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# Permian-Triassic palynofloral succession in subsurface from Bazargaon, Nagpur District, Maharashtra

Suresh C. Srivastava & A.P. Bhattacharyya

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Srivastava Suresh C & Bhattacharyya AP 1996. Permian-Triassic palynofloral succession in subsurface from Bazargaon, Nagpur District, Maharashtra. *Palaeobotanist* 43 (2) : 10-15.

The palynoflora contained in Bore-core DGW-6 from Bazargaon area near Nagpur is divisible into three palynozones. Palynozones 1 and 2 are characterised by *Densipollenites magnicarpus* and *Crescentipollenites fuscus* respectively are equivalent to the Raniganj palynoflora, while Palynozone - 3 marked by *Falcisporites stabilis*, compares with the Panchet palynoflora. The sedimentary sequence between 236.15 to 526.30 m is equivalent to Raniganj Formation (Late Permian) and includes the coal-bearing horizon. The strata between 236.15 to 108.4 m (Lower Member) and sediments up to 108.40 m from top (Upper Member) belonging to the Kamthi Formation are considered to represent the Early Triassic (Scythian).

**Key-words** —Palynology, Palynozonation, Kamthi Formation, Permian, Triassic (India).

Suresh C. Srivastava & A.P. Bhattacharyya, Birbal Sahni Institute of Palaeobotany, 53 University Road, Lucknow 226 007, India.

## सारांश

महाराष्ट्र में नागपुर जनपद में बजरगाँव की उपसतह में परमी-त्रिसंधी परागाणु वनस्पतिजातीय अनुक्रम

सुरेश चन्द्र श्रीवास्तव एवं अनन्त प्रसाद भट्टाचार्य

नागपुर के पास बजरगाँव के वेध-क्रोड़ डीजीडब्ल्यू 6 से प्राप्त परागाणुवनस्पतिजात तीन परागाणविक मंडलों में विभाजित किया गया है। परागाणविक मंडल 1 और 2 क्रमशः *डेन्सिपोलिनाइटिस मैग्नीकार्पस* एवं *क्रीसेन्टीपोलिनाइटिस फस्कस* से अभिलक्षित हैं, जबकि परागाणविक मंडल 3 *फाल्सिस्पोराइटिस स्टेबिलिस* से प्रभावी है तथा पंचेत परागाणुवनस्पतिजात से तुलनीय है। 336.15 से 526.30 मीटर के मध्य स्थित अवसादीय अनुक्रम रानीगंज शैल-समूह (अंतिम परमियन) के समतुल्य है तथा इसमें कोयला-धारक संस्तर विद्यमान हैं। 236.15 से 108.4 मीटर गहराई के मध्य (अधरि सदस्य) स्थित स्तरों तथा ऊपर से 108.40 मीटर के बीच विद्यमान कामथी शैल-समूह से सम्बद्ध अवसाद प्रारम्भिक त्रिसंधी कल्प (सायथियन) का निरूपण करते हैं।

THE Bazargaon area occurs as an inlier of the Kamthi Formation within the Deccan Traps about 30 km north-west of Nagpur on Nagpur-Amaravati Road. This area represents a detached outcrop outside the present limits of the Kamptee Coalfield and the physical continuity of the sediments of this basin below the Deccan Traps is yet to be established.

The Kamthi Formation (50-270 m) in Kamthi Coalfield overlies Motur Formation (Middle Permian) and underlies Lameta Formation (Cretaceous) with pronounced unconformity at both ends (Raja Rao, 1982). The disconformable nature of contact was

considered on the basis of the absence of argillaceous member of Kamthi Formation, which usually contain shale and coal seams in the Kamptee Coalfield and the Upper and Middle Members (*sensu* Raja Rao, 1982) were considered to rest directly over the Motur Formation. Shingte and Sah (1993) have preferred a similar stratigraphic set up of the Kamthi Formation (thickness  $\pm$  149 m).

The Kamthi Formation in Godavari graben has been divided into three members by Raja Rao (1992), the Lower Member corresponding to the coal-bearing Sondila Seam (=Raniganj Formation) while the Upper

Member correlated with the Kamthi beds of the type area and thus the age of the Kamthi Formation was considered to be Permo-Triassic. Later on Kutty *et al.* (1988) and Pande (1988) restricted the Kamthi Formation equivalent to the Upper Member (*sensu* Raja Rao). Ramanamurthy and Madhusudan Rao (1987) demarcated Panchet Formation in the upper part of the Middle Member of the Kamthi Formation. Recently, Jha and Srivastava (MS) have reclassified the Kamthi Formation into two members: the Lower Member correlating to the Panchet Formation and the Upper Member to the Kamthi beds of the type area and the Supra Panchet /Mahadeva Formation of the Damodar Valley. The lithological succession in the bore-hole DGW-6 has been demarcated according to this classification.

The sedimentary sequence in Bore-hole DGW-6 from Bazargaon area begins with dark brown coarse-grained ferruginous sandstone at the top (up to 108.40 m) representing the Upper Member of the Kamthi Formation and compares with the Kamthi beds of the type area. At various levels these sandstones are sufficiently hard and compact with conglomerate lenses and red to brick-red yellow limonitic shales. This constitutes a sufficiently thick horizon in the younger part of the bore-core. The middle part of the bore-core representing the Lower Member of the Kamthi Formation (108.40-236.15 m) is composed of medium to coarse-grained sandstone with blotches and streaks of red and purple shale bands underlain by alternating green clay, shale and sandstone. The lowermost unit (236.15-526.30 m) in this bore-hole includes an alternation of grey shale, carbonaceous shale, coal and sandstone representing the Raniganj equivalent sediments. The coal is highly banded in nature and dull durain type. Carbonaceous shale, coal and grey shale contain innumerable plant fossil impressions at various depths, *viz.*, *Glossopteris* (442.80 m, 428.60 m, 236.15 m) and *Schizoneura gondwanensis* (182.50 m) have also been observed in the present bore-hole (DGW-6).

Chandra and Prasad (1981) have described plant impressions of three species of *Glossopteris*, *viz.*, *G. musaefolia*, *G. mohudaensis* and *G. arberi* along with *Schizoneura gondwanensis* and *Dictyopteridium sporiferum* from a clay quarry in the Upper Member of the Kamthi Formation near Bazargaon. Kulkarni and Parmane (1991) also recorded two pteridophytic fronds, *viz.*, *Pecopteris* and *Sphenopteris* from Bazar-

gaon. However, there is no record of palynofossils from this area. The palynological records from Kamptee Coalfield are also limited and restricted to Barakar Formation (Agashe & Geetha, 1979).

## PALYNOZONATION

The palynoflora investigated from the sediments of Bore-hole DGW-6 drilled near Bazargaon is well preserved, diversified and dominant in striate-disaccate pollen grains. On the basis of the appearance and also maximum development of various taxa at different levels three palynozones have been demarcated (Text-figure 1).

*Palynozone 1*—Striate-disaccate+*Densipollenites magnicarpus* (403.30-526.30 m).

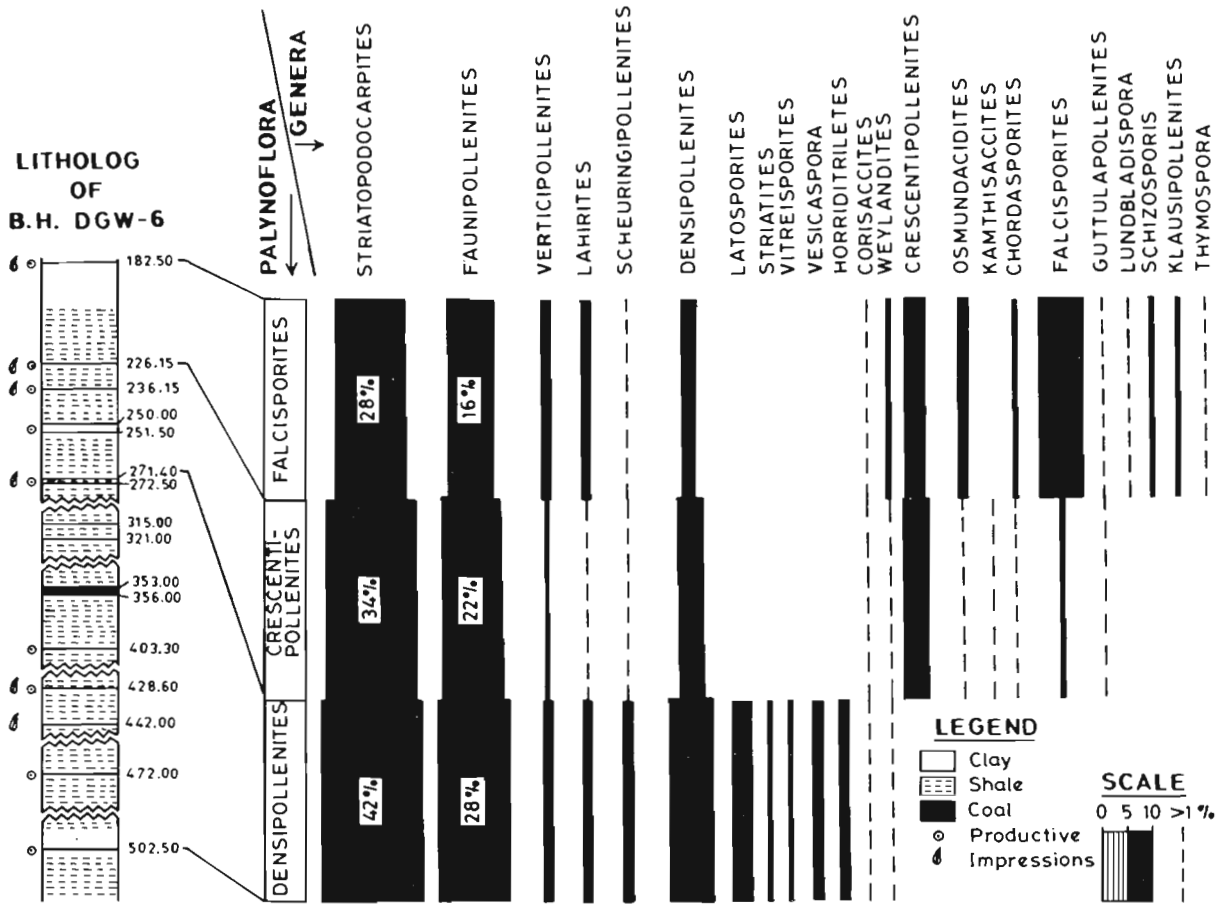
*Palynozone 2*—Striate-disaccate+*Crescentipollenites fuscus* (236.15 - 403.30 m).

*Palynozone 3*—Striate-disaccate + *Falcisporites stabilis* (182.50-236.15 m).

*Palynozone 1*—The palynoflora is essentially rich in striate disaccate pollen, chiefly *Faunipollenites* and *Striatopodocarpites*. Amongst various species of *Striatopodocarpites*, *S. venustus* is most common and similarly *Densipollenites magnicarpus* is characteristic of this palynozone. These two species are also present in the younger palynozone though their frequency decreases. *Protohaploxylinus microcarpus* is present persistently in low percentages. The other significant taxa in association are *Verticipollenites gibbosus*, *Lueckisporites nyakapendensis*, *Horriditriletes curvibaculosus*, *Osmundacidites senectus*, *Latosporites colliensis*, *Kendosporites striatus*, *Praecolpites sinuosus*, *Marsupipollenites triradiatus* and *Weylandites lucifer*. Except the first, rest all other taxa occur in very low percentages yet their consistent presence is stratigraphically significant. *Guttulapollenites hannonicus* and *Corisaccites alutas* continue to be present in low percentages in all the palynozones.

*Palynozone 2*—It is characterised by the subdominance of *Crescentipollenites*, *viz.*, *C. fuscus* and *C. gondwanensis*. *Distriatites*, *Kamthisaccites* and *Striamonosaccites* are restricted while *Falcisporites stabilis* makes its first appearance in this zone.

Palynozones 1 and 2 compare with similar palynozones in the Raniganj equivalent sediments in Godavari graben (Srivastava & Jha, 1990) and Satpura Basin (Bharadwaj *et al.*, 1978). *D. magnicarpus* and



Text-figure 1—Distribution of palynozones of the bore-hole DGW 6 in Bazargaon, Nagpur District, Maharashtra.

*Crescentipollenites* zones represent the youngest assemblages in the Raniganj Formation of Damodar Valley (Tiwari & Tripathi, 1992). Its comparison with the Chhidru Formation (Salt Range, West Pakistan; Balme, 1970) is notable in view of the presence of *P. microcorpus*, *O. senectus*, *L. nyakapendensis*, *G. hannonicus* and *C. alutas*. The latter two taxa also occur in the Sakamena Group of Madagascar

(Goubin, 1965), Luangwa Valley, Zambia (Utting, 1979) and Rhodesia (Falcon, 1973). The Bazargaon area thus shows palaeogeographic provincialism in this respect. Almost all these taxa are also present in the Amery Formation of Lambert graben in Antarctica (Playford, 1989). The presence of *P. sinuosus* in sufficient numbers in Bazargaon further strengthens this linkage with Amery Formation.

### PLATE 1

All the figures are magnified X ca 500 unless otherwise mentioned. Scale bar is 10  $\mu$ m.

- Lunbladisporea microconata*, slide no. BSIP 11241.
- Verrucosporites* sp., slide no. BSIP 11249.
- Osmundacidites senectus*, slide no. BSIP 11240.
- Praecolpites sinuosus*, slide no. BSIP 11248.
- Callumisporea fungosa*, slide no. BSIP 11240.
- Falcisporites stabilis*, slide no. BSIP 11241.
- Distriatites insolitus*, slide no. BSIP 11248.
- Corisaccites* sp., slide no. BSIP 11240.
- Corisaccites alutus*, slide no. BSIP 11243.
- Guttulapollenites hannonicus*, slide no. BSIP 11244.
- Faunipollenites minor*, slide no. BSIP 11245.
- Densipollenites magnicarpus*, slide no. BSIP 11248 (X 300).
- Weylandites lucifer*, slide no. BSIP 11247.
- Lunatisporites pellucidus*, slide no. BSIP 11246.
- Strotersporites indicus*, slide no. BSIP 11245.
- Crescentipollenites fuscus*, slide no. BSIP 11242.
- Kamthisaccites kamthiensis*, slide no. BSIP 11250.
- Leiosphaeridia* sp., slide no. BSIP 11242.
- Scheuringipollenites* sp., slide no. BSIP 11241.

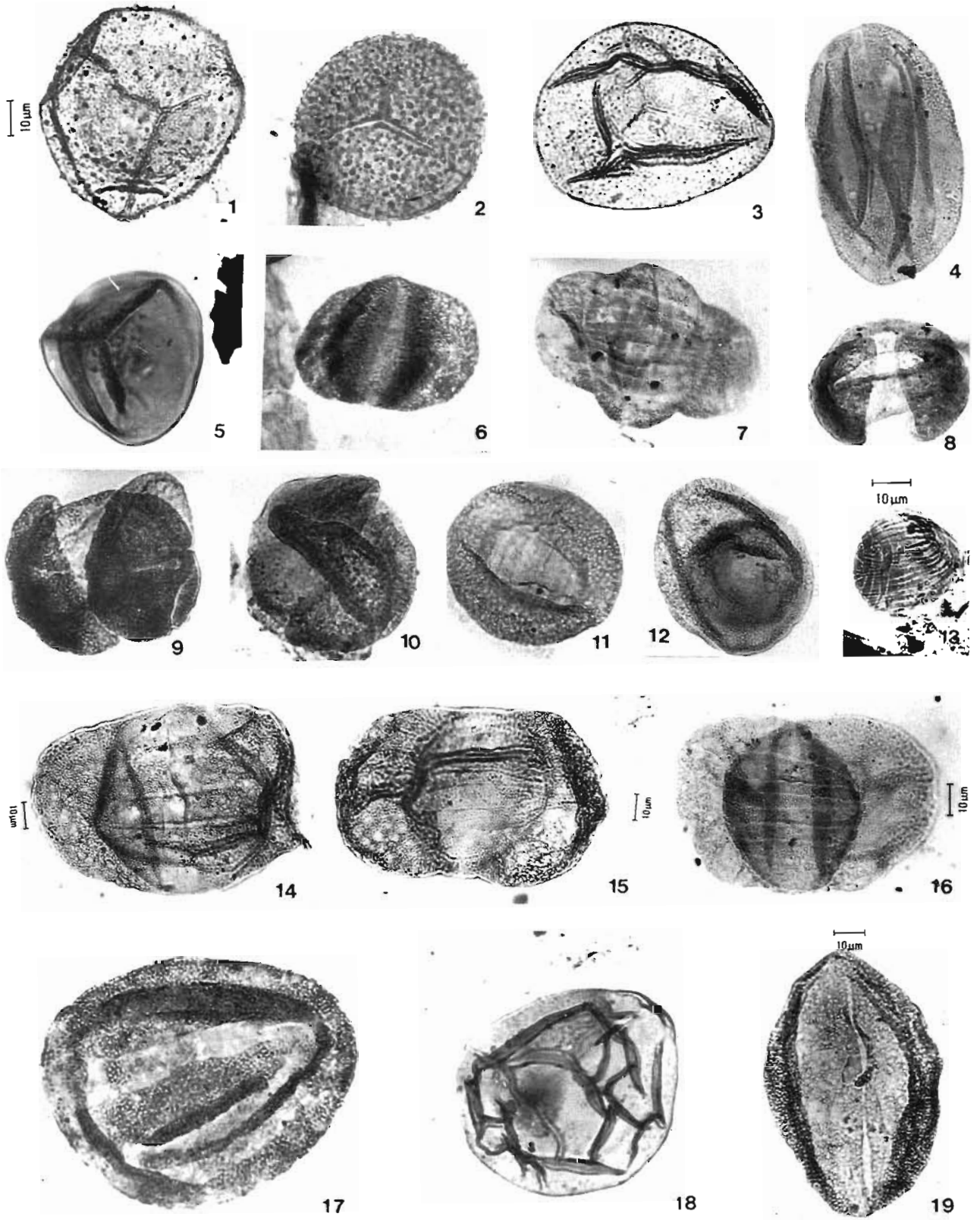


PLATE 1

*Palynozone 3*—*Falcisporites stabilis* rises to sub-dominance and represents the youngest palynoflora in this succession. Many other notable taxa get associated in Palynozone-3, such as *Callumispora*, *Guttatisporites*, *Verrucosisporites*, *Chordasporites*, *Vitreisporites pallidus*, *Lunatisporites pellucidus*, *Lundbladispora microconata* and *Klausipollenites schaubergeri* though they are present in low percentages. The latter three taxa have appeared for the first time. The presence of *Leiosphaeridia* is also significant.

Some of the dominant striate-disaccate continue with diminishing frequencies in Palynozone-3 but the majority of other taxa decline sharply. The emergence of Early Triassic taxa get more significant. Palynozone-3 in Bore-hole DGW-6 is equivalent to Early Triassic palynozones of India (Tiwari & Singh, 1986; PIA-*Striatopodocarpites* + *Klausipollenites*). This assemblage is older than the *Densoisporites* + *Lundbladispora* assemblage from Budharam area (Srivastava & Jha, 1990) in Godavari graben.

### DISCUSSION

The Kamptee Coalfield is considered to be the northerly extension of the Pranhita-Godavari coalfields in central India and represents a distinct tectono-sedimentary basin where Talchir and Barakar formations are well-developed and Kamthi Formation comprising ferruginous sandstone, red and mottled shales overlies the eroded surface of the Barakar sediments with an angular discordance (Datta & Mitra, 1982). Similar observation was also made by Raja Rao (1982) who considered the Kamthi to rest over the Motur Formation unconformably. Thus a major break in sedimentation was envisaged at this level.

However, the lithological succession in Bore-hole DGW-6 near Bazargaon represents almost a complete sequence of the Kamthi Formation similar to those found in Godavari graben (*sensu* Raja Rao, 1982). The palynological succession in Bore-hole DGW-6 also shows similar resemblance with the palynoflora of the Kamthi and Raniganj formations in Godavari graben (Srivastava & Jha, 1990; Srivastava, 1992). Palynozones 1 and 2 represent the Late Permian palynofloral zones in Bazargaon. Its affinity with Godavari Basin is further strengthened by the

common occurrence of *Corisaccites alutas*, *Guttulapollenites hannonicus*, *Striatopodocarpites venustus* and *Kamthisaccites*. Out of the six palynozones described from Raniganj Formation of Godavari graben only the younger two palynozones have been recorded in Bazargaon. This indicates that the Raniganj equivalent sediments are expected further deeper in this area which may contain the older four zones, raising the probability of further thicker Raniganj Formation in Bazargaon area.

Palynozone-3 is the youngest in succession and associated with the green shale and clay unit of the Lower Member of Kamthi Formation and is equivalent to the oldest palynoassemblage of the Panchet Formation of Damodar Valley.

The present investigation leads to the conclusion that the coal-bearing oldest unit in bore-hole DGW-6 is equivalent to the Sondila Seam bearing coal horizon of the Godavari graben and thus holds a greater promise of economically viable coal reserves in this area. The earlier view of the absence of this member (equivalent to Raniganj Formation) in Kamptee Coalfield by earlier workers is thus ruled out palynologically and the nature of contact with the underlying Motur Formation may not necessarily be considered always a disconformity. This also provides evidence of the plausible physical continuity of Late Permian-Triassic sediments with the main basin in Kamptee Coalfield. The Lower Member of the Kamthi Formation is equivalent to the Panchet Formation of the Damodar Valley and the transition with the underlying Permian is gradational in Bazargaon area. The lithological association of the Lower Member is supported by the palynoflora which is comparable with Lower Kamthi in Godavari graben and the Panchet Formation of Damodar Valley. The Upper Member of the Kamthi Formation as a sequel becomes correlatable with the Supra Panchet/Mahadeva Formation in order of superposition. This unit forms prominent hill ranges in Godavari graben and in Bore-hole DGW-6 it is the youngest unit (up to 108.4 m). The fern fronds recorded by Kulkarni and Parmane (1992) and also the *Glossopteris* flora described by Chandra and Prasad (1981) from Bazargaon may belong to this unit. The occurrence of *Glossopteris* and *Vertebraria* is also known from the Mahadevas (Ball, 1886) of Auranga Coalfield. The

continuation of the *Glossopteris* flora in Kamthi Formation is also known from Kamthi, the type area (Oldham 1860), and Wardha Valley Coalfield (Chandra & Prasad, 1981). In Mangli beds *Glossopteris* occurs along with *Estheria* (Tasch *et al.*, 1975). Similar looking Handapa beds (Chandra & Singh, 1992) contain congregation of *Glossopteris* but 50 per cent species present in them also occur in Triassic. *G. gopadensis*, although rare, is also present in Handapa beds and indicates Triassic affinity. Pal *et al.* (1991) recorded *Lepidopteris* and *Dicroidium?* in addition to *Neomariopteris* and *Glossopteris* from almost equivalent beds near Sarimunda Hills close to Handapa, and considered it to be equivalent to be Lower Triassic in age. These observations also support the present contention inferred here.

#### ACKNOWLEDGEMENT

The authors are thankful to the authorities of the Geological Survey of India for providing necessary facilities for the collection of bore-core samples.

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