THE MESOZOIC AND TERTIARY FLORAS OF INDIA — A REVIEW*

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INTRODUCTION

IT is intended in this article to present a general account of the Mesozoic and Tertiary floras of India. Two very informative surveys of the Indian fossil floras, including those of Mesozoic and Tertiary age, have already been made by the late Professor Birbal Sahni in 1921 and 1938. The present article, therefore, apart from supplying a brief introduction to the different Mesozoic and Tertiary plant-bearing formations of India, will be mainly concerned with the new material discovered in them since 1938.

THE MESOZOIC FLORAS

(i) *Mesozoic Formations of the Gondwana System*

The general sequence of these formations is shown in Table 1[1]. The deposits are mostly of fluviatile and lacustrine nature, and range in age from the Lower Triassic to the Lower or perhaps Middle Cretaceous. The chief areas of their occurrence are in the Peninsular India. Jurassic plants of Gondwana affinities are also found in Ceylon. In the Salt Range of the West Punjab (Pakistan) a rich flora of Jurassic age is met with in beds intercalated with marine formations.

For the first and, still in several respects, the most comprehensive illustrated description of Gondwana plants, reference must be made to the *Fossil Flora of the Gondwana System*, in four volumes, begun by Oldham and Morris and completed by Ottokar Feistmantel. The account of Mesozoic plants is contained in the first two volumes (OLDHAM & MORRIS, 1863; FEISTMANTEL, 1876-79) and in parts of the third and the fourth volumes (FEISTMANTEL, 1880-82).

Triassic — In the Trias the lowest beds are of the Panchet series which corresponds in age to the Bunter of Europe. Fossil plants have been found in the lower part of the series in the Raniganj coalfield, near Maitur. They include Triassic forms like *Schizoneura* and *Thinnfeldia* together with the elements of the *Glossopteris* flora.

The Parsora stage (after Parsora in south Rewah) constitutes an important plant-bearing horizon within the Triassic. The flora here is characterized by an abundance of *Thinnfeldia* associated with *Cordaites* and *Glossopteris*. The age of the Parsora beds has been much debated. It has been regarded (*see* SAHNI, 1938) in turn as Lower Triassic (even late Permian), Rhaetic and only slightly older than the Jurassic. The Parsora flora has figured actively in the controversy surrounding the classification of the Indian Gondwanas.

The Maleri stage, also included within the Trias, has yielded a few conifers. *Mesembrioxylon malerianum* Sahni comes from the Maleri horizon in south Rewah, while *Araucarites cutchensis* and *Elatocladus jabalpurensis* are found in Naogaon (west of Maleri) in Hyderabad State. On the evidence of these fossils, the last two of which are common in the Kota and Jabalpur stages, Sahni (1931) regards the Maleri beds to be Rhaetic or Jurassic in age.

Jurassic — In the Jurrassic are included the series of strata named Rajmahal, Kota and Jabalpur. The relationship between the Kota and Rajmahal stages is uncertain, and of the two Kota is probably the younger. Plant-bearing strata assigned to the Rajmahal, Kota and Jabalpur stages occur scattered in several parts of India. The best development of the Rajmahal stage is to be found in the Rajmahal Hills of Bihar where a rich flora is preserved in Intertrappean beds.

1. The Gondwana system in India has been classified by different workers into either two or three main divisions. The significance of this is discussed later under the section entitled " The Problem of the Middle Gondwana ".

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TABLE 1 — SHOWING THE GENERAL SEQUENCE OF THE GONDWANA GROUPS

1

UPPER GONDWANA	Umia-Jabalpur Series	Umia	L. Cret.
		Jabalpur	Mid. or Up. Oolite
	Mahadeva Series	Kota	L. Oolite & Up. Lias.
		Rajmahal	Lias.
LOWER GONDWANA	Panchet Series	Parsora & Maleri	Up. Trias & Rhaetic
		Panchet	L. Trias
	Damuda Series	Raniganj	Up. Perm.
		Ironstone shale	Mid. Perm.
		Barakar	L. Perm.
	Talchir Series	Karharbari	Up. Carb.
		Talchir	Up. Carb.

2

UPPER GONDWANA	Jabalpur Series	Umia	Up. Jurassic & L. Cret.
		Jabalpur	Jurassic
		Chaugan	
	Rajmahal Series	Kota	
		Rajmahal	
		Parsora	Triassic
	Mahadeva Series	Maleri	
		Pachmari	
LOWER GONDWANA	Panchet Series	Hirapur	
		Maitur	
		Mangli	
	Damuda Series		Permian
	Talchir Series		Carboniferous

3

UPPER GONDWANA	Umia	Up. Jurassic & L. Cret.
	Jabalpur	Up. Jurassic
	Rajmahal	
	Kota	Lias.
MID. GONDWANA	Maleri & Parsora	Keuper & Rhaetic
	Mahadeva (or Pachmari)	Muschelkalk
	Panchet	Bunter
L. GONDWANA	Damuda	Up. Perm.
	Talchir	Up. Carb.

1 and 2, twofold division. 1, as proposed by G. DE P. COTTER (1917); 2, as amended by C. S. FOX (1931); 3, tripartite division (WADIA, 1953), based on the classification adopted by FEISTMANTEL and VREDENBURG.

(The stages of the Damuda and Talchir series have been omitted from columns 2 and 3.)

The beds at Gollapilli near Ellore in the new Andhra State also belong to the Rajmahal stage. The Rajmahal flora, among all others of Jurassic age in India, contains the largest number of species. The cycadophytes (mostly Bennettitales) predominate, while conifers come a close second. The next in order are ferns and there also occur a few lycopods and equisetales.

The Kota stage is developed in the Godavari valley south of Chanda and its outcrops are found in several localities along the east coast of India. The Jabalpur beds occur at Jabalpur and other localities in Madhya Pradesh and in the Satpura basin. The majority of plant fossils in these two stages belong to the Coniferae; there are several species of cycadophytes and a few ferns. The Kota and Jabalpur beds also contain a few Ginkgoalean leaves which, till a few years ago, were the only fossils of this group known from the Jurassic rocks of India. Recently Ginkgoalean leaves have been discovered in the Rajmahal Hills also.

Cretaceous—The Umia series of Kach are the highest beds of the Gondwana system. They extend from Upper Jurassic to Lower Cretaceous. The Umia flora consists almost wholly of conifers with a few cycadophytes and ferns.

Apart from the plant remains, the Panchet, Parsora and Maleri stages contain many remains of vertebrate animals (fishes, amphibians and reptiles). Vertebrate fossils also occur in the Kota stage, while the Umia series are rich in marine fossils, chiefly cephalopods.

In the appendix is given a list of the important species found in the different stages of the Gondwana system falling within the Mesozoic era. This list, based on the table of species given by Sahni in 1921, incorporates, as far as possible, all the nomenclatural changes and important discoveries of fossil plants made since Sahni's table was published.

(ii) *The Problem of the Middle Gondwana*

A division of the Gondwana system into an upper and a lower part has been adopted by the Geological Survey of India. This classification was first given in 1879 by W. T. Blanford and H. B. Medlicott in the *Manual of Geology of India*, and was followed with a few alterations in the second edition of the manual by R. D. Oldham (1893). In 1917 Cotter revised the classification, but retained the twofold division (*see* TABLE 1, col. 1). The line of separation in this case lies at the top of the Panchet series which, together with the Damuda and the Talchir series, constitute the Lower Gondwana; the Upper Gondwana is formed of the Rajmahal, Kota, Jabalpur and Umia stages.

The idea of the Middle Gondwana originated from the plant fossils collected by Hughes in south Rewah, particularly from two localities, Parsora and Daigaon. In 1882 Feistmantel proposed for the plant-bearing beds at these places the name "transitional beds". Feistmantel felt that these beds could not be accommodated satisfactorily within either of the two Gondwana divisions; because, although stratigraphically they had an Upper Gondwana aspect, their plant fossils showed Lower Gondwana affinity. He, therefore, placed them with the Panchets in a new division — the Middle Gondwana.

In 1910 Vredenburg, following the suggestion of Feistmantel, adopted the tripartite division of the Gondwana system in his *Summary of Geology of India*. In this scheme the Lower Gondwana corresponded with the Permian, and the Middle and the Upper with the Trias and the Jurassic respectively. This classification is also followed by Dr. Wadia (1953). In adopting a threefold division (TABLE 1, col. 3), Wadia has been influenced chiefly by the lithological similarity of the strata included in the Middle Gondwana and the affinities of the vertebrate fauna contained in them. Further, as the Mesozoic-Palaeozoic boundary occurs at the base of the Panchets, the tripartite division conforms to the European time scale. According to Wadia there is a striking difference between the life and physical conditions of the Middle Gondwana and those of the preceding Damudas; after the end of the Damuda period there was widespread extinction of *Gangamopteris* and the Sphenophyllales indicating a datum line of considerable importance.

The late Dr. C. S. Fox, who devoted considerable thought to the classification of the Gondwana system, believed that there was no justification for a tripartite division. He (1931) proposed a modification of the twofold division, with the line of demarcation lying, as in Cotter's scheme, above the Panchets (TABLE 1, col. 2). In Cotter's scheme the whole of the Triassic is included in the Lower Gondwana, but the new arrangement suggested by Fox removes the Maleri and

Parsora stages from the Lower Gondwana and puts them in the Upper. Fox was of the view that there was no serious floral ' break ' between the Damudas and the Panchets. The plant fossils of these two series were closely related. There was, on the other hand, a marked change in the aspect of the flora at the close of the Panchet stage; it is, therefore, here that a separation of the Upper Gondwana should be made. Dr. Fox believed that from floristic as well as climatological considerations the introduction of a Middle Gondwana served no useful purpose, unless its only aim was to enforce a strict agreement with the European time scale.

The Age of the Parsora Flora — The name Parsora stage was given by Cotter (1917) to include several plant-fossil localities in south Rewah, viz. Daigaon, Karkati and Ganjra. The whole of this area was critically examined by Fox and Aiyengar in 1929. From this survey Fox (1931) concluded that *two distinct* floras were present in south Rewah: (i) the flora of Daigaon-Pali-Karkati beds which contains Damuda plants (*Glossopteris, Vertebraria,* etc.); and (ii) the flora of the Parsora beds which shows Rajmahal affinities. According to him (loc. cit., p. 190) the presence of *Cordaites* at Parsora has not been confirmed, while good specimens of *Neocalamites* have been discovered in these strata. He, therefore, advises the restriction of the name Parsora stage only to the beds around Parsora which in his opinion are of *Rhaetic age.*

Recently Saksena (1952) has examined Aiyengar's collection from south Rewah and the fresh collections made by himself from several localities including Daigaon and Parsora. He classifies these plant beds into two categories: (i) those having a purely Lower Gondwana flora, and (ii) those showing a mixture of the *Glossopteris* and *Thinnfeldia* floras. The beds with the mixed flora, he would like to be placed in the Middle Gondwana. Thus on purely palaeobotanical grounds, Saksena regards the Middle Gondwana to be a convenient division.

It seems that in spite of the controversy which has raged for more than 70 years around the Parsora flora we still do not know all its constituents. Now K. M. Lele (1954) reports the occurrence of a *Pterophyllum* from the Parsora beds. The group to which this genus belongs predominated the vegetation of the Rajmahal stage. The latest discovery, if anything, lends weight to Dr. Fox's opinion about the Rajmahal affinities of the Parsora flora.

(iii) *Recent Discoveries in the Rajmahal Flora*

After the publication of the *Fossil Flora of the Gondwana System,* there have not been many new discoveries of fossil plants in the Panchet, Parsora, Kota, Jabalpur and Umia beds. In 1920 Seward and Sahni brought out a revision of the more important Gondwana species; and in 1928 and 1931 Sahni published a revision of the fossil conifers of India. In the latter work several new additions were made to our knowledge of Indian Mesozoic plants. Since then, the attention of workers in Indian Mesozoic floras has been focussed chiefly on the Rajmahal Hills. An important collection comprising four new genera was described by the late B. P. Srivastava in 1945 from Nipania in the Rajmahal Hills. The new genera are: (1) *Lycoxylon indicum,* a petrified lycopod stem; (2) *Pentoxylon Sahnii,* a gymnosperm stem with vascular cylinder composed of 5-6 steles showing pronounced centripetal growth; (3) female cones named *Carnoconites* (with two species, *C. laxum* and *C. compactum*); and (4) *Nipanioxylon Guptai,* another gymnospermous stem with a ring of eight vascular bundles, each having an equally developed zone of secondary wood round it. *Pentoxylon Sahnii* and *Carnoconites* are now considered related to the leaves *Taeniopteris spatulata* which also occur plentifully at Nipania.

The peculiarities of the individual structure of *Taeniopteris spatulata, Pentoxylon* and *Carnoconites* had long impressed Sahni. But he found it difficult to assign them definitely to any known group of gymnosperms. *Taeniopteris spatulata* has vascular bundles, characteristic of the Cycadales (A. R. Rao, 1943), but its stomata are fundamentally of the Bennettitalean type. The stele of *Pentoxylon* distantly recalls that of *Rhexoxylon,* but is unique in having a ring of tangentially expanded and curved bundles with a peculiarly eccentric development of the secondary wood; the secondary xylem is, however, typically conifer-like. In *Carnoconites* the ovules (with a very thick outer fleshy layer) are attached directly to the cone axis without any ovuliferous scale or megasporophyll. Sahni, therefore, proposed (1948) a new group of gymnosperms, the

Pentoxyleae, for the accommodation of these three genera. He believed that *Pentoxylon Sahnii* was the parent stem which bore the leaves *Taeniopteris spatulata* (renamed *Nipaniophyllum Raoi* by Sahni) and the female cones *Carnoconites compactum*. *Nipanioxylon*, in the opinion of Sahni, is allied to *Pentoxylon* and its proper place is in the Pentoxyleae. The Pentoxyleae is to be regarded a synthetic group exhibiting a combination of characters of the Cycadales, Bennettitales and Coniferales. The new group occupies a rather isolated position despite certain affinities with both the stachyosperms and phyllosperms.

A flower, *Sahnia nipaniensis*, which is probably a male flower of the Pentoxyleae, has been described by Vishnu-Mittre (1953). It is borne on dwarf shoots closely resembling those of *Pentoxylon*. It consists of many filiform-branched microsporophylls bearing stalked sporangia which contain boat-shaped pollen grains.

For several years evidence has been accumulating of the presence of podocarpaceous plants in the Rajmahal flora. The possibility of fossils like *Mesembrioxylon* and *Elatocladus* being podocarpaceous was pointed out by Sahni in 1931. Now we have from the Rajmahal Hills *Nipaniostrobus Sahnii* and *Masculostrobus rajmahalensis* (A. R. Rao, 1953). *Nipaniostrobus*, a female cone with single-seeded scales, shows great resemblance with *Dacrydium* in several characters. *Masculostrobus rajmahalensis* is a male cone containing two-winged pollen grains. These two cones perhaps belong to the same plant. *Nipanioruha granthia* (A. R. Rao, 1946) with needle-like spirally placed leaves and pycnoxylic wood is another conifer showing affinities with Podocarpaceae. The female cone of this has been discovered recently (A. R. Rao, 1949). Three-winged pollen grains, probably belonging to some podocarp, occur in the Nipania chert. Another conifer recently discovered at Nipania is *Stachyotaxus* sp. (A. R. Rao, 1949).

From Onthea, Ganju (1947) has described *Beaniopsis rajmahalensis* and two other fructifications, *Ontheanthus polygandra* and *Ontheostrobus sessilis*. *Ontheanthus* was regarded by Ganju to be a unique type of male flower which differs from Bennettitales in possessing a perianth and in the spiral arrangement of its numerous sporophylls round a central peduncle. A male *Williamsonia*, *W. santalensis*, described by Sitholey and Bose in 1953 from Sakrigalighat, has thrown light on the structure of *Ontheanthus*. The latter is now found to be the upper part of a flower of the *W. santalensis* type. It may be added that the puzzling features seen in Ganju's *Ontheanthus* were due to the fossil being examined upside down. *W. santalensis* is a large flower with the microsporophylls bearing finger-like spore-producing members, superficially resembling those of *Cycadocephalus*. A new species of *Williamsonia*, *W. Sahnii*, believed to be bisexual, is reported by K. M. Gupta (1943) from Khairbani. But here only the stalks of the microsporophylls are present and nothing is known of the synangia.

In *Ontheostrobus* numerous fairly large seeds are attached to a central organ, the exact form of which is not determinable. Unfortunately, nothing more of the structure of this fossil is known. The seed-scars form a pattern strikingly similar to the impressions of the ovules and interseminal scales on the problematical fossil described by Sahni and Rao in 1935 as *Rajmahalia paradoxa*. In *Ontheostrobus sessilis*, however, there is no sign of interseminal scales.

Further investigation of the structure of *Homoxylon rajmahalense* Sahni, formerly regarded as showing strong resemblance to the homoxylous Magnoliaceae, leaves little doubt that it is the wood of a Bennettitalean plant (Hsü & Bose, 1952). This is not surprising, for such a possibility was foreseen by K. M. Gupta as early as 1934 and was not entirely ruled out by Sahni. *H. rajmahalense* shows great resemblance with the secondary wood of *Bucklandia*. A new species of *Bucklandia*, with *Homoxylon*-like compact secondary wood possessing sharply marked growth-rings, has been described by M. N. Bose (1953). Bhardwaj (1953) has described three new species of coniferous woods referred to the genera *Mesembrioxylon*, *Cupressinoxylon* and *Dadoxylon*.

A recent important discovery in the Rajmahal flora has been of the leaves of Ginkgoales, a group previously not known from this flora (Sah, 1953; Mehta & Sud, 1953). There have been only a few additions to the Rajmahal ferns. Among these the best known anatomically is *Tinpaharia sinuosa* described by Jacob (1943) from Tinpahar. This species is based on branched rhizomes which are believed to represent the vegetative organs of the widespread Jurassic form *Coniopteris hymenophylloides*.

(iv) *The Upper Limit of the Gondwana System*

The plant-bearing beds of the Umia series of Kach occur in its upper part interstratified with marine beds. The marine fauna is of uppermost Jurassic to Lower Cretaceous age. According to Sahni (1938) no undoubted Lower Cretaceous plants are known from the Umia beds and he, therefore, advised that a search be made for them in the Umia flora. The general facies of the Umia vegetation, in Sahni's opinion, is Jurassic and the majority of the plant-fossils, specially the conifers, is identical with the Jabalpur species.

Professor Raj Nath, who carried out for several years an extensive investigation of the Kach strata, has given the name Bhuj series to the plant beds at Umia. According to him the Bhuj series are post-Aptian and not older than the Middle Cretaceous, but they may be slightly younger. Raj Nath (1953) attaches considerable importance to a palm wood (*Palmoxylon Mathuri* Sahni)[2] as furnishing evidence of Middle to Upper Cretaceous age for these beds. He recognizes in the Bhuj series at least three horizons, viz. the *Zamia* beds at the bottom, the *Ptilophyllum* beds in the middle, and the *Palmoxylon* beds at the top. The discrepancy in the Umia flora (the occurrence of a palm together with Jurassic Cycadophytes and conifers) is the result of failure to recognize the different horizons in the plant beds (RAJ NATH, loc. cit.).

(v) *Jurassic Marine Algae from Trichinopoly*

From the Cullygoody limestone of Trichinopoly S. R. N. Rao (1946) has described two species of *Solenopora*, *S. jurassica* and *S. coromandelensis*. The age of this limestone has not been satisfactorily settled, and by some authorities it is regarded as a part of the Trichinopoly Cretaceous. According to Rao the algae (especially *Solenopora jurassica* which has been recorded from the Bathonian of England and France) point to a Lower to Middle Oolitic age for the Cullygoody limestone.

2. This palm was collected from Kach probably by the late Professor K. K. Mathur of Banaras. It is believed to have come from the Umia beds, but at the time Sahni described it, he was not certain about its geological age. According to Professor K. N. Kaul this palm is a *Bactris*.

(vi) *The Jurassic Flora of Ceylon*

Fossil plants of Jurassic age occur at two localities, Tabbowa and Andigama, in the north-western part of Ceylon. The plant remains from Tabbowa were first described by Seward and Holttum (1922). Later Jacob (1938) and Sitholey (1944) recorded several other species from this locality. According to Seward and Holttum the flora shows a close affinity with the fossils of the Kota stage of the Madras coast, with which it has several species in common. The Tabbowa beds and the Kota beds of Madras are also similar in their relationship to the underlying rocks; in both the cases the plant-bearing beds rest unconformably on crystalline Archaean rocks.

The second locality, Andigama, lies about 20 miles south of Tabbowa. *Cladophlebis* sp. and *Elatocladus plana* (SITHOLEY, 1943) are found here in a concretionary haematite. A carbonaceous shale, which probably represents another Jurassic horizon at Andigama, contains a rich microflora which includes many types of spores and cuticles (SAH, 1953). Deraniyagala (1939) regards the carbonaceous shale to be equivalent to the Rajmahal stage. About the Tabbowa beds he agrees with the opinion of Seward and Holttum. The Andigama microflora contains several three-winged pollen grains which show a striking resemblance with *Podosporites tripakshi* of the Rajmahal flora.

(vii) *The Mesozoic Flora of the Salt Range*

At several localities in the western part of the Salt Range plant-bearing beds occur intercalated with marine formations. Feistmantel regarded the Jurassic plant beds of the Salt Range to be representatives of the Gondwanas in the Punjab, associated, as in Kach and the east coast, with marine strata. These beds indicate land conditions, not necessarily in the place where the beds occur but more probably in the vicinity from where the vegetable remains were swept into the sea bordering western India (FOX, 1931). The Triassic plants (SITHOLEY, 1943) include *Equisetites*, *Sphenopteris*, *Cladophlebis*, *Indotheca* (a pteridosperm microsporophyll) and a large number of megaspores described under the genus *Triletes*. Jurassic plants are plentiful in beds known as the variegated stage. There are two

species of *Phlebopteris* (SAHNI & SITHOLEY, 1945), a tree-fern stem, *Protopteris nammalensis* (SITHOLEY, 1949), several species of *Otozamites*, and many coniferous shoots. *Ptilophyllum* is found in a massive sandstone of Cretaceous age in the trans-Indus part of the Salt Range.

(viii) *The Cretaceous Plants of India*

The Cretaceous system in India is very divergent in facies and spread over several parts of the country. Plant remains are, however, scarce and confined only to a few places, principally on the Coromandel coast. The majority of the species belong to marine algae. A *Cycadeoidea*[3] is reported by Jacob and Aiyengar (1941) from Varagur in the Trichinopoly district. From the same district Feistmantel (1877) has described *Protocyathea trichinopoliensis*.

From the Ahmednagar (Himmatnagar) sandstones in Idar (western India) *Matonidium indicum* and *Weichselia reticulata* have been described by Sahni (1936). The fossils, according to Sahni, indicate a Wealden age for the Himmatnagar sandstones.

The Upper Cretaceous rocks of the Coromandel coast are divided into three distinct stages. These are known (from the oldest to the newest) as the Utatur, Trichinopoly and Aryalur stages. Cycadaceous wood occurs in association with many marine animal fossils in the Utatur and the Trichinopoly stages. The Aryalur beds contain a very rich marine fauna. The uppermost beds of Aryalur (recognized as a separate Niniyur stage) are characterized by an abundance of marine algae (L. R. RAO & J. PIA, 1936). The groups most abundantly represented here are the Corallinaceae and Dasycladaceae. The Niniyur stage is believed to be Danian in age.

THE FLORA OF THE DECCAN INTERTRAPPEAN SERIES

The Deccan Intertrappean beds contain perhaps the best preserved petrified flora of India. These beds are found interstratified with volcanic rocks which cover wide areas in central and western India. The fossils of Deccan Intertrappean series have been known for more than 100 years and were collected by the earliest geologists (Carter, Hislop, Hunter, Malcolmson) who worked in India. Along with the plants many animal remains such as those of molluscs, crustaceans, frogs and fishes are found in this series.

A graphic description of the conditions under which the organic remains of this formation were preserved was given by Sahni (1940) in his presidential address to the 27th Indian Science Congress, Madras. The fossil flora includes many palms and dicotyledonous remains, coniferous woods, and a large aquatic element comprising algae, charophyta and water-ferns.

The non-vascular elements of the flora comprise several members of the Dasycladaceae (J. PIA, S. R. N. RAO & K. S. RAO, 1937; S. R. N. RAO & K. S. RAO, 1937); Chara oogonia (K. S. RAO & S. R. N. RAO, 1939; SAHNI & S. R. N. RAO, 1943); and some fungal remains (SAHNI & H. S. RAO, 1943).

The water-ferns include *Azolla intertrappea* (SAHNI, 1941) and *Rodeites*, a bisporangiate sporocarp closely resembling the sporocarps of the Brazilian water-fern *Regnellidium* (SAHNI, 1943a). The genus *Massulites* of Sahni and H. S. Rao is now regarded by Dr. T. S. Mahabale (1950) as the hollow massula of a fossil *Salvinia*. Mahabale has also pointed out the strong resemblance between the genus *Sausarospermum* (described by Sahni and B. P. Srivastava in 1934) and the megaspore of *Salvinia auriculata*.

The conifers are represented by seed-bearing cones, *Takliostrobus*, *Indostrobus* and *Pityostrobus* (SAHNI, 1931) and many woods referred to species of *Dadoxylon* and *Cupressinoxylon*.

Among the angiosperms the most numerous are palm stems (SAHNI, 1931a), a large number of which still remain to be investigated. Professor K. N. Kaul (1942) has suggested the splitting up of the highly artificial genus *Palmoxylon*, to which all the Deccan Intertrappean palms have been referred, into more natural genera with the help of the characters of the ground tissue. Thus some of the Palmoxyla, it is noticed, can be identified anatomically with genera like *Borassus*, *Bactris* and *Cocos*. The palm fruits so far recorded are *Nipa hindi*,

3. This is now described as *Pseudocycadeoidea indica*. See Aiyengar and Jacob, 1952. *Rec. Geol. Surv. India.* **82**(2): 325-341.

Palmocarpon and *Tricoccites* (SAHNI & RODE, 1937).

Besides the palms the other monocots in the Deccan Intertrappeans are *Sparganium* (MAHABALE, 1953) and two species of cardamoms. According to Sahni and Surange (1953) *Palmoxylon Sahnii* of Rode may not be a true palm but an extinct member of the Cyclanthaceae; they have, therefore, proposed for it the name *Cyclanthodendron*. It is possible that the 6-seeded fruits described as *Viracarpon* belong to the Cyclanthaceae. It is of considerable interest to note that in the Deccan Intertrappeans we have at least two plants, *Cyclanthodendron* and *Rodeites*, which have close affinities with living types now confined to parts of South America.

The dicotyledons are represented chiefly by leaves and woods, the earliest described being *Phyllites mohgaoensis* and *Dryoxylon mohgaoensis* (SAHNI & RODE, 1937). Of considerable interest is the fruit *Enigmocarpon Parijai* (SAHNI, 1943), the structure of which indicates affinities with the family Lythraceae. In 1944 Shukla discovered a flower which in the characters of its ovary showed a remarkably close resemblance with *E. Parijai*. Shukla believes that his flower, which he named *Sahnianthus Parijai*, and *Enigmocarpon* belong to the same plant.

Age of the Intertrappean Beds — The eruptions which formed the Deccan Traps were subsequent to the deposition of the Bagh (Cenomanian) and Lameta beds. The upward limit of the traps is indicated by the interstratification of some of the flows with the *Cardita beaumonti* beds of Sind, which are of Danian or newer age. The traps of the west coast are unconformably overlain by outliers of Nummuitic beds.

The evidence of the plant remains, according to Sahni, indicates an early Tertiary (Lower Eocene) age from the Deccan Intertrappean beds. This was also the opinion of the early geologists, Malcolmson, Hislop and others, and they compared the flora of these beds with the flora of London clay. Some fish remains found in the Lametas are, according to Smith-Woodward, of Danian to Lower Eocene age; and since the Lametas are infratrappean, the base of the traps should be Eocene. In the opinion of Dr. S. L. Hora some fish scales which occur in the intertrappean beds at Betul are not earlier than the Eocene.

THE TERTIARY FLORAS

The chief exposures of Tertiary strata in India are along the foot of the mountains on the western, northern and north-eastern borders of the country. Small outcrops of Tertiary rocks are also found near the west coast of Travancore, in Gujerat, Kathiawar and Kach, and near the east coast. All over the country the Tertiary system exhibits a dual facies: (i) a lower, marine facies, and (ii) an upper, fresh-water facies. The Eocene everywhere is marine and the Pliocene fluviatile or subaerial.

The most common plant fossils are petrified woods, mostly dicotyledonous. There are also many leaf impressions and some fruits and seeds. The leaves are generally poorly preserved. Marine algae occur in the Eocene at several places.

The most striking fact about these Tertiary plant remains is the absence of conifers. Coniferous wood is met with in Tertiary rocks in South India, but none of the strata of this age in northern India, where at the present time the conifers flourish extensively in the Himalayas, have yielded a single coniferous remain. Attention to this fact was drawn by Sahni in 1931 while discussing the advent of modern conifers in India. Sahni concluded that this event must be placed at a date at the end of the Pliocene or even later, when the elevation of the Himalayas had provided a climate suitable for their growth.

Fossil Woods — The occurrence of fossil angiospermous woods in the Irrawadi and the Pegu systems of Burma (Oligocene to Pliocene) has been known for a long time. The majority of them are dicotyledonous, but some palm stems also occur. One of the dicot woods was described by Miss Holden in 1916 as *Dipterocarpoxylon burmense*. Big trunks of silicified wood are known also from the Nari series (Oligocene) of Sind and the Siwalik system (Middle Miocene to Lower Pliocene) in the foothills of the Himalayas.

With the exception of the specimens described by Miss Holden, the anatomy of none of these woods has been worked out. At present the best known fossil angiospermous woods of India come from the Middle Tertiary rocks of Assam and from the Cuddalore sandstones of South India. The Assam woods have been investigated by Dr. K. A. Chowdhury and his co-workers

(1938, 1946, 1949, 1952). They have been referred to the genera *Cynometroxylon* (Leguminosae), *Kayeoxylon* (Guttiferae), *Glutoxylon* (Anacardiaceae), and *Dipterocarpoxylon* (Dipterocarpaceae). Chowdhury believes that one of Miss Holden's specimens of *Dipterocarpoxylon* from Burma, subsequently placed by K. M. Gupta in the new genus *Irrawadioxylon*, is really a *Glutoxylon*.

The exact age of the Cuddalore sandstones is not known, but it is said to range from Oligocene to Lower Miocene. Ramanujam (1953) has described from here a palm (*Palmoxylon arcotense*) resembling the genus *Livistona* and two coniferous woods referred to the genus *Mesembrioxylon*. The only wood previously described from these sandstones was *Mesembrioxylon Schmidianum* (SAHNI, 1931). The Cuddalore sandstones contain many other dicotyledonous woods which are at present being investigated by Ramanujam. These woods resemble genera such as *Mangifera, Shorea, Albizzia, Cassia, Dalbergia, Garcinia* and *Sonneratia*.

Angiospermous Leaves, Fruits, etc. — Dicotyledonous leaf impressions occur in the Ranikot series (Eocene) of Sind and in the Middle Eocene strata of Baluchistan, Salt Range, Bikaner, Jammu, Burma and Assam. They are also found in the Siwalik system (Miocene to Lower Pleistocene) and in the Murree and Kasauli series of western Himalayas which are of Lower Miocene age. Since Seward described *Phyllites kamrupensis* in 1912 from the Middle Tertiary of Assam, hardly any descriptions of Tertiary leaf impressions from India have been published.

From some localities near Garo Hills in Assam R. N. Lakhanpal (1948, 1952) has described a number of leaf impressions (probably Eocene) resembling *Eriodendron* and *Neolitsea*, and a palm fruit, *Nipa Sahnii*. The age of the *Nipa* fossils is regarded as Miocene. From Kasauli beds the only leaf known till recently was that of a palm. This was discovered more than 85 years ago by H. B. Medlicott and was referred by Feistmantel to *Sabal major* Heer. Some dicotyledonous leaves (*Dicotylophyllum* spp.) have been described by Sahni (1953, in a posthumous paper) from these beds. At Kapurdi (Jodhpur) in Rajasthan a fuller's earth bed of Eocene age has yielded monocot and dicot leaves, fruits and stems (LAKHANPAL & BOSE, 1951). From the same beds a coconut (*Cocos Sahnii*) has been described by Kaul (1951).

Spores and Pollen Grains — A rich microflora comprising spores and angiospermic pollen grains has been discovered from the Tertiary strata in Rajasthan (BOSE, 1952; SINGH & NATRAJAN, 1950; A. R. RAO & VIMAL, 1952); Travancore (A. R. RAO & VIMAL, 1952a); and Assam (SAHNI, SITHOLEY & PURI, 1948). The richness of the microflora, particularly from Assam where it occurs in strata ranging from the Lower Oligocene to the Pliocene, is in striking contrast with the paucity of the Tertiary species known in the form of leaves, fruits and fossil woods.

Algae — Marine algae occur in the Eocene strata at several localities. In Assam there is a rich limestone algal flora belonging to the families Corallinaceae and Dasycladaceae (K. S. RAO, 1943). The genus *Triploporella* (Dasycladaceae) occurs in the Ranikot beds of Sind (WALTON, 1926). In the Eocene of the Salt Range (L. RAMA RAO & K. S. RAO, 1939) there is an interesting algal flora in which common Eocene forms like *Dissocladella, Acicularia* and *Neomaris* occur with *Diplopora* and *Oligoporella* elsewhere not found in beds younger than the Triassic. The other genera recently discovered in the Eocene beds of Salt Range are *Lithophyllum* (VARMA, 1953) and *Solenomeris* (S. R. N. RAO & VARMA, 1953). Several genera of the Corallinaceae such as *Lithophyllum, Archaeolithothamnium* and *Mesophyllum* also occur in the Ranikot series in the Samana Range (S. R. N. RAO, 1941).

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APPENDIX

LIST OF THE IMPORTANT MESOZOIC SPECIES FROM THE GONDWANA ROCKS OF INDIA AND RELATED FORMATIONS IN CEYLON AND SALT RANGE

NAME OF SPECIES	INDIA							CEYLON (JURASSIC)		SALT RANGE	
	Panchet	Parsora	Maleri	Rajmahal	Kota	Jabalpur	Umia	Tabbowa beds	Andigama	Triassic	Jurassic (variegated stage)
Charophyta (oospores)	...	...	...	×	...	...	...	...	...	...	...
Equisetales											
Schizoneura gondwanensis Fst.	×	×	...	...	...	...	...	...	...	...	...
Equisetites rajmahalensis (Schimp.)	...	...	...	×	...	...	...	...	...	...	...
Equisetites sp.	...	...	...	...	...	...	...	...	...	×	...
Lycopodiales											
Lycoxylon indicum Srivast.	...	...	...	×	...	...	...	...	...	...	...
Lycopodites gracilis (Morr.)	...	...	...	×	...	...	...	...	...	...	...
Triletes Sahnii Sitholey	...	...	...	...	...	...	...	...	...	×	...
Filicales											
Danaeopsis rajmahalensis Fst.	...	...	...	×	...	...	...	...	...	...	...
Marattiopsis macrocarpa (Morr.)	...	...	...	×	...	...	...	...	...	...	...
Gleichenites gleichenoides (Morr.)	...	...	...	×	...	...	...	...	...	...	...
G. rewahensis Fst.	...	...	...	...	...	×	...	...	...	...	...
Cladophlebis denticulata Bgt.	...	...	...	×	×	×	×	×	...	...	...
C . reversa (Fst.)	...	...	...	...	×	...	...	×	...	...	...
C. zeylanica Sitholey	...	...	...	...	...	...	...	×	...	...	...
Cladophlebis sp.	...	...	...	...	...	...	...	...	×	...	...
Cladophlebis sp.	...	...	...	...	...	...	...	...	...	×	...
Coniopteris hymenophylloides Bgt.	...	...	...	×	...	...	...	×	...	...	...
Tinpaharia sinuosa Jacob	...	...	...	×	...	...	...	...	...	...	...
Sphenopteris rajmahalensis Sahni & Rao	...	...	...	×	...	...	...	...	...	...	...
S. khairbaniensis Ganju	...	...	...	×	...	...	...	...	...	...	...
S. Hislopi (O. & M.)	...	...	...	×	...	...	...	...	...	...	...
S. Wadiai Sitholey	...	...	...	...	...	...	...	×	...	...	...
Sphenopteris spp.	...	...	...	...	...	...	...	...	...	×	...
Pecopteris lobata O. & M.	...	...	...	×	...	...	...	...	...	...	...
Phlebopteris indica Sahni & Sitholey	...	...	...	...	...	...	...	...	...	...	×
P. hirsuta Sahni & Sitholey	...	...	...	...	...	...	...	...	...	...	×
Phlebopteris sp.	...	...	...	×	...	...	...	...	...	...	...
Protocyathea rajmahalense Jacob	...	...	...	×	...	...	...	...	...	...	...
Protopteris nammalensis Sitholey	...	...	...	...	...	...	...	...	...	...	×
Rhizomopteris chakshu Ganju	...	...	...	×	...	...	...	...	...	...	...
Eboracia lobifolia (Phill.)	...	...	...	...	...	×	...	...	...	...	...
Alethopteris Medlicottiana Oldh.	...	...	...	...	...	×	...	...	...	...	...
Actinopteris sp.	...	...	...	...	...	...	×	...	...	...	...
Pachypteris sp.	...	...	...	...	...	...	×	...	...	...	...

APPENDIX — *contd.*

LIST OF THE IMPORTANT MESOZOIC SPECIES FROM THE GONDWANA ROCKS OF INDIA AND RELATED FORMATIONS IN CEYLON AND SALT RANGE

Name of species	India							Ceylon (Jurassic)		Salt Range	
	Panchet	Parsora	Maleri	Rajmahal	Kota	Jabalpur	Umia	Tabbowa beds	Andigama	Triassic	Jurassic (variegated stage)
Pteridospermae											
Glossopteris angustifolia Bgt.	×	...	...	...	...	...	...	...	...	...	...
G. indica Schimp.	×	×	...	...	...	...	...	...	...	...	...
Vertebraria indica Royle	×	×	...	...	...	...	...	...	...	...	...
Thinnfeldia odontopteroides (Morr.)	×	×	...	...	...	...	...	...	...	...	...
T. indica Fst.	...	...	...	×	...	...	...	...	...	...	...
T. subtrigona Fst.	...	...	...	...	×	...	...	...	...	...	...
Danaeopsis (Thinnfeldia) Hughesi Fst.	...	×	...	...	...	...	...	...	...	...	...
Pecopteris concinna Presl.	×	...	...	...	...	...	...	...	...	...	...
Cyclopteris pachyrhacis Goepp.	×	...	...	...	...	...	...	...	...	...	...
Samaropsis sp.	×	×	...	...	...	...	...	...	...	...	...
Indotheca sakesarensis Sitholey	...	...	...	...	...	...	...	...	...	×	...
Caytoniales											
Sagenopteris Bhambhani Jacob	...	...	...	×	...	...	...	...	...	...	...
Cycadophyta											
Ptilophyllum acutifolium Morr.	...	...	...	×	×	×	×	...	...	...	...
P. amarjolensis Bose	...	...	...	×	...	...	...	...	...	...	...
Ptilophyllum sp.	...	...	...	...	...	...	...	×	...	...	...
Pterophyllum incisum Sahni & Rao	...	...	...	×	...	...	...	...	...	...	...
Pterophyllum sp.	...	×	...	...	...	...	...	...	...	...	...
Williamsonia microps Fst.	...	...	...	×	...	...	...	...	...	...	...
W. indica Sew.	...	...	...	×	...	×	...	...	...	...	...
W. Blanfordi Fst.	...	...	...	...	...	...	×	...	...	...	...
W. Sahnii Gupta	...	...	...	×	...	...	...	...	...	...	...
W. Sewardiana Sahni	...	...	...	×	...	...	...	...	...	...	...
W. santalensis Sitholey & Bose	...	...	...	×	...	...	...	...	...	...	...
Homoxylon rajmahalense Sahni	...	...	...	×	...	...	...	...	...	...	...
Bucklandia indica Sew.	...	...	...	×	...	...	...	...	...	...	...
B. Sahnii Bose	...	...	...	×	...	...	...	...	...	...	...
Otozamites bunburyanus var. indica Sew. & Sahni	...	...	...	...	×	...	...	...	...	...	...
O. bengalensis (Morr.)	...	...	...	×	×	...	...	...	...	...	...
O. pecten Sahni & Sitholey	...	...	...	...	...	...	...	...	...	...	×
Otozamites sp.	...	...	...	...	...	...	...	×	...	...	...
Dictyozamites indica (Fst.)	...	...	...	×	...	...	...	...	...	...	...
D. falcatus (Morr.)	...	...	...	×	×	...	...	...	...	...	...
D. Hallei Sahni & Rao	...	...	...	×	...	...	...	...	...	...	...
D. bagjtoriensis Jacob	...	...	...	×	...	...	...	...	...	...	...
Taenioperis lata Oldh.	...	...	...	×	...	...	...	...	...	...	...
T. Morrisii Oldh.	...	...	...	×	...	...	...	...	...	...	...
T. ovata (Schimp.)	...	...	...	×	×	...	...	...	...	...	...
T. crassinervis (Fst.)	...	...	...	×	...	...	...	...	...	...	...
T. musaefolia Oldh.	...	...	...	×	...	...	...	...	...	...	...
T. vittata Bgt.	...	...	...	...	...	...	×	...	...	...	...
T. spathulata McCl.	...	...	...	×	×	...	...	×	...	...	...
T. McClellandi (Morr.)	...	...	...	...	×	...	...	...	...	...	...
Taeniopteris sp. cf. McClellandi	...	...	...	×	...	...	...	...	...	...	...
Nilssonia princeps (O. & M.)	...	...	...	×	...	...	...	...	...	...	...
N. rajmahalensis (Oldh.)	...	...	...	×	...	...	...	...	...	...	...
N. Morrisiana (Oldh.)	...	...	...	×	...	...	...	...	...	...	...
N. Medlicottiana (O. & M.)	...	...	...	×	...	...	...	...	...	...	...

APPENDIX — *contd.*

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Name of species	India							Ceylon (Jurassic)		Salt Range	
	Panchet	Parsora	Maleri	Rajmahal	Kota	Jabalpur	Umia	Tabbowa beds	Andigama	Triassic	Jurassic (variegated stage)
Cycadophyta											
N. bindrabenensis Sew. & Sahni	...	...	...	×	...	...	...	...	...	...	...
N. (Anomozamites) fissa (Fst.)	...	...	...	×	...	...	...	×	...	...	...
Pseudoctenis Footeana (Fst.)	...	...	...	...	×	...	...	...	...	...	...
Ontheanthus polyandra Ganju	...	...	...	×	...	...	...	...	...	...	...
Ontheostrobus sessilis Ganju	...	...	...	×	...	...	...	...	...	...	...
Beaniopsis rajmahalensis Ganju	...	...	...	×	...	...	...	...	...	...	...
Cycadinocarpus rajmahalensis Fst.	...	...	...	×	...	...	...	...	...	...	...
Ginkgoales											
Ginkgoites crassipes (Fst.)	...	...	...	...	×	...	...	...	...	...	...
G. lobata Fst.	...	...	...	...	...	×	...	...	...	...	...
Ginkgoites spp.	...	...	...	×	...	...	...	...	...	...	...
Baiera ? sp.	...	...	...	×	...	...	...	...	...	...	...
Cordaitales											
Cordaites (Noeggerathiopsis) Hislopi (Bumb.)	...	×	...	...	...	...	...	...	...	...	...
Coniferales											
Desmiophyllum indicum Sahni	...	...	...	...	×	×	...	...	...	...	...
Desmiophyllum sp.	...	...	...	...	...	...	...	×	...	...	...
Elatocladus plana (Fst.)	...	...	...	×	×	×	...	×	×	...	...
E. jabalpurensis (Fst.)	...	...	×	...	×	×	...	...	...	...	...
E. conferta (O. & M.)	...	...	...	×	×	×	...	...	...	...	...
E. tenerrima (Fst.)	...	...	...	×	×	×	×	...	...	...	...
Elatocladus sp.	...	...	...	...	...	...	...	×	...	...	...
Retinosporites indica (O. & M.)	...	...	...	×	×	×	×	...	...	...	...
Brachyphyllum spiroxylum Bose	...	...	...	×	...	...	...	...	...	...	...
B. mamillare Bgt.	...	...	...	×	...	×	...	×	...	...	...
B. expansum (Sternb.)	...	...	...	×	×	×	×	...	...	...	...
B. expansum var. indica Sahni	...	...	...	...	...	×	...	...	...	...	...
B. rhombicum (Fst.)	...	...	...	...	×	×	...	...	...	...	...
B. Feistmantelli (Halle)	...	...	...	...	×	×	...	...	...	...	...
Pagiophyllum perigrinum (L. & H.)	...	...	...	...	...	×	...	...	...	...	...
P. cf. perigrinum	...	...	...	×	...	×	...	...	...	...	...
P. cf. divaricatum (Bunb.)	...	...	...	...	...	...	×	...	...	...	...
Torreyites constricta (Fst.)	...	...	...	...	×	...	...	...	...	...	...
T. Sitholeyi Ganju	...	...	...	×	...	...	...	...	...	...	...
Athrotaxites Feistmanteli Sahni	...	...	×	...	...	...	...	...	...	...	...
Taxites lanceolata Ganju	...	...	...	×	...	...	...	...	...	...	...
Araucarites cutchensis Fst.	...	...	×	...	×	×	×	×	...	...	...
A. macropterus Fst.	...	...	...	×	×	×	×	...	...	...	...
A. latifolius Fst.	...	...	...	...	...	×	...	...	...	...	...
Coniferocaulon sp.	...	...	...	×	...	...	...	...	...	...	...
Ontheodendron Florinii Sahni & Rao	...	...	...	×	...	...	...	...	...	...	...
Conites sessilis Sahni	...	...	...	×	×	...	...	...	...	...	...
C. sripermaturensis Sahni	...	...	...	...	×	...	...	...	...	...	...
C. rajmahalensis Sahni	...	...	...	×	...	...	...	...	...	...	...
C. verticillatus Sahni	...	...	...	...	×	...	...	...	...	...	...
Conites sp.	...	...	...	...	×	...	...	...	...	...	...
Conites sp.	...	...	...	...	...	×	...	...	...	...	...
Conites sp.	...	...	...	...	...	...	×	...	...	...	...

APPENDIX — *contd.*

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	Panchet	Parsora	Maleri	Rajmahal	Kota	Jabalpur	Umia	Tabbowa beds	Andigama	Triassic	Jurassic (variegated stage)
Coniferales											
Strobilites Sewardi Sahni	...	...	...	...	...	×	...	...	...	...	...
Stachyotaxus sp.	...	...	...	×	...	...	...	...	...	...	...
Nipanioruha granthia Rao	...	...	...	×	...	...	...	...	...	...	...
Masculostrobus rajmahalensis Rao	...	...	...	×	...	...	...	...	...	...	...
Nipaniostrobus Sahnii Rao	...	...	...	×	...	...	...	...	...	...	...
Podosporites tripakshi Rao	...	...	...	×	...	...	...	...	...	...	...
Alisporites jurassicus Rao	...	...	...	×	...	...	...	...	...	...	...
A. auriculiformis Rao	...	...	...	×	...	...	...	...	...	...	...
Mesembrioxylon godaverianum Sahni	...	...	...	...	×	...	...	...	...	...	...
M. indicum Bhardwaj	...	...	...	×	...	...	...	...	...	...	...
M. Parthasarathai Sahni	...	...	...	...	×	...	...	...	...	...	...
M. malerianum Sahni	...	...	×	...	...	...	...	...	...	...	...
Cupressinoxylon (Taxodioxylon) rajmahalense Bhardwaj	...	...	...	×	...	...	...	...	...	...	...
C. alternans Sahni	...	...	...	...	×	...	...	...	...	...	...
C. coromandelinum Sahni	...	...	...	...	×	...	...	...	...	...	...
Dadoxylon (Araucarioxylon) rajmahalense Sahni	...	...	...	×	...	...	...	...	...	...	...
D. (Arauc.) jurassicum Bhardwaj	...	...	...	×	...	...	...	...	...	...	...
Taxoxylon rajmahalense Bhardwaj	...	...	...	×	...	...	...	...	...	...	...
Pentoxyleae											
Nipaniophyllum Raoi Sahni	...	...	...	×	...	...	...	...	...	...	...
Pentoxylon Sahnii Srivast.	...	...	...	×	...	...	...	...	...	...	...
Carnoconites laxum Srivast.	...	...	...	×	...	...	...	...	...	...	...
C. compactum Srivast.	...	...	...	×	...	...	...	...	...	...	...
Haitingeria rajmahalensis (Wiel.) Kras.	...	...	...	×	...	...	...	...	...	...	...
Nipanioxylon Guptai Srivast.	...	...	...	×	...	...	...	...	...	...	...
Sahnia nipaniensis Vishnu-Mittre	...	...	...	×	...	...	...	...	...	...	...
Angiospermae											
Palmoxylon Mathurai Sahni	...	...	...	...	...	...	×	...	...	...	...
Incertae											
Strobilites ontheansis Ganju	...	...	...	×	...	...	...	...	...	...	...
Sakristrobus Sahnii Jacob	...	...	...	×	...	...	...	...	...	...	...
Rajmahalia paradoxa Sahni & Rao	...	...	...	×	...	...	...	...	...	...	...
Podozamites lanceolatus	...	...	...	×	×	×	...	...	...	...	...
Phoenicopsis ? sp.	...	...	...	...	...	×	...	...	...	...	...
Squamae	...	×	...	...	...	...	...	...	...	...	...