

## CHAPTER-II

### PREVIOUS WORK

Our investigation is based on the studies of Upper Jurassic plants found in the Sriperamatur beds of Tamilnadu, these beds are located on the East Coast of India and their age forms the part of the Upper Gondwana division of Gondwana system hence this Chapter consists of the earlier work done on various divisions of Upper Gondwana strata from different parts of India.

Recently, Venkatchala & Sinha (1986) have discussed stratigraphy and age of Upper Gondwana beds of Krishna-Godavari basin and pointed that there is tripartite division of Upper Gondwana sediments in Prakasam district of Andhra Pradesh. The divisions are Budavada sand stones is oldest Vemavaram shale in the middle and pavalur sand stone is the youngest. Out of these three Vemavaram shale is upper jurassic in age and belong to Kota stage in Godavari district. Raghavpuram shale is equivalent to Vemavaram shale, similarly in Tamilnadu Sriperamatur shales are equivalent to Vemavaram shales indicating Kota stage in this area.

The table below gives correlations of Upper Gondwana formations of East-Coast of India.

Table showing Upper Gondwana correlations in East Coast,  
India.

Standard Scale	Gondwana	Division	East Coast			
			Godavari	Guntur	Madras	Remnad
Lower cretaceous	Jabalpur	Uma	-	-	-	-
	series	Jabalpur	Tirupati	Pavalaur	Satyavedu	-
		Kota	Raghavapuram	Vemavaram	Sriperamatur	Sivaganga
Middle-Upper Jurassic	Rajmahal	Rajmahal	Gollapalle	Budavada	-	-
	series					

Upper Gondwana consists of triassic, Jurassic and Lower cretaceous, therefore, a brief account of earlier work carried out on various stages of Upper Gondwana is included in this chapter. Upper Gondwana consists of four distinct stages in India.

- i) Rajmahal stage,
- ii) Kota stage,
- iii) Jabalpur Stage,
- iv) Umia stage.

I) Rajmahal Stage : In this stage we come across development of richest fossil flora in India, therefore, it is considered as an important stage of the Upper Gondwana. The flora suggests favourable humid climate and environment present in this period and this situation first developed in Bihar and Madhya Pradesh and gradually developed along the east coast of India.

It marks the reasume of Upper Gondwana and shows the development of Ptilophyllum flora which is regarded as the characteristic of Upper Gondwana period. Following workers have made major contributions on the fossil plants of Rajmahal stage, they are Feistmantel (1877, 1879), Foote (1879), Oldham and Morris (1863), Seward and Sahni (1920), Sahni (1931), Sahni & Rao (1933-34), Sah (1953), A.R.Rao (1947-74), Sah & Jain (1964), Sharma (1967-71), Sitholey (1954-63), V.Mittre (1953-59), Sitholey and Bose (1953-74).

The work is divided into groupwise.

PTERIDOPHYTES : This stage is developed in the Rajmahal Hill where ferns are dominant while other members of pteridophytes are rather restricted.

LYCOPSIDA : Srivastava (1946) described stems as Lycosylon indicum vegetative branches were described as Lycopodites gracilis by Seward and Sahni (1920) but Pal and Ghosh (1987) suggested a new name Paralycopodium instead of Lycopodites.

Equisetites rajmahalense is described by Oldham and Morris (1863) it represents living genus Equisetum.

FERNS : Family - Osmundaceae -

Sahni & A.R.Rao (1933) described Cladophebis indica from Rajmahal Hills, these are sterile leaves of Osmundaceae, Gupta (1966-a) described another species namely Cladophebis sahnii from the same area. Petrified stems are described under the name Osmundites. V.Mittre (1956) recorded O.sahnii from Rajmahal Hills.

Family - Gleicheniaceae

Seward & Sahni (1920) described Gleichenites gleichenoides from this area.

Family - Matoniaceae

Bose & Sah (1968) described Phlebopteris from the Rajmahal Hills.

Family - Dipteridaceae

Gupta (1955-b) described H.indica but Bose & Sah (1968) revised the name as H.crenita.

Genus - Sphenopteris Brogniart.

It is a fern of doubtful affinities. Sahni & Rao (1934) described S.rajmahalensis; Ganju (1946) described S.khairbaniensis and Bose & Sah (1968) described S.bindrabunensis and S.petagonica.

Genus - Rhizomopteris Schimper.

It is a rhizome of fern having uncertain affinities. Ganju (1946) described R.chakshy. Gupta (1955) described R.sahni and R.rajmahalensis.

#### CYCADOPHYTA

They represent the major constituent of the Rajmahal flora and preserved as both impressions and pterifications they are divided into Bennettitales and Cycadales.

BENNETTITALES - leaves : They are represented by following four Genera -

1. Ptilophyllum,
2. Pterophyllum,
3. Dictyozamites,
4. Otozamites.

Genus - Ptilophyllum is abundantly found in this flora

and consider as a common member here. Recently Bose and Kasat (1972) have given the monographic account of Ptilophyllum in India, it is represented by following 15 species.

1. P.acutifolium Morris
2. P.rarinervis (Fiest.) Bose & Kasat
3. P.cutchensis Morris
4. P.tenerrimum Feistmantel
5. P.oldhamii Jacob & Jacob
6. P.indicum Jacob & Jacob
7. P.horridum Roy
8. P.sakrigaliensis Sah
9. P.institacallum Bose
10. P.distans (Feist.) Jacob & Jacob
11. P.jabalpurensis Jacob & Jacob
12. P.gladiatum Bose & Sukhdeo
13. P.sahni Gupta and Sharma
14. P.niponica Vishnu-Mittre
15. P.amoriolense Bose

Mahabale and Satyanarayan (1979) described two new species namely P.raghudeopurensis and P.deodikarii, this addition shows that there are 17 species of Ptilophyllum found in India. It appears that dominance of Ptilophyllum is considered while naming the Upper Gondwana flora as Ptilophyllum flora.

Genus - Pterophyllum Oldham & Morris

It is represented by following 9 species :

1. P. distans Morris
2. P. rajmahalense - Morris
3. P. medlicottinum Oldham & Morris
4. P. princeps Oldham and Morris
5. P. morrisianum Oldham
6. P. incisum Sahni & Rao
7. P. kingianum Feistmantel
8. P. guptii Bose & Banerji
9. P. sp.

Genus - Dictyozamites Oldham

Recently Bose and Zeba-bano (1976) have given a monographic account of Dictyozamites in India. According to them following six species have been reported from India out of these species D. feistmantellii comes from Gollapalli and not from Rajmahal Hills. Similarly Mahabale and Satyanarayana (1979) recorded D. falcatus from East Godavari district belonging to Gollapalli stage. This stage is equivalent to Rajmahal stage, hence it is included here.

1. D. falcatus (Morris) Medlicott & Blanford (1879).
2. D. indicus Feistmantel (1876).
3. D. feistmantellii Bose & Zeba-Bano (1978).
4. D. hallei Sahni and Rao (1933).
5. D. sahnii Gupta and Sharma (1968).
6. D. sp.

Genus - Otozamites Braun.

Bose (1974) has given a detailed account of this genus in India, he considers it as a rare plant and represented by 5 species in India. From Rajmahal Hills, O.gondwanensis is the only record from this stage.

FLOWERS : There are unisexual and bisexual flowers. Genus Williamsonia is either male or female and represented by following species from Rajmahal Hills.

MALE FLOWERS : In India, it is represented by Genus - Weltrichia Braun.

1. W.santalensis (Sitholey & Bose) Bose (1967).
2. W.singhii Bose (1967).
3. W.polyandra (Ganju) Sitholey & Bose (1971).

FEMALE FLOWERS : Genus - Williamsonia Carruthers.

1. W.sewardiana Sahnii (1932)
2. W.sahnii Gupta (1943).
3. W.harrisiana Bose (1968)
4. W.guptai Sharma (1968)
5. W.amarjolense Sharma (1968)
6. W.microps Feistmantel (1877)
7. W.indica Seward (1917)

Bisexual flowers : There is only one report by Bose (1966-a) and that is Cycadeoidea dactylota from Rajmahal Hills.



STEMS : It is represented by Genus - Bucklandia Presl. and represented by following three species.

1. B.indica Seward (1917)
2. B.sahni Bose (1953-a)
3. B.guptii Sharma (1967)

Order - Cycadales :

It is represented by following leaf genera.

Genus - Taeniopteris Brongniart

According to Bose and Banerji (1981) following three species of Taeniopteris have been recorded from Rajmahal Hills.

1. T.spatulata
2. T.oldhami
3. T.buskoghotosensis

Bose (1958) established a new Genus Morrisia and reported M.mcclellandi (Oldham and Morris) Bose.

Recently Bose and Banerji (1981) reported two more species viz. M.raimahalensis (Feistmantel) Bose & Banerji and M.dentata (Rao & Jacob) Bose & Banerji.

Order - CONIFERALES :

They are quite dominant and represented by several genera.

Genus - Brachyphyllum Brongniart.

Sahni (1928) described following two species.

1. B. mamillare Brongniart.
2. B. expansum (Sternberg) Seward

Genus - Elatocladus Halle

Sahni (1928) reported E. conferta and E.sp. from Rajmahal Hills.

Genus - Pagiophyllum Heer

Sahni (1928) described Pagiophyllum Cf. peregrianum from Rajmahal Hills, he also described a cone bearing shoot under the name Arthrotaxites feistmantelli.

Recently Vishnu-Mittre (1959) described leafy shoots under the generic name, Endophyllum. Rao (1943) described Musculostrobus raimahalensis a male cone of podocarpaceae. Rao & Bose (1971) revised its name as Podostrobus raimahalensis. Rao (1943) described a female cone under the name Nipaniostrobus. Vishnu-Mittre (1959) added two more female cone under the names Mehtala & Sitholeya.

Sahni (1948) discovered a new group of gymnosperms under the name Pentoxylae. Srivastava (1946) described its stem as Pentoxylon sahni and female cone Carnoconites compactum and C. laxum.

Sahni (1948) described the leaf as Nipaniophyllum raoi. Vishnumittre (1953) described the male cone as Sahnia nipaniensis.

Following woods were reported,

Jain (1965) reported Podocarpoxyton rajmahalense.

Bose and Maheshwari (1974) Araucarioxyton agathioides, Bharadwaj (1952) reported Taxaceoxyton rajmahalense and Sah and Jain (1965) reported Ginkgoites rajmahalense, it is a Ginkgo leaf.

## II) KOTA STAGE :

In Tamilnadu, it is found at Sriperamatur and Sivaganga and shows rich assemblage of fossil plants.

## PTERIDOPHYTES :

Cladophlebis indica is reported from Sriperamatur, which is the member of Osmundaceae.

Saxena (1974) have listed following Pteridophytes from Kota Stage in Andhra Pradesh and Sivaganga in Tamilnadu, they are Sphenopteris, Cladophlebis reversa and Cladophlebis lobata. Bose et al. (1981) reported from Gangapur beds in Andhra Pradesh following plants.

1. Cladophlebis sp.
2. Gleichenia sp.
3. Gleichenia nordenskiöldii

## Pteridosperms :

Genus - Dicroidium

From Vemavaram Jain reported Dicroidium and Rao (1959) reported D. feistmantelii. Baksi (1968) described Dicroidium spp. from Raghavpuram in Andhra Pradesh. Feistmantelii (1879) described Thinfeldia subtrigona from Vemavaram. Gopal et al.

(1957) described *Thinnfeldia* sp. from Ramanad dist. of Tamilnadu. Bose and Roy (1968) described *Pachypteris indica* from Vemavaram.

BENNETTITALES -

Genus - *Ptilophyllum* Morris.

According to Bose & Kasat (1972) following three species have been reported from Kota stage.

1. *P. acutifolium* Morris
2. *P. catchense* Morris
3. *P. rarineris* (Feist) Bose & Kasat

Genus - *Pterophyllum* Brongniart

According to Bose & Banerji (1981) *P. footanum* is reported from Vemavaram in Andhra Pradesh. Recently Vagyani (1986) reported it from Uppugunduru in Prakasam district of Andhra Pradesh. Vagyani and Zuting (1986) reported *P. distans* from Uppugunduru and Sahni & Rao (1933) reported *P. incisum* from Vemavaram.

Genus - *Dictyozamites* Oldham

According to Bose and Zeba-Bano (1978) *D. feistmantelli* is reported from Vemavaram, Sriperamatur and Raghavapuram. Vagyani and Jamane (1988) reported it from Uppugunduru in Prakasam district. *D. indicus* is reported from Vemavaram and *D. falcatus* is reported from Raghudevapuram by Mahabale and Satyanarayana (1979) and from Uppugunduru by Vagyani and Jamane (1987).

Genus - Otozamites Brongniart

Bose (1974) have given a brief account of this genus in India. O.vemavarensis Bose & Jain (1967).

O.exhislopii Bose (1974) and O.gondwanensis Bose (1974) have been reported from Vemavaram in Andhra Pradesh.

Genus - Taeniopteris Brongniart

According to Bose and Banerji (1981) it is reported from Sriperamatur, Naikulam and Sivaganga in Tamilnadu and in Andhra Pradesh from Vemavaram and Raghavapuram. Recently Mahabale and Satyanarayana (1979) have reported it from East Godavari district in Andhra Pradesh.

Genus - Morrisia Bose

According to Bose and Banerji (1981) Morrisia maclellandia (Oldham and Morris), Bose (1958) is reported from Raghavapuram, Vemavaram in Andhra Pradesh and Sriperamatur and Sivaganga in Tamilnadu.

CONIFERALES :

Genus - Brachyphyllum Brongniart

Sahni (1928) reported B.expansum (Sternberg) Seward from Vemavaram in Andhra Pradesh and Sriperamatur in Tamilnadu. Mahabale and Satyanarayan (1979) described it from Raghudevapuram in Andhra Pradesh. Sahni (1928) added B.feistmantellii from Vemavaram and B.rhombicum from Sriperamatur.

Genus - Pagiophyllum Heer.

Pagiophyllum sp. is described from Vemavaram in (1968).

Pagiophyllum sp. Cf. P.peregrinum is described from Raghavapuram by Bakai in (1968) P.marwarensis is described by Bose and Sukhdev (1978) from Gangapur beds.

Genus - Elatocladus Halle

Elatocladus plana (Feistmantel) Seward is reported from Raghavapuram and Sriperamatur by Sahni (1928). Mahabale and Satyanarayana (1979) also reported it from East Godavari district in Andhra Pradesh. Vagyani & Jamane (1987) reported it from Uppugunduru in Andhra Pradesh. E.jabalpurensis (Feist.) Seward is described by Sahni (1928) from Vemavaram. Bose et al. (1981) recorded Elatocladus sp.; E.confurtus and E.kingianus from Gangapur beds in Andhra Pradesh.

Genus - Desmiophyllum Lesquerex

It is detached leaf with uncertain affinities. D.indicum is reported from Raghavapuram by Sahni (1928). Recently Vagyani (1984) reported it from Vemavaram.

Genus - Torreyites Seward

It is a member of Taxaceae showing affinities to living genus Torreya.

Seward and Sahni (1920) described T.constricta from Vemavaram, it represents a vegetative branch. Biradar (1967) described following fossil woods from Kota in Andhra Pradesh.

1. Dadoxylon
2. Mesembrioxylon
3. Ginkgo
4. Taxaceoxylon

From this account it appears that conifers were abundantly distributed in Kota Stage.

III) JABALPUR STAGE :

PTERIDOPHYTES -

Family - Gleicheniaceae

Saxena (1974) reported Gleichenites gleicheoides from South Rewa and Seward and Sahni (1920) described Gleichenites rewahensis from Jabalpur.

Family - Dipteridaceae

Crookshank reported Hausmannia buchii and H. dicotoma from Jabalpur stage. Saxena (1974) reported Hausmannia from S.Rewa.

Genus - Alethopteris

Feistmantel (1877) described following three species from Sher river.

1. A. lobifolia
2. A. medlicottia
3. A. whitbyensis

Saxena (1974) reported A. vitata from S.Rewa, he further listed following members such as Sphenopteris, Coniopteris, Cladophlebis, Onychiopsis and Weichselia from S.Rewa.

BENNETTITALES -

Genus - Ptilophyllum Morris

Bose and Kasat (1972) have reviewed a Genus Ptilophyllum in India from their account following ten species of Ptilophyllum are found in Jabalpur Stage.

1. P.acutifolium
2. P.cutchense
3. P.oldhamii
4. P.indicum
5. P.horridium
6. P.sakrigaliensis
7. P.distans
8. P.institacallum
9. P.jabalpurensis
10. P.glabratum

Genus - Pterophyllum Brongniart

Comparing to Ptilophyllum it shows poor distribution and represented by following two species.

1. P.distans
2. P.medlicottianum

Genus - Dictyozamites Oldham

According to Bose and Zeba-bano (1978) from Paraspani in Madhya Pradesh following two species have been recorded -

1. P.indicus
2. P.festemantelli



Genus - Anomozamites Schimper

Bose and Banerji (1981) described Anomozamites  
hansapurensis from Madhya Pradesh.

CONIFERALES :

Bose and Maheshwari (1974) have given a monographic  
account of Mesozoic conifers in India.

Genus - Brachyphyllum Brongniart

Sahni (1928) recorded B.rhombicum from S.Rewa,  
B.mamillarae from Bansa, B.festimantelli also from Bansa  
B.expansum from S.Rewa and B.expansum var. indica from Sher  
river. All these localities are present in Madhya Pradesh.

Genus - Pagiophyllum Heer

Sahni (1928) reported P.peregrianum and P. Cf.Perigranium  
from Sher river and Bansa in Madhya Pradesh.

Genus - Elatocladus Halle

Sahni (1928) described E.conferta from Sher river and  
Bansa in Madhya Pradesh. E.jabalpurensis from Jabalpur, and  
E.tenerrimum from Sher river.

Genus - Araucarites Presl.

It represents a detached cone scale A.cutchense is  
described from Sher river and Bansa by Sahni in (1928).

Genus - Desmiophyllum Lesquerex.

D.indicum is reported from Sher river by Sahni (1928)

he also reported *Conites* sp. Cf. Strobilites, Conites sp.cf. Strobilites anceps, these are cones and comes from Bansa in Madhya Pradesh, he also reported another cone namely Strobilites sewardii from Jabalpur.

GINKGOALES :

Genus - Ginkgoites Seward

Seward and Sahni (1920) described G.lobata from Sher river in Madhya Pradesh.

PTERIDOSPERMS :

Genus - Pachypteris

Bose and Roy (1968) described P.indica from Sher river and Jabalpur in Madhya Pradesh.

Genus - Cycadopteris

Bose and Sukhdev (1958) described from Bansa following five species.

1. C.brauniana
2. C.pulcherrima
3. C.auriculata
4. C.indica
5. C.majus

IV) UMIA STAGE :

It indicates lower creataceous age and exposed at Trambu and Kakadbhit in Cutch and Gardeshwar and Sonarh in Gujrath.

PTERIODOPHYTES :Family - CyathiaceaeGenus - Protocyathia

Feistmantel (1877 b,c) described Protocyathia trichinopoliensis from Tiruchirapalli in Tamilnadu belonging to Uttatur beds.

Family - MatoniaceaeGenus - Matonidium

Sahni (1936) described M.indica from Himmatnagar in Gujrath, he also described Weichselia reticulata from the same place.

Bose and Roy (1964) described Isoetites indicus and I.serratifolius from Cutch.

Roy (1967) reported Phleboteria sp., Weichselia reticulata, Cladophlebis kathiawariensis, c.sp.cf. C.lingipennis, Onychopsis psilotoides, Sphenopteris specifica, Sphenopteris sp. from various localities in Cutch and Kathiawar. According to author these localities belong to Lower cretaceous.

PTERIDOSPERMS :

Pachypteris haburensis is reported from Pariwar formation in Rajasthan by Bose et al. (1982). Age of this formation is controversy according to authors it is Upper Jurassic but mostly it is considered as cretaceous.



Bennettitales -

Genus - Ptilophyllum Morris

According to Bose and Kasat (1972) following six species of Ptilophyllum are found in Cutch area they are -

1. P. acutifolium
2. P. cutchense
3. P. distans
4. P. oldhamii
5. P. horridum
6. P. sakrigaliense.

Bose and Banerji (1984) reported Dictyozamites sp. from Kakadbhit in Cutch. The age of this locality is doubtful earlier it was consider as belonging to lower cretaceous but authors consider it as Upper Jurassic hence, it appears that occurrence of Dictyozamites is Umia stage is doubtful.

Roy (1965) described Otozamites imbricatus from Cutch. Bose and Banerji (1981) have listed occurrence of following cycadophytic plants from Cutch area.

1. Taeniopteris spatulata
2. T. cutchensis
3. Pterophyllum distans
4. Weltrichia spp.

CONIFERALES :

Genus - Elatocladus Halle

Sahni (1928) described E.tenerrima from Cutch. Bose and Banerji (1984) described E.confertus and E. cf.tenerrimus from Cutch.

Genus - Brachyphyllum Brongniart

Brachyphyllum expansum is reported by Seward and Sahni (1920).

Genus - Pagiophyllum Heer.

Sahni (1928) described Pagiophyllum cf. P.divaricatum from Cutch. Bose and Banerji (1984) described P.grantii from Trambau and Kakadbhit in Cutch. Seward and Sahni (1920) described Araucarites cutchense from Cutch.

PTERIDOSPERMS :

Recently, Maheshwari (1986) described Thinnfeldia indica from Naicolam and Terani in Tiruchirapalli district in Tamilnadu. According to authors this locality belongs to Uttatur stage having lower Cretaceous age.