CHAPTER TWO:
GEOGRAPHICAL BACKDROP,
GEOLGY & COAL RESOURCES
2.1 PHYSICAL SETTING

Location of Raniganj Coalfield

The major part of Raniganj Coalfield lies within Barddhaman district, West Bengal i.e., above 1,000 sq.km. out of the total area of 1,530 sq.km., i.e., about 71% of the total coalfield area. Other districts covered by the coalfield are Birbhum, and Puruliya of West Bengal and Dhanbad and Santal Parganas of Bihar.

The actual location of the Raniganj Coalfield within the district Barddhaman is in its north-western part which is called Asansol Sub-division (Fig.3). In shape, the district resembles a club or hammer, of which the handle consisting of the Asansol sub-division. Almost all the police stations have coal mines except Kanksa, Raniganj, Jamuria, Barabani, Asansol, Hirapur, Chittaranjan, Salanpur and Kulti Police Stations have coincided with coal bearing areas of Asansol sub-division of Barddhaman district. The area is bounded by the latitudes 23°33' and 23°52' North and longitudes 86°43' and 87°20' East and the Survey of India toposheets number 73M/1, 2, 5, 6, 73I/9', 10, 13, 14 is covered the area on 1:50,000 scales.

This is the broad study area of the thesis and the coal-bearing area is bounded on the north-west by the hilly
LOCATION OF RANIGANJ COALFIELD
WITHIN BARDHAMAN DISTRICT
SHOWING DIFFERENT AREAS
OF EASTERN COALFIELDS
LIMITED

Fig. 3
tracts of Santal Parganas, on the north by the river Ajay which separates it from the district of Birbhum, on the south by the Damodar, on the east by Kanksa Police Station of the same sub-division and the Damodar which separates the area from Bankura district of West Bengal and Dhanbad district of Bihar. Rivers Ajay, Damodar and Barakar are the natural barriers to effective transportation between the sub-division and the surrounding areas.

**Communication**

The coal belt is very well developed in terms of communication and can be approached either by train along the Eastern Railway mainline connecting Howrah-Sealdah (Calcutta) with northern India and by road by Grand Trunk Road (National Highway Number - 2). The Andal-Sainthia and Andal-Deoghar chord line of Eastern Railway and Asansol-Purulia line of South-Eastern Railway traverse this area, connecting many places with it.

The link with Bankura, Puruliya and Birbhum districts depends to a great extent on the provisions of adequate crossings over the river Ajay and Damodar. The single track railway line from Andal to Sainthia crosses the Ajay at Pandaveswar and a road bridge over the Ajay at Illambazar connects Asansol with Birbhum district. Coalbelt of this district is connected with Puruliya over the Panchet dam through Raghunathpur. Over the Barakar river, there are one road bridge and another rail bridge in addition to the roadways.
over the Maithon dam.

All the interior places can be approached by metalled and unmetalled roads. Development of roads and railway lines has taken place in a very rapid rate because of the widespread mining activities after nationalisation of coal mines. Almost every village can be approached by jeepable roads. Raniganj, Asansol, Andal, Jamuria, Kulti, Barakar and Rupnarayanpur are the major towns and market centres of the area. The average accessibility index for the area is about 5.5 miles of roads and railways for every 10 sq. miles.

Physiography

From a regional point of view, this part of the district with its varied tectonic elements and riverine features, is a transitional zone between the Bihar plateau which is a portion of peninsular shield in the west, and the Ganga-Brahmaputra alluvial plain in the north and east. (Fig.4).

This portion of the district resembles a promontary jutting out from the hill ranges of central India and consists of barren, rocky and rolling country with a laterite soil rising into rocky hillocks on the right bank of the Ajay river, the highest being 227 mts. From the shingles (pebbles) and rock outcrops and a few domes it appears that the landscape has reached near maturity. This tract is a part of the Gondwana basin but it lost its true character owing to sedimentation.
The area is characterised by a very gently sloping undulating topography with the average height of the ground level varying between 73 mts and 120 met. Ups and downs with very gentle slopes generally towards south are the most characteristic features. The high grounds of laterite are dissected by numerous shallow gullies discharging the surface run off to different tributaries of the Damodar and Ajay. But the topography has been modified to some extent due to mining activities since last two hundred years, the chains of quarries (opencast mining) forming depressions and the mine dumps forming high grounds. Moreover there are some major and minor depressions of land caused by the subsidences. In the vicinity of working and abandoned colliery areas, quarry depressions, mine head gears, mining colonies, coal depot, railway siding line etc. modify to a great extent the otherwise picturesque landscape of the area. A study of the profile sections of different colliery gives an idea about the changed condition of the terrain. (Fig.5)

The Raniganj Coalfield is a part of peninsular drainage system and constitutes the interfluve between the rivers Ajay and the Damodar both flowing west to east along the northern and southern boundary of Barddhaman district respectively. (Fig.6) The water-divide between these two rivers is marked by a broad west-north-west to east-south-east trending ridge passing through the northern part of the coal belt. The river Damodar enters the coalfield at the south-west corner, where the Barakar river flowing from north
to south, joins it. From this place, the Damodar follows a west-north-west to east-south-east path. The river Ajay, also having a general west-north-west to east-south-east, enters the coalfield at the north-west corner and flows towards east. A large number of major and minor tributaries join these two major rivers at different points. Pusai, Khudia, Nunia, Singaran, Tamla are some of the significant tributary streams of Damodar which contribute to the drainage system of the coalfield. Most of the intensely mined areas lie within the Damodar river basin while a relatively smaller area of the coalfield, including the trans-Ajay tract to the north, lies within the Ajay river basin. A large number of man-made ponds are present in the area. Some important 'bils' (lakes) are 'Napur Bil' near Napur village located south-east of Raniganj town, 'Rajbandh Bil', located east of Raniganj town and 'Sukho Bandh' in south-west of Ukhra town. All the large and small tanks/ponds are concentrated in the southern part of the coalfield.

Several abandoned quarries have now been transformed into big pools of water. Numerous non-perennial channels descending at almost right angles to the Nunia and Singaran 'nala' show fairly high rate of gully erosion and sheet erosion. Nalas and rivulets in some areas have been partially blocked because of the dumping of over-burden materials of opencast quarries, while in some other places they have been diverted from their original courses to facilitate the exploitation of natural resource. Nunia nala has been
partially blocked by the adjacent old OB dumps near Pahargora village. Two large opencast projects namely Ghanashyapur and Dhandardini in the east are located at the bank of Singaran nala. Perhaps the spoil materials drained out into the nala during the rainy season.²

The longitudinal and cross profiles of the river Damodar, as determined by D.V.C., have shown that the river morphology has been changed due to the collection of huge amount of river sand at various places for the purpose of sand stowing in underground mines. It is found that there was sharp fall in depth and gradient of the river between Chinakuri (near Panchet) and Asansol in the period from 1961-81, the reason of which may be attributed to the construction of the dams (Panchet and Maithon) and heavy force of discharges thereby. There was only a minor change in the part of the river bed between Asansol and Raniganj as the river in this part was free from human activities. Between Raniganj and Waria there was again a sharp degradation of the river bed. This has been caused possibly due to extensive extraction of sand for sandstowing in the underground mines.³

Geomorphic sub-areas

The broad geomorphic units are recognisable in the coalfield area. Two broad geomorphic sub-areas are (1) pediplain and (2) alluvial valley fills. (1) The first division covers almost whole of the area under study covering the Gondwana country except the river and stream courses and narrow strip of land on the northern bank of Damodar river.
Within this pediplain there are two sub-divisions a) the laterite uplands and b) the soil covered areas.

a) The laterite cappings rest above the soil cover or directly above the Gondwana bed rocks. There is a complete gradation of loose unconsolidated lateritic soil of reddish brown colour (litosols or 'morrum') and very hard compact 'hardpan crust' laterite below. The loose lateritic soil cover has a thickness upto 0.50 mt. The laterite capping occurs mainly in central and eastern parts of the area.
b) A thin veneer (upto 3 mts) of soil, resting over the Gondwana rocks, occurs towards the south and north-western parts. The soil is brownish grey in colour, mature in nature and is composed of fine sand, silt and rock particles.4

(2) Alluvial valley fills : This is the youngest geomorphic unit. This occurs along the courses of major rivers or rivulets. The alluvium deposit of the river Damodar extends upto about 1 to 1.5 kms. inside the northern bank line and in the river banks of Singaran, Nunia and Tamla nala. The alluvium is composed of layers of all gradations of sand, silt and clay. The alluvium valley fills are mostly affected in the down-stream area of Singaran, Nunia and Tamla nalis due to opencast mining. Younger flood plains are also being affected and modified by the sediments carried by these small rivulets from active mine dumps.
Climate

Being in the region of the Tropic of Cancer, the climate in this part is hot and tropical. The hot westerly winds from central India penetrate at times. Exceptionally high day temperatures is a characteristic feature of hot western months. During the summer months temperature goes upto 44°C and during the winter months it goes down upto a minimum of 8.5°C. Humidity is relatively low throughout the year. The coldest month is December whilst the warmest are April and May of the year. After May, there is a steady fall until the monsoon is established when the average day temperature remains steady. The difference in day and night temperatures during December is 10°C to 14°C.

The rainfall during the monsoon months (June to October) constitutes about 75 per cent of the annual rainfall which amounts 1200 mm. The coal field suffers from inadequate and irregular rainfall. There is an acute shortage of drinking water as well as ground water for the inhabitants. The area is, at times subjected to cyclonic storms locally called 'Kal Baishakhi' (Norwester) during April and May.

The cold season starts from about the middle of November and continues till the end of February; March to May is dry summer intervened by tropical cyclones and storms, which, although infrequent, are notable feature of weather and climate of the area. June to September is wet summer while October and November represent the autumn is
again visited by post monsoon cyclonic storms. The wind
direction during the summer months is generally north-north-
west and during the winter months east-south-east.

The environmental hazards associated with collieries
include atmospheric pollution like dust, smoke etc. A thick
layer of dust and smoke, generated from the operation of
different heavy equipments and movement of vehicles and due
to burning of coal in coke 'bhattas' (ovens) almost always
persist in the atmosphere of the coalfield. This results in
a very gloomy atmosphere and extremely poor visibility during
night specially in the winter. Health hazards of the
colliery workers and the people living nearby arising out
due to dust and smoke are very acute.

Soil

Although the coalfield is a part of Barddhaman
district of West Bengal, its physical characteristics are
quite different from those of the rest of the district.
They are more akin to those of the hill ranges of central
India and the Santal Parganas of Bihar. The soil of this
part are formed from the debris of the hills of Manbhum,
Singbhum and the Santal Parganas. In may places the soil is
formed directly from the subjacent rocks more or less
altered by the action of rain water, and other disintegrating
agencies. The soil is partly a laterite clay more or less
altered, and partly a red coloured coarse sand.
The surface cover in general is clay, in some parts alluvial, while in others the soil is formed through decomposition of rocks. At places, the land is extremely rocky, unfit for cultivation. The most practical classification of soils is (1) high land, (2) low land, and (3) 'diara' or alluvium-covered river land. The elevated tracts generally consist of sand or sandy loam whilst the low grounds are more or less of clay.

In the eastern part of the coalfield, alluvium mantle is 4 to 8 mt. in thickness where it is free from any surface mining structures, wash-out of top soil has taken place from the overburden dumps associated with the opencast quarries. There will be an acute shortage of top soil at the time of land reclamation of opencast mines in future or for reclaiming areas damaged by subsidences and fire. It has been estimated that no dump of filling material is available within subsided zone. Top soil may be available in the land adjoining subsided areas, which are mostly cultivable. But if these soils are scrapped out for reclamation, it will make the land infertile, only 48% of the total requirement of OB materials available for reclaiming quarry depressions. Moreover, as the top soil in the OB has not been kept systematically, its after-use is very difficult.

Ground Water Condition

The depth of ground water in the coalfield is upto
about 20 mts below the ground surface (Fig.7). The ground water table more or less follows the topographical slope. The laterite cappings normally serve as catchment areas to the adjacent low-lying alluvium plains. Comparison of measured data for ground water level of 1967-68 and 1982-83 shows the fluctuation of the level. In many areas ground water level receded over 10 mts. within this period due to excessive pumping of water from the underground mines in the surrounding localities. However, in some localities there are few abandoned mine pits which contain huge quantity of ground water and the water level is nearer to the surface. The recession of water level and poor rainfall may further deteriorate the agricultural productivity of the area. But the demand for water from the users like miners, agriculture, industry and urban areas has increased considerably.

In this field ECL pumps out about 115 million gallons per day during summer even when about 12 MGD of water is available as surplus. It could be used for irrigating the comparatively low-yield agricultural land of the region to produce more than one crop in normal lands and grow vegetables in reclaimed areas. The same water, if necessary, with rudimentary treatment could be stored in existing tanks ponds. Some parts of the discharged water from the mines is used within the colliery for industrial purposes or for domestic consumption. The balance is usually discharged into adjacent malas or rivers which ultimately discharge to the main drainage channels of Ajay and Damodar. Water samples
collected from various mines show mostly normal pH value varying between 6.4 and 7.9 and other chemical contents are also observed to be well within ISI tolerance limit. However, affluents from coal handling plant, workshop etc. are usually carrying suspended coal dust particles and other suspended particles, grease etc. Such pollution is not very pronounced in this coalfield at present.7

Natural Vegetation

The coalfield areas of Raniganj-Jharia were called 'Jungle Mahals' in past. The uplands of Raniganj coalfield area are in places covered with Sal trees (Shorea robusta Gaertin), Mahua (Madhnea Latifolia), Palas' (Butea monosperma), Bamboo (Bambusa arundinacea), Shereesha (Albizzia Lebbek), Airca (Calotropis gigantea), Kend (Diospyros melanoxyn), Arjun (Terminalin Arjuna) and Ashan (T. fonantosa).

The very name of Asansol is derived from 'Asan' and 'Sal' trees which were extensively distributed in the area in the long past. Urbanisation has depleted the large forest areas, mainly of Sal which once covered almost whole of the coalfield. Today forests of Sal trees exist in the north-eastern parts of the coalfield near the Ajay, and areas north-west of Durgapur town. Moreover, due to rapid growth of mines especially opencast mines over the last few years, large scale deforestation has taken place. The areas of forests and pastural lands decreased remarkably especially in Andal block.
In the abandoned coal mines, ditches and rocky plains, mainly two groups of plant communities dominate. Firstly, the communities of Lantana (Putush) and secondly, Papaver (Regni). The Lantana attains some height during monsoon and have attractive pink white and reddish flowers. It forms a thick shrub forest. Papaver thrives on alkaline soil but never in association with Lantana. The common plants in hedges and wastelands are Latbaredra, Banokra, Heliotropium, Hati-soond and Ulu.

The forest lands of the area are chiefly situated in the lateritic and red soil high lands of the Damodar-Ajay interfluve. Since the second half of the previous century the vegetation of this area has been undergoing a tremendous change due to burning, grazing, denudation, ruthless exploitation of forests, human invasion and industrialisation.

After taking over of the forests by the forest department a large number of species were tried in the plantations. But later emphasis has been put to teak, sal, peasal and lately on quick growing species like eucalyptus (for paper and pulp). Among the species that were tried but not much favoured now are arjun minjri, neem, kajubadam, sirrish etc.

At present, about 6 to 8 lakh trees are being planted annually by Eastern Coalfields' Limited in this coalfield. With implementation of new mining projects such afforestation...
work is expected to increase in future years.

Fauna

A few deer, bear, peacock and patridges are found in the forested zone. Only hare and patridges are growing well in the newly afforested areas. Tigers were formerly common in the district, especially in the jungles of the coalfield adjoining the Santal Parganas, but now have entirely disappeared. Destruction of habitat was the prime cause for the disappearance of wild life in the area.

Fishes

Of the rivers and rivulets which pass by or through the area, the Damodar, the Ajay constitute the fisheries of some importance.

The flow of water in the Damodar depends upon the discharge of water by the DVC from its barrages. The other rivers practically dry up in summer when fishes accumulate in depressions here and there to be caught indiscriminately by the fisherman.

Land-use

The present land-use pattern can be easily linked up with the extensive mining activities of this coalfield. However, the traditional agricultural practices are in vogue in the fertile lands of the coalfield. Patches of remnant forests are also seen mainly in the north along the river.
bed of Ajay and along the river bed of Damodar in the south.
The land-use patterns as noted in the area are classified as
follows:

(1) Villages and towns, (2) collieries, colliery
colonies, factories, factory colonies etc. (3) cultivated
lands, (4) forest lands, (5) orchards, (6) fallow lands
including land under spoil dumps, quarry depressions, factory
slag dumps and areas of subsidence and fire.

The lateric uplands occurring mostly in the eastern
and central parts of the coalfield, constitute mainly the
fallow lands. Some forests areas have also grown on these
lateritic uplands or others occupy high soil-capped lands.
The low lying soil covered pediplain areas mainly support
rice cultivation. The quarries and collieries are located
mostly along the strike length of the coal seams being aligned
in a general north-east to south-west direction. The colliery
colonies have generally grown on the lateritic uplands and
other fallow lands. In addition to the village ponds and
'bils', many waterlogged abandoned quarries supply water for
domestic purposes.
References


3. Officers of DVC; Plates of Damodar River Profiles.


2.2 PEOPLE

The coal mines of Bengal located in formerly 'jungle' areas inhabited by tribal, semi-tribal and low caste Hindus engaged in a somewhat crude form of agriculture and also partly dependent on gathering of forest produce. Moreover, the labourers of coal mines were not willing to work throughout the week in the later part of the previous century. There was acute shortage of labour during cultivating seasons especially when the paddy is transplanted in July or August and again for a shorter time in December, the time of cutting the paddy. The Bengal Coal Company gave each worker one bigha of arable and five cottahs of garden lands and other companies had done likewise. Therefore, it is clear that cultivation was the mainstay of the people of this area and at first they took mining as a secondary occupation. Thus the coalfield enclave included quite a few villages whose straw thatched huts and green rice terraces provided a striking contrast to the grimy mines next door.

Now-a-days the whole of the cultivable lands are not actually cultivated, the limiting factors being lack of irrigation, depletion of sub-soil water due to mining and poor quality of soil. Jamuria, Barabani, Salanpur are agriculturally important police stations. The main crops are paddy (aman), sugarcane and potato. Some wheat is also grown, cash crops cover about 10% of the cultivated area though productivity is generally low. There is scope of extension
of agriculture in Asansol Police Station area if proper irrigation facilities can be extended to this place. There have been sporadic attempts in the past to utilise coal pit water for agriculture. Such attempts did not, however, make much headway because of lack of adequate pumping facilities and the objections raised by the mining authorities on grounds of possible subsidence of coal bearing lands.

The erstwhile land-use patterns have continuously been changing due to mining activities since the beginning of mining activity about two hundred years ago. But due to recent intensification in exploitation of fossil fuel resources and emphasis on opencast mining, the rate of change has accelerated to a considerable extent. Among all the police stations/blocks, Jamuria 1 block shows a remarkable loss of total cultivable lands, same is the case with the Asansol block. Forest land in Andal block has considerably decreased along with pasture land within a time span of six-seven years.
References


2.3 GEOLOGY AND COAL RESOURCES OF RANIGANJ COALFIELD AREA

Coal

Of all utilisable sources of energy, such as solar heat, atomic energy, hydel power, natural gas, petroleum and coal, coal easily outranks the rest. The scientific definition of coal is given by E.A.N. Arber, who defines,

"Coal as a solid stratified rock, composed mainly of hydrocarbons and capable of being used as a fuel to supply heat or light or both."\(^1\)

The vegetable origin of coal is now well accepted. It had been formed by the decay of woody matter, owing to the long burial of large ancient forests under a thick cover of sediments. The transformation of plant debris to coal occurs mainly in two stages -

1. Bio-chemical stage or peat forming stage - humification process,
2. Geo-chemical stage of transformation of peat into higher rank coals. This is called coalification process.\(^2\)

Two opposed views have been put forward, one called the 'in-situ' theory means origin of coal seams where the vegetation grows and coal seams are found at the same place, and the 'drift theory' states that the vegetal debris have been transported by water from their original site of growth.
to present site of coal seams.

Coal seams got famed in almost every geological epoch, from Devonian to Pleistocene, but the major periods of coal formation was the Carboniferous period. In some parts of the world some good quality coal, however, was formed both in Mesozoic (Jurassic and Cretaceous periods) and the Tertiary eras (Eocene coal).

Coal is a mixture of various hydrocarbons. During the decomposition of wood, the hydrogen goes in the form of methane and water and the oxygen in form of water and carbon-dioxide. If coal is analysed, it yields the following; (i) carbon; (ii) oxygen; (iii) hydrogen; (iv) traces of sulphur; (v) phosphorous and (vi) nitrogen.

There are various classification by different authors of the ranks of coal. In common usage, the following varieties of coal are recognised: (1) peat; (2) lignite; (3) sub-bituminous coal; (4) bituminous coal; (5) anthracite.

The progressive change from pit to anthracite involves chemical, physical and optical changes. After the 'peat' stage bacteria presumably play little part and most of the changes are chemical, induced by pressure and slight increase in temperature. The result of these changes is the creation of successively higher ranks of coal. The change in rank is largely a result of pressure and time.
Anthracite is the highest rank coal where peat or brown coal is the lowest. Percentage of oxygen fast decreases with the rise of carbon content according to the age of formation. In other words, lower the inherent moisture higher is the degree of maturity.\(^4\)

Coal can be broadly be classified into two categories - a) coking and b) non-coking. Again depending on the quality of coke produced from them, coking coals are subdivided into -

a) coking coal which can produce coke for metallurgical uses without beneficiation;

b) medium coking coal which produce metallurgical coke with or without beneficiation;

c) semi-coking coal not capable of yielding metallurgical coke on their own except it blends with suitably matching coals;

d) weakly coking coal can only be used for metallurgical uses after blending.

The coal seams are sedimentary strata. They are usually associated with sandstones, shales, siltstones and rarely with clay and limestones. The coal seams normally extend over large areas and exhibit an uniformity of composition and conditions of deposition. Some of the coal seams are enormous in thickness and at times are faulted and intensely folded.
There are often bands and partings of clays, shales and sandstones, which are responsible for splitting the seams into several thin sections, which are noticed in most of the thick coal seam horizons of Damodar Valley Coalfields of India.

India has approximately one per cent of the total reserve of coal of the world. According to Coal India Limited the reserves of coal of different countries of the world are as follows:

<table>
<thead>
<tr>
<th>Country</th>
<th>Total reserve in million</th>
<th>Percentage of world reserve</th>
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</thead>
<tbody>
<tr>
<td>U.S.S.R.</td>
<td>4,860</td>
<td>46</td>
</tr>
<tr>
<td>U.S.A.</td>
<td>2,570</td>
<td>24</td>
</tr>
<tr>
<td>China</td>
<td>1,438</td>
<td>14</td>
</tr>
<tr>
<td>U.K.</td>
<td>163</td>
<td>1.6</td>
</tr>
<tr>
<td>Poland</td>
<td>125</td>
<td>1.2</td>
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<tr>
<td>F.R.G.</td>
<td>280</td>
<td>2.7</td>
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<tr>
<td>Australia</td>
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<td>3.1</td>
</tr>
<tr>
<td>Canada</td>
<td>207</td>
<td>2.6</td>
</tr>
<tr>
<td>South Africa</td>
<td>200</td>
<td>1.9</td>
</tr>
<tr>
<td>India</td>
<td>112</td>
<td>1.0</td>
</tr>
<tr>
<td><strong>World</strong></td>
<td><strong>10,538</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>

**Geological Formation of Coal Deposits in India**

Lower Gondwana Coalfields  Upper Permian Raniganj, Jharia, Bokaro and Karanpura Coalfields of Bihar and West Bengal.
<table>
<thead>
<tr>
<th>Era</th>
<th>Coalfield Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower Permian</td>
<td>All the Gondwana Coalfields of peninsular region and of eastern Himalayas and northeast provinces.</td>
</tr>
<tr>
<td>Upper Upper Jurassic</td>
<td>Coalfields of Maharashtra, Madhya Pradesh, Satpura regions and in Kutch.</td>
</tr>
<tr>
<td>Gondwana Coalfields</td>
<td></td>
</tr>
<tr>
<td>Tertiary Lower Eocene</td>
<td>Cherapunji, Mowlong and Khasi hills, Garo and Mikir hills of Meghalaya Coalfields of Western Assam and Jammu Coalfields.</td>
</tr>
<tr>
<td>Tertiary Coalfields</td>
<td>Lignites of Palana, Rajasthan, and Kutch.</td>
</tr>
<tr>
<td>Tertiary Middle Eocene</td>
<td>Lignites of Meghalaya, Jaipur, Nazira, Namchek and Makum Coalfields of Upper Assam.</td>
</tr>
<tr>
<td>Oligocene and Upper Eocene</td>
<td>Lignites of Kashmir Valley.</td>
</tr>
<tr>
<td>Miocene</td>
<td>Lignite of Arkot district, Tamil Nadu (Neyveli), Varkala, Quilon and Kerala province.</td>
</tr>
<tr>
<td>Early Pleistocene to Upper Pliocene</td>
<td></td>
</tr>
</tbody>
</table>

Though total reserves of coal and lignite in India are estimated at comfortably around 131,000 million tons, proved reserves are only 30,000 MJ, and the present method of extraction have so far been able to recover about 50 per cent on the average. Therefore, the need to conserve coal resources is not only desirable but necessary. The reserve
of coking coal constitutes only 4 per cent of the total available coal reserves. So far as the reserves of non-coking coal are concerned they are adequate to meet our requirement for many more decades to come.

The important coalfields of the Damodar Valley form a chain of Condwana basins running east and west and separated from each other by very short distances. (Fig.8) The valley lies south of the tract in Birbhum and northern Hazaribagh, the two regions approaching each other to the eastward but being separated to the west by Hazaribagh plateau, on which no Gondwana rocks are found with the exception of one small outlier thereof. The small basins near Hazaribagh, Daltonganj are classed with the present group, they form links with the more extensive areas of the Son valley.

Most of the coals in the Gondwanas are found in the Damuda Group in Barakar and Raniganj formations and to a lesser extent in Karharbaris, the lowermost coal measures. Usually Barakar coals have low moisture content varying between 1% to 3%. Volatile matters are also low which vary between 20% to 30% and the fixed carbon is rather high which ranges between 56% and 65%. In addition, they possess excellent coking properties and are good steam raising coals. On the other hand, the coals from Raniganj formation are high in moisture, as well as volatile matters. The proportion of fixed carbon is quite moderate and varies between...
50 and 60%. The coal is non-coking in character although there are some semi-coking varieties. They are good gas coals and are also considered as long flame steam coal. None of Gondwana coals are anthracitic in character.

The Raniganj Coalfield

The Raniganj Coalfield, the easternmost field of the Damodar Valley and admittedly the most potential repository of quality coals in the country, has an aerial extent of 1530 sq.km. Except for a portion towards the west which is lying in Bihar, the major part of the field is in West Bengal. The coalfields of West Bengal contribute 25% of the country's coal production and contain over 24% of its coal resources, almost the entire bulk of which is confined to a single field, viz. Raniganj.  

The proved limits of the field are included within the latitudes 23°33' and 23°52' North and longitudes 86°48' and 87°20' East. Geologists of the Geological Survey of India recently identified an eastward extension of Raniganj coalfields upto Domra-Paṇaḍgarh area in Barāddhaman district, by a reconnoitory geophysical survey. The major parts of the coalfield lies to the east of the Barakar river within the district of Barāddhaman with the slight extension into Bankura, Birbhum, Puruliya districts of West Bengal and into the Santal Parganas and Dhanbad districts of Bihar. The major part of the field covering about 1,100 sq.km., lies between the Damodar and Ajay rivers and to the east of the...
Barakar river.

Raniganj basin is structurally 'half graben' basin with the southern boundaries prominently faulted and northern boundaries with an uncomfortable contact of the Gondwana sedimentaries with the Pre-Cambrian metamorphic rocks (basement rocks). Maximum sediment thickness is about 2.8 km. The most important structural elements of this basin are: (1) the southern boundary faults; (2) the network of intra-basinal normal faults; (3) a number of sub-basins and troughs of deposition separated by saddle type upwarps. The first systematic survey of the field was done by D.H. William in 1845-46 and in 1850, followed by W.T. Blanford, W.L. Wilson, H. Walker and R.R. Simpson during 1908-13 and by C.S. Fox, S. Sethu Rama Rao, E.R. Gee and A.K. Banerjee during 1925-28.

The beds exposed within the coalfield include (Fig.9):

<table>
<thead>
<tr>
<th></th>
<th>Maximum thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.</td>
<td>Supra Panchet</td>
</tr>
<tr>
<td>3.</td>
<td>Panchet</td>
</tr>
<tr>
<td>2.</td>
<td>Damuda Series</td>
</tr>
<tr>
<td></td>
<td>c. Raniganj</td>
</tr>
<tr>
<td></td>
<td>b. Ironstone shale</td>
</tr>
<tr>
<td></td>
<td>a. Barakar</td>
</tr>
<tr>
<td>1.</td>
<td>Talchir</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The Raniganj formation is distinguished by the excellent development of Raniganj formation of rocks from where it was derived its name. This field has two distinct coal horizons - Barakar Measure (640 mt. thick) and Raniganj Measure (1034 mt. thick). These two are separated by a Barren Measure (610 mt. thick) of Iron-stone Shale devoid of any coal.

The Barakar measure starts from Bihar side and gradually vanishes from west to east crossing the river bed of Barakar. Then Raniganj measure starts after a barren gap. The Barakar measure has seven coal seams of four feet thickness and above. These are mostly inferior quality coal with low moisture excepting a few like Chanch-Begunia mining coking coals. Moreover, (1) Pesei, (2) Damagaria-Salanpur A, (3) Bindabanpur-Salanpur B, (4) Gopinathpur-Salanpur C, Kasta, (5) Laikdih-Salanpur 5 - Ramnagar 5, Ramnagar, (6) Shampur, (7) Chanch-Begunia-Shampur - one also exhibit a fair degree of coking properties. The Barakar formations are reasonably well developed towards the western fringe of this coalfield.

The Raniganj sequence of rocks comprises essentially sandstones, shales and coal seams. The sandstones are fine grained. Coalfield contains valuable coal seams and the coals normally possess higher volatile and moisture contents than the Barakars. The coal seams have been named after local places in which they were first encountered or well.
developed, such as Dishergarh seam, Poniati seam, Sanctoria seam, etc. These seams are excellent high grade coals with long flame and enough steam raising capacity.

The Raniganj beds are faulted against the Archaeans on the three sides of the field and towards east it is covered by thick alluvial deposits. Besides, the boundary fault, there are a number of oblique and cross faults in the Raniganj coal field. The coal seams are very much affected by dolerite and mica peridotite dykes which may be of Rajmahal and Deccan Trap age. The coalseams of Raniganj formation have been named from bottom to top as follows: (1) Taltor; (2) Sanctoria-Poniati; (3) Hantol-Koithi, (4) Dishergarh-Samia; (5) Bara Dhamo-Raghunathbati-Monoharbahal-Rana-Poriarpur-Satgram-Jote-Janaki-Dobrana-Sonpur; (6) Sripur-Toposi-Kenda-Chora-Purushottampur; (7) Lower Dhadka-Narainkuri-Bansra-Sonachora-Bonbahal; (8) Borachak-Nega-Jemari-Raniganj-Lower Kajora-Jambad-Bowlah-Bankola; (9) Gopalpalpur-Upper Dhadka-Satpukhuria-Ghusick-Searsol-Upper Kajora; (10) Hirakhum-Narsamuda.

Raniganj coals are best suited for metallurgical coke, industrial fuel, industrial and domestic coke and thermal power generation. Being the best non-coking coal, this area was explored first and specially the reserves of selected grade coal is decreasing rapidly. Dishergarh, Poniati, Koithee seams are the best coals of the field. Low ash coals having reasonable coking property have been
earmarked as 'blendable coal' for the plants to blend with prime coking coals to manufacture hard coke. Dishergarh is the principal blendable coal. The inferior quality of coal which is unfit for metallurgical purpose, are converted to semi-coke for domestic use. By wasteful method of burning, volatile matter is lost. Raniganj coal is largely used by copper mines. Due to high volatile matter and easy ignition Raniganj coal is used successfully in rotary klins of many cement works.  

The general stratigraphic sequence of the coalfield is given below:

<table>
<thead>
<tr>
<th>Age</th>
<th>Stratigraphic Division</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recent and</td>
<td>Recent, and Quaternary</td>
<td>Laterites Alluvium Soil etc.</td>
</tr>
<tr>
<td>Sub-recent</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unconformity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Upper</td>
<td>Durgapur beds?</td>
<td>Coarse grained red, yellow</td>
</tr>
<tr>
<td></td>
<td>Dubrajpur beds?</td>
<td>and grey sand stones and</td>
</tr>
<tr>
<td></td>
<td></td>
<td>conglomerates.</td>
</tr>
<tr>
<td>Gondwanas</td>
<td>Igneous intrusives</td>
<td>Dykes and sills of dolerites</td>
</tr>
<tr>
<td></td>
<td></td>
<td>and mica peridotite.</td>
</tr>
<tr>
<td>Unconformity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lower</td>
<td>Panchets</td>
<td>Coarse grained yellow and</td>
</tr>
<tr>
<td></td>
<td></td>
<td>grey micaceous sand stones,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>red clays greenish shales.</td>
</tr>
<tr>
<td>Gondwanas</td>
<td>Damudas Raniganj measures</td>
<td>Fine to medium grained sand stones and shales with a number of coal seams.</td>
</tr>
</tbody>
</table>
Ironstone shales
Black carbonaceous micaceous shales with clay and ironstone shales.

Barakar formation
Medium to coarse grained sandstones and shales with a number of coal seams.

Talchirs
Shales, mudstones, soft sandstones with boulder bed at the base.

Unconformity

Archaean
Granites and Gneisses.

Beyond limits of the Gondwanas of the Raniganj Coalfield, small inliers within the Talchir areas of the northwestern part of the field, metamorphic rocks, belonging to the Archaean system, are well exposed. The Talchir is exposed along the northern edge of the western half of the Raniganj coalfield. This series is overlain by a thick coal-bearing Damuda Series which occupy about 550 sq.km.

Barakar measures occur in an irregular belt roughly parallel to the northern boundary of the coalfield and cover nearly 155 sq.km. The coal seam to strata ratio in this stage of Barddhaman district is about 1:6 to 1:10. It is the chief coal-bearing horizon in the Indian sub-continent.

Overlying the Barakar is the Ironstone Shale (Barren Measure) exposed over an area of about 113 sq.km.
country between the Barakar and the Ajay rivers. This stage is so called because of the complete absence of any workable coal seams.

Raniganj measures crop out along the southern half of the coalfield and vary in width from 8 to 16 km, the maximum width being in the eastern part near Raniganj. Coal from the seams of Raniganj formation are largely of high moisture, high volatile, non-coking type, bulk of the non-coking coals of this formation fall into the superior grades (B and C). There are also large reserves of coal of inferior grades (D to F).

Panchets succeeds the Raniganj stage with a slight but distinct unconformity. At places it rests directly upon the Barakar completely overlapping the rocks of the Raniganj stage. Small exposures of Supra-Panchet series of Upper Gondwanas occur within the Raniganj coalfield.

Gondwana rocks of the Raniganj coalfield are intruded by a large number of igneous intrusions comprising the dolomite or basaltic dykes and ultrabasic mica peridotite and lamprophyre dykes and sills. Of the dolerite dyke, the names of some prominent ones, viz. the Salma dyke (width 46 mts.), the Nursunuda dyke, the Sitarampur dyke may be mentioned.

Over a greater part of the field, the dip of the beds is in southerly direction, due to which the oldest rocks;
the Talchirs are exposed along the northern boundary. These
are followed successively southwards by the next group of
younger rocks. The strata dip towards south and south-west
at angles ranging from 2° to 35°.

The Raniganj coalfield has been divided into fifteen
sectors. Reserves of coal in million tonnes in this coal-
field are as follows:

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Non-coking</td>
<td></td>
</tr>
<tr>
<td>0 - 300</td>
<td>12,092.19</td>
</tr>
<tr>
<td>300 - 600</td>
<td>6,821.40</td>
</tr>
<tr>
<td>b) Medium coking</td>
<td></td>
</tr>
<tr>
<td>0 - 300</td>
<td>150.81</td>
</tr>
<tr>
<td>300 - 600</td>
<td>105.50</td>
</tr>
<tr>
<td>c) Blendable</td>
<td></td>
</tr>
<tr>
<td>0 - 300</td>
<td>475.15</td>
</tr>
<tr>
<td>300 - 600</td>
<td>590.16</td>
</tr>
<tr>
<td>Grand Total :</td>
<td>20,235.21</td>
</tr>
</tbody>
</table>

Raniganj Coalfield is important due to a number of
factors. They are:

i) This coalfield has 70 per cent of non-coking Superior
grade coal of the country.

ii) It has coals of high calorific value, long flame, quick
ignition and high volatile contents.

iii) It accounts for country's almost 100 per cent export.

iv) This coalfield meets 95 per cent need of semi-coking
coal.
v) It meets the major demand for soft coke.

vi) It contains coal suitable for low temperature carbonisation, sponge iron making and other coal-base fuel industries.

Sectorwise demand on Raniganj coalfield are as follows:

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Sectors</th>
<th>Projected in M.T. 89-90</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Power</td>
<td>15.46</td>
<td>35.06</td>
</tr>
<tr>
<td>2</td>
<td>Steel and Hard Coke</td>
<td>2.30</td>
<td>5.20</td>
</tr>
<tr>
<td>3</td>
<td>Railways</td>
<td>3.75</td>
<td>8.41</td>
</tr>
<tr>
<td>4</td>
<td>Cement</td>
<td>1.35</td>
<td>3.42</td>
</tr>
<tr>
<td>5</td>
<td>Fertilizer</td>
<td>0.73</td>
<td>1.56</td>
</tr>
<tr>
<td>6</td>
<td>Export</td>
<td>0.60</td>
<td>1.35</td>
</tr>
<tr>
<td>7</td>
<td>LTC and Soft Coke</td>
<td>3.90</td>
<td>8.75</td>
</tr>
<tr>
<td>8</td>
<td>Others</td>
<td>16.00</td>
<td>36.25</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>44.09</td>
<td>100.00</td>
</tr>
</tbody>
</table>

Coking and blendable coal of this coalfield are used in coke ovens and steel works while non-cooking coal are used in railways, thermal power stations to cement fertilisers, refractories and for exports. Coal is being exported to Burma, Sri Lanka, Nepal and Bhutan.

The leasehold areas under different coal companies presently cover only about 680 sq.km. (about 45%) out of
total coal bearing area of 1530 sq.km., such as

a) by Eastern Coalfields' Limited 41.83%
b) by Bharat Coking Coal Limited 2.03%
c) Indian Iron and Steel Company 0.16% \(^{15}\)

Previously, in this coalfield all the mines were under the ownership of private entrepreneurs. In 1971, during nationalisation of coking coal mines, six mines of this coalfield were taken over and are under the management of Bharat Coking Coal Limited. In 1973, 373 non-coking coal mines (215 working and 158 closed) were taken over and are presently under management of Eastern Coalfields' Limited. Initially after take-over these were regrouped and after the latest reorganisation, there are 116 working mines under 14 areas. Under IISCO, there is only one working mine which acts as a captive mine for its steel plant at Burnpur. \(^{16}\)

The total production from this coalfield was around 20 million tonnes per annum at the time of nationalisation in 1973 and at present ECL produces about 39 million tonnes per annum.

It is tentatively estimated that about 4750 million tonnes of coal is blocked due to various townships and surface features. Besides these an amount of 765 million tonnes of coal is covered by three major rivers flowing over this coal belt. Thus 22% of the total reserve is covered by various surface features.
Although coal has been a great boon to man, their recovery and use have had some serious side effects. In Raniganj coalfield, these effects are summarized as follows from the viewpoint of safety.

1. Number of active fire 6
2. Number of explosion disaster 8
3. Number of III degree gassy mines 8
4. Unsafe residential localities 32 due to subsidence damage
References


17. ibid, p.5.

18. Master Plan of Raniganj Coalfield in Figures, 1984, Central Mine Planning and Design Institute, Asansol.