CHAPTER - VI

GENERAL CONSIDERATIONS

Present investigation deals with two Upper Gondwana localities in Andhra and one in Tamil Nadu. The localities chosen for the investigation in Andhra are (1) Vemavaram and (2) Uppugunduru.

These localities are situated on the coastal part of Prakasam district. The first locality Vemavaram is a well known locality and maximum number of plants are described from it. According to Pasco (1963), plants are recorded from this place. The second locality Uppugunduru is a new locality and the plants are collected from it for the first time. This place is, in the vicinity of vemavaram and marks an additional Upper Gondwana exposure in this area. These plants are preserved as impressions only. The impressions are on white to yellowish shales and no cuticals are recovered from the shales. Hence only morphological studies have been made. The fossil plants are mostly leaf impressions of Bennettitalean, Coniferales, Cycadales and Ginkgoales.

Presence of Bennettitalean leaves and Coniferales leaves suggest that the climate prevailing here was warm and humid, having tropical evergreen elements. This is supported by Ramanujam and Srisailam (1975) on the basis of palynological work on the Kottavakkam and other Upper Gondwana - exposure in South India. Their work show presence of several pollen

grains of tropical evergreen plants. Hence it appears that the vegetational zones in India during Upper Gondwanas were resembling each other.

Fern genera are less in Rajmahal than those in Jabalpur series. It indicates the weather of Rajmahal was somewhat dry. Where-as that of Jabalpur was rather humid. Fern genera gradually show reduction in number at Gollapalle, Budavada and Vemavaram. In the present work though they are not included, their presence, is already reported from Vemavaram and these localities are assigned to Rajmahal stage. It is observed that Fern Genera are plenty in most of the localities of Jabalpur stage. Naturally it suggests that Rajmahal beds were drier though older than the Jabalpur stage which had tropical evergreen plants. Perhaps this climate was more suitable for Angiosperms which later on emerged and dominated the other elements on the earth's flora. So on the basis of climate, Jabalpur comes near to Tertiary period and particularly palaeogenes. On the other hand, Gondwana localities in the East-Coast can be assigned to Jurassic or Upper Jurassic to early Cretaceous.

The above comparison put forth a new problem that is relationships between Vemavaram and Raghavpuram beds which were formerly assigned to Kota stage but presence of more genera in the Vemavaram series suggest younger age than the Raghavpuram series having less Fern-Genera. Perhaps it may be

due to local variations in climate and the vegetation or due to meagre work on the fossils of these series.

Extensive work is done on the Rajmahals still its age is a controversial topic. According to Sahni (1928) and Halle (1913) - Rajmahals belong to the Middle Jurassic period but Arkell (1956), Spath (1933) believe that they are of Lower Cretaceousage. A.R.Rao (1972) suggest that they belong to Rhaetic. Hence the vegetational groups here are many and existed in large areas with some local variations. Therefore, it is difficult to assign the correct age and past climate of this area.

Feistmantel (1877 b), Bakshi (1969b) have added to the list of fossil plants found in Raghavpuram area. The information of fossil flora of East-Coast Gondwanas has been enhanced by Jain (1968), Patra (1971), Suryanarayana (1953-1955) and Ramanujam (1953-1957). The present localities resemble with these individual places. Only in having presence of Ptilophyllum species. Since Ptilophyllum existed in the Gondwanas. It does not throw more light on the correlation of these localities.

I Bennettitales :

The group includes following leaf genera : (i) Ptilophyllum, (ii) Pterophyllum, (iii) Dictyozamites and Otozamites.

1 Genus - Ptilophyllum Morris 1840

Bose and Kasat (1971) have given a detailed account of Ptilophyllum in India. They have noted occurrence of 15 species in India. From east coast only three species are reported. They are - (1) P. acutifolium, (2) P. cutchense and P. rarinervis. Recently Bakshi (1968) added P. tennerinum to this list which is found at Raghavapuram. From Sriperamatur only two species are known. They are P. acutifolium and P. cutchense. In the present work 8 species of Ptilophyllum are described from 3 localities. They are - 1) P. acutifolium, 2) P. cutchense, 3) P. horridum, 4) P. sahnii, 5) P. rarinervis 6) P. jabalpurensis, 7) P. institacallum and 8) P. distans. Among these maximum number of species (6) are reported from a new locality Uppugunduru and one each from Vemavaram and Sriperamatur. Occurrence of P. rarinervis at Sriperamatur shows it is reported from this place for the first time. Again P. horridum is also reported from Vemavaram for the first time. Identification of Ptilophyllum species was made on the basis of the diagnostic morphological characters given by Bose and Kasat (1972). The importance is given to the imparipinnate condition of the frond and angle of divergence of pinnae.

It is generally observed that so many species in a smaller place are never found. Since morphological characters given by Bose and Kasat (1971) requires their identification in this manner. Statistical analysis of these species may place them into 5-6 groups.

2. Genus - Dictyozamites Oldham

Recently Bose (1974) made a detailed review of Dictyozamites in India. Presently following five species are reported. (1) D. falcatus, (2) D. indicus, (3) D. hallei, (4) D. bagjoriensis, (5) D. sahnii and (6) D. feistmanteli.

According to Bose (1974) only two following species are known from east coast. (1) D. falcatus, (2) D. feistmanteli. Present work shows that there are as many as four species are found. They are -1) D. falcatus, 2) D. indicus, 3) D. feistmantelii, 4) D. sahnii. Out of these four species D. feistmantelii is collected at Vemavaram and other three species are found at Uppugunduru. This indicates that Genus Dictyozamites is quite common in this area. Previously it was more commonly found at Rajmahal hills. Mahabale and Satyanarayana (1979) has reported D. sahnii from East Godavari district in Andhra Pradesh. Its occurrence at Uppugunduru shows that the plant has a wide occurrence from Rajmahal hills to Andhra Pradesh. Hence it is concluded that genus Dictyozamites is not rare in India. It has frequent occurrence in different areas.

3. Genus - Otozamites Braun.

Bose (1974) has recently reviewed the genus and found five species are recognized in India. They are - 1) O. imbricatus Feistmantel, 2) Otozamites sp. 3) Otozamites vemavaramensis Bose & Jain, 4) Otozamites exhislopii Bose, 5) Otozamites gondwanensis Bose.

Our collection has only one species O.vemavaramensis. It is earlier reported from Vemavaram by Bose and Jain(1967). Now it is collected by us from Uppugunduru. This shows that O. vemavarmensis is fairly common species in this area. It is first time reported from Uppugunduru.

Bose (1974) remarked that the genus is extremely rare in India. It is more commonly found in the Middle Jurassic. It is found in Rajmahal hills, Cutch, Rajasthan and East coast. Patra (1973) recently reported it from Orissa. It is absent in the Jabalpur series and Lower cretaceous beds of Himmatnagar and Songad.

4. Genus - Pterophyllum Brongniart 1928

Recently Bose and Banerjii (1981) have given a detailed account of the genus Pterophyllum in India.According to these authors Ten species of Pterophyllum are found in India. From the East coast following three species are reported : (1) P. kingianum from Gollapallae

(2) P. footeanum from Vemavaram

(3) P. incisum from Vemavaram.

Present collection has three species of Pterophyllum.

(1) P. distans, (2) P. footeanum, (3) P. incisum. All the three species are collected at Uppugunduru. Hence it shows that P. footeanum and P. incisum have wide occurrence since they are earlier reported from Vemavaram. Occurrence of P. distance shows that it is first time reported from East coast and indicates that four species of Pterophyllum are found in this area. Their occurrence at Uppugunduru which is a new locality shows that Pterophyllum is quite common at this plane. Amongst the Bennettitalean leaves Pterophyllum is the only genus which is also found in the Triassic of India. Lele (1955) reported P. sahnii from Parsora beds. But its identification is doubtful. It is quite common at Rajmahal hills and frequently occures at Gollapallae and Vemavaram. So it is found that it appears in the Triassic, became dominant in the Jurassic and got reduced in the Cretaceous. Earlier some species of Pterophyllum were identified as Nilssonia but recent work by Bose (1974) has shown that Nilssonia is not found in India. This indicates that Pterophyllum is second common Bennettitalean leaf genus in India, while Ptilophyllum is the most dominant one.

Cycadales :

In the Mesozoic rocks of India the order is represented by following leaf genera - (1) Taeniopteris Brogn. (2) Morrisia Bose, (3) Cycadites Sternberg, (4) Pseudoctenis. Among these genera Taeniopteris is more common Morrisia is the next common genus and found in the Rajmahal hills and doubtfully in the East coast. Cycadites is only known from Rajmahal hills. Bose and Banerji (1981) reported Cycadites rajmahalensis from Rajmahal hills. Present report of Cycadites rajmahalensis from Uppugunduru shows that it had more wider distribution in the Mesozoic rocks of India. Hence its occurrence at Uppugunduru shows that it is reported for the first time from East coast of Andhra. More search for it will perhaps show that it is not much rare in India.

Ginkgoales

The order Ginkgoales is represented in the Upper Gondwana beds of India by leaves. They belong to the genera Ginkgoites and Baiera. Genus Ginkgoites is more common than Baiera. It is represented by four following species : (1) G. lobata, (2) G. crassipes, (3) G. feistmantelli, (4) G. rajmahalensis. Recently Sitholey and Bose, (1974) gave a brief account of Mesozoic Ginkgoales in India. According to them G. crassipes is reported from Sriperamatur and Sivaganga area in Tamilnadu. G. feistmantelli is reported from South Rewa Gondwana basin and Raghavapuram mudstones. Hence it is

seen that only two species of Ginkgoites are reported from east coast of India. Present report of G. crassipes is from Uppugunduru in Prakasam district of Andhra Pradesh. It shows that G. crassipes is reported from Uppugunduru for the first time which is a newly discovered locality. So it is concluded that the record of Ginkgoales in the Upper Gondwana beds of India is quite meagre.

Coniferales :

In the present collection coniferales are represented by 1) Elatocladus Halle and 2) Brachyphyllum. Brongn.

Genus Elatocladus is known from all stages of Upper Gondwanas in India. It is represented by five species in India. They are - 1) E. plana, 2) E. tenerrima, 3) E. jabalpurensis, 4) E. conferta and 5) E. sahnii. E. plana occures at Jabalpur stage (M.P.). Raghavapuram shales, Sriperamatur beds (East coast). Recently Mahabale and Satyanarayana (1979) reported it from East Godavari district in Andhra Pradesh. Its report in the present collection is from Sriperamatur. Hence it appears that it is more common in the East coast localities than others. The second species described here is E. conferta. Earlier it is reported from Rajmahal Hills (Bihar) Jabalpur stage (M.P.). Golapalli sandstones (East Coast) and Kota stage (Chirakunt, A.P.) Its occurrence at Uppugunduru shows that it is widely distributed in the East coast. From Uppugunduru it is reported

for the first time.

Brachyphyllum Brongn.

This genus was created for sterile shoots having pinnate branching in one plane and spirally disposed, appressed leaves. According to Sahni (1928) several species of the genus are known from India. In the present collection Brachyphyllum expansum (Sternb.) Seward is described. It is collected from Sriperamatur. It is reported from Rajmahal hills (Bihar), Golapilli sandstones, Sriperamatur beds, Vemavaram shales (East coast) Jabalpur stage (M.P.) and Umia series (Cutch). Hence it seems that it is widely distributed in India. Sahni (1928) described B. expansum (Sternb) var. indica from Jabalpur stage. Here the cuticle is preserved. The present report shows that B. expansum has the more wider distribution in India than other species of Brachyphyllum. Recently Mahabale and Satyanarayana (1979) reported Brachyphyllum expansum from East Godavari district in Andhra Pradesh. This supports more wider distribution of it in India.

Flora and its Age

The assemblage of fossil plants is rather interesting. Flora of East coast Gondwana consists of Bennettitales, Conferales, Cycadales, Gikgoales and Filicales. In addition there are plants which are kept under unclassified group. Pteridosperms are rarely represented in the East coast flora. Among the Gymnosperms, Bennettitales are dominant than others. Presence of Bennettitales suggest tropical climate. Among the Bennettitales genus Ptilophyllum is dominant. Since Ptilophyllum is a characteristic plant of Upper Gondwana flora it suggests Upper Jurassic age to the flora. This is true for Vemavaram and Uppugunduru. While at Sriperamatur Ptilophyllum is not dominant but conifers are present in equal proportions. Present work has Eight (8) species of Ptilophyllum of which six (6) are reported from Uppugunduru and one each from Vemavaram and Sriperamatur. Among other Bennettitales leaves Dictyozamites is quite important. It is not abundantly known from Jurassic beds (Jacob 1951). It is considered as a characteristic genus of Middle Jurassic. But present collection shows that it is abundantly found at Vemavaram and Uppugunduru which are upper Jurassic localities. Dictyozamites is also quite common in the Rajmahal group. Genus Pterophyllum is another commonly occurring plant of Upper Gondwana beds. According to Bose and Banerji (1981) Ten (10) species of Pterophyllum are found in India. In the present collection three (3) species

of Pterophyllum are found. It is quite common in the Rajmahal group suggesting Upper Jurassic age. In the East coast earlier only three species are reported. Our work has added one more species, P. distans to this list. Hence it appears that Pterophyllum is fairly common in the East coast. Range of Pterophyllum shows that it occurs from Upper Jurassic to Lower cretaceous. It is found that only one species P. princeps is reported from Lower cretaceous of Than (Saurashtra). Hence Pterophyllum found in this area supports upper Jurassic age to first two localities. Genus Otozamites is extremely rare in India. According to Bose (1974) five (5) species of the genus are reported in India. It is more common in the Middle Jurassic formations.

Amongst the five species, Otozamites vemavarmensis is the commonest. It is reported in the present work. The genus Otozamites is so far not reported from Lower Cretaceous beds. Coniferales are found in limited proportion in this area. They suggest temperate climate. Genus Elatocladus is represented by five (5) species in India. In the present work E. plana is reported from Sriperamatur and E. conferta from Uppugunduru. Their occurrence here shows closeness to Rajmahal flora. Brachyphyllum is another genus belonging to coniferales. It has six (6) species in India. B. expansum is reported from Sriperamatur and supports the observation of close relation of this flora with that of Rajmahal. Cycadales are represented by a single plant Cycadites

rajmahalensis. It is first time reported from East coast beds. It is collected from Uppugunduru and further strengthens the close relation of this flora with the Rajmahal flora.

The order Ginkgoales is represented in the Upper Gondwana beds of India by leaves assigned to the genera Ginkgoites and Baiera. In the present collection Ginkgoites crassipes is reported. It is earlier reported from Sriperamatur only. Our report shows that it is first time reported from Uppugunduru. The record of Ginkgoales in the Indian Upper Gondwanas is quite meagre. Genus Ginkgoites has a range from Jurassic to lower Cretaceous. Hence the present flora has the element which has a range upto Lower cretaceous. Feistmantel (1876, 1877, 1879) expressed that East coast flora has a mixture of Rajmahal and Jabalpur plants. His analysis showed that East coast flora has 12 plants of Rajmahal flora and 14 plants of Jabalpur flora. Sahni (1920) has shown that flora of this area can be correlated with the floras of Rajmahal and Jabalpur. According to King (1880) three district stages are identified in the East coast Gondwanas. (1) Tirupati sandstones, (2) Raghavapuram mudstones, (3) Gollapalli sandstones. In the Ongole area Uppugunduru and Vemavaram belong to Jabalpur stage. Present flora has more genera of Rajmahal stage. Hence it is proposed that the age of this flora is Upper Jurassic. Additional data when collected will throw more light on this problem.