

# ON THE KARHARBARI AGE OF COAL-MEASURES OF RAY-BACHRA AREA, NORTH KARANPURA COALFIELD\*

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## ABSTRACT

In the south-eastern portion of the North Karanpura coalfield, Bihar, two coal seams, known as Ray seams in Ray ( $23^{\circ}40': 85^{\circ}4'$ ) and Bachra seams in Bachra ( $23^{\circ}41'19": 85^{\circ}5'17"$ ) areas, occur in Lower Gondwana coal-measures that comprise a maximum thickness of 140 metres. Coal petrography has established that Bachra seams are the eastward extension of Ray seams. While some workers have described them as Barakars, others have regarded them as Karharbaris.

The author examined their geology, field relations of coal seams, borehole logs of Bachra area, and petrography of Ray and Bachra seams in detail, and studied the available palaeobotanical and palynological data. This paper presents conclusive evidences of their being of Karharbari age.

## INTRODUCTION

THE Ray-Bachra area is a strip of the Lower Gondwana coal-bearing formations in the extreme south-eastern part of the North Karanpura coalfield, Bihar. In the area around Ray ( $23^{\circ}40': 85^{\circ}4'$ ) in Ranchi district, two coal seams named as Ray Top and Ray Bottom are being worked at localities Manki, Churi, Ray and Bishujhapa by private enterprises. In the adjoining Bachra area, named after the nearby village ( $23^{\circ}41'19": 85^{\circ}5'17"$ ) in Hazaribagh district, the existence of two coal seams, Upper Bachra and Lower Bachra, has been proved by drilling operations by the Geological Survey of India (PAREEK, 1962); these seams are now being worked by the National Coal Development Corporation Ltd.

The geology and field relations of the coal seams of the two contiguous areas are indicative of the Bachra seams being the eastward extension of Ray seams (PAREEK, 1964a); coal petrography has confirmed this conclusion (PAREEK, 1964b).

While much has been published on geology of the Ray area (BANERJEE, 1958; GHOSH, 1958; MEHTA *et al.*, 1963), practically nothing is known about the Bachra area,

probably because it has been explored only recently. The age of these coal-measures has been described as Barakars by Jowett (1925) and Banerjee (1958), and as Karharbaris by Puri (1952), Ghosh (1958) and Mehta *et al.* (1963). The author studied lithology of these coal-measures and examined bore hole cores and logs of Bachra area in detail, along with the palaeobotanical and palynological evidences to arrive at a conclusion. This paper discusses the evidences for the inferred Karharbari age of the coal-measures. In order to provide the lithological evidences, a geological account of the less-known Bachra area, as revealed by bore hole logs, is also incorporated.

## GEOLOGY OF THE BACHRA AREA

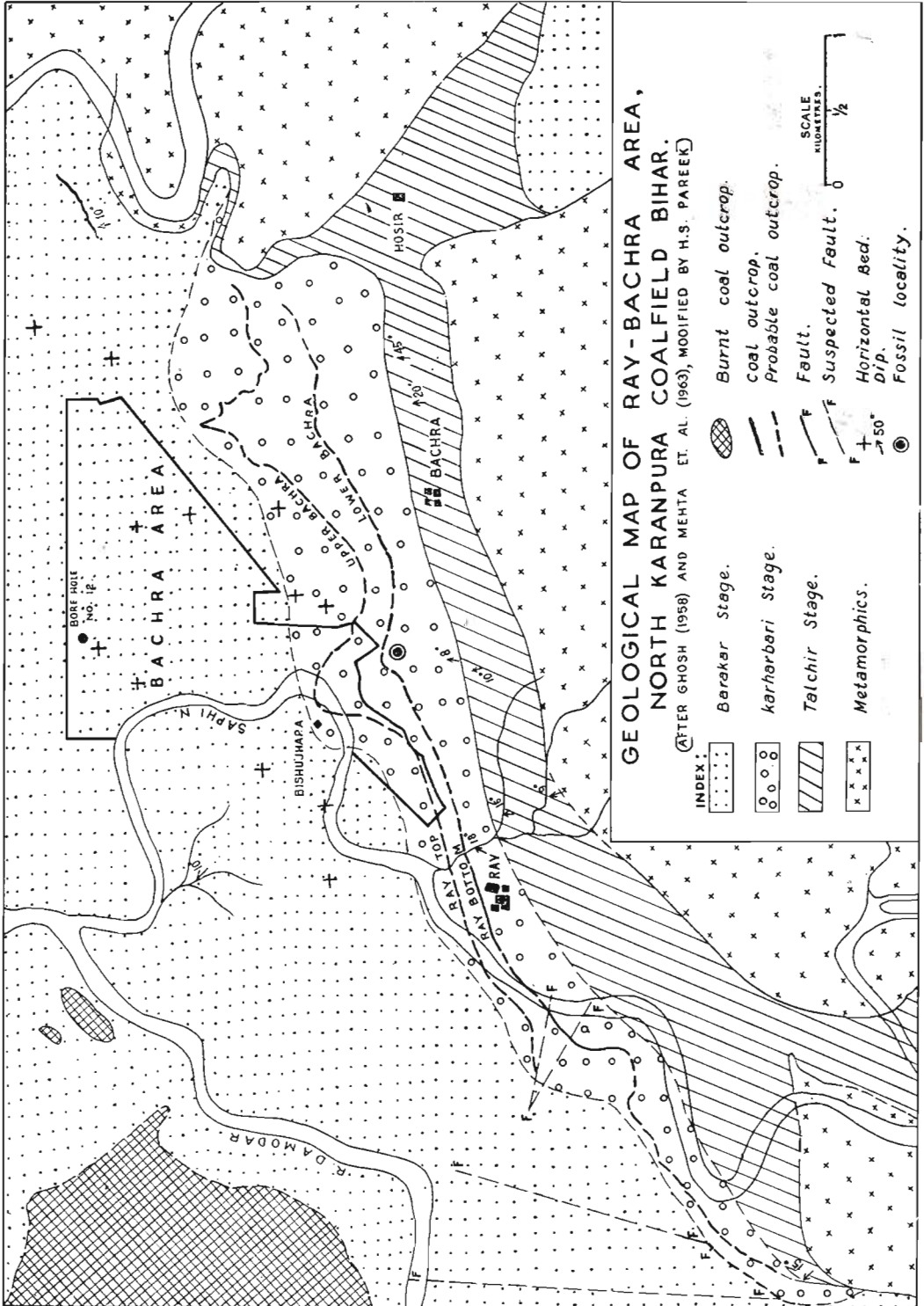
The Bachra area is a triangular block of about 3.62 sq. km. extent bordering the right bank of the Saphi nala (*see* FIG. 1). It is confined between the parallels  $23^{\circ}41'16"$  and  $23^{\circ}42'48"$  N. Latitude and  $83^{\circ}3'45"$  and  $85^{\circ}5'41"$  E. Longitude, falling just north-east of the Ray area. It has an undulating topography with a slope towards the Saphi and has a soil cover in which quartz pebbles have reconsolidated.

The general nature of the underground sedimentary strata appears in Fig. 2 in a bore hole section. The geological sequence of formations, as interpreted from bore hole cores and as established is given in Table 1.

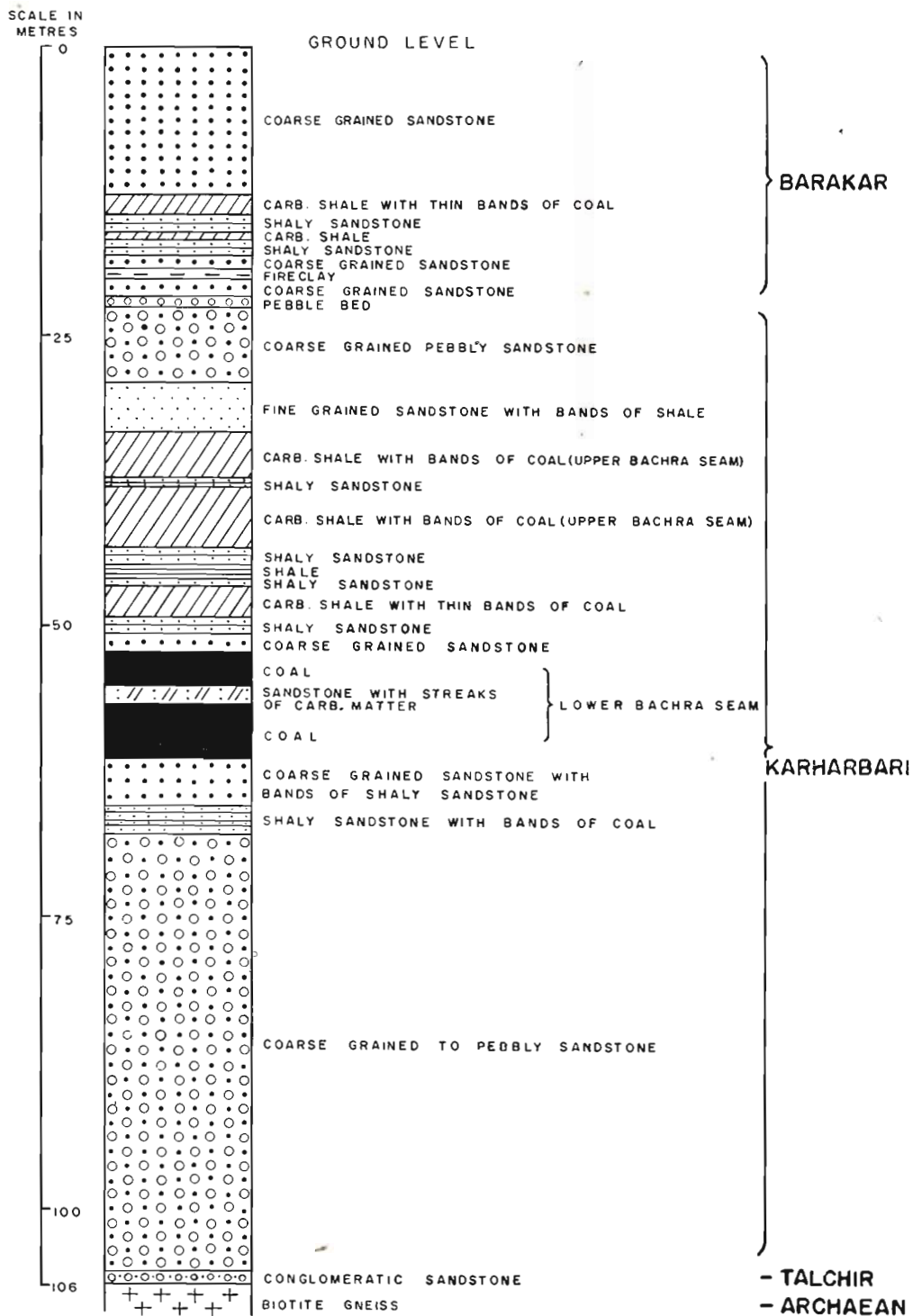
The general strike direction of the sedimentaries is N.E.-S.W. The surface dips indicate horizontal nature of the beds, but core dips and bore hole sections suggest their rolling nature and even a minor folded pattern of the formations. There is no evidence of any major faulting.

The bore hole data indicates that the Talchirs vary in thickness from one metre to 2.55 metres in north-western to eastern portions of the area. But they are absent

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TEXT-FIG. 1 — Geological map of Ray-Bachra area, North Karanpura Coalfield, Bihar.



TEXT-FIG. 2 — Description of strata in bore hole No. 12, Bachra area, North Karanpura Coalfield.

TABLE 1

AGE	DESCRIPTION OF STRATA	THICKNESS (METRES)
Recent	Surface soil with quartz pebbles reconsolidated.	1.5-3.5
Lower Gondwana	Unconformity Barakar stage — fine to medium-grained and occasionally coarse-grained sandstone, thin bands of shale and of coaly shale.	Increases from 2.0 in southern to 29.0 in northern portions.
	Unconformity Karharbari stage — Coarse-grained, gritty and pebbly sandstones with angular and subangular quartz and felspars. The matrix is of yellow or light grey colour containing in places soft, greenish-yellow material. Carbonaceous shale, coal seams, and fireclay.	
	Unconformity Talchir stage — fine-grained, khaki-grey to greenish sandstone and boulder bed, occasionally containing varved bands of clay.	75.0-105.0
Archaeon	Unconformity Metamorphics — Biotite-gneiss.	up to 3.0

in the extreme east near the Damodar River where all rocks outcrop. Towards the south, near Bachra and Ray, outcrops of Talchir shales with bands of varved clay have been recorded by Ghosh (1962).

Most of the area is covered with soil, which prevents examination of outcrops, except along the streams and *nalas*. The bore hole data, however, indicates that the Talchir-Karharbari boundary is generally well-marked by a band of conglomerate of thickness up to 25 cm. The Karharbari and Barakar junction is similarly marked by a pebble bed of thickness varying from a few centimetres to 3.5 metres. Table 2 shows its thickness and location from the base of Upper Bachra and Lower Bachra seams in the different portions and bore holes of the area. It is of greater thickness in the portion adjoining the Saphi and has apparently thinned out towards north-western and south-western portions.

*Coal seams* — The Upper Bachra and Lower Bachra, exhibit tendency to thicken or thin out commonly laterally and also along the dip. The Upper Bachra splits into thin bands in the north-eastern, south-eastern and eastern portions, and disappears in the northern and north-western portions. The Lower Bachra splits laterally into two seams, the upper portion is named as Middle Bachra and the lower as Lower Bachra. It thins out in the north-eastern, south-eastern southern and south-western portions. Eventually it disappears towards the southern and south-eastern portions.

Towards the north-east of Bachra area, all these seams are reported to have disappeared completely. The general seam characteristics appear in Table 3.

*Fireclay* — It invariably overlies the Upper Bachra seam. Its maximum thickness is 11.60 metres that is gradually reduced to 10 metres in the southern portion and has thinned further towards northern, north-eastern and north-western portions with simultaneous development of partings and shaly character of the underlying seam.

## DISCUSSION

The coal-measures of Bachra and Ray areas have similar sequence of rock formations. The criteria discussed here for inferring their Karharbari age are based on their lithological character, presence of distinctive plant fossils and micro-fossils, and petrological nature of the coals.

1. *Lithological evidences* — The sandstones of the coal-bearing formations are persistently coarse-grained, gritty to pebbly containing angular to sub-angular pieces and fragments of quartz and of felspar, usually kaolinised. Their outcrops are marked by the weathered product of the felspars that covers the entire surface. The sandstone matrix is very soft and of yellow or light grey colour containing greenish-yellow material similar to that of the Talchirs. The overlying Barakar sandstones retain their gritty and pebbly character, but quartz and felspar pieces are

TABLE 2 — THICKNESS OF PEBBLE BED IN BACHRA BORE HOLES

PORTION OF AREA	BORE HOLE NO.	THICKNESS OF PEBBLE BED (METRES)	THICKNESS OF THE STRATA BETWEEN	
			PEBBLE BED AND TOP OF UPPER BACHRA (METRES)	PEBBLE BED AND BOTTOM OF LOWER BACHRA (METRES)
Northern	11	0.60	15.55	44.10
	12	0.90	17.20	43.00
	10	1.20	19.20	40.00
	6	0.30	15.90	32.80
Eastern	27	1.20	—	19.03
	31	0.50	—	21.40
Central	13	1.50	22.90	44.65
	14	0.15	18.05	42.80
	2	2.75	20.90	45.90
	3	? at 11.70	20.80	43.40
	32	0.60	23.35	43.95
	17	0.30	18.30	43.30
Southern	8	? at 3.35	—	45.10
	1	3.50	—	16.90
	18	? at 2.15	—	42.70
South-western	20	? within 2.15	—	34.75
	21	0.30	16.15	36.10
(?) Non-coring zone				

TABLE 3 — BACHRA SEAM CHARACTERISTICS

SEAM	VARIATION IN SEAM-THICKNESS	SEAM OVERLAIN BY	SEAM UNDERLAIN BY
Upper Bachra	35 cm. to 3.80 metres	Fireclay	Carbonaceous shale
Middle Bachra	60 cm. to 3.75 metres	Carbonaceous shale	Shaly sandstone
Lower Bachra	90 cm. to 9.15 metres	Fine to coarse-grained sandstone	Fine to coarse-grained sandstone

rather partially well-rounded. This indicates deposition after transportation. Thus conditions of deposition were dissimilar and indicate a Karharbari age for the beds underlying the Barakars. As regards the junction between the two, there is enough evidence to mark that horizon distinctly.

The bore hole data shows the persistent occurrence of a pebble bed marking junction of the Karharbari with the Barakars throughout the area. Table 1 shows its thickness in the different bore holes drilled by the Geological Survey of India, and also its location from the base of the Lower Bachra and top of Upper Bachra seams. The pebble bed is thicker in the central portion, persisting towards the dip side and thinner

towards the outcrop side. It is traceable about 40 metres above the bottom of Lower Bachra and this zone being thinned to 20 metres in the eastern and 35 metres in south-western portions. In the Ray area, "the presence of a conglomeratic bed at the upper limit of the Karharbari formation and of a similar horizon with a carbonaceous band at its base" has been recorded by Ghosh (1958), "so that the Talchir-Karharbari and the Karharbari-Barakar boundaries could be clearly defined". Ghosh pointedly states that "the occurrence of a conglomeratic band denoting the uppermost stratum of the Karharbari has been traced in the Saphi *nala*, north of Ray, which is about 40 feet (12.20 metres) above the Ray

Top seam." This significant characteristic in both the areas proves beyond doubt the inferred age of the beds.

2. *Palaeobotanical evidence* — The identification of plant fossils *Gondwanidium validium* and *Buriadia seawardi* in specimens collected by Puri (1952) from a locality near Bachra (see FIG. 1) is confirmative of the Karharbari age of these coal-measures.

3. *Palynological evidence* — The palynological study of coal samples of seams of Bachra and Ray areas (samples collected and submitted by the author) carried out by Srivastava (1961) has indicated their Karharbari age. *Raistriki* and *Nusko-sporites* are commonly noticeable in these coal seams, as seen in macerated residues, and their presence is confirmative of a Karharbari age.

4. *Petrological nature* — The Bachra and Ray coals are mostly "dull", non-banded, and composed, microscopically, of dominantly inertinite, and commonly of vitrinite and exinite. On a microlithotype basis, the "intermediates" comprising duroclinite and clarodurite are very common, while

durite and fusite are common (PAREEK, 1964, 1965). The coal seams contain a distinct assemblage of megaspores that have been classified into five types and ten sub-types. In these features, they are different and distinct from banded, lustrous, vitrain-rich, semibright to bright coals of Karkata and Bukbuka seams of Barakar age. These inherent differences were developed during the coal formation period, which was obviously different for the Karharbaris and Barakars of the Karanpura basin.

The Ray-Bachra coal-measures are, therefore, concluded to be of Karharbari age.

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