATCHES OF SEL. 'A' GRADE METALLURGICAL COAL TO 'IMPORTANT INDUSTRIES'
DURING THE YEAR 1949—concl.

Class.	January.	February.	March.	April.	May.	June.	July.
GIN . . . . .	—	..	..	..	..	..	..
LMS . . . . .	—	..	..	..	..	..	..
EDU	23	..	..	..	..	..	..
MCA . . . . .	—	..	..	..	..	..	..
JAL . . . . .	—	..	..	..	..	..	..
RUB	1,888	467	—	—	44	112	92
TRM . . . . .	—	..	..	..	..	..	..
ICE . . . . .	—	..	..	..	..	..	..
GAS . . . . .	—	..	..	..	..	..	..
MAT . . . . .	—	..	..	..	..	..	..
SLK	41	—	..	..	..	..	..
DAR	21	—	..	..	..	..	..
STH . . . . .	—	..	..	..	..	..	..
CPR	—	—	—	—	—	—	504
TOTAL	128,735	109,740	156,315	159,067	171,468	163,265	163,757

Appendix—L (iv)—concl'd.

Class.	August.	September.	October.	November.	December.	Total.	Average.
GIN
LMS
EDU	23	..
MCA
JAL
RUB	260	161	245	233	131	3,633	303
TRM
ICE
GAS
MAT
SLK	41	..
DAR	21	..
STH
CPR	—	—	—	—	721	1,225	102
TOTAL	158,977	154,555	147,062	138,089	131,063	1,782,093	148,508

Appendix—L (v)

STATEMENT SHOWING DESPATCHES OF SEL. "B" GRADE METALLURGICAL COAL TO 'IMPORTANT INDUSTRIES'
DURING THE YEAR 1949.

Class.	January.	February.	March.	April.	May.	June.	July.
LOCO	64,023	83,567	93,156	69,903	88,458	66,788	105,788
XX & Bunker	37,965	34,864	33,597	40,430	34,031	37,517	46,114
STL	144,651	133,032	153,249	134,426	140,657	135,278	169,357
ELC	10,192	9,551	16,296	10,283	14,035	7,830	11,602
PROV	2,406	1,557	3,297	1,923	1,180	2,435	2,219
COT	12,356	9,063	16,273	14,743	16,758	20,866	24,814
PPR	382	111	787	748	431	1,311	201
MIS	1,093	795	637	1,255	190	750	19
COKE	20,189	19,811	22,037	24,471	22,329	26,155	24,930
POT	742	696	692	456	1,438	1,999	2,113
HOS	19	—	22	23	43	43	196
RRL	654	810	968	1,082	1,768	2,665	1,861
DIS	1,239	1,018	2,037	1,857	1,501	862	1,797
REF	75	277	309	303	329	698	640
MWW	860	1,584	622	1,122	868	982	495
TEA	778	156	88	2,728	1,797	1,967	5,028

Appendix—L (v)—*contd.*

Class.	August.	September.	October.	November.	December.	Total.	Average.
LOCO	108,840	121,447	110,704	100,627	138,849	1,152,150	96,013
XX & Bunker	39,216	47,070	47,001	34,227	23,480	455,512	37,959
STL	166,598	140,340	140,685	113,616	130,104	1,701,993	141,833
ELC	11,570	13,291	13,171	13,898	14,977	146,696	12,225
PROV.	1,778	1,194	2,325	4,347	4,123	28,784	2,399
COT	25,669	31,176	27,248	28,751	25,495	253,232	21,103
PPR	2,150	1,866	1,486	838	698	11,009	917
MIS	147	133	160	115	155	5,449	454
COKE	23,442	17,766	20,001	24,165	26,011	271,327	22,611
POT	2,080	807	837	911	603	13,374	1,115
HOS	112	127	18	259	169	1,033	86
RRL	1,094	1,896	1,014	869	1,308	15,987	1,332
DIS	1,879	2,822	3,257	2,904	1,163	22,336	1,861
REF	775	88	307	111	137	4,049	337
MWW	529	177	233	1,566	1,158	10,196	850
TEA	1,093	3,925	4,775	2,922	208	25,465	2,122

Appendix—L (v)—contd.

STATEMENT SHOWING DESPATCHES OF SEL. "B" GRADE METALLURGICAL COAL TO 'IMPORTANT INDUSTRIES'
DURING THE YEAR 1949.

Class.	January.	February.	March.	April.	May.	June.	July.
ENG	1,120	858	2,147	812	1,031	2,745	2,257
GLS	1,041	1,307	3,969	1,827	2,099	2,278	2,531
CMT	1,719	10,091	10,459	4,695	6,199	9,029	15,834
JUT	6,751	4,082	7,948	8,080	7,068	7,334	9,652
TOB	—	—	480	579	22	361	69
CHM	1,481	1,272	2,555	4,983	3,100	2,388	4,268
DEF	157	..	43	1,048	421	604	810
WOL	572	394	220	262	508	702	220
LTH	24	..	64	40	174	69	19
ENM	110	130	25	171	350	133	24
OIL . . . . .	..	3,044	5,877	3,232	5,758	5,297	7,668
SOP	90	131	471	192	268	108	114
CPR . . . . .	..	..	..	..	..	..	..
ORD . . . . .	..	..	..	..	..	..	..
BRK	179	—	649	724	62	737	3,282
FOD	630	424	1,216	995	1,085	2,277	1,443

Class.	August.	September.	October.	November.	December.	Total.	Average.
ENG	3,052	2,979	4,908	3,284	3,772	28,063	2,414
GLS	2,662	1,224	1,828	2,226	1,315	24,367	2,026
CMT	9,401	5,549	3,310	2,912	13,697	92,895	7,741
JUT	7,626	4,934	6,017	6,750	4,741	80,983	6,749
TOB	244	193	154	..	175	2,277	190
CHM	3,437	1,952	2,474	3,191	2,512	33,613	2,810
DEF	727	830	604	275	135	5,654	471
WOL	170	65	..	90	113	3,322	277
LTH	81	89	21	532	351	1,464	122
ENM	553	89	239	243	165	2,469	206
OIL	8,887	6,663	3,697	4,493	4,615	59,231	4,936
SOP	441	45	268	195	129	2,452	204
CPR	..	..	..	..	..	..	..
ORD	..	..	..	..	147	147	12
BRK	9,064	2,452	3,247	1,467	215	22,078	1,840
FOD	1,584	1,345	1,864	1,424	2,297	17,484	1,457

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Appendix—L (v)

STATEMENT SHOWING DESPATCHES OF SEL. "B" GRADE METALLURGICAL COAL TO 'IMPORTANT INDUSTRIES'
DURING THE YEAR 1949.

Class.	January.	February.	March.	April.	May.	June.	July.
SUG	779	259	42	238	816	618	1,663
GIN . . . . .	..	..	..	64	25	..	..
LMS . . . . .	..	..	..	..	..	..	..
EDU	71	63	19	21	44	132	662
MCA . . . . .	..	..	67	64	64	85	..
JAL . . . . .	..	23	111	180	326	87	290
RUB	45	67	40	67	179	89	286
TRM . . . . .	..	43	84	..	..	..	..
ICE	435	325	22	947	3,107	2,644	4,173
GAS . . . . .	..	..	..	..	..	..	..
MAT	24	24	..	22	..	..	69
SLK	154	46	..	..	95	46	81
DAR	23	23	..	20	22	10	268
STH . . . . .	..	..	..	..	20	..	..
TOTAL	313,029	310,497	380,601	335,016	359,556	345,948	453,096

Class.	August.	September.	October.	November.	December.	Total.	Average.
SUG	1,709	1,514	2,128	694	1,238	11,698	975
GIN . . . . .	..	..	..	22	..	111	9
LMS . . . . .	..	26	27	..	..	53	4
EDU	153	110	88	88	293	1,744	145
MCA	69	70	89	48	..	556	46
JAL	758	99	108	214	162	2,358	197
RUB	235	108	89	68	109	1,388	116
TRM . . . . .	..	..	..	..	..	126	11
ICE	3,183	2,088	1,494	501	523	19,442	1,620
GAS . . . . .	..	..	..	..	..	..	..
MAT	22	..	21	..	..	182	15
SLK	62	130	131	130	115	690	83
DAR	112	23	..	23	21	554	46
STH . . . . .	..	132	..	66	24	242	20
TOTAL	441,210	416,834	406,026	359,062	405,500	4,535,375	377,948

Appendix—L (vi)

STATEMENT SHOWING DESPATCHES OF GRADE I METALLURGICAL COAL TO 'IMPORTANT INDUSTRIES' DURING THE YEAR 1949.

Class.	January.	February.	March.	April.	May.	June.	July.
LOCO	180,274	143,697	154,246	141,437	150,122	138,034	151,579
XX—SS	48,304	28,331	29,491	30,013	31,388	42,190	45,401
STL	9,773	2,313	9,790	4,740	8,334	4,419	3,818
ELC	—	1,540	2,728	6,028	4,882	3,756	2,526
PROV.	1,755	2,180	3,130	1,183	1,417	905	1,450
COT	426	121	1,351	290	518	2,142	1,117
PPR	281	22	152	90	570	108	—
MIS	67	519	972	770	1,582	2,514	3,160
COKE	489	621	1,052	609	748	989	852
POT	—	160	—	22	—	—	20
HOS	21	—	—	—	22	—	—
RRL	23	22	—	—	543	44	91
DIS	38	322	36	24	154	383	137
REF	—	—	—	—	—	—83	—47
MWW	—	—	180	—	206	43	158
TEA	523	—	128	—	—	—	—

Class.	August.	September.	October.	November.	December.	Total.	Average.
LOCO	132,603	159,281	171,713	159,132	139,294	1,830,412	152,534
XX-SS	46,840	19,197	16,426	25,286	18,724	381,681	31,897
STL	7,838	9,891	9,756	9,185	11,719	91,576	7,631
ELC	950	1,485	234	977	1,407	26,533	2,211
PROV.	1,251	2,405	3,552	1,922	2,295	23,454	1,955
COT	1,255	1,671	1,026	316	434	10,976	800
PPR	849	70	573	—	131	2,846	237
MIS	3,163	1,135	2,129	1,727	2,329	20,067	1,672
COKE	1,243	—	285	—	—	6,978	582
POT	67	86	46	43	45	439	41
HOS	23	—	—	—	—	60	8
RRL	88	—	101	43	42	997	83
DIS	174	228	213	238	532	2,515	210
REF	—	—	—	—	—	130	11
MWW	148	84	—	—	—	819	68
TEA	—	451	86	—	—	1,188	99

-Appendix—L (vi)

STATEMENT SHOWING DESPATCHES OF GRADE I METALLURGICAL COAL TO 'IMPORTANT INDUSTRIES'
DURING THE YEAR 1949.

Class.	January.	February.	March.	April.	May.	June.	July.
ENG	463	368	458	407	1,410	572	960
GLS	515	154	493	46	253	111	373
GMT	2,921	468	1,586	4,345	2,551	2,277	—
JUT	1,215	672	125	—	81	—	38
TOB	—	—	—	—	41	—	—
CHM	371	304	444	610	297	511	329
DEF	19	—	115	39	240	—	515
WOL	—	—	—	388	—	107	71
LTH	—	—	—	—	—	—	—
ENM	—	—	—	—	23	—	—
OIL	—	455	756	499	1,092	661	637
SOP	458	23	—	—	—	21	23
CPR	—	—	—	—	—	—	—
ORD	—	—	—	—	—	—	—
BRK	1,240	609	1,570	1,477	187	—	1,993
FOD	1,520	1,141	404	376	636	615	1,676

Class.	August.	September.	October.	November.	December.	Total.	Average.
ENC	1,066	1,317	904	607	1,040	9,677	806
GLS	400	44	—	—	—	2,389	199
CMT	1,959	2,699	1,487	1,513	941	22,747	1,896
JUT	84	—	244	84	—	2,543	212
TOB	—	—	—	—	—	—41	3
CHM	41	174	22	42	—	3,145	262
DEF	349	228	—	—	—	1,505	125
WOL	—	85	—	—	—	651	54
LTH	—	—	—	—	—	—	—
ENM	22	45	—	43	10	152	13
OIL	574	1,144	554	312	376	7,060	588
SOP	22	—	20	22	—	589	48
CPR	—	—	—	—	—	—	—
ORD	23	415	—	—	20	458	38
BRK	5,468	3,604	3,225	2,130	825	23,387	1,860
FOD	218	433	1,017	177	—	8,213	684

Appendix—L (vi)

STATEMENT SHOWING DESPATCHES OF GRADE I METALLURGICAL COAL TO 'IMPORTANT INDUSTRIES'
DURING THE YEAR 1949.

Class.	January.	February.	March.	April.	May.	June.	July.
SUG	2,452	2,106	955	403	450	85	718
GIN	—	64	160	—	22	—	—
LMS	—	—	23	—	23	23	—
EDU	22	—	64	—	23	—	—
MCA	—	—	—	—	—	—	—
JAL	—	21	21	21	—	—	—
RUB	23	22	—	42	66	66	—
TRM	—	—	—	—	—	—	—
ICE	—	—	—	117	679	218	89
GAS	—	—	—	—	—	—	—
MAT	—	—	—	—	—	—	—
SLK	—	—	—	—	—	—	—
DAR	—	—	—	—	—	—	—
STH	—	—	—	—	—	—	—
TOTAL	253,283	186,255	210,430	194,185	217,560	200,877	217,819

Class.	August.	September.	October.	November.	December.	Total.	Average.
SUG	1,769	2,349	5,188	3,283	3,132	22,890	1,908
GIN	—	154	64	86	43	593	40
LMS	—	42	—	490	—	601	50
EDU	21	42	61	—	46	279	23
MCA	—	—	—	—	90	90	8
JAL	—	—	19	—	—	82	7
RUB	—	—	—	—	—	219	18
JRM	—	—	—	—	—	—	—
ICE	—	138	156	67	91	1,556	130
GAS	—	—	—	—	—	—	—
MAT	—	—	—	—	—	—	—
SLK	—	—	—	—	—	—	—
DAR	—	—	—	—	—	—	—
STH	—	—	—	—	—	—	—
TOTAL	208,508	208,957	219,101	207,734	183,584	2,508,293	200,024

Appendix—L (vii)-

MONTHWISE DESPATCHES OF GRADE II METALLURGICAL COAL TO THE DIFFERENT CLASS OF INDUSTRIES DURING 1949.

Class.	January.	February.	March.	April.	May.	June.	July.
LOCO	48,507	49,678	71,953	64,781	73,062	77,389	83,549
XX+Bunka	444	362	1,149	1,820	836	1,788	2,568
STL	252	81	—	312	—	1,797	1,213
ELC	5,212	3,195	1,993	3,196	2,084	7,867	5,557
PROV.	22,999	22,441	23,561	28,828	35,093	26,340	39,361
COT	20,320	18,187	24,093	15,761	18,911	25,954	20,386
PPR	719	364	61	256	478	85	66
MIS	1,631	539	1,017	653	1,848	2,976	3,724
COKE	902	415	1,069	1,048	671	774	1,937
POT	—	—	156	105	45	22	63
HOS	19	36	21	—	102	62	42
RRL	18	41	42	24	—	—	—
DST	86	324	43	145	181	474	233
REF	—	—	—	—	—	—	—
MWW	59	67	93	119	—	44	—
TEA	—	—	—	—	—	—	—

Class.	August.	September.	October.	November.	December.	Total.	Average.
LOCO	84,609	61,403	80,432	71,059	52,431	319,933	63,987
XX+Bunka	1,568	4,131	4,650	3,872	4,142	18,363	2,278
STL	988	5,044	734	898	647	11,966	997
ELC	4,539	5,121	4,090	5,640	4,666	24,056	4,505
PROV.	35,500	32,608	17,019	28,360	28,713	142,200	28,503
COT.	25,460	23,264	25,957	23,159	18,501	116,341	22,170
PPR	—	20	110	—	—	250	180
MIS	6,979	1,314	875	2,201	1,773	13,142	1,157
COKE	2,580	—	1,697	2,030	761	7,068	1,157
POT	22	64	120	22	44	272	55
HOS	139	62	88	—	61	350	53
RRL	161	254	27	118	25	585	58
DST	464	278	163	251	243	1,399	240
REF	—	—	—	—	—	—	—
MWW	370	67	—	135	164	736	93
TEA	—	—	411	304	19	734	61

Appendix—L (vii)

MONTHWISE DESPATCHES OF GRADE II METALLURGICAL COAL TO THE DIFFERENT CLASS OF INDUSTRIES DURING 1919.

Class.	January.	February.	March.	April.	May.	June.	July.
ENG	548	372	625	459	915	642	686
GLS	18	106	99	163	209	174	23
GMT	867	1,936	1,728	430	1,839	6,398	2,233
JUT	—	40	93	118	184	39	23
TOB	68	309	—	—	21	448	23
CHM	759	1,071	2,356	1,286	2,226	2,326	1,457
DEF	905	1,759	1,418	2,471	308	2,288	132
WOL	107	100	362	305	326	—	170
LTH	80	23	—	42	70	22	25
ENM	153	111	59	40	295	85	134
OIL	2,645	2,478	3,026	2,656	4,094	3,919	4,885
SOP	61	87	48	—	23	64	40
ORD CPR	—	—	—	—	—	—	—
BRK	22,459	8,429	19,823	15,922	17,879	17,052	50,681
FOD	2,503	2,709	1,996	2,814	4,195	4,054	6,191

Class.	August.	September.	October.	November.	December.	Total.	Average.
ENG	1,009	1,062	1,057	1,087	712	9,774	815
GLS	100	252	—	287	287	1,718	143
CMT	4,741	364	1,853	1,546	2,575	26,510	2,209
JUT	240	90	—	137	60	1,039	87
TOB	—	21	62	22	21	995	83
GHM	1,213	2,026	1,526	1,137	664	18,046	1,504
DEF	718	752	903	240	102	12,176	1,015
WOL	415	106	—	44	387	2,331	194
LPH	69	—	60	82	—	485	40
ENM	283	212	128	237	150	1,887	157
OIL	5,492	2,902	3,867	3,864	4,591	44,419	3,702
SOP	—	62	46	20	—	461	38
CPR	—	—	—	—	—	—	—
ORD	—	—	—	—	—	—	—
BRK	53,716	32,970	54,644	39,669	23,070	356,076	309,603
FOD	6,158	2,623	4,081	4,941	8,844	45,109	3,759

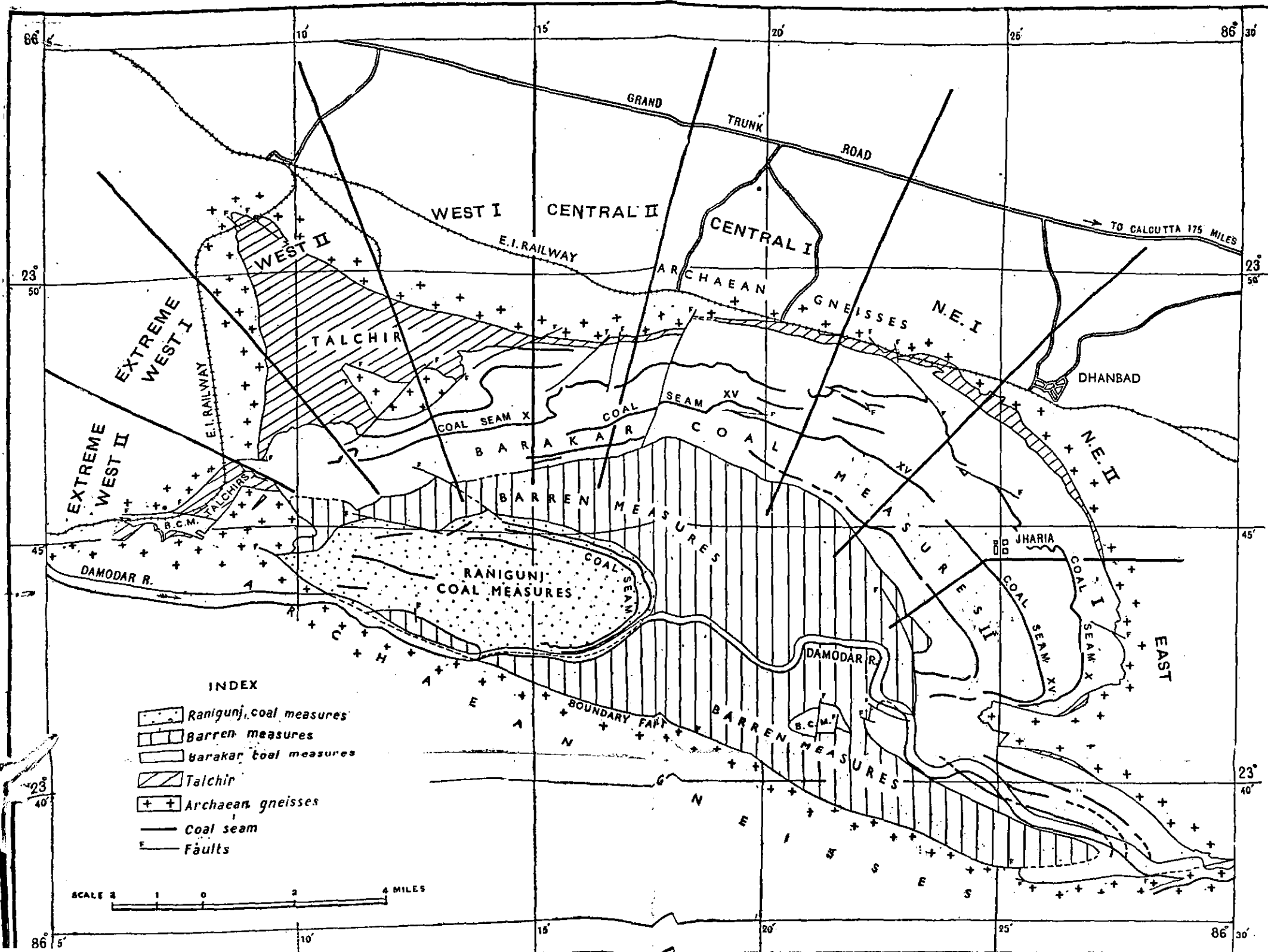
Appendix—L (vii)

MONTHWISE DESPATCHES OF GRADE II METALLURGICAL COAL TO THE DIFFERENT CLASS OF INDUSTRIES DURING 1949.

Class.	January.	February.	March.	April.	May.	June.	July.
SUG	3,030	2,165	1,455	324	1,282	493	1,193
GIN	773	1,401	571	2,003	382	—	—
LMS	1,520	2,126	1,228	620	2,004	1,561	1,632
EDU	106	78	144	62	23	19	24
MCA	—	285	155	243	143	59	151
JAL	—	—	104	174	114	131	86
RUB	119	135	25	139	133	242	241
TRM	—	—	—	—	—	—	—
ICE	262	171	—	302	111	87	335
GAS	—	—	—	—	—	—	—
MAT	—	—	22	22	—	—	—
SLK	—	—	—	—	—	—	—
DAR	95	—	—	—	—	—	—
STH	95	—	—	—	21	22	—
TOTAL	138,413	121,630	160,590	147,661	172,588	185,706	234,006

Class.	August.	September.	October.	November.	December.	Total.	Average.]
SUG	3,553	3,569	4,425	6,271	3,318	31,084	2,590
GIN	253	2,118	2,105	1,623	843	12,072	1,006
LMS	1,771	809	1,211	1,163	530	16,334	1,361
EDU	82	66	23	295	—	922	77
MCA	131	403	267	117	210	2,167	181
JAL	84	45	45	161	—	943	79
RUB	221	84	265	88	177	1,869	156
TRM	—	—	—	—	—	—	—
ICE	61	109	171	24	222	1,855	155
GAS	—	—	—	—	—	—	—
MAT	—	—	—	—	—	44	4
SLK	—	—	—	—	22	22	2
DAR	—	—	22	—	—	117	10
STH	—	90	—	173	22	423	35
TOTAL	244,307	284,453	213,807	201,307	154,166	2,158,754	179,896]


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