The Palaeobotanist 65(2016): 177–187
0031–0174/2016

Late Permian palynoassemblage from Borehole No. WG–22 near Sekapur, Wardha District, Maharashtra, India

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(Received 30 October, 2015; revised version accepted 21 January, 2016)

ABSTRACT

Sarate OS, Murthy S & Kalkar SA 2016. Late Permian palynoassemblage from Borehole No. WG–22 near Sekapur, Wardha District, Maharashtra, India. The Palaeobotanist 65(1): 177–187.

The present paper deals with the palynological investigation of the Lower Gondwana sequence intersected in Borehole No. WG–22, drilled near Sekapur Village, in Wardha District, Maharashtra. The study divulges the incidence in significant proportion and with consistency of striate bisaccate palynomorphs, viz. *Striatopodocarpites* and *Faunipollenites* and non–striate genus *Scheuringipollenites*. The associated genera recorded include, *Weylandites*, *Tiwariasporis*, *Densipollenites*, *Verticipollenites* and *Klausipollenites*, though with meagre distribution. This palynoassemblage has been dated as Late Permian and affiliate closely with the palynofloral assemblages known from the basal part Raniganj Formation of East and West Bokaro coalfields, Damodar Basin, Makardhokada area of Nagpur District and vast areas of Godavari Valley. The study indicates that almost similar vegetational pattern existed in the Nagpur, Wardha–Godavari and Damodar basins however, there existed regional variations in the generic composition of the vegetation in Satpura Basin as suggested by their palynofloral contents. The mega– and microfloral studies of the Wardha Basin with particular reference to Sekapur area suggests prevalence of warm and temperate climate in this region.

Key–words—Palynoflora, Subsurface Lower Gondwana, Permian, Sekapur, Wardha Valley Coalfield, Maharashtra..

वेध छिद्र संख्या डब्ल्यु जी–22 सेकापुर के निकट, जिला वर्धा, महाराष्ट्र, भारत

ओमप्रकाश एस. सराटे, श्रीकांत मूर्ति एवं एस.ए. कालकर

सारांश

मौजूदा शोध पत्र वेध–छिद्र संख्या डब्ल्यु जी–22, सेकापुर गाँव के नजदीक जिला वर्धा, महाराष्ट्र में प्रतिच्छेदित अधो गोंडवाना अनुक्रम के परागाणविक अन्वेषण से संबद्ध है। अध्ययन महत्वपूर्ण समानुपात एवं रेखित द्विसपुट परागाणुसंरूपों अर्थात *स्ट्रिएटोपोडोकार्पाइटिस* व *फॉनीपॉल्लेनाइटिस* एवं गैर रेखित वंश *स्युरिंगीपॉल्लेनाइटिस* की अनुरूपता सहित घटना को प्रकट करता है। यद्यपि अत्यल्प वितरण परंतु अभिलिखित संबद्ध वंश *वीलेंडाइटिस, तिवारिआस्पोरिस, डेन्सीपॉल्लेनाइटिस, वर्टिसीपॉल्लेनाइटिस* एवं *क्लॉसीपॉल्लेनाइटिस* सन्निहित है। यह परागाणुसमुच्चय विलंबित पर्मियन के रूप में आयुनिर्धारित की गई है तथा गोदावरी घाटी के विशाल क्षेत्र, जिला नागपुर के पूर्वी एवं पश्चिमी बोकारो कोयलाक्षेत्र, दामोदर घाटी, मकरधोकरा क्षेत्र के आधारी भाग एवं रानीगंज शैलसमूह से ज्ञात परागाणुपुष्पी समुच्चयों से निकटता से संबद्ध हैं। अध्ययन बताता है कि करीब–करीब मिलता जुलता वानस्पतिक प्ररूप नागपुर वर्धा–गोदावरी एवं दामोदर द्रोणियों में था, फिर भी सतपुड़ा द्रोणी में वनस्पति के जातिगत संघटन में वहाँ आंचलिक उतार–चढ़ाव व्याप्त थे जैसा कि उनकी परागाणुपुष्पी अंतर्वस्तुओं से सुझावित है। सेकापुर क्षेत्र के विशेष संदर्भ सहित वर्धा द्रोणी के स्थूल एवं सूक्ष्मपुष्पी अध्ययन इस अंचल में कोष्ण और शीतोष्ण जलवायु की व्यापकता सुझाते हैं।

सूचक शब्द—परागाणु वनस्पति–जात, उपपृष्ठीय अधो गोंडवाना, पर्मियन, सेकापुर, वर्धा घाटी कोयलाक्षेत्र, महाराष्ट्र।

INTRODUCTION

WARDHA Valley Coalfield displays existence of Lower Gondwana deposits in the form of discontinuous and isolated patches in the Wardha, Yeotmal and Chandrapur districts, infact most of the lower Gondwana sediments are mostly concealed either below the thick cover of the Deccan Traps or are overlain by the Lameta Formation.

The major contributors in the field of Gondwana palynology and megaflora include the significant contribution from Agashe & Chitnis (1970, 1972), Hindustan Lalpeth Colliery, Anand–Prakash & Khare (1974) carried out the petro–palynofloral study from Majri, Ghugus, Lalpeth, Ballarpur and Sasti areas of Wardha Valley. Whereas, Agashe & Suresh (1979) worked on Padmapur area, Agashe *et al.* (1984) mega and microflora from Durgapur area of Chandrapur District, Maharashtra. Similarly, Agashe & Geetha (1979) and Sarate (1985) carried out the microfloral studies whereas, Agashe (1980) recorded megaspores from Kamthi Coalfield, Nagpur District. Mahesh *et al.* (2011, 2014) also analysed the sub–surface sediments from Pisgaon and Majri Open Cast Mine of Chandrapur District.

Recently, Directorate of Geology and Mining, Maharashtra took up sub–surface explorations in Wardha District to work out the existence of coal deposits concealed below the traps. This venture provided an opportunity to collect sub–surface Gondwana sediments in Sekapur region for their palynodating and to ascertain the depositional environment.

Since the Gondwana sediments in Wardha District are mostly concealed below the Deccan traps, the only way to carry out their palynological study is by way of collecting its subsurface sequence.

GENERAL GEOLOGY

Wardha Valley Coalfield covers nearly 4,130 km^2 of the Wardha River Valley (Raja Rao, 1982), demarcated between north latitudes 19º30' and 20º27' and east longitudes 78º50' and 79º45' which extends in north–west and south–east directions for about 115 km and occupies the areas in entire Wardha, Chandrapur and a part of the Yeotmal District of Maharashtra (Table 1). Nearly 95% area of the Wardha District is covered by the Deccan Trap lava flows with basaltic composition. However, a few patches of the sedimentary rocks of the

Table 1—General geological succession recorded from Wardha Valley Coalfield, Maharashtra (after, Raja Rao, 1982).

Age	**Group/Formation**	**Lithology**
Recent	–	Alluvial gravel beds, black cotton soil
? Eocene	Deccan Trap	Basalts
—————— Unconformity ——————		
Cretaceous	Lameta Formation	Limestones, cherts and silicified sandstones
—————— Unconformity ——————		
Late Triassic	Maleri Formation (only in the south eastern extremity)	Fine– to medium–grained sandstone and red shales
Late Permian–Early Triassic	Kamthi Formation	Red, brown and variegated sandstones, reddish siltstones and variegated shales
—————— Unconformity ——————		
Early Permian	Barakar Formation	Light grey to white sandstones, shales and coal seams
? Late Carboniferous–Early Permian	Talchir Formation	Tillites, turbidites, varves, needle shales and sandstones
—————— Unconformity ——————		
Precambrian	Sullavai Sandstones	White to light brown quartzitic sandstones, conglomerates
—————— Overlap ——————		
	Pakhal Limestone	Grey bluish or pinkish limestones and cherts
—————— Unconformity ——————		
Archaean		Quartzites, granite gneisses, etc.

Gondwana Supergroup are found in the eastern extremity of the Basin, whereas, the Lameta exposures can be witnessed in the eastern and south eastern parts of Wardha District. Alluvial soil deposits are generally confined to the banks of the river Wardha and its tributaries. Wardha is the major river of the Valley and it originates from the high Multai Plateau of the Satpura Range near Betul in Madhya Pradesh.

It is observed that the deposits of the Barakar and its overlying Barren Measures and the Kamthi Formation in the Valley suffered from intense erosion, e.g. in Ghugus area of Chandrapur District, the Barakar sediments overlying the main seam have been reduced to the thickness of 26.7 m whereas, the strata overlying the seam in Ballarpur area measures about 124 m which indicates the rate of erosion varied from place to place and region to region. In some of the places in the Valley the intensity of the erosion has been so high that the complete Barakar and its overlying Barren Measures Formation were eroded completely and the sediment of the Kamthi Formation directly rest over the Talchir Formation. There also exists lithological dissimilarity betewen the sedimentary sequence overlying the Barakar Formation of the Satpura Gondwana Basin, here the sediments are designated differently as the Motur and Bijori formations which are considered to be the time equivalents of the Barren Measures and the Raniganj formations of the Damodar Valley and the Barren Measures

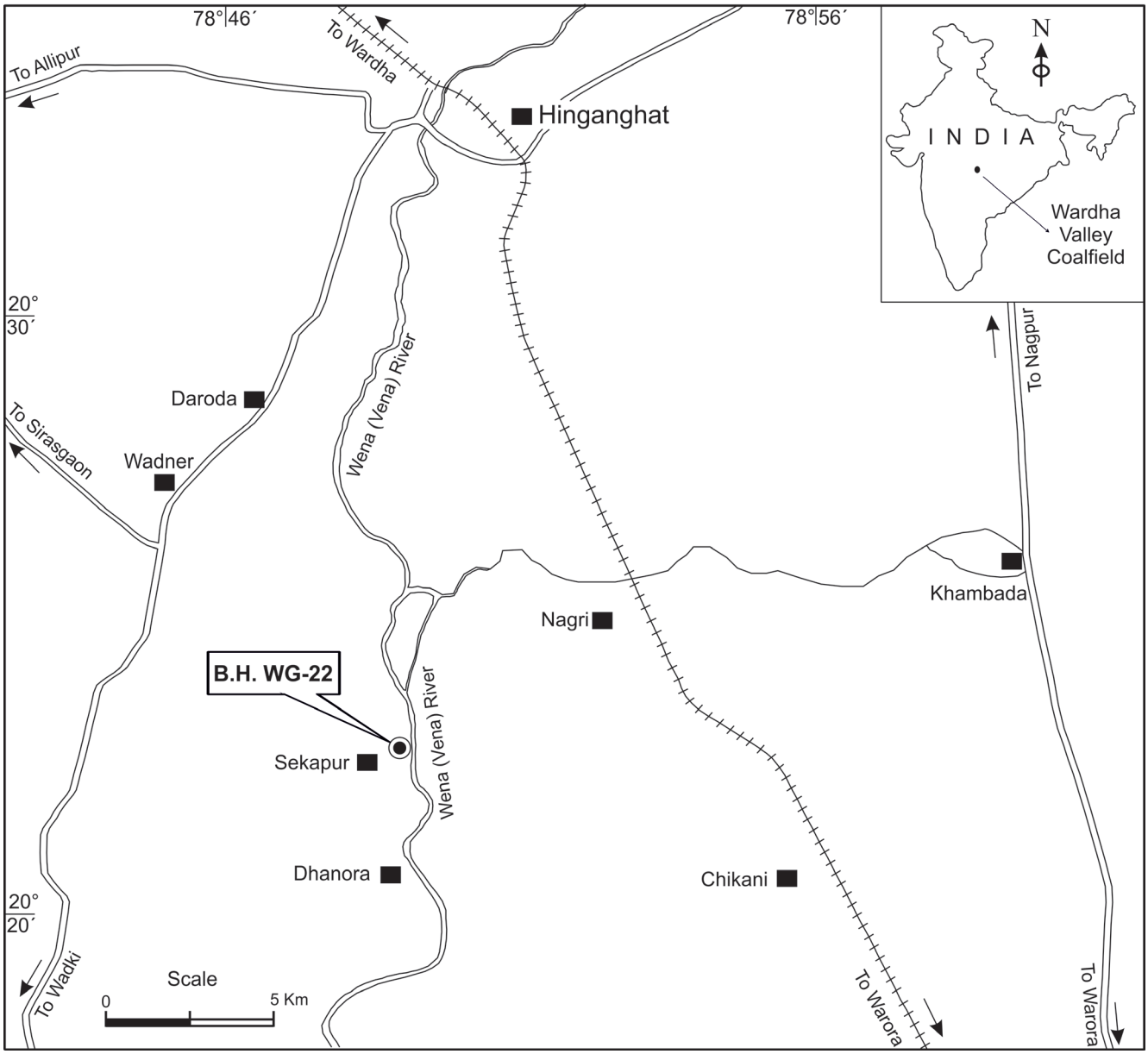

Fig. 1—Map showing location of Borehole No. WG–22, Sekapur area, Wardha District, Maharashtra.

Table 2—Showing lithological details of the samples collected from Borehole No. WG–22, Sekapur area, Wardha Valley Coalfield, Wardha District, Maharashtra.

S. No.	Depth (in meter)	Lithology	Pollen present "+" Pollen rare "#"
1.	75.00	Grey shale	#
2.	77.00	Grey shale	#
3.	78.00	Grey shale	#
4.	80.00	Grey shale	#
5.	82.00	Grey shale	#
6.	99.00	Grey shale	#
7.	99.50	Grey shale	#
8.	100.00	Grey shale	+
9.	101.00	Grey shale	+
10.	102.00	Shaly coal	+
11.	103.00	Shaly coal	+
12.	104.00	Shaly coal	+
13.	110.00	Shaly coal	#
14.	112.50	Shale	+
15.	157.00	Shale	+
16.	159.00	Shale	+

and the Kamthi formations of the Wardha and Godavari Valley coalfields.

MATERIAL AND METHODOLOGY

The sub–surface samples for the present study were procured from Borehole No. WG–22 (Table 2, Fig. 1), drilled at about 1 km north–east of Sekapur Village in closer proximity of the Wena River by the Directorate of the Geology and Mining, Government of Maharashtra. Sekapur Village is located in Hinganghat Tehsil of Wardha District, Maharashtra. The distance between Hinganghat (20.57°N 78.83°E) and Wardha is about 47 km, whereas the Borehole site (Sekapur Village) is situated nearly 20 km south–west of Hinganghat.

For chemical processing, 10–15 gm of the crushed (powdered) sample was used and if the material is shaly in nature or contains silica then treated with 40% Hydrofluoric Acid (HF), otherwise (if coal) directly treated with HNO_3 (40%), following the standard maceration technique. KOH (10%) solution was used to dissolve the humic contents within the samples. One or two drops of the macerate containing palynomorphs were placed over the cover slip and mixed with same proportion of Polyvinyl Chloride solution and spread uniformly over it. Dried cover slips were mounted on the slides using Canada balsam. The clean and dry slides were then studied under the transmitted light microscope (Olympus 51) and micro–photographed.

PALYNOSTRATIGRAPHY

The quantitative and qualitative distribution of various palynotaxa recorded from the subsurface sequence of Borehole WG–22, between the depth 100 m and 150 m indicates existence of single palynoassemblage which

PLATE 1

1. *Callumispora fungosa* Balme 1973
2. *Microfoveolatispora raniganjensis* Tiwari and Singh 1981
3. *Microfoveolatispora foveolata* Tiwari 1965
4. *Microbaculispora gondwanensis* Bharadwaj 1962
5. *Parasaccites korbaensis* Bharadwaj & Tiwari 1964
6. *Faunipollenites varius* Bharadwaj emend. Tiwari *et al.* 1989
7. *Striamonosaccites ovatus* Bharadwaj 1962
8. *Densipollenites indicus* Bharadwaj 1962
9. *Densipollenites invisus* Bharadwaj & Salujha 1964
10. *Striatopodocarpites globosus* Maheshwari 1967
11. *Rhizomaspora indica* Tiwari 1965
12. *Striatopodocarpites magnificus* Bharadwaj & Salujha 1964
13. *Crescentipollenites fuscus* (Bharadwaj) Bharadwaj *et al.* 1974
14. *Arcuatipollenites rhombicus* Bharadwaj & Tiwari 1964
15. *Arcuatipollenites pellucidus* Tiwari &Vijaya 1995
16. *Arcuatipollenites damudicus* (Tiwari & Rana) Tiwari & Vijaya 1995
17. *Klausipollenites schaubergeri* Potonié & Klaus 1954
18. *Falcisporites zapfei* Leschik emend Klaus 1963
19. *Alisporites ovalis* Kumar 1973
20. *Scheuringipollenites tentulus* (Tiwari) Tiwari 1973
21. *Tiwariasporis indicus* Srivastava 1970

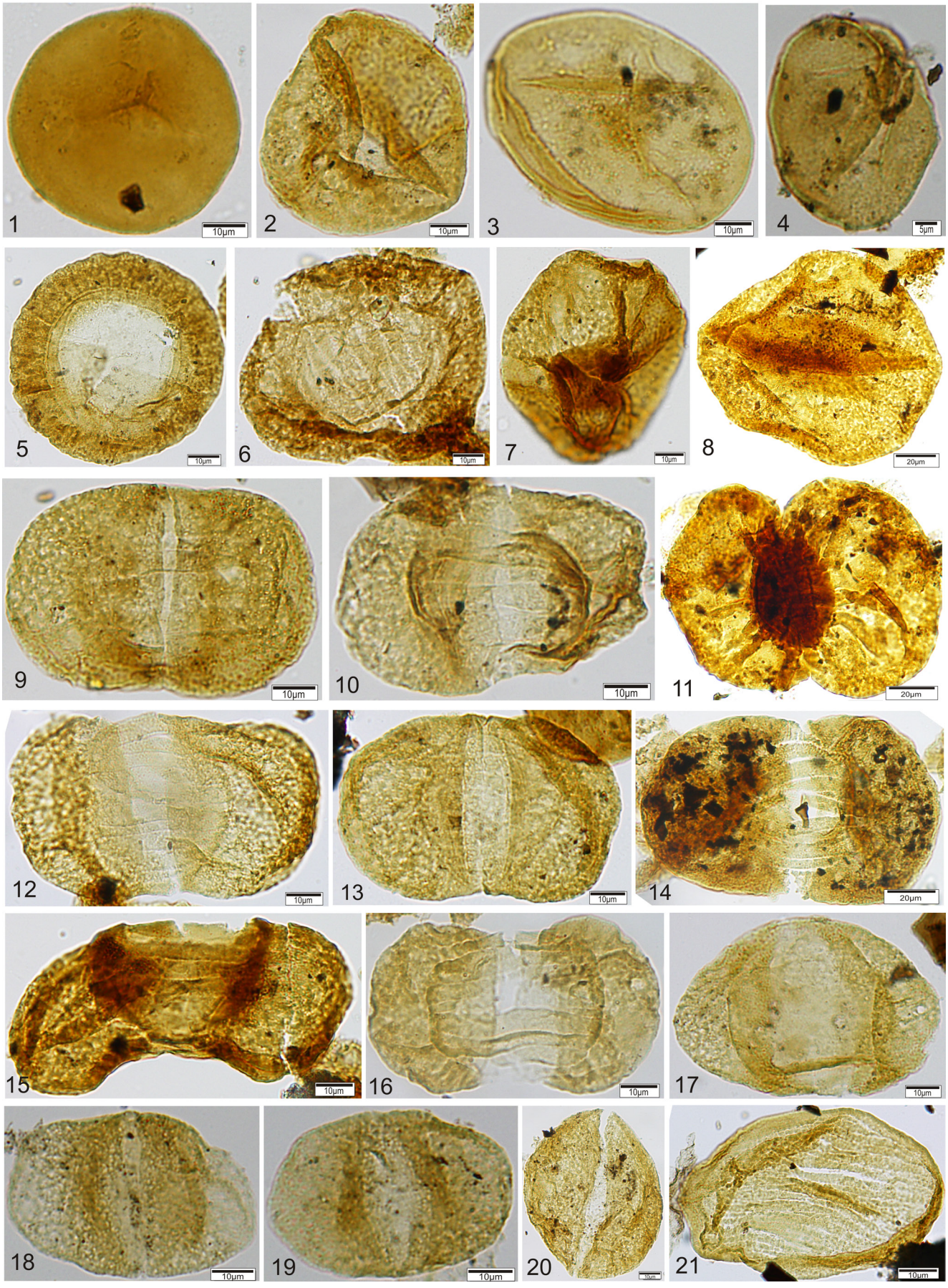
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PLATE 1

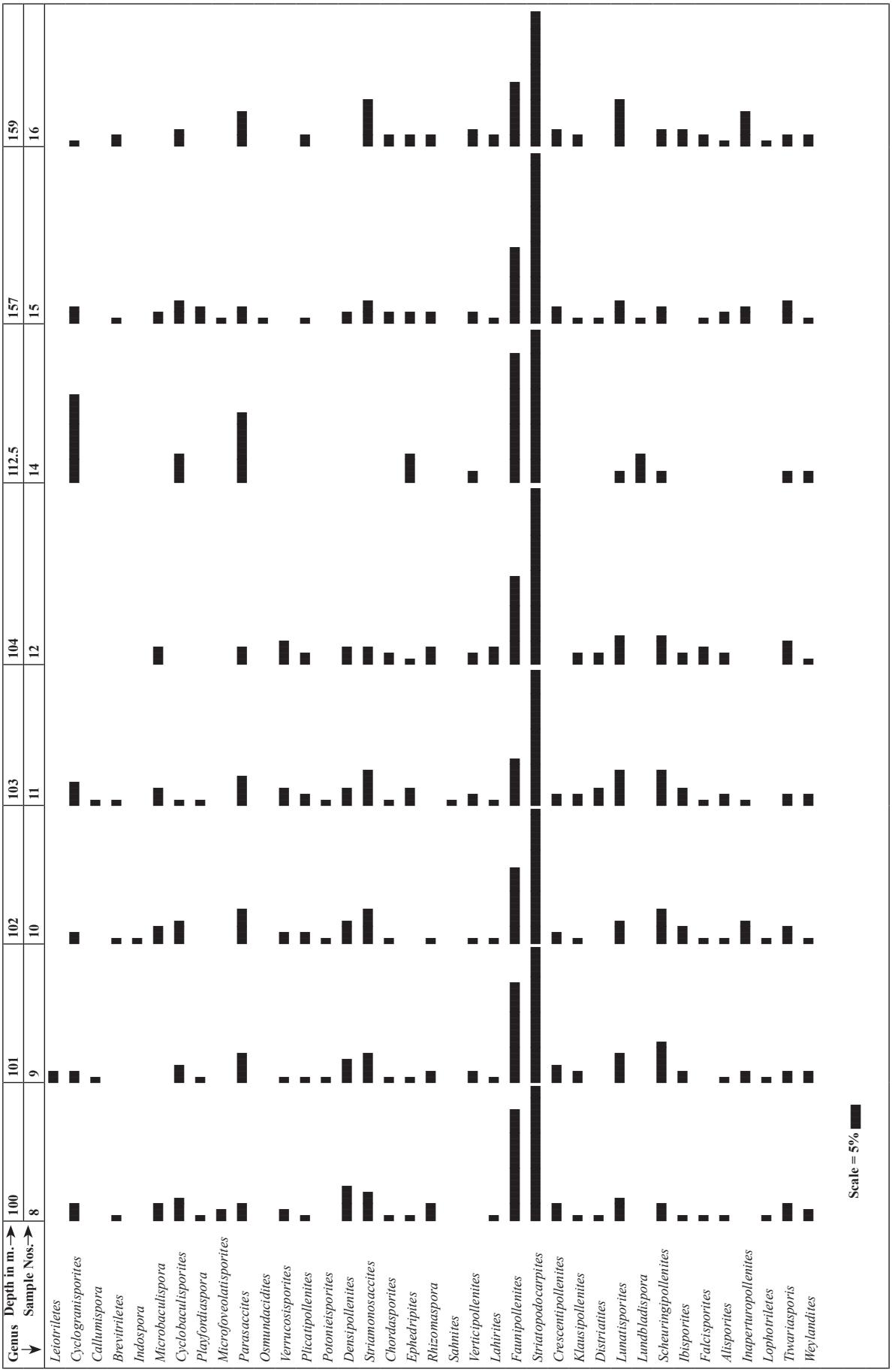

Fig. 2—Frequency distribution of the palynoflora recorded from Borehole No. WG–22, Sekapur area, Wardha District, Maharashtra.

Table 3—Frequency distribution of the palynoflora recorded from Borehole No. WG–22, Sekapur area, Wardha District, Maharashtra.

Genus ↓	Depth in meters →	100	101	102	103	104	112.5	157	159
	Sample Nos. →	8	9	10	11	12	14	15	16
Leiotriletes		–	2	1	–	–	–	–	–
Cyclogranisporites		3	2	2	4	–	15	3	1
Callumispora		–	1	–	1	–	–	–	–
Brevitriletes		1	–	1	1	–	–	1	2
Indospora		–	–	1	–	–	–	–	–
Microbaculispora		3	–	3	3	3	–	2	–
Cyclobaculisporites		4	3	4	1	–	5	4	3
Playfordiaspora		1	1	–	1	–	–	3	–
Microfoveolatisporites		2	–	–	–	–	–	1	–
Parasaccites		3	5	6	5	3	12	3	6
Osmundacidites		–	–	–	–	–	–	1	–
Verrucosisporites		2	1	2	3	4	–	–	–
Plicatipollenites		1	1	2	2	2	–	1	2
Potonieisporites		–	1	1	1	–	–	–	–
Densipollenites		6	4	4	3	3	–	2	–
Striamonosaccites		5	5	6	6	3	–	4	8
Chordasporites		1	1	1	1	2	–	2	2
Ephedripites		1	1	–	3	1	5	2	2
Rhizomaspora		3	2	1	–	3	–	2	2
Sahnites		–	–	–	1	–	–	–	–
Verticipollenites		–	2	1	2	2	2	2	3
Lahirites		1	1	1	1	3	–	1	2
Faunipollenites		19	17	13	8	15	22	13	11
Striatopodocarpites		23	23	23	23	30	26	29	23
Crescentipollenites		3	3	2	2	–	–	3	3
Klausipollenites		1	2	1	2	2	–	1	2
Distriatites		1	–	–	3	2	–	1	–
Lunatisporites		4	5	4	6	5	2	4	8
Lundbladispora		–	–	–	–	–	5	1	–
Scheuringipollenites		3	7	6	6	5	2	3	3
Ibisporites		1	2	3	3	2	–	–	3
Falcisporites		1	–	1	1	3	–	1	2
Alisporites		1	1	1	2	2	–	2	1
Inaperturopollenites		–	2	4	1	–	–	3	6
Lophotriletes		1	1	1	–	–	–	–	1
Tiwariasporis		3	2	3	2	4	2	4	2
Weylandites		2	2	1	2	1	2	1	2

exemplify consistently dominant association of striate bisaccate genera *Striatopodocarpites (*23–30%) followed by *Faunipollenites* (15–22%), the other striate bisaccates recorded are *Crescentipollenites*, *Verticipollenites*, *Distriatites, Lahirites, Ibisporites* and *Rhizomaspora* with frequency ranging between 1 to 3 percent, besides, *Cyclogranisporites, Cyclobaculisporites, Microbaculispora*, *Microfoveolatispora Verrucosisporites, Lundbladispora* and *Brevitriletes* up to a maximum representation of 5%. However, *Callumispora, Leiotriletes, Indospora* and *Osmundacidites* have scanty distribution. *Inaperturopollenites* exists between the range of 2 per cent and 6 per cent. Monosaccates, viz. *Densipollenites* (2–6%), *Parasaccites* (3–6%), *Striamonosaccites* (3–8%), *Plicatipollenites* (1–2%) and *Playfordiaspora* (1–3%) have also been noticed. There is meagre representation of taeniate forms, such as *Lunatisporites* (4%–8%) and *Chordasporites* (1%–2%). The non–striate bisaccates found associated in the palynoassemblage are *Klausipollenites, Alisporites, Falcisporites* (1%–3%) and *Scheuringipollenites* (2–7%). Other associated taxa present in this palynozone are *Tiwariasporis* (2–4%) and *Weylandites* ((1–2%), Table 3, Fig. 2, Pl. 1.

COMPARISON AND DISCUSSION

The palynoassemblage recorded during the present study has closer affiliation with the palynoflora recorded by Srivastava and Jha (1988a) from the lower member of the Kamthi Formation from Ramakrishnapuram (BH GGK–24), Ramagundam and Mantheni areas (BH Nos. GGK–20 and GGK–27), Chelpur (BH GJ–3), Bhopalpalli (GK–6) and Manuguru (BH GM–4 and GM–8) locality of the Godavari Valley Coalfield with respect to the dominance of striate disaccates, *Striatopodocarpites* along with the sub dominant *Faunipollenites*. The other common palynomorphs recorded in this assemblage includes *Striatites*, *Crescentipollenites* and *Lahirites*, non–striate genera, such as *Scheuringipollenites* and *Falcisporites,* taeniate, viz. *Lunatisporites,* trilete forms represented by *Brevitriletes* and *Verrucosisporites*. Srivastava and Jha (1988b) also recorded Late Permian *Striatopodocarpites–Faunipollenites* dominant palynoassemblage from sub–surface sediments between 206 m and 214 m depth range of Borehole No. GRB–7 from Budharam area within Chinnur Belt of the Godavari Valley Coalfield, which is broadly comparable with present findings, however as it contains Cavate–cingulate spores along with *Falcisporites, Klausipollenites* and *Lunatisporites* it is comparatively younger in age.

Srivastava and Jha (1990) also recorded Late Permian palynofloral evidence (assemblage 1–4) from sub–surface sequence of Borehole GAM–7 representing Mailaram area of the Godavari Valley, the palynoassemblages recovered shows the dominance of *Striatopodocarpites* and *Faunipollenites* along with variable frequencies of the *Densipollenites, Crescentipollenites, Lunatisporites, Falcisporites, Klausipollenites, Guttulapollenites* and *Gondisporites.* It compares well with present finding with respect to the striate disaccates association, however, is younger in age than the present assemblage. Bharadwaj *et al.* (1978) analyzed the sediments of Bijori Formation exposed in upstream direction of Sukh–Tawa Nala from its confluence with the river Tawa of Satpura Basin, Madhya Pradesh. As observed during the present study the sediments of the Sukh–Tawa River also contains the dominance of *Striatopodocarpites–Faunipollenites* complex in association with genera, like *Densipollenites*, *Scheuringipollenit*es, *Lunatisporites*, *Crescentipollenites*, *Verticipollenites*, *Alisporites*, *Lahirites* and *Klausipollenites*. However, the absence of the *Corisaccites* and *Guttulapollenites* besides, *Polypodiidites*, *Hindipollenites* and *Circumstriatites* indicates a regional basinal variation in the then prevailing vegetational pattern of Satpura Basin and Wardha Valley Coalfield. This palyno–combination equates well with the topmost part of the Raniganj Formation therefore is comparatively older than the present assemblage.

Bharadwaj *et al.* (1979) also recorded similar palynoflora assemblage 1, with *Striatopodocarpites–Faunipollenites* combination from the Raniganj–Panchet and Supra–Panchet sediments exposed near Machhakanda Johr stream, a tributary in south of the Damodar River, Saburbandha Nala Section representing East Raniganj Coalfield and Nonia Nala Section exposed in the northern side of Damodar River of Damodar Basin.

The present study displays analogy with palyno–combination recorded by Kalkar *et al*. (2010) from Makardhokada area of Nagpur District which suggests the continuity of the almost similar vegetational pattern around Nagpur and Chandrapur district areas of Maharashtra, however, the absence of some important genera, viz. *Densipollenites*, *Navalesporites*, *Lunatisporites* and *Striatites* in the present assemblage marks the regional generic local variation and thus this assemblage is slightly older (basal part of Raniganj Formation) than that of the Makardhokada which equated with middle part of Raniganj Formation of Damodar Valley.

Vijaya *et al.* (2012) made the palynological analysis of the coal bearing horizon from East Bokaro Coalfield of the Damodar Basin, their assemblage zone III contains the dominance of *Striatopodocarpites–Faunipollenites* and *Scheuringipollenites* which equates well with the present results. Similarly, Tiwari and Tripathi (1992) studied the sediments representing the basal part of the Upper Permian Sequence (Raniganj Formation) their Assemblage zone (A) has close affinity with the present palynoassemblage.

Kumar (1996) recorded assemblage from Permo–Triassic carbonaceous shale sequence exposed at the Tamia Scrap in Chhindwada District of the Satpura Gondwana Basin, Madhya Pradesh, the palynoassemblage A is characterized

Table 4—List of the palynomorphs identified during the present study and their probable affinity.

Probable affinity	**Palynotaxa**
Pteridophytes	*Brevitriletes* Bharadwaj & Srivastava 1969
	Leiotriletes (Naumova) Potonié & Kremp 1954
	Callumispora Bharadwaj & Srivastava emend. Tiwari *et al*. 1989
	Cyclogranisporites Potonié & Kremp 1954
	Cyclobaculispora Bharadwaj 1955
	Indospora Bharadwaj 1962
	Microbaculispora Bharadwaj 1962
	Microfoveolatispora Bharadwaj 1962
	Osmundacidites Couper 1953
	Verrucosisporites Ibrahim emend. Smith 1971
	Lundbladispora Balme & Playford 1965
	Lophotriletes (Naumova) Potonié & Kremp 1954
Gymnosperms	
Cycadales–Ginkgoales	*Tiwariasporis* Maheshwari & Kar 1967
	Weylandites Bharadwaj & Srivastava 1969
Conifers	
Monosaccate pollen grains	*Densipollenites* Bharadwaj 1962
	Parasaccites Bharadwaj & Tiwari 1964
	Playfordiaspora Maheshwari & Banerji emend. Vijaya 1995
	Potonieisporites Maheshwari 1967
	Plicatipollenites Lele 1964
	Striamonosaccites Bharadwaj 1962
Non–striate bisaccate pollen grains	*Alisporites* Daugherty emend. Jansonius 1971
	Falcisporites Leschik emend. Klaus 1963
	Klausipollenites Jansonius 1962
	Scheuringipollenites Tiwari 1973
Striate bisaccate pollen grains	*Crescentipollenites* Bharadwaj, Tiwari & Kar 1974
	Faunipollenites Bharadwaj 1962
	Rhizomaspora Wilson 1962
	*Striatopodocarpites S*oritsch & Sedova emend. Bharadwaj 1962
	Verticipollenites Bharadwaj 1962
	Sahnites Pant emend. Tiwari and Singh 1984
	Lahirites Bharadwaj 1962
	Distriatites Bharadwaj 1962
	Ibisporites Tiwari 1968
	Arcuatipollenites (Lunatisporites) Tiwari & Vijaya 1995
Taeniate bisaccate pollen grains	*Chordasporites* Klaus 1960

by the dominant association of *Striatopodocarpites–Faunipollenites* in association with younger elements, such as *Corisaccites, Guttulapollenites, Lunatisporites, Satsangisaccites, Nidipollenites, Klausipollenites, Falcisporites, Chordasporites,* etc. and therefore this assemblage has been dated to be Permo–Triassic in age and thus is comparatively younger in age than the present palynoflora.

Srivastava and Bhattacharyya (1996) studied the sub–surface Gondwana sediments encountered in Borehole No. DGW–6 from Bazargaon area near Nagpur, their assemblage A recorded between the depth 403 m and 526 m range shows the dominant association of *Striatopodocarpites* and *Faunipollenites* as recorded in the present case but in Bazargaon assemblage the existence of the genera, like *Marsupipollenites, Densipollenites, Guttulapollenites* and *Weylandites* makes it closely analogous with the top part Raniganj Formation of the Damodar Valley and thus is comparatively younger in age than our findings.

The palynoassemblage shows affinity with Gymnosperm, Pteridophyte and Conifer plant groups (Table 4). Tewari (2007, 2008), Tewari & Rajanikanth (2001) and Joshi *et al*. (2014) also mentioned about the existence of megaflora of heterogeneous nature having dominance of Gymnosperms followed by Pteridophytes during the Gondwana regimes in Wardha Valley Coalfield, which includes the members of Glossopteridales, Cordaitales, Equisetales and Filicales. Their inference also supports the finding of Stach *et al.* (1982) regarding the existence of the thick Glossopteris forest of Glossopteridae Group forests containing along with luxuriant growth of the aquatic plants of the group Calamariaceae. Existence of striate bisaccates in the present palynoassemblage indicates the prevalence of the warm temperate conditions of deposition; a similar view has been expressed by King (1961). The sub–surface palynological study leads to infer the existence of the sediments representing basal (Lower) part of the Kamthi succession is encountered from the studied borehole located near Sekapur area of the Wardha District of the Wardha Valley Coalfield.

CONCLUSIONS

The palynoflora has closer affiliation with the Lower Kamthi palynoassemblages of Makardhokada area, whereas, the assemblage recorded from Bazargaon area Nagpur District Maharashtra, is comparatively younger in age.

Most of the areas in Godavari Valley, Andhra Pradesh show deposition of the lower Kamthi sequence as indicated by their palyno contents, viz. Ramkrishnapuram, Chelpur, Bhopalpalli and Mailaram. However, deposition of younger, sediments with Permo–Triassic affiliation has been recorded from Budharam and Mailaram areas.

Existence of similar palynotaxa has also been revealed from the sediments of Nonia Nala, Machhakanda Johr and Saburbandha Nala of the Raniganj Coalfield of the Damodar Basin.

Similarly, the sediments *Striatopodocarpites–Faunipollenites* association but with Permo–Triassic affiliation due to the presence of palynomorphs of younger age is noticed from the Tamia outcrop of Chhindwada District of Satpura Basin is recorded. Thus, it is apparent that in all the above mentioned basins almost similar vegetation flourished indicating the prevalence of by and large similar climatic conditions with a slight regional variation. Existence of warm temperate depositional conditions is inferred.

Acknowledgements*—The authors (Drs O.S. Sarate & Srikanta Murthy) are thankful to Prof. Sunil Bajpai, Director BSIP, Lucknow, for his permission for this publication. Similarly, Dr O.S. Sarate & Dr (Mrs) S.A. Kalkar, wish to express their gratitude to Shri V.S. Sawakhande, former Director, Directorate of Geology and Mining, Govt. of Maharashtra, Nagpur, for his permission for sample collection along with their relevant details.*

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