



*General
Consideration*

GENERAL CONSIDERATION

The Gondwana deposits in Maharashtra are restricted to Nagpur, Chandrapur, Yeotmal and Bhandara districts. The major part of these deposits belong to Lower Gondwanas or Palaeozoic age. However, small pockets of Upper Gondwana deposits are found in Chandrapur district near the boundary of Andhra Pradesh. The Lower Gondwana deposits have preserved the fossil plants belonging to Carboniferous and Permian age. They are preserved as impressions as well as petrifications. The impressions are associated with coal mines which are found in Nagpur and Chandrapur districts. Some times they are found at the places other than coal mines such as stream beds and stone quarries. The petrified woods are mostly exposed in the stream beds and some times in the open areas like cotton fields etc. Previous work on Lower Gondwana flora of Maharashtra includes the contributions of Bunbury (1861), Feistmantel (1881), King (1881), Fox (1934) and others. Due to rich plant fossil assemblage recently these areas are studied by several workers, they included Chitale (1949), Vagyani & Mahabale (1974), Mahabale and Vagyani (1980), Vagyani and Raju (1982), Vagyani and Jamane (1989), Varadpande (1977 a,b), Prasad (1978), Prasad and Chandra (1978 a,b), Chitanis and Vagyani (1979), Agashe and Gowda (1979), Chandra and Prasad (1980), Prasad and Chandra (1981), Chandra and Prasad (1981), Agashe et al. (1981) Biradar and Bonde (1981), Agashe & Gowda (1982), Prasad (1982), Prasad and Chandra (1984).

The Lower Gondwana deposits having plant fossil assemblage covers mostly Barakar and Raniganj stages. In Maharashtra, Raniganj stage is recognised by the term 'Kamthi Stage' or 'Kamthi formation'. The name Kamthi was first used by Blanford (in Hughes 1877) for a place called as Kamptee which is situated 20 Kms. from Nagpur in North-east direction. The Kamthi formation is exposed in Pranhita Godavari valley in Maharashtra and Wardha Godavari valley in Maharashtra and Andhra Pradesh. The flora of Kamthi Stage is meagerly worked out inspite of its rich plant fossil contents. Present work deals with only few exposures found in Nagpur district. The object of under taking this region is that flora of Chandrapur district is recently studied by several workers while little attention was paid to the Lower Gondwana flora of Nagpur district hence the plant fossils were collected from three different places viz. (1) Satnavari, (2) Bazargaon, (3) Umred.

The plant fossils here are mostly in the form of impressions hence the earlier workers thought that the petrified woods are absent in this region. Recently Varadpande (1977 a, b) described some petrified woods from Satnavari, therefore, it was thought worthwhile to investigate additional petrified material which will throw more light on the flora.

(1) Satnavari:

This locality is situated on the Nagpur Amravati road at the distance of 28 Kms. from Nagpur. The region shows small

hillocks having fossiliferous shales in the form of fine grained sand stone deposits. The material was collected from a well known quarry which has yielded number of plant impressions, the impressions were also collected from isolated patches which vary in colour ranging from chocolate brown to violet. From these patches the shales were broken and impressions were exposed at the bedding plane. At Satnari^a few streams which are near the village and main road have yielded the petrified woods. The woods were found mostly embeded in the banks of streams while some of them are found insitu. The woods belong to coniferales except these spots the petrified woods are not found at other places.

(2) Bazargaon :

This locality lies on the same track of Satnari^a but it is few Kms. ahead of Satnari here only impressions are found, they are mostly yellowish white or brown in colour, preserved on fine grained sandstone. At Bazargaon, there are no quarries and the material was collected from nallah cuttings as well as few isolated patches.

(3) Umred :

This locality lies about 40 Kms. from Nagpur, where an opencast coal mine is exposed, the fossiliferous material is dumped on the surface by the authority of coal mine. The material includes pink coloured soft sand stones showing impressions only.

The present work includes impressions as well as petrifications and it is divided into two parts -

Part - One : Includes study of petrified woods found at Satnari.

Part - Two : includes study of impressions collected from Satnari, Bazargaon and Urmed.

PART I - PETRIFIED WOODS :

Several petrified woods were collected from Satnari, from these 12 specimen were investigated on the basis of anatomical characters. They were identified and compared with the genera and species which are described earlier. From the comparison and detail studies finally 4 specimens were selected and incorporated in the dissertation. This is done due to their distinct features. These specimens belong to 4 genera of coniferous woods. They were investigated upto specific level and on the basis of critical comparison. They are assigned to four new species.

Genus - Araucarioxylon Kraus 1870

The genus Araucarioxylon represents the Family Araucariaceae. The fossil woods of Araucariaceae have been earlier described under two different generic names such as (1) Araucarioxylon, Kraus (2) Dadoxylon Endlicher.

The woods were describedd by earlier authors under

these names without distinct criteria Therefore, lot of confusion has taken place while selecting the proper genus for Araucariaceae. It is found that in India Araucarian woods are abundant in Palaeozoic, particularly in Barakar and Raniganj Stage. They are also found in the Mesozoic in considerable amount while very few members have been described from Coenozoic rocks. Lepekhina (1972) resolved the problem of assigning the fossil woods of Araucariaceae to the proper genera. According to the scheme woods with Araucarian features having only secondary xylem are placed under Araucarioxylon, while those with primary features like pith and primary xylem are placed under Dadoxylon. Comparing to Raniganj little work has been done on the Araucarioxylon of Kamthi formation. The present work shows the occurrence of a new species from Nagpur district. The wood shows distinct features like 1-3 seriate radial pitting 1-2 seriate xylem rays and 1-8 crossfield pits. The rare features like Xylem parenchyma, bars of sanio and tangential pitting justifies this new species. It is named after Russian Palaeobotanist Lepekhina due to her extensive contribution on the Palaeozoic coniferous woods. The species A. lepekhinae shows the occurrence of rich coniferous members at Satnari^a which is a well known place for members of Glossopteridales. However, presence of Araucarioxylon in Kamthi formation does not give any clear view about the age of Kamthis. This is due to a well known fact that Araucarioxylon has an extensive vertical range of distribution. So far the time

is concerned, but it adds more information about the flora developed at Satnari.

Genus - Kamthioxylon Mahabale and Vaygani 1980

The genus is instituted by Mahabale and Vaygani (1980) for an interesting transitional conifer found in the Kamthi rocks of Chandrapur district. The features of the wood are not only distinct but they are noteworthy in having an admixture of characters belonging to two families. The Araucarian features are represented by multiseriate hexagonal pits while the vestured pits represent the family Cupressaceae. The genus Fitzroya and Libocedrus shows vestured pits, further abundance of xylem parenchyma support the affinity of Cupressaceae. Bars of Sanio, abundance of resin in the form of resin plugs and presence of xylem parenchyma shows characteristic features of the genus. Mahabale and Vaygani described K. adhariense from Adhari in Chandrapur district of Maharashtra, while K. sathariense described in the present work indicates its occurrence at a new locality viz. Satnari in Nagpur district. The creation of new species is based on some clear difference from K. adhariense. The report of Kamthioxylon in Nagpur district suggest that the genus had wider distribution in the Gondwanas belonging to Kamthi Stage. Kamthioxylon can be considered as a distinct representative of fossil flora developed in the Kamthi rocks of Maharashtra. The combination of characters also suggest the distinct palaeoenvironment prevailing in these areas. One can assume the transitional conifers such

as Kamthioxylon must have been developed in the past which needs further investigations.

Genus - Dadoxylon Endlicher

Present status of Dadoxylon is quite clear due to outstanding contribution of Lepekhina (1972). Earlier the genus was considered as synthetic genus and any Araucarian wood irrespective of age or presence or absence of primary features were described under this generic name. Therefore, several earlier descriptions of Dadoxylon species described from India should be revised under the new scheme of Lepekhina. More than half a dozen of Dadoxylon woods have been described from India, they come from Raniganj as well as Kamthi rocks. From Raniganj Dadoxylon species have been described in the earlier phase of palaeobotanical research in India but Dadoxylon from Kamthi represent the recent palaeobotanical research which has taken place in last 30-40 years. The contribution of Prasad (1986) is commendable in this respect. He has described D.chandrapurensis, D. adhariense and D.maharashtrasis from Chandrapur district of Maharashtra, while this is the first record of the genus from Satnari^a due to presence of distinct features like homogenous pith, endarch primary xylem, 1-3 seriate radial pits uniseriate xylem rays and 1-5 crossfield pits. It is assigned to a new species D.maheshwarii sp.nov. Occurrence of Dadoxylon at Satnari^a gives an additional information about the coniferous members developed in the fossil

flora of this area. Presence of primary features and other characters clearly gives a clue about warm temperate climate where family Araucariaceae thrives well.

Genus - Prototaxoxylon Krausel & Dolianti 1958

This genus also gives a larger vertical range of its distribution and indicates an admixture of characters belonging to Araucariaceae and Taxaceae. Out of these two families; family Taxaceae is modern coniferous family while Araucariaceae is a primitive member. The transitional conifers like Prototaxoxylon throws some light on the evolution of conifers. It is suggested that in Mesozoic we get modern conifers from ancestral stalk of Araucariaceae. Genus Prototaxoxylon must have served as an intermediate phase in the course of evolution. Occurrence of Prototaxoxylon in Kamthi rocks is already confirmed by contributions of Biradar and Bond~~e~~(1978) Prasad and Prasad. However all these records belong to Chandrapur district only, present work adds new information about its occurrence at Satnori which is new locality for such conifers. Hence the Kamthi rocks of Maharashtra shows wider occurrence of Prototaxoxylon due to its reports in Chandrapur and Nagpur districts. It also indicates richness of Satnori flora whereas as many as four different coniferous fossil genera have been recorded in the present work. The occurrence of new species P. satnori^a is based upon distinct features of the species which are different from others. It also suggest conifers like Prototaxoxylon must have been emerging in the Kamthi formation.

PART II - IMPRESSIONS :

Total number of impressions described in the present investigation is 12. They include different groups such as Gymnosperms and Pteridophytes.

GYMNOSPERMS :

Under this group member of Glossopteridales form the major part. The leaf genus Glossopteris includes five specimens and assigned to five species. They come from Satnaori and Bazargaon - two distinct localities in the Nagpur district. The Glossopteris leaf shows variations in morphological characters as well as cuticular features. Since the present material is devoid of carbonaceous matter the descriptions are based on morphological characters only. Following species have been identified and described -

1. Glossopteris emarginata
2. G. retifera
3. G. longicaulis
4. G. sp.
5. G. surangei.

Among these G. emarginata is characterised by an emarginate apex and hence it is different from others. Similarly G. retifera shows notches on the upper part of the margins and also stands apart from others. G. longicaulis is characterised by presence of long petiole and hence it is easily identified. G. surangei shows the typical venation pattern and form of

meshes. G. sp. could not be assign to already known species due to its fragmentary nature. Hence the five different species occuring in a small part of Nagpur district indicates Kamthi flora of Nagpur district showed much variations in form and structure. It is well known fact that the leaves are abundant while reproductive organs are rare, sole representative of Glossopteridean reproductive organ is a fertile scale of venustostrobis type of fructification. Genus Venustostrobis is earlier known from Raniganj and Hadappa formations of Orissa. The Raniganj stage belongs to Upper Permian while Hadappa formation represents Kamthi stage of Orissa hence presence of such scale in Maharashtra indicates that the fructification showed wider distribution in Kamthi rocks of Maharashtra and Orissa.

Genus Gangamopteris is second important component of Glossopteridales and represented by 2 species viz. G.major and G.sp. It is well known fact that Gangamopteris is more dominant in Karharbari and Barakar than Glossopteris while Glossopteris is dominant in Raniganj, Kamthis and some times reaches upto Lower Triassic. Presence of 2 sps. of Gangamopteris reflects mixture of older elements below the Raniganj stage in Nagpur flora.

Genus Rubidgea which is rare genus and represented by only 1 sp. It is known from Satnaori. Presence of R.lanceolata in Nagpur district indicates a new element of flora as well as it suggests wider distribution of the genus.

Genus Noeggerathiopsis it is a member of Cordaitales. The leaves are abundant in Karharbari and Barakar. Noeggerathiopsis gets reduced in Raniganj and finally disappears at the end of Permian. Two species of this genus indicates the cordaitalean members which were present in Nagpur flora where pockets of temperate climate was present.

PTERIDOPHYTES :

Under this a single specimen belonging to Genus Neocalamites is described as N. foxi Lele. Genus Neocalamites is considered as a typical member of Indian Triassic. It followed after the large tree sized calamites in Northern hemisphere. It is included under Equisetales where it is associated with Genus Schizoneura, Phyllothea and Equisetites. Interestingly Phyllothea is reported in the Lower triassic by Lele. However, Schizoneura becomes extinct in the earlier part of Triassic. In the Mesozoic the genus Equisetites is dominant representative which is found in Jurassic and Cretaceous rocks. The well known species E. rajmahalensis from Rajmahal formation and E. sehoraense from Jabalpur formation indicate that Equisetites was dominant in the period ranging from Middle Jurassic to Cretaceous. Hence sequence of Triassic Equisetales and Phyllothea from the earlier part of Mesozoic continued in Mesozoic in the form of Equisetites. In connection with this observation the presence of Neocalamites in Kamthi flora of Nagpur district is perplexing matter because we observe that more than 50% of members belong to Barakar and Raniganj i.e.

Carboniferous and Permian while other three represent a Triassic age. Therefore, the flora of Nagpur district cannot be correlated with that of flora of Chandrapur district of Maharashtra. If we assign the Kamthis to Nagpur flora then we have to consider the age of Kamthis in the newly available data. Pande (1987) suggested that Kamthi beds represent group of rocks disconformably overlapping the Permian beds in Wardha Godavary valley. He further points out that it represents a distinct pattern of Gondwana formation which takes place in Palaeozoic and Mesozoic period in Wardha-Godavary valley. The palynological studies also indicates the Lower Triassic age, this is highly disputed by Chandra and Prasad (1981) on the basis of studies of fossil rocks from Kamthi beds of Maharashtra. They strongly supports Upper Permian age which is equal to Raniganj Stage in West-Bengal. Vagyani and Mahabale (1972) while describing transitional conifers like Planoxylon indicum discussed the palaeoenvironment of Kamthi and arrived at conclusion that Kamthi is Lower Triassic in age. King (1818) suggested the same opinion on the basis of coal measures found in Pranhita-Godavary valley. Fox (1934) and the studies of G.S.I. (1960-66) have put forth a new concept where the Kamthis are divided into three units. Lower equivalent to Raniganj, Middle equivalent to Lower Panchet and Upper part, the Panchet stage which is equivalent of Triassic. Considering these contraversial facts that firm results cannot be obtained because the present studies cover a limited number of impressions and petrified woods. However, it is suggested that

the woods definitely represent a temperate palaeoclimate while the members like Neocalamites, Noeggerethiopsis and Glossopteris suggests a tropical humid climate. Today except Antarctica the Glossopteris fossils are found in southern hemisphere countries which have tropical climate. Therefore, one can build a picture of palaeoclimate prevailing in Nagpur district as follows - Major area representing a warm tropical humid climate having small pockets of temperate environment. Perhaps these were hilly areas present in the large piece of light. To have a precise picture of palaeoclimate and proper age of Gondwana flora developed in Nagpur district further work is necessary, for the time being the age of flora assumed as from Upper Permian to Lower Triassic.

difficult to draw
paleoclimatic
conclusions based on
discovery of few
specimens!