VI. GENERAL CONSIDERATION

The present investigation deals with petrified woods collected from Adhari, Nandori and Panwadala in Chandrapur district of Maharashtra State. The localities are situated in Wardha-Godavari valley, which mostly consist of rocks belonging to Kamthi Stage. Impressions were collected from Adhari in Chandrapur district and Bazargaon and Satnori in Nagpur district. These localities are also situated in Wardha-Godavari valley and the fossiliferous rocks exposed here belongs to Kamthi Stage. The woods described here were found in situ and also embeded in strata. This situation is found at Adhari, however, at Nandori and Panwadala they were found scattered on the surface of fields or on the banks of streams. The woods were abundent at Nandori and Adhari but they were rare at Panwadala. In some places, like Bazargaon they were completely absent. The impressions were comparatively less in number. They were mostly preserved as mineralized and devoid of cuticle or carbonaceous matter. They are preserved on ferrugenous variegated sandstones, yellowish brown or reddish-white in colour.

I) Woods :

Several pieces of petrified woods were collected from Adhari (20°8'; 79°11'), Nandori and Panwadala (20°12'; 79°02'). Some pieces showed excellent preservation while others were not much promising. Hence those pieces were selected for the description which show excellent preservation. All the woods

belongs to conifers. In the present work 4 woods belonging to 4 different genera were selected. The identifications were made by using xylotomical characters given by Lepekhina (1972), Maheshwari (1972), and Prasad and Chandra (1981).

Family - Araucariaceae :

According to Lepekhina (1972), this family includes three fossil genera, (1) Araucarioxylon Kraus, (2) Dadoxylon Endlicher, (3) Agathioxylon Hartig. In the present collection woods having characters of Araucariaceae are dominant. Better preserved specimens were selected for description. About 8 woods showed the characters of Araucariaceae but only one of it is included in the present dissertation due to its promising characters. It belongs to genus Agathioxylon.

(A) Genus - Agathioxylon :

The genus Agathis is a member of the family Araucariaceae. It is confined to Southern hemisphere, but more common in Australia. Usually, it is difficult to distinguish between the woods of Araucaria and Agathis. Recently Greguss (1955) examined these two genera and on the basis of their xylotomical character he has suggested following diagnostic characters of Agathis.

(1) Gradual transition from spring and Autumn wood,

(2) Absence of resin canals.

(3) Presence of xylem parenchyma.

(4) Two to eight field pits arranged horizontally.

(5) Vestured pits.

The genus Agathioxylon was instituted by Hartig 1848, for the fossil wood from the Keuper (Jurassic) of Germany. He described A.cordianum. It is one of the rare representative of this genus in Northern Hemisphere. Since it was found in Germany. Later on two more species are known from Southern Hemisphere in Australia and Newzealand. Mahabale and Rao (1968) described Agathioxylon in India from Jurassic of Rajahmendry. Biradar (1967) described it from Jurassic of Kota in Andhra Pradesh. Vagyani and Jamane (1989) reported it from Nandori in Chandrapur district of Maharashtra. Hence, it appears that the wood is more common in Southern Hemisphere and some what rare in Northern Hemisphere. Further, it shows range from Kamthi Stage (Upper Permian) to Jurassic in India. Outside India, it show range from Keuper (Jurassic) to Pliocene (Tertiary). Therefore, it ranges from Upper permian to Pliocene; krausel and Jain described a wood under the name Dadoxylon agathioides. The authors suggests relation with Agathis but placed their wood under the genus Dadoxylon. This wood needs revision and should be merged with the Agathioxylon.

(B) Genus - Australoxylon Marguerier:

Marguerier (1971) instituted the genus Australoxylon to accomodate following characters. Picnoxylic, decorticated secondary woods showing mixture of characters representing Araucariaceae and Pinaceae. He collected woods from Lower Gondwana beds of Africa and described two new species -

(1) A.taixeire (2) A.natalense. Recently Prasad & Chandra (1979 b, 1981) described two new species from the Kamthi beds of Kanhargaon village in Chandrapur district of Maharashtra, they are (1) A.kanhargaonse, (2) A.longicellularis. Vagyani and Raju (1986) described A.maheshwarii from Nandori in Chandrapur district of Maharashtra. In the present work A.panwadalensis is described which differs from all other known species of Australoxylon. It shows three to five field pits and 1 to 3 seriate radial pits. It also shows circular pits in groups of 2,3 and 5. The locality Panwadala is present in Chandrapur District of Maharashtra belonging to Kamthi Stage. Hence, our investigation adds a new species of Australoxylon from a new locality Panwadala. This suggests wider distribution of Australoxylon in the Kamthi beds of Maharashtra. The significant fact about this genus is all the species described so far are known from Kamthi beds only. It can be considered as one of the characteristic wood element of Kamthi flora. Further, it adds more information regarding the distribution of Australoxylon in the world. From Africa it is known from Upper Permian and in India it is known, from Kamthi beds which is either Upper Permian or Lower Triassic in age. Further, intensive work in this direction may throw more light on the occurance and distribution of Australoxylon.

(C) Genus - Kamthioxylon Mahabale and Vagyani (1980).

This interesting genus was instituted by Mahabale and Vagyani for woods showing a set of interesting characters, they are, distinct growth rings, presence of bars of Sanio, vestured

pits, xylem parenchyma, tangential pits, resin plugs and cupressoid field pits. The authors described K.adhariense from Adhari in Chandrapur district of Maharashtra. The locality belongs to Kamthi Stage. In the present work a new species is added viz. K.mahabalei. The wood is collected from Nandori belonging to Kamthi Stage. It shows all the important features of the genus but differs from K. adhariense in having 2-6 field pits. The other important characters observed in this wood are distinct growth rings, uniseriate to biseriate xylem rays. One to three seriate radial pits, bars of sanio and hexagonal, alternate pits. The genus is named after Kamthi Stage due to its distinct features and it forms a significant element of the Kamthi flora. Further present record suggests its occurance at more than one places in Chandrapur district suggesting its frequent occurance in the Kamthi stage. Intensive search in this area may bring to light additional localities for this genus.

(D) Genus - Prototaxoxylon Krausel & Doliantii 1958.

The genus was established by Krausel and Doliantii (1958) for fossil wood showing spiral thickening. Earlier Walton (1925) described Spiroxylon africanum showing the spiral thickening. Later on the name Prototaxoxylon was suggested for Spiroxylon. This wood shows only secondary xylem and circular to hexagonal pits in R.L.S. having one to two seriate xylem rays. Recently Biradar and Bonde (1977) described Prototaxoxylon mahabalei for a wood collected from Panwadala in Chandrapur district of Maharashtra. Prasad (1986) described

from Kanhargaon in Chandrapur district of Maharashtra, following two species - (1) P.uniseriale (2) P.maithyi. Agashe and Gowada (1982) described P.chandrapurense from Lohara in Maharashtra. Hence it appears that as many as four species of Prototaxoxylon are known from Chandrapur district in Maharashtra belonging to Kamthi Stage. In the present work, P.uniseriale Prasad is described, but it is collected from Adhari which is a new locality for the species. Therefore, it is suggested that genus Prototaxoxylon is widely distributed in the Kamthi Stage and known from different localities. Present work confirms this observation. Further, it appears that genus Prototaxoxylon constitutes an important part of the Kamthi flora.

II) Impressions :

The impressions were collected from Adhari, Bazargaon and Satnori in Chandrapur district of Maharashtra. They were mostly mineralized and devoid of cuticle of carbonaceous material. The impressions were found on typical Kamthi shales showing reddish brown or yellowish white sandstones. The number of impressions included in this work are 14. They belong to Glossopteridales and Equisetales. They represent gymnosperms and Pteridophytes. Impressions include mostly leaves and sometimes a stem or a fructification. They belong to following genera :

(A) Genus - Glossopteris Brongn.

The name Glossopteris was given by Brongniart (1822) to tounge shaped leaves from India, Africa and Australia.

Sternberg (1825) gave generic status to this name. Later on Feistmantel (1876, 1880, 1882, 1886); Zeiller (1902); Arber (1905) have described Glossopteris leaves from India. Recently several workers like Pant (1962), Saxena (1962), Lele (1962), Surange (1966), Srivastava (1968), Maheshwari & Prakash (1965), Maheshwari (1965), Chandra & Prasad (1981) have made contributions on the Glossopteris leaves from India. These workers have described more than 50 species of the genus on the basis of morphological as well as cuticular characters. In the present work genus Glossopteris is represented by nine species. viz. G.fibrosa, G.damudica, G.browni, G.verticellata, G. communis, G.indica, G.euryneura and G.musaefolia.

Chandra and Prasad (1981) have given distribution of Glossopteris species in Raniganj flora, Kamthi flora and Triassic flora. Out of nine species Glossopteris indica shows a presence in all these floras while G.fibrosa is only found in Raniganj, according to Chandra and Prasad. In our work G.fibrosa is described from Kamthi stage. It suggests the distribution of G.fibrosa in Raniganj and Kamthi flora. Similarly G.damudica and G.browni were earlier reported only from Raniganj. Now they are found in Kamthis, same situation is found in case of G.intermedia, G. euryneura and G.verticellata. G.musaefolia is earlier reported from Raniganj and Kamthi. Hence the present work gives additional information about six species of Glossopteris which were only known from Raniganj and our work shows their presence in Kamthis. In case of G.musaefolia its occurance in Kamthis supports earlier finding.

G.indica has larger distribution and longer range from Raniganj to Triassic. Our work supports this finding also. Hence occurance of six species in Kamthis which were not earlier reported from Raniganj suggests richness of Kamthi flora, which includes more number of Glossopteris species, than earlier. This further throws light on the age of Kamthis which is considered as Upper Permian by most of the workers.

(B) Genus - Gangamopteris :

It is represented by only one species Gangamopteris cyclopteroides, Genus Gangamopteris is more dorminant in Karharbari and Barakar stage. In our work only one species C.cyclopteroides is described. Though it was dominant in Talchir and Karharbari, it must have been lingering in the Kamthis where it might have disappeared in the later part of the stage. Surprisingly Chandra and Prasad (1981), Prasad (1986) while giving the tabular form of various genera found in the Raniganj and Kamthi have not included Gangamopteris in the tables. Perhaps the authors might not have collected this plant earlier. The occurance of Gangamopteris does not make much impression on the general composition of Kamthi flora. It is an allied genus of Glossopteris. Hence its presence will not affect the age of the flora.

(C) Genus - Dictyopteridium :

Only one species viz. D. sporiferum is included in this work. Earlier it was described from Raniganj formation by Surange and Maheshwari and from Orissa by Surange and Chandra

(1973 a). Recently Chandra and Prasad (1981) described it from Bazargaon in Nagpur district of Maharashtra belonging to Kamthi stage. Hence our report strongly supports the occurance of Dictyopteridium in Kamthi Stage. Further it supports wider distribution of Dictyopteridium in India.

(D) Genus - Neocalamites Halle

It is a member of Equisetales and represented by two species in India. In our work Neocalamites foxi is described. It shows a typical member of Triassic flora. The genus was instituted by Halle (1908). It was a plant of median height without secondary growth. The information about this plant is based on the impression. Neocalamites foxi is described by Lele (1962) from Parsora beds in South Rewa district. He considered it as a member of Middle Gondwana flora. The presence of Neocalamites foxi in the Kamthis suggest that it was developed much more earlier than the Triassic and therefore, its presence in the Kamthis is significant. Perhaps Neocalamites indicates the basal part of the Kamthis suggesting Lower Triassic age to it. There are disputs about the correct age of Kamthis Stage hence more information is needed to ascertain the correct situation. Occurance of Neocalamites in Kamthis suggest that the flora was developed in the Upper most part of the Permian and Lower most part of Triassic.

(E) Genus - Schizoneura Schimper & Mouget

In India it is represented by a single species viz.

Schizoneura gondwanensis Feistmantel. According to Chandra and Prasad (1981), Prasad (1986), it is found in Kamthi, Raniganj and Triassic flora. Hence its presence at Satnori confirms the earlier findings of its occurance. Further it contineous in the Triassic period like Neocalamites. Therefore, it throws some light on the age of Kamthi flora.

(F) Genus - Psygmophyllum Schimper

Genus Psygmophyllum is represented by three species in India, they are known from Permian beds of Kashmir. Their earlier reports were made by Seward (1907,1912) and Ganju (1943). Afterwards there are no reports from other parts of India. In our work P.flabellatum is described. This species is not earlier known from India and hence becomes a new report. Genus Psygmophyllum is known from Permian of India and Africa. Now here it occurs in the Kamthis. This supports Permian affinities of Kamthi flora. The other members of Ginkgoales like Rhipidopsis are earlier reported from Kamthi flora. Hence Psygmophyllum supports the occurance of Ginkgoales in the Kamthis.

Flora and its Age :

Regarding the age of Kamthis beds there are different opinions. According to King (1881) Kamthi beds are the group of rocks which disconfermably overlap. The permian coalbeds in the Wardha-Godavari valley and he considered them as Upper Permian to Lower Triassic in age. Due to piculiar geological

structures and lithology, the Kamthi beds are subject of dispute. According to Fox Kamthi beds are exposed in the coal fields near Warora and Chandrapur. He considered them Upper Permian in age. Recently geological survey of India have made exploration of the Kamthi beds by drilling number of bores and found that Kamthi is made up of three sub-divisions which are (1) Lower Kamthis which is comparable to Raniganj, (2) Middle Kamthis - comparable to Lower Panchet, (3) Upper Kamthis which is conformably like one over the other and present between first and second. On the basis of Palaeobotanical data Vagyani and Mahabale (1974) suggested Triassic age to the Kamthi beds. However, Chandra and Prasad (1981) suggest Upper Permian age to Kamthi beds. Dasgupta (1915) considered that the Kamthi beds are situated above the Raniganj series. Cotter (1917) considered Kamthis are equivalent to Raniganj series. Fox (1931) placed the Kamthi formation just above the Raniganj formation. Acharya, Raha and Singh suggested the fossil flora of Kamthi stage is similar to that of Raniganj formation. They assigned the Upper Permian age to Kamthi beds. Tasch et al. (1975) assigned the age of Kamthi rocks in between the Upper Permian and Lower Triassic.

In the present investigation fossil woods belonging to four genera and plant impressions belonging to six are included. Among the woods the genus Australoxylon shows a limited range and that is only Upper Permian period. While the genus Agathioxylon shows a range from Jurassic to Pliocene. Genus Prototaxoxylon which is found in both Palaeozoic and Mesozoic also has a broad range. The genus Kamthioxylon has limited range that is Upper Permian. Therefore, when we analyse the

occurance of four genera in the Kamthi flora we came across two important facts, first is two genera viz. Australoxylon and Kamthioxylon have a limited range that is Upper Permian only. While second fact indicates the other two genera viz. Prototaxoxylon and Agathioxylon have a broader range that is Upper Permian to Pliocene. Therefore, on the basis of woods a certain conclusion can not be drawn regarding the age of Kamthis. The impressions dominate the Genus Glossopteris having a range from Karharbari to Triassic. Therefore, among Glossopteridales genus Gangamopteris is somewhat restricted to range of Karharbari to Barakar. But other members are found even in the Triassic. Genus Schizoneura is also shows a broad range of Raniganj to Triassic. While Neocalamites is more dominant in Triassic than in the Upper Permian. Genus Psygmophyllum, however, occurs in India in the Permian rocks of Kashmir only. Considering all these facts we come to conclusion that more than half genera of this investigation shows their presence in both Upper Permian and Triassic. Therefore, we suggest a position laying between the Upper Permian and Lower Triassic to the Kamthi flora. To ascertain this position further intensive work is necessary and it may throw more light on the correct age of the Kamthi beds.