PETRO-PALYNOLOGICAL STUDY OF THE COALS EXPOSED NEAR GOPALPRASAD OF TALCHER COALFIELD (ORISSA), INDIA

G. K. B. NAVALE & SURESH C. SRIVASTAVA
Birbal Sahni Institute of Palaeobotany, Lucknow

ABSTRACT

The samples collected from the exposed beds of coal near Gopalprasad have been studied since no previous knowledge exists about the microstructure and microfossil contents of this coal.

The coals are typically dull, fine-grained and hard in nature. They are constituted by Vitrinite, Exinite, Inertinite organic macerals and sedimentary mineral matter. Among these Inertinite and mineral grains dominate the coal components. Rapid alternating bands of Durite and Carbargillite and increasing high percentage of mineral matter makes the coal more dull and shaly.

Sporological analysis reveals that the coal consists of 20 genera including a number of trilete, monolete, monosaccate and bisaccate spores. The miospore assemblage dominates in striated bisaccate spores with subdominance of non-striated pollen. Trilete miospores are less common, while monosaccates are rare. The common striated bisaccate genera are *Faunipollenites, Striatopodocarpites, Lahirites* and *Striatites* while nonstriated bisaccate genus is *Sulcatisporites*.

Petro-palynologically, compared with the Lower Seam and Upper Seam No. 1 of Talcher Coalfield and others, the coals are of very inferior quality and referable to Upper Barakar Stage in Lower Gondwana sequence.

INTRODUCTION

TALCHER Coalfield lies in the Brahmani River Valley between the longitudes 84°20′ North and latitudes 20°50′ and 20°13′ East. On its North-West boundary it is connected with the neighbouring Ib-river Coalfield by a narrow prolongation of Talcher Series rocks.

Considerable knowledge now exists about the geology of the area (BLANDFORD *et al.* 1859, PAREEK 1965 & NAVALE 1965). The coal horizons of the area are known to consist of 3 thick seams, viz. Lower seam, Upper seam No. I and Upper seam No. II, besides 4 thin and impersistent ones. The seams usually do not outcrop anywhere due to its flat gradient and low degree of inclination. However, one seam is exposed near Gopalprasad village and is usually known as 'Carbonaceous shale bed of Gopalprasad or Gopalprasad seam'. The seam is 23′ thick, very much banded with high ash content and is exposed only for a very short distance along Tengria Nala. Blandford *et al.* (1859) have collected from this bed all fossils found in Talcher basin and have suggested a probable resemblance of some of these forms to those found in Damoodah and Nagpur coalfields. The overlying and underlying sediments in the area are not known at present. A coal seam, presumably similar to Gopalprasad 120°58′ : 85°2′), is reported to occur in the Hingir Coalfield (BALL and SIMPSON, 1922).

The present investigation has been carried out since no knowledge exists about the microstructure and palynological contents of the coal beds exposed near Gopalprasad, Talcher Coalfield, although detailed petrological data of Talcher coals restricted to the working coal horizons are available (PAREEK 1963, 1965). Das (1958, 1959) also has done some preliminary investigations into the Fusain and microfloral contents of Talcher Coalfield in general. Recently Pant and Srivastava (1963) have studied the megaspores from this coalfield and Navale (1966) has also studied in general the petrological and palynological constituents from the working mines (N.C.D.C.) of Talcher Coalfield.

Coal blocks were collected from the top, middle and bottom portions of the exposed bed near Gopalprasad village. An overall representative sample of 18 B.S. mesh size were prepared and 5-10 gms out of the same were macerated for preparation of thin slides in glycerine jelly. Palynological units were carefully identified and photographed. 500 specimens were counted and their percentage frequency were determined with a view to evaluate the miofloral association. Particulate coal pellets of the overall samples were moulded with thermoplastic resin Araldite and requisite Hardener, one surface of which was grinded and polished. Petrological con-

tents were studied in polished surface by reflected light under the microscope. The percentage frequency of the occurrence of macerals were done by point counter.

PETROGRAPHY

The coals of Gopalprasad bed are typically dull Durain type. They are hard, fine grained in texture, nonbanded and nonfibrous in nature. In general appearance they look like carbonaceous shale, hence, the name 'Carbonaceous shale bed of Gopalprasad'.

Under microscopic analysis it shows to consist of the following maceral groups; Vitrinite, Exinite and Inertinite. The quantitative distribution of the macerals are as represented in Text-fig. 1.

Vitrinite — Pl. I, Figs. 1 and 2.

This maceral is represented upto 25 per cent (TEXT-FIG. 1) and consists mostly of nonstructured Collinite (PL. I; FIG. 1). Collinite is present only in the form of thin sheets or fragmentary strips which do not exceed more than 1 mm in thickness. The Collinite fragments are mostly teared up, thinning into lenticular extensions or in fish-tail pattern (PL. I, FIG. 2). Also these bands are traversed by numerous cracks and fractures perpendicular to the plane of stratification (PL. I; FIG. 2). This character may indicate that the source of the maceral might have undergone extensive crushing and tearing during drifting of vegetation. They do not show any botanical details due to carbonization and are dull, dark grey in colour. Collinite bands are invariably associated with Exinite group of macerals. Pyrite and clay minerals always fill in the cleats and fractures of the Collinite bands. Clay minerals even lie scattered over the surface of woody macerals and make their structure insignificant.

Exinite — Pl. I, Figs. 1-2.

Exinite group of maceral is present in very poor amounts and ranges upto 6 per cent by volume (TEXT-FIG. 1). The main maceral component consists of miospore and megaspore exines together grouped in Sporinite. The microspore exines are thin narrow bands flattened parallel to the stratification. Exinite macerals are distinguishable only under high magnifications of the microscope as they are mostly associated with high mineral content which makes the organic microconstituents inconspicuous (PL. I, FIGS. 1, 5). They are dark grey in colour with both the edges smooth, and usually cut in different planes and as such show no morphographical defferentiation. Exinite macerals are mostly associated with thin Collinite bands, the interestitial spaces of which are mostly filled with clay minerals. Megaspore exines are rare and wherever they occur are mostly filled with organic mineral deposits. Cutinite and Resinite are also rare in occurrence.

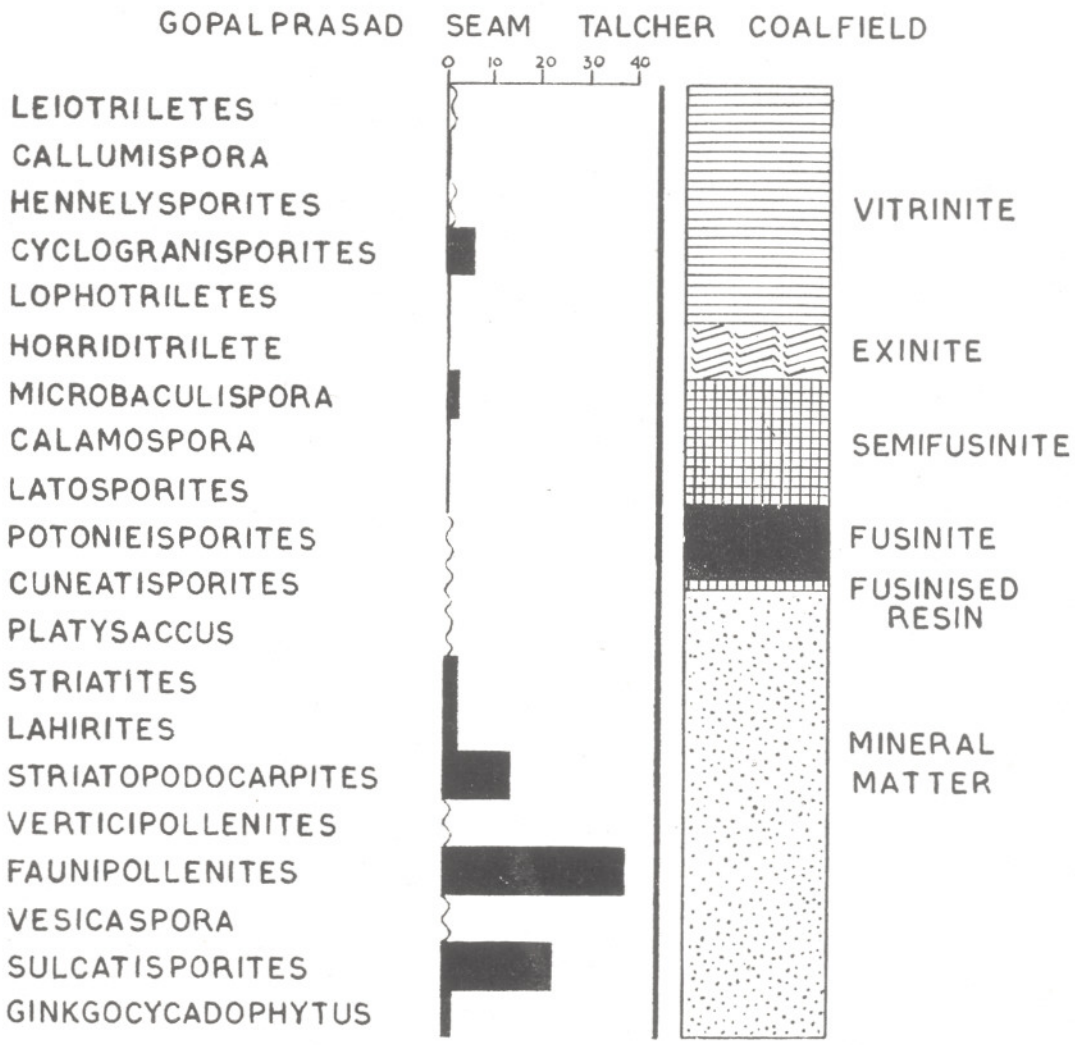
Inertinite — Pl. I, Figs. 3-6.

This group of maceral is the most dominant component in the present investigation and consists of Fusinite, Semifusinite, Fusinised Resin and Mineral matter. Amongst these, the last maceral predominates over other ones. Its total volume representation ranges upto 69 per cent (TEXT-FIG. 1).

Fusinite is present in fairly good amounts (3·6% by volume). The tissues are mostly derived from woody remains and the cells are distinctly preserved. Cell lumens are either empty or filled with mineral matter (PL. I, FIG. 4). Fusinized fungal structures also occur but infrequently. Fungal structures, distinctly preserved, are either one celled or more than one celled structures with thick walls. These structures are mostly empty (PL. I, FIG. 6).

Semifusinites are more common than Fusinite and are present upto 13 per cent by volume. They occur in the form of thin bands or fragments of not more than 0·5 mm in thickness. Fuzinised resins are rather uncommon and wherever present are small rounded bodies impregnated mostly with mineral matter. Rounded pockets of semifusinite are also present, which suggest the extensive rolling of vegetation before being deposited (PL. I, FIG. 3).

Mineral and shaly matter are present in high amounts being present upto 52 per cent by volume (TEXT-FIG. 1). These secondary inorganic deposits chiefly mask the true nature of other microconstituents (PL. I, FIG. 5). They are found intimately associated with Vitrinite, Exinite, Fusinite and Semifusinite. The chief inorganic minerals identified in association are pyrite, siderite, clay and shaly matters. Pyrite occurs as small discrete bodies with bright luminosity and lie in betweeen the cleats



TEXT-FIG. 1 — SHOWING PERCENTAGE FREQUENCY OF MIOSPORES AND MACERALS

and fractures of Vitrinite, cell lumen of Fusinite and Semifusinite. Simple isolated Pyrite grains or compound ones both are found in these deposits. Siderite occur always associated with shaly matter. Shaly matter and clay minerals are the chief inorganic sediments occurring abundantly associated with Collinite bands. They fill the cell lumen of Fusinite and also lie scattered over the Collinite bands.

In microlithotype association the coal chiefly consists of Carbargillite and Durite. Vitrite, Clarite, Fusite and 'Trimacerite' are rather uncommon. Rapid alternating microbands of Carbargillite and fine-grained Durite characterizes the association under microscope. The Carbargillite itself constitute more than 50 per cent of the microlithotype.

PALYNOLOGY

The mioflora of Gopalprasad coal bed is rich and diversified in nature and con-

sists of 22 genera including a number of trilete, monolete, monosaccate, bisaccate and colpate forms. The miospore genera constituting the mioflora (sensu BHARADWAJ, 1962; BHARADWAJ & SRIVASTAVA, 1969b; BHARADWAJ & SALUJHA 1964) are listed below :

Leiotriletes (Naum.) Pot. & Kr.
Callumispora Bharadwaj & Srivastava
Hennellysporites (Naum.) Tiwari
Cyclogranisporites Pot. & Kr.
Lophotriletes (Naum.) Pot. & Kr.
Horriditriletes Bharadwaj & Salujha
Microbaculispora Bharad.
Indospora Bharad.
Cyclobaculisporites Bharad.
Calamospora S.W. & B.
Latosporites Pot. & Kr,
Densipollenites Bharad.
Potonieisporites (Bhard.) Bharaad.
Platysaccus Pot. & Kl.
Striatites (Pant) Bharad.
Lahirites Bharad.
Striatopodocarpites (Soritsch. & Sed.) Bharad.
Verticipollenites Bharad.
Faunipollenites Bharad.
Vesicaspora (Schemel) Wilson & Venkat.
Sulcatisporites (Lesch.) Bharad.
Ginkgocycadophytus Samoil.

The assemblage is sufficiently rich in gymnospermic pollen grains which are present upto 82 per cent (TEXT-FIG. 1). The most abundant genera among them are striated and nonstriated bisaccate pollen-grains, viz. *Striatites, Lahirites, Striatopodocarpites* and *Sulcatisporites*. The cryptogamic miospores are, however, present in subordinate amount and are represented upto 12 per cent. The chief cryptogamic miospores are *Lophotriletes, Horriditriletes* and *Microbaculispora*.

The most dominant genera of the present assemblage are listed below with their respective percentage frequency which together form the chief characteristic feature of Gopalprasad seam (TEXT-FIG. 1).

Cyclogranisporites	6.3%
Microbaculispora	3·2%
Striatites	3·0%
Lahirites	3.3%
Striatopodocarpites	14.5%
Faunipollenites	37.8%
Sulcatisporites	22.9%

Relatively less represented genera in the assemblage are:

Lophotriletes	1.0%
Horriditriletes	1.3%
Calamospora	1.2%
Latosporites	1.3%
Ginkgocycadophytus	1.5%

Rest of the genera mentioned below are present in the assemblage but are poorly represented being always present in less then 1% :

Leiotriletes	0.2%
Callumispora	0.6%
Hennellysporites	0.2%
Indospora	0.1%
Cyclobaculisporites	0.1%
Densipollenites	0.1%
Potonieisporites	0.2%
Platysaccus	0.2%
Verticipollenites	0.4%
Vesicaspora	0.4%

As is evident from the occurrence of miospore genera, the chief characteristic features of the present assemblage are high precentage representation of striated and nonstriated pollen grains with pteridophytic miospores low.

GENERAL OBSERVATIONS

The coal of Gopalprasad bed is very characteristic and when compared, it differs from the coals of Raniganj Coalfield (Raniganj Stage) in the absence of distinct banded type of Durain and high proportions of macro-fragments. Similarly the Giridih and Jharia Coalfield coals differ in having rich Vitrite, Clarite and Fusite type of coals. Typical Durains of coking type of S. Karanpura (Argada Top, Sirka), Bokaro (Kargali seam) coals are also different from these coals. The coals of coal type — Ib-l of Ib-river Coalfield resemble, however, with the coals of Gopalprasad seam but the latter differs strikingly in very high percentage of mineral matter. Comparing with the coal seams within the Talchir Coalfield, significantly enough the coals of Lower seam are distinctly different from the present type as they are microfragmental in nature and chiefly consists of 'Trimacerite' group. The coals of Upper seam No. I are fine grained Durain with high Semifusinite and Exinite and are essentially spore Durain type. As opposed to the above, coals of Gopalprasad bed are typically shaly coal of low rank type.

Miofloristically the assemblage of Gopalprasad coal bed is complex and diversified. This assemblage is distinctly different from Lower Seam and Upper Seam No. I of Talcher Coalfield (BHARADWAJ & SRIVASTAVA, 1969c) in having high dominance of gymnospermic pollen grains. The seam is characterized by the dominant representation of *Faunipollenites*, *Striatopodocarpites* and *Sulcatisporites* which are also well represented in Assemblage E of Korba Coalfield (BHARADWAJ & TIWARI, 1964) and Assemblage C of Chirimiri Coalfield (BHARADWAJ & SRIVASTAVA, 1969a). Miospore assemblage described from Churcha seam (Sohagpur Coalfield NAVALE & TIWARI, 1967) are definitely older than the present one in being rich in pteridospermic miospores. The younger deposition in Ib-river Coalfield (Assemblage Ib-l, NAVAE & TIWARI, 1968) possesses qualitative resemblance in view of high *Sulcatisporites* but differs in the absence of *Striatopodocarpites* and *Faunipollenites*. The palynological assemblage described by Venkatachala and Kar (1968a, TEXT-FIG. 3) from Barakar exposures near Lungatoo, Hazaribagh district, resembles very closely to the present assemblage but differs by having a dominance of *Strotersporites*.

Miospore assemblage described by Bharadwaj, Sah and Tiwari (1965) from Sibbabudih and Katri Nalas, Jharia Coalfield closely resemble with the assemblage under discussion but for the good representation of *Densipollenites* in the former.

The sporological analysis given by Venkatachala and Kar (1968b, TEXT-FIG. 3; 1969, TEXT-FIG. 2) from Raniganj stage shows certain resemblances but differs in having appreciable amounts of *Densipollenites* and almost absence of *Sulcatisporites*. Considering the distribution of miospore genera in the Lower Gondwana sediments of India (sensu BHARADWAJ, 1966) the assemblage of Gopalprasad seam appear younger than Chirimiri and Korba Coalfields and older than those of Sibbabudih and Katri Nalas, Jharia Coalfield and is designated to belong to Upper Barakar Stage.

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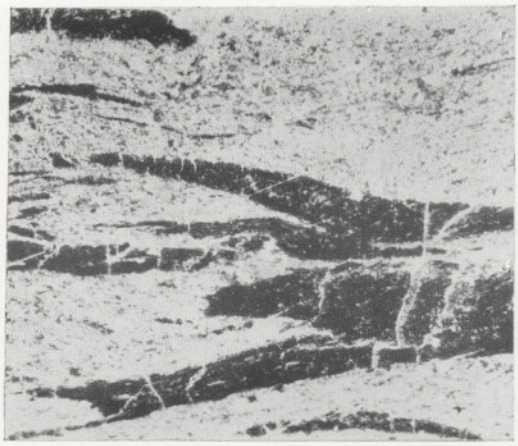

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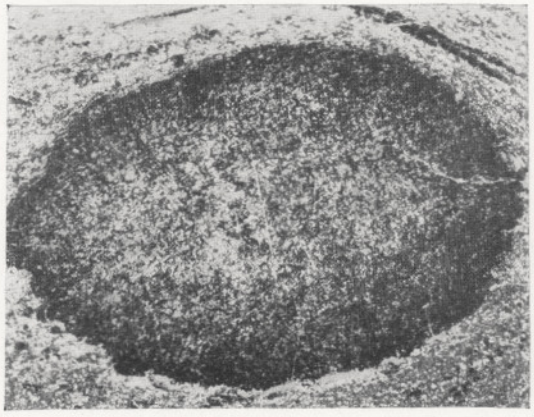

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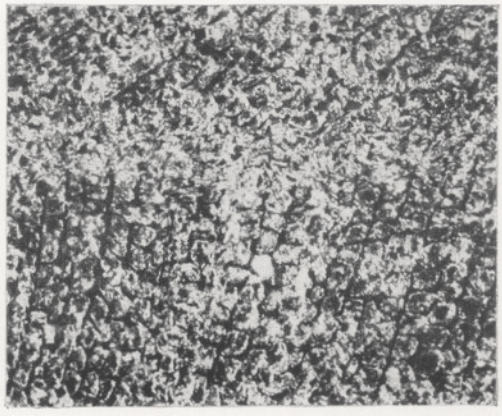

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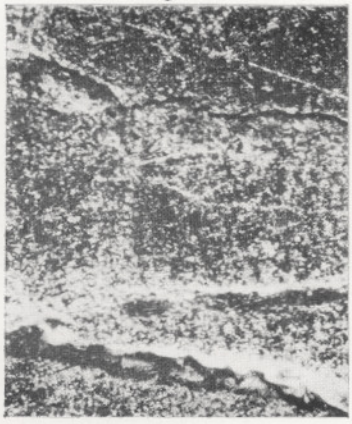

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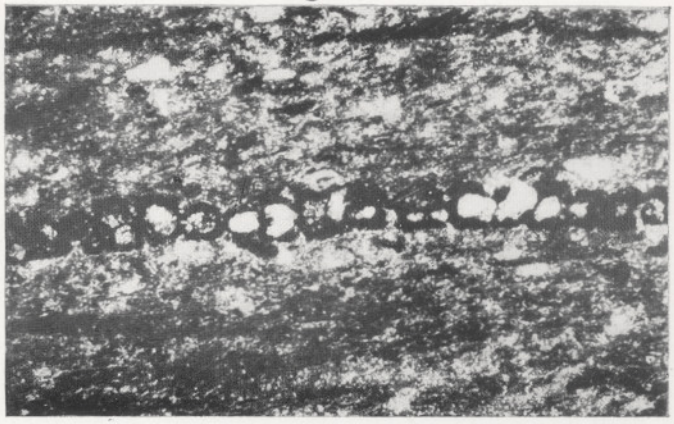

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EXPLANATION OF PLATE

PLATE 1

1. Nonstructured Vitrinite (Collinite).
2. Collinite showing fish-tail pattern in the matrix.
3. Rounded Semifusinite.
4. Fusinite showing tracheidal cells.
5. Carbargillite (ground mass of sedimentary mineral matter).
6. Fusinized fungal structure.