

Palynological assemblage from Motur Clay Bed of Satpura Gondwana Basin, Madhya Pradesh, India

A.K. Srivastava and Ram-Awatar

Birbal Sahni Institute of Palaeobotany, 53 University Road, Lucknow-226 007

Srivastava A.K. & Ram-Awatar, Palynological Assemblage from Motur Clay Bed of Satpura Gondwana Basin, Madhya Pradesh, India. *Geophytology* 31 (1&2) : 81-86.

Palynological samples belonging to mottled clay bed of Motur Formation, exposed in Rawanwara Colliery of Pench Valley Coalfield, Satpura Gondwana Basin, for the first time has revealed the presence of well-preserved miofloral represented by the species of *Callumispora*, *Cyathidites?*, *Cyclogranisporites*, *Dentatispora*, *Osmundacidites*, *Parasaccites*, *Densipollenites*, *Ibisporites*, *Rhizomaspora*, *Scheuringipollenites*, *Faunipollenites*, *Striatopodocarpites*, *Crescentipollenites*, *Lahirites*, *Striatites*, *Verticipollenites*, *Arcuatipollenites*, *Araucariacites* and *Ginkgocycadophytus*. The fair occurrence of striate disaccate pollen grains suggests the floral proximity with Upper Barakar Formation, nevertheless poor representation of *Densipollenites* and non-striate disaccate signify the incoming of younger elements of Barren Measures Formation. Evidently, palynological assemblage of mottled clay bed of Motur Formation of Satpura Gondwana Basin, represents a transitory flora of Lower to Upper Permian sequence of Lower Gondwan formations of India.

Key-words—Palynology, Satpura Basin, Motur Formation, Lower Gondwana.

INTRODUCTION

THE Satpura Gondwana Basin lying south of the Narmada alluvium tract extends from Jabalpur in the east to Lokartalai in the west, between 22° 06' & 22° 28' latitudes and 77° 48' & 78° 53' longitudes. The geology of the area has extensively been studied by Medlicott (1871, 1879), Fox (1931, 1934), Crookshank (1936), Pareek (1970) and Raja Rao (1983).

The entire Gondwana sequence of the basin includes sediments ranging from Lower Permian to Lower Cretaceous. Some of the lithological units identified as Motur, Bijori (Permian), Denwa and Bagra (Triassic) are exclusively known in the Basin. Their exact stratigraphic position is still to be demarcated in the field. The geological succession of the basin is as follow (Raja Rao, 1983; Table-1)

Table-1

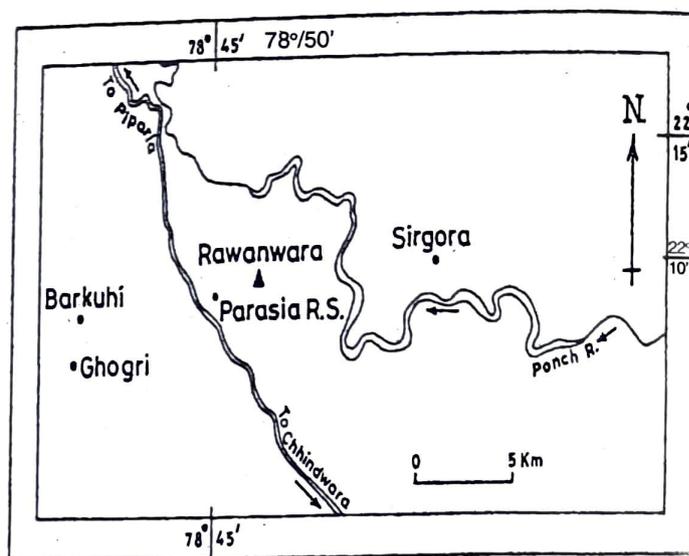
| Age | Formation | Lithology (Thickness) |
|-------------------------------|-----------|---|
| Recent | Alluvium | Basalt |
| Up. Cretaceous to Eocene | | Deccan Traps Basic flows, Dykes and sills |
| Up. Cretaceous | Lameta | Conglomerate, limestone and clays |
| Lr. Cretaceous | Jabalpur | Massive sandstone with jasper conglomerate, white clays and red clays, carbonaceous shales and coal lenses (50-100 m). -----Unconformity----- |
| Rhaetic (?) | Bagra | Predominantly coarse conglomerates with bands of calcareous sandstones, variegated clays, limestone and dolomite (180-240m). ----- Unconformity----- |
| Upper part of Middle Triassic | Denwa | Soft variegated clays interbedded with conglomeratic bed at places (350 m) |
| Lower Triassic | Pachmarhi | White-coarse grained cross bedded sandstone with lenses of subangular quartz pebbles (750 m). |
| Upper Permian | Bijori | Micaceous, flaggy sandstones and micaceous shales at places (80-250 m). |
| Lower Permian | Motur | Buff, green and variegated clays with coarse to very coarse grained sandstone (600 m). |
| | Barakar | Coarse to medium grained sandstone, shale, carbonaceous shale and coalseams (250-450 m). |
| Upper Carboniferous (?) | Talchir | Diamictites, sandstones, grey and olivegreen needle shale, varves and rhythmites (450m). -----Unconformity----- |
| Precambrian | | Gneiss, schists, quartzites and limestone, etc. |

Motur Formation: Overlying the Barakar beds with gradational contact massive sandstone unit with red and mottled colour clay bands having calcareous nodules is exposed in PENCH-KANHAN and TAWA valley of Satpura Gondwana Basin. Such type of lithology differs from those of any other Gondwana basin and the sequence is recognized by Medlicott (1873), as Motur Formation, after the village Motur., located 18 km, SSE of Pachmarhi. The geology of Motur Formation and its relationship with other formations of Gondwana is still not clear and the sequence is often correlated with Barakar (Medlicott 1873), Pachmarhi (Fox 1931), Raniganj (Fox 1934, Crookshank 1936) and sometimes even with overlying sequence of Bijori, exposed in Satpura and Pranhita-Godavari basins (Medlicott 1873). Recent workers have correlated the strata with Barren Measures Formation of Damodar Valley Coalfield (Pareek 1969, Raja Rao 1983). Its equivalent strata have also been recognised in Pranhita-Godavari Valley Coalfield (Sengupta, 1970; Kutty, 1972).

The presence of *Glossopteris indica*, *G. conspicua* and *Schizoneura* has been recorded from Motur Formation of Satpura Gondwana Basin by Crookshank, 1936. Later Pareek (1969), studied a fossil wood *Dadoxylon ghorawariensis* from Kanhan Valley Coalfield of the basin. However, the palynofossils have not yet been recorded from Motur Formation.

MATERIAL

During the collection of plant fossils from Rawanwara area of PENCH VALLEY COALFIELD, good ex-



Map 1. Geographical location of Sample sites (▲).

posures of Motur sediments were observed in Rawanwara Colliery (Map - 1). The palynological samples were collected at different levels from Motur Formation of the Colliery (Figure-1). The red and pink colour mottled clay beds, overlying the thin beds of coaly shale of Barakar Formation have yielded the well preserved palynofossils. The samples were processed for palynological analysis by usual method of maceration using hydrofluoric acid for relatively a longer duration i.e. 15-20 days. The spores and pollen grains are not much in number but they demonstrate the variety and distinct morphological features.

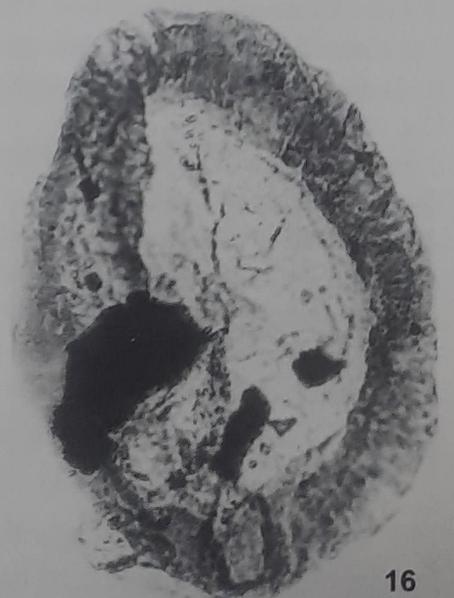
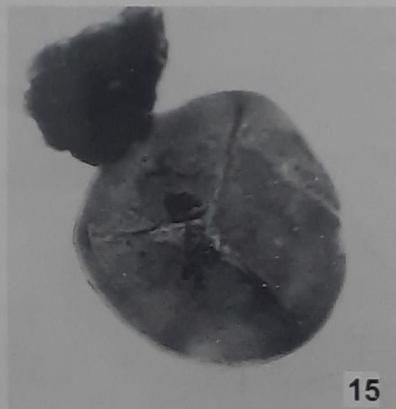
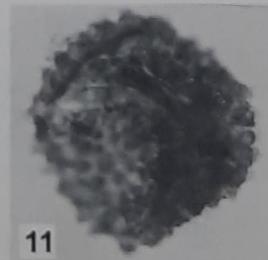
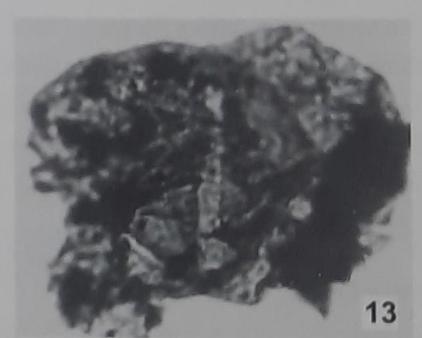
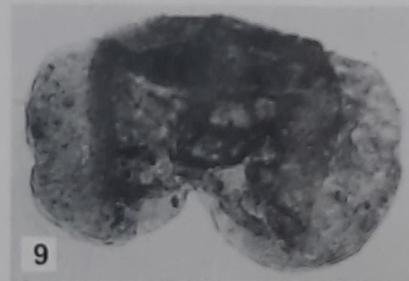
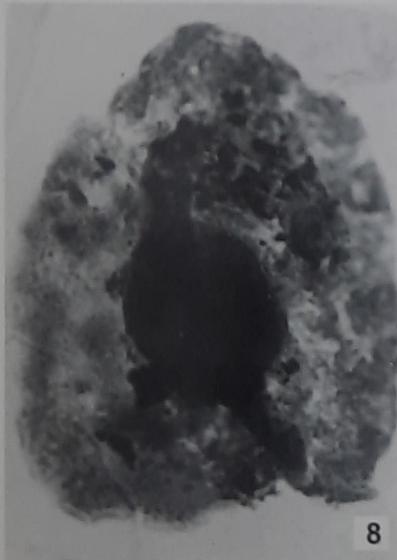
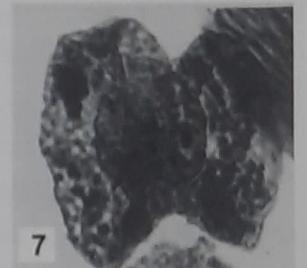
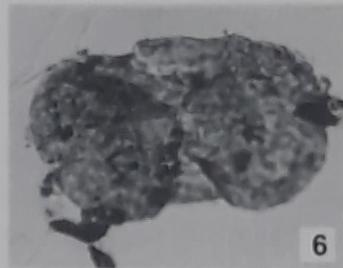
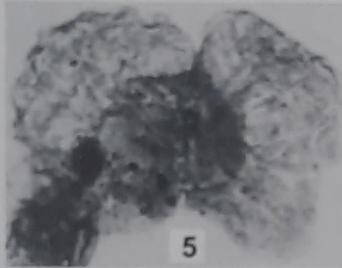
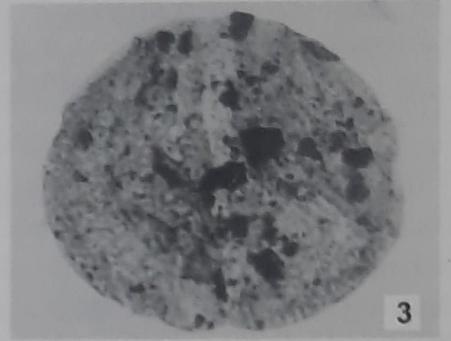
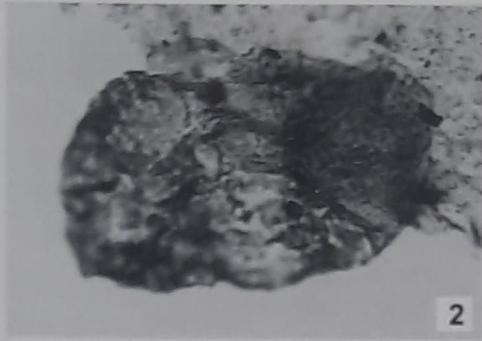
PALYNOLOGICAL COMPOSITION

Nineteen genera and twenty-eight species of spores and pollen are recovered from the samples. Characteristic and significant taxa are illustrated.

PLATE 1

(All photomicrographs are enlarged ca x 500)

1. *Crescentipollenites notabilis* (Tiwari) Bharadwaj, Tiwari & Kar, 1974
2. *Faunipollenites varius* Bharadwaj emend. Tiwari et al., 1981
3. *Scheuringipollenites maximus* (Hart) Tiwari, 1973
4. *Verticopollenites gibbosus* Bharadwaj, 1962
5. *Rhizomaspota indica* Tiwari, 1965
6. *Striatopodocarpites decorus* Bharadwaj & Saluja, 1964
7. *Lahirites rarus* Bharadwaj & Saluja, 1964
8. *Densipollenites indicus* Bharadwaj, 1962
9. *Arcuatipollenites paliensis* (Tiwari & Ram-Awatar) emend. Tiwari & Vijaya, 1995
10. *Scheuringipollenites tentulus* (Tiwari) Tiwari, 1973
11. *Crescentipollenites fuscus* Bharadwaj, Tiwari & Kar, 1974
12. *Dentatispora indica* Tiwari, 1964
13. *Cf. Araucariacites indicus* Dev., 1961
14. *Ibisporites diplosaccus* Tiwari, 1968
15. *Callumispora gretensis*, Bharadwaj & Srivastava emend. Tiwari et al., 1989
16. *Parasaccites obscurus* Tiwari, 1965 emend. Tiwari et al., 1989.

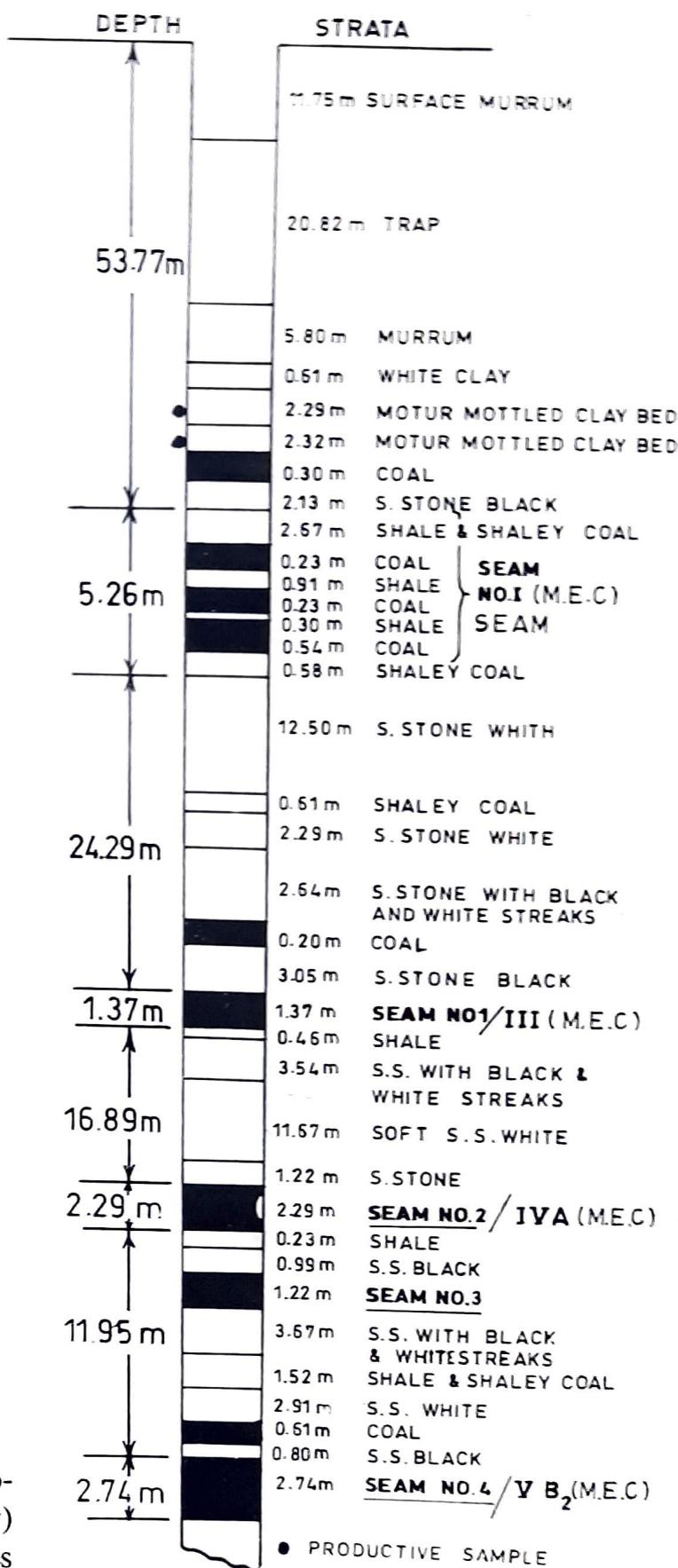


Name of the species

- Callumispora gretenensis* Bharadwaj & Srivastava 1969 emend. Tiwari et al., 1989
C. barakarensis Bharad. & Srivastava, 1969, emend. Tiwari et al., 1989
Cyathidites sp Couper, 1953
Cyclogranisporites barakarensis Bharadwaj & Salujha, 1964
Dentatispora indica Tiwari, 1964
Osmundacidites sp. Couper, 1953
Parasaccites korbaensis Bharadwaj & Tiwari, 1964, emend. Tiwari et al., 1989
P. obscurus Tiwari 1965 emend. Tiwari et al., 1989
P. bilateralis Tiwari 1965, emend. Tiwari et al., 1989
Densipollenites indicus Bharadwaj, 1962
Ibisporites diplosaccus Tiwari, 1968
Rhizomaspora lintrus Tiwari, 1965
Rhizomaspora indica Tiwari, 1965
R. costa Venkatachala & Kar, 1968
Scheuringipollenites barakarensis Tiwari, 1973
S. tentulus Tiwari, 1973
Faunipollenites varius Bharadwaj emend. Tiwari et al., 1989
F. perexiguus Bharadwaj & Salujha 1965 emend. Tiwari et al., 1989
Striatopodocarpites decorus Bharadwaj & Salujha, 1965
S. rotundus Bharadwaj & Diwedi, 1981
Lahirities rarus Bharadwaj & Salujha, 1964
Crescentipollenites fuscus Bharadwaj, Tiwari & Kar, 1974
C. notabilis (Tiwari) Bharadwaj, Tiwari & Kar, 1974
Verticipollenites gibbosus Bharadwaj, 1962
Striatites notus Bharadwaj & Salujha, 1964
Arcuatipollenites paliensis Tiwari & Ram-Awatar emend. Tiwari & Vijaya, 1995
Araucariacites indicus Dev., 1961
Ginkgocycadophytus novus Srivastava, 1970

COMPARISON AND DISCUSSION

Most of the palynological samples are unproductive but two samples (red to pink mottled clay) (Figure 1) yielded well preserved miofloral assemblages (Plate). Poor yield of samples warrant us to estimate the flora quantitatively, however, it is possible to assess the qualitative relationship of the palynoflora with

SECTION OF SEAM (NO.3 PIT)

(After Western Coalfield Limited)

Fig. 1. Litholog of Rawanwara Colliery

the known flora of Indian Lower Gondwana sequences.

The present assemblage is the first record of palynofossils from Motur Formation of Satpura Gondwana Basin. The earlier workers have recorded the palynological assemblages from other formations of the basin. Bharadwaj *et al.*, (1978) recorded miospore from Talchir Formation showing rich acritarch assemblage along with radial monosaccates, accordingly they have compared it with the mioflora of Umaria marine beds. The Barakar mioflora shows two types of assemblages, the lower seams contain palynotaxa of Karharbari Formation whereas upper seams possess the Lower Barakar palynoassemblage (Trivedi & Ambwani, 1977, 1984; Bharadwaj *et al.*, 1974). Similarly the Bijori Formation also exhibits two types of miofloral assemblage, the lower one represents typical Raniganj flora and Upper Bijori sediments contain Lower Triassic palynoassemblages (Bharadwaj *et al.*, 1978; Nandi & Aglaw, 1996). Geologically, a new formation i.e., Sukhtawa Formation has been carved out from upper Bijori beds, having typical lithology of Khaki green and red facies of Satpura Gondwana Basin containing Triassic flora (Bharadwaj *et al.*, 1979).

The palynological assemblages recovered from Motur Formation shows the frequent occurrence of striate disaccate pollen which is characteristic of the Upper Barakar palynoflora of Lower Gondwana formations. Tiwari (1973) studied the palynological succession in the type area of Barakar Formation situated in the west of Barakar River, Raniganj Coalfield. The Palynozone-5 of Upper Barakar is comparable with Motur assemblage in having dominance of striate disaccate pollen grains. Similar mioflora is also known from North Karanpura and Auranga coalfields (Kar, 1973; Srivastava, 1977). *Faunipollenites varius* Assemblage zone of Upper Barakar recognized by Tiwari and Tripathi (1992) and Tiwari (1999) also compares with the present palynoassemblage.

The occurrence of *Densipollenites* and non-striate disaccates suggests the closing phase of Barakar palynosuccession and indicates definite change in the flora from Barakar to Barren Measures Formation. The

relative distribution of *Densipollenites* is correlated with the different stages of Barren Measures (Bharadwaj 1971, 1974). Tiwari (1999) has also recognized *Densipollenites indicus* Assemblage zone as typical palynoassemblage of Barren Measures Formation. The assemblage is also comparable with Barren Measures flora of Jharia Coalfield (Bharadwaj *et al.*, 1965, Tiwari, 1974); North Karanpura Coalfield (Kar, 1973) and Auranga Coalfield (Lele & Srivastava, 1977).

CONCLUSION

The qualitative assessment of palynoflora recovered for the first time from mottled red clay beds of Motur Formation shows its relationship with the mioflora of Upper Barakar and Barren Measures formations of the type area and other Lower Gondwana basins of India. In all probability the miospores of Motur Formation exhibit changing pattern of flora during upper Permian in Indian Gondwana System. In order to understand the floristic and stratigraphic position of Motur beds with Gondwana sequences it is imperative to carry out detail work on different sections of the Motur Formation.

ACKNOWLEDGEMENT

The authors are grateful to Prof. Anshu Kumar Sinha, Director, Birbal Sahni Institute of Palaeobotany, Lucknow for permission to publish the present paper.

REFERENCES

- Bharadwaj, DC 1971. Palynostratigraphy of Lower Gondwanas succession in India. *Int. Gondwana Symp. Ann. Geol. Dept.*, AMU, Aligarh, 5 & 6 (Spl. Issue, 1970): 390-419.
- Bharadwaj, DC 1974. Permian palynostratigraphy in India. *Proc. 3rd Int. Palynol. Conf. Novosibirsk* (1971): 125-129.
- Bharadwaj, DC, Navale, GKB & Anand-Prakash 1974. Palynostratigraphy and petrology of Lower Gondwana coals in Pench-Kanhan Coalfield, Satpura Gondwana Basin, M.P. India. *Geophytology* 4(1): 7-24.
- Bharadwaj, DC, Sah, SCD & Tiwari, RS 1965. Sporological analysis of some coal and carbonaceous shales from Barren Measures Stage (Lower Gondwana) of India. *Palaeobotanist* 13(2): 222-226.
- Bharadwaj, DC, Tiwari, RS & Anand-Prakash 1978. Palynology of Bijori Formation (Upper Permian) in Satpura Gondwana Basin, India. *Palaeobotanist* 25: 72-78.
- Bharadwaj, DC, Tiwari, RS & Anand-Prakash 1979. Permo-Triassic

- palynostratigraphy and lithological characteristic in Damodar Basin, India. *Biol. Mem.* 4(1 & 2): 49-82.
- Crookshank, H 1936. The geology of the northern slopes of the Satpura between the Morand and the Sher rivers. *Mem. geol. Surv. India.* 66(2): 217-218.
- Fox, CS 1931. The Lower Gondwana System and related formations. *Rec. geol. Surv. India* 58: 1-241.
- Fox, CS 1934. The Lower Gondwana coalfields of India. *Mem. geol. Surv. India* 59: 243-315.
- Kar, RK 1973. Palynological delimitation of the Lower Gondwana in the North Karanpura sedimentary Basin, India, *Palaeobotanist* 20(3): 300-317.
- Kutty, TS 1972. A Permian reptilian fauna from India. *Nature* (London) 237(5356): 462-463.
- Lele, KM & Srivastava, AK 1979 A mioflora of Barren Measures age from the Araunga Coalfield, Bihar. *Palaeobotanist* 24(2): 118-124.
- Medlicott, HB 1871. Notes on the Narbada coal basin. *Rec. geol. Surv. India* 4(3): 59-88.
- Medlicott, HB 1873. Notes on the Satpura Coal Basin. *Mem. geol. Surv. India* 10(1): 1-188.
- Medlicott, HB 1879. Note on the Mohpani Coalfield.. *Rec. geol. Surv. India* 12(2): 95-140.
- Nandi, A & Aglawe, V 1996. Occurrence of Late Permian-Early Triassic transitional mioflora from Bijori grey shale in the southeastern part of the Satpura Basin, M.P. *Indian Minerals* 50(1 & 2): 105-108.
- Pareek, HS 1969. On the geology and correlation of coal seams of Pench-Kanhan-Upper Tawa Valley coalfield, District Chhindwara, Madhya Pradesh. *Palaeobotanist* 18(1) : 45-102.
- Pareek, HS 1970. On the claystone of Talchir Stage, Kanhan Valley Coalfield, Madhya Pradesh. *Rec. geol. Surv. India* 98(2): 65-68.
- Raja Rao, CS 1983. Coal resources of Madhya Pradesh, Jammu and Kashmir.-- coalfields of India. *Bull. geol. Surv. India, Ser. A.* no. 45 : pp 1-204.
- Sengupta, S 1970. Gondwana sedimentation around Bheemaram (Bhimaram), Pranhita-Godavari Valley, India. *Jour. Sed. Pet.* 40(1): 140-170.
- Srivastava, AK 1977. Studies in the Glossopteris flora of India. 42. Barakar plant megafossils and miospores from Auranga Coalfield, Bihar *Palaeobotanist* 24(1): 50-59.
- Tiwari, RS 1973. Palynological succession in Barakar type area. *Geophytology* 3 : 166-186.
- Tiwari, RS 1974. Inter-relationships of palynofloras in the Barakar Stage (Lower Gondwana) India. *Geophytology* 4(2): 111-129.
- Tiwari, RS 1999. The palynological succession and spatial relationship of the Indian Gondwana Sequence. *INSA* 65A (3): 329-375.
- Tiwari, RS & Tripathi, Archana 1992. Marker assemblage zones of spores and pollen species through Gondwana Palaeozoic and Mesozoic Sequence in India. *Palaeobotanist* 40: 194-236.
- Trivedi, BS & Ambwani, K 1977. Miospore study of Lower Gondwana of Madhya Pradesh, India : With reference to its age. In: Venkatachala, BS and Shastri, VV (eds.)- Proc. 4 th *Indian Colloq. Micropalaeontol. & Stratigr.*, Dehradun (1974-75): 144-149.
- Trivedi, BS & Ambwani, K 1984. Palynology of Pench-Kanhan Valley Coalfield (Lower Gondwana), Madhya Pradesh, India with reference to its age. In : Sharma, A.K. *et al.* (eds)- *Sym. Evolutionary Bot. & Biostratigraphy, Calcutta* (1979): 291-302. Today and Tomorrows Print. & Publ. New Delhi.