

CONSERVATION OF COAL.¹

By M. S. KRISHNAN, M.A., Ph.D., F.N.I., Geological Survey of India.

The term 'conservation' as applied to any assets connotes their preservation. In the case of irreplaceable or wasting assets like minerals it can only mean the avoidance of waste in all phases of handling, and the careful and wise utilisation of the deposits. The conservation of coal will therefore necessitate careful control of mining, processing, beneficiation, transport, distribution and industrial use. True conservation will not be attained unless every one connected with any phase of winning, trade and utilisation of the mineral takes steps to see that no waste takes place.

Reserves.

The first step towards conservation is the acquisition of knowledge of the available resources of the country. As dealt with in another paper in this symposium, conservative estimates show that India possesses about 20,000 million tons of workable coal within a depth of 1,000 feet from the surface. Good quality coal (*i.e.* coal with less than 16 per cent ash on a moisture-free basis) amounts at present to about 4,850 million tons within a depth of 2,000 feet. Of this again, only about 1,400 million tons are good coking coal. This inventory is a good approximation to truth on the data available at present. With more detailed data and the inclusion of seams thinner than 4 feet in the estimate, appreciably larger reserves may be available.

Life of the reserves.

A certain definite proportion of the reserves is not mineable since some waste is unavoidable in mining. Peculiarities of structure and composition, faulting, crushing, proximity to igneous intrusives, etc. have all some influence on mining and on the amount that could usefully be recovered. Hence calculations of the life by a simple division of the reserves by the present or estimated future consumption will be falsified by a large margin.

Best material usually worked first.

There is also the natural human tendency to get at the best material first and exhaust it before any serious thought is given to the poorer qualities available. The exploitation of all minerals in all countries has been, and still is, subject to this tendency. If the best seams are worked first, parts of these and much of the less attractive material in the contiguous strata become spoilt

¹ Published by permission of the Director, Geological Survey of India.

or even unworkable at a later date, unless special precautions are taken in due time. The less accessible areas are naturally left over for future exploitation. Thus, as the market demand steadily mounts up, the price of the commodity also goes up because of the higher expense of mining at depth and of the greater difficulties to be overcome, and also the longer haulage to the consuming centres.

We are quite familiar with the phenomenon of the ordinary consumer in India buying coal by the name or the number of the seam which has an established reputation on the market, rather than on analysis and other scientific criteria. This leads to the continued exploitation of particular seams while the others may suffer simply because they are not sufficiently well known. Again when part of a seam is of high quality, only that portion is worked while the rest is neglected and not infrequently wasted.

Incidence of freight.

In a large country like India with a limited geographical distribution of the coalfields, the cost of transport becomes an important and often the paramount consideration. Thus, Lahore or Peshawar has to pay, in freight, five or six times the pit's mouth value of the coal from Bihar. Places west of Nagpur have often to be content with the second grade coal produced in the Central Provinces because the cost of Bengal or Bihar coal is double or treble that of the local coal. In the fields producing different grades, the demand is generally brisk only for the best grades, unless price differences are sufficient to encourage the use of lower grades or unless research has proved that certain particular types are best suited for specific uses.

Underground mining.

Underground mining in India involves at present a heavy loss of coal in the seams. It was estimated by the Coal Mining Committee of 1936-37 that only 60 per cent and 50 per cent respectively of the coal in pillars in the Raniganj and Jharia fields is being recovered at present. This would mean that roughly 25 to 40 per cent of the original coal in the seams is irretrievably lost under the present methods of working.

Disadvantages of deep mining.

In some European countries it has been found necessary to work seams 3 feet or less in thickness, because thicker seams have already been worked out or are not able to meet all the demand. In Belgium, for instance, some seams barely 20 inches (51 cm.) thick, and having comparatively high dip, are being worked at a depth of nearly 4,000 feet. Such conditions involve high engineering efficiency, costly mechanical equipment, and high maintenance and labour costs concomitantly with less production per man-shift, all these factors inevitably increasing the cost of the commodity. In the above instance, the output per man-shift is only about 1 ton, whereas in working

seams of 6 to 7 feet thickness under moderate depths with the same mechanical facilities the output is 4 to 5 tons. Though we, in India, are still far from the period when thinner and inferior seams will regularly have to be worked, it would be well to recognise and emphasise the evils of prodigality in the early stages of intensive exploitation and be forewarned about the future.

Geological factors.

The geological structure of the seam and the nature of the floor and roof limit the recovery to some extent. Coal has often to be left in the roof, especially of thick seams, and where the roof is weak; also in panel walls, pillars and boundaries, and around the shaft bottom. It has also to be left to support surface structures, railways, roads, stream beds, etc. Local patches of low quality and undulations or rolls in the seams are also sources of loss. It has been pointed out by the Coal Mining Committee that some portions of the seams which are worked for export are of low grade and are not worked. In this case, part of the responsibility for ultimate loss rests upon the State since it is prohibited by law to work the ungraded and graded coals at the same time. As a general statement it is true that only the best and cheapest worked coal is mined and an appreciable portion of the reserves is left behind and lost at least in part. Such loss is undoubtedly 'avoidable waste' and militates against conservation.

Mining methods.

The system of mining has to be adapted to the peculiar local conditions in the field and the structure of the seams in order to avoid losses to a minimum. Since the seams are thick in India and the mining system followed is the 'pillar and stall', the question of pillar extraction presents great difficulties unless adequate measures are taken for the support of the roof. The measures now being taken by the Government of India for the enforcement of universal sand-stowing will go a long way towards the realisation of conservation.

Machine mining.

It may be mentioned in this connection that mechanisation of mining operations is not always conducive to the avoidance of loss. Certain types of equipment (*e.g.* face conveyor and scraper) permit of mining thin seams with high recovery. If, however, the seam contains layers of poor quality, machine mining cannot be as discriminating as hand mining, with the result that the grade of coal is brought down or an appreciable part of the better portion of the seam is left behind. Under certain circumstances, therefore, mechanical mining is much less flexible than hand mining.

Labour.

Increasing efficiency of labour and the use of labour-saving devices will make for lower cost of production, and incidentally greater safety. Labour

is cheap in India but comparatively inefficient, but there is no reason why it could not be trained to better efficiency. The proper observance of mining rules and regulations depends ultimately on intelligent and responsible labour, and though mining regulations aim primarily at safety they also indirectly aid in conservation.

Reopening of abandoned mines.

Private agencies can function only so long as there is a reasonable prospect of profit. Since industries in most countries are sensitive to fluctuations and vagaries of trade, premature abandonment of mines (*i.e.* with partial recovery of coal) is fairly common. Once a property is partially worked and then abandoned, it is difficult to reopen it, for this would involve heavy additional expenditure in pumping, reconditioning, support, etc. In several cases it is quite uneconomic to reopen such properties and try to recover the unmined coal.

Rehabilitation of the surface.

Finally, mined areas often present a desolate and ruined aspect, caused by collapses and fires. This is already assuming appreciable proportions in some of our important coalfields. We can also imagine what the large open-cast mines in the Bokaro field will look like when finished with. The collapsed and mined areas could profitably be repaired and re-graded so that they could be afforested or made fit for agricultural purposes.

Some economic aspects.

In countries which do not exercise much control over the industry, the market is highly competitive, and the producers naturally want to mine the coal as cheaply as possible. Such conditions generally encourage waste. It then becomes the duty of the State to enforce certain necessary steps for the prevention of waste, ensuring at the same time that no class of producers suffers a handicap thereby in comparison with others. This means inevitably a slightly higher cost of production which will be passed on to the consumer, but this sacrifice on the part of the latter becomes a national necessity. For, if the consumer is reluctant to pay a little higher price now, he will be forced to pay a much higher sum in future for a distinctly inferior product. Under good and efficient management it is possible to obtain a higher recovery of coal without material increase in cost, within limits. The complete recovery of pillars and roof coal, however, generally means extra cost, but there is the countervailing advantage that a larger tonnage is recovered from the same mine, there being some savings in certain items of cost such as the general equipment, ventilation, haulage, etc. The land-owner gets more money as royalty from the same property, as also the taxing authorities. The charges for depreciation of the value of the mining property are spread over a longer period and over a larger tonnage of output.

These considerations will apply in varying degrees to different properties. In the case of the very long leases of the early days which were given under extremely cheap rates—*e.g.* some of the very early leases given by the Permanent Settlement landlords of Bengal and Bihar—it may not be at all profitable for a concern to work the small amount of extra coal. On the other hand, certain items are always more costly, such as de-pillaring, timber supports and labour. Considering all the factors, however, the extra cost per ton spread over the whole of the resources of the mine will be very small and will not seriously affect the market price in most cases.

The steady or intermittent nature of the operations has an important effect on cost, since a steady output is always conducive to better planning, ordered development and lower costs.

Regarding the effect of complete recovery of coal on surface subsidences, there should not be a great deal of difference between partial recovery and complete recovery, for even if pillars are left to support the surface, they tend to become crushed in time and produce sags and cracks. Unless there are costly structures on the surface, the expense of re-grading the surface for agricultural purposes will not tell seriously on the cost of recovery of the coal which would otherwise be left unworked.

Much the most important obstacle to complete recovery is the keen competition in an uncontrolled market. Unless it is made worth while for the lessee to win the extra coal, *i.e.* unless there is a market for the extra coal, which may be sometimes of a low grade, it will be impossible to induce him to take the trouble of mining it. It is therefore imperative that the question of the additional cost involved should be studied in all its aspects and measures adopted to enable the industry to take the necessary steps for ensuring conservation. In the last analysis, this will necessitate not only production control but also price control.

Excess capacity is a common feature, at the present day, of the mining and manufacturing industries of many countries, particularly of those which have had an early start in industrialisation. It also happens that an enormous impetus is given to the increase of productive capacity during times of crises like wars, but generally no steps are taken to reduce the capacity to normal as soon as the crisis passes. Thus overproduction lingers on with its attendant disability—price cutting and cut-throat competition. Control of production is the only remedy for this state of affairs.

Conservation in preparation and use.

Great progress has been made in recent years in the preparation of the coal for the market by sizing and cleaning. Sizing enables the consumer to use the material straight in the form in which it is delivered to him and which suits his purpose best. Sizing of the product is an essential operation at the pit-head in many countries for this classifies the material for the market and is also a preliminary to the cleaning operation which is becoming quite common.

Cleaning makes it possible to recover part of the coal which might otherwise find its way to the dumps. Moreover, fine coal produced during the mining operations could be brought to the surface and cleaned and sold instead of being left underground to become a source of danger through liability to spontaneous combustion, production of coal dust, etc. In countries where coal cleaning has become common, the consumer has begun to appreciate the value of a clean product. Moreover the cleaned product pays freight only on the material which is usable and not on the impurities; for instance, coal with 10 per cent ash is paying freight unnecessarily on a tenth of its weight between the pit-head and the consumer's stockyard. Hence coal preparation also makes for conservation.

The coal, when it reaches the consumer, should be put to the best use possible. Research and experience have proved that certain coals are best suited for certain purposes. In the case when coal is used as a general fuel, prevention of the loss of valuable by-products is a necessary measure of conservation. Recovery of by-products will not be an economic proposition unless there is a market for them. But it must be remembered that markets do not come into existence by themselves but have to be created and carefully developed. As an example might be cited the case of nickel which came into prominence during the Great War, but which has now assumed enormous importance as a peace time metal through intensive research and propaganda by the producing companies. It should therefore be quite possible to put on the market carbonised coal from which the greater part of the volatile materials have been extracted. Various methods of carbonisation, improvements of fuel efficiency, manufacture of liquid fuels from coal, etc. should therefore be studied in relation to the types of coal available in the country. We are nowadays producing appreciable quantities of soft coke by the crudest of methods, completely wasting all the valuable volatile constituents. The recovery of these products will be a useful measure of conservation. There is much scope in India for the manufacture of motor fuel from coal, since the petroleum resources of the country are limited. Countries similarly situated with regard to domestic petroleum—*e.g.* England, Germany and Japan—are now engaged in meeting the deficiency by using coal as the raw material for the manufacture of liquid fuel. Again, with two important coalfields within easy reach of a great consuming centre like Calcutta, it should be possible to produce much of the power requirements cheaply in a few large central power stations based on coal.

There is a vast field for research in Indian coal. A few lakhs of rupees spent on research will result in several-fold return to the country in the shape of prevention of waste, improvement of fuel efficiency and the starting of new industries to supply many of the articles which the country is now forced to import at great cost.