PALMS : THE BIG GAME OF PLANTS

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The great explorer and naturalist, ALEXANDER VON HUMBOLDT called the palms as the loftiest and noblest of all plant forms. Indeed, palms by their slender, long but strong stems, enormous leaves and giant fruits bewitched the early explorers who in their search endured unaccountable hardships in the Amazon and Orinoco deltas, as also in Sumatra, Java and Borneo Islands. Palms are mainly pantropical in distribution but have subtropical extensions as well. Thus, they are found in California, North Carolina, Chile, Argentina, Italy, Greece, Asia Minor, India, China, Korea, South Japan, New Zealand and South Africa. They are distributed from 44° N to 44° S. It may, however, be mentioned that some palms are erratic in distribution while others are endemic. There are only two genera, viz. the oil palm *Elaeis* and *Raphia* which are found in America and Africa. On the other hand, *Phoenix*, *Hyphaene*, *Borassus* and *Calamus* occur only in Africa and Asia. This goes to show that most genera are restricted to the three major tropical continents. *Cocos* for its human interest is cosmopolitan.

MOORE (1973) divided palms into 15 major groups with 212/217 genera and 2,700 species. Of them, the Coryphoid palms possess 33 genera and 330 species which grow in America, Europe, Asia and Australia. Borassoid palms have only 6 genera and 22 species. They are restricted to Africa and Asia. Phoenicoid group has only one genus and 12 species occurring only in Africa and Asia. Caryotoid palms consist of 3 genera and 38 species and occur in Asia and Australia. Cocoid group has 600 species distributed in 27 genera and spread over in America, Africa and Asia. Arecoid palms are pantropical in distribution and have 130 genera and 1,100 species. Nypoid group represented by *Nypa* is unusual in having only one species which is distributed in Asia and Australia. *Phytelephas* the many seeded, dioecious genus has 10 species and is restricted to America. Lepidocaryoid palms with fruits which are covered with scales are divided into 25 genera and 500 species, and are pantropical. Many systematic botanists place Cyclanthaceae, Palmae, Pandanaceae and Araceae close to each other (BENTHAM & HOOKER, 1862-83 ; WETTSTEIN, 1911). HUTCHINSON (1934) derived palms from the Liliaceous stock, viz., Liliales—Agavales, Palmales—Pandanales—Cyclanthales. CORNER (1966) thinks that only Cyclanthaceae possesses splitting plicate leaves comparable to the advanced palmate-leaved palms ; and that Cyclanthaceae evolved from the ancestral palm stock before the flower was reduced to the palm character of one ovule per loculus.

Palms grow luxuriantly in tropical swamps, river banks and sea shore and thus they have a better chance for fossilisation but actually it is not so. While collecting fossils we come across a fragmentary fossil wood or some worn out fruits, a little bit of inflorescence stalk, petiole and on maceration we may recover pollen grains. In most cases, the incomplete specimens are classified into various 'organ genera' ; of these, the best known is *Palmoxylon* used for the stem. This genus has over hundred species reported

Geophytology, **12**(2) : 137-143, 1982.

from various regions of the earth. Other genera are *Rhizopalmoxylon* for roots, *Palmocarpon* for fruits, *Palaeorachis* for inflorescence and *Palmophyllum* for leaves. The pollen grains assignable to palms are placed into *Monocolpites*, *Palmaepollenites*, *Palmidites*, *Monosulcites* *Couperipollis*, *Arecipites*, *Dicolpopollis*, *Mauritidites*, *Retimonocolpites*, *Spinizonocolpites*, etc.

In cases where the identity of the fossil is certain, generic names like *Nipadites* and *Sabalites* are used. In contrast to over two hundred living genera and a couple of thousand species, the fossil record of palms is poor. The unsatisfactory preservation, fragmentary nature of the specimens, and imperfect knowledge of modern palm anatomy make it an uphill task to classify them properly, tracing their origin, migration routes and distribution in the past.

Croizat (1952) postulated that the flowering plants deversified from an Antarctic continent of mild climate through three 'gates of angiospermy'. These are the Magellan gate of Cape Horn, the African gate of Good Hope and the Polynesian gate of New Zealand. He believed that the palms came through the Good Hope gate into Gondwanaland.

Corner (1966) considered that the ancestral portait of a palm should be a massive, spiny dichotomously branched plant, ten to fifteen feet high, with rosettes of large compound leaves, terminal inflorescences and big flowers. It grew in dense, formidable forests, along rivers where reptiles used to roam. Palms offered honey, pollen, flowers and arillate seeds to these animals.

About where this hypothetical plant grew, Corner is uncertain. He thinks that the region where the species of a genus or the genera of a family are concentrated most, may be taken as the place of origin of that genus or the family. But he also mentions that it is possible that the centre may have shifted with climatic changes. He advocated an Indian origin for *Phoenix* because many species of *Phoenix* are found in this subcontinent. In the same way, he deduced that *Calamus* evolved in Malaysia. For *Cocos* it is postulated that Malaysia might be its original home because coconut has attained the highest development in this region.

In Malaya, there are no Middle Cretaceous sediments as the Tertiaries rest unconformably on the post-Triassic and Triassic basic and ultrabasic intrusive rocks (Alexander, 1956). Thus, palm fossils of Malaya occur from the beginning of the Tertiary. Investigations carried on coal samples from the neighbourhood of Kuala Lumpur of middle—late Eocene in age showed 18 spore-pollen genera out of which only two genera, viz. *Palmaepollenites* and *Palmidites* could be ascribed to palms. Both these genera are laevigate and monocolpate. Strangely enough no *Calamus* or *Nypa*-like pollen could be recovered.

Muller (1968) was, however, able to describe two species of *Dicolpopollis* from the Palaeocene of Kalimantan (Borneo). These are *Calamus* pollen and they overwhelmingly dominate (90%) the assemblage. Dransfield (1974) described a peat swamp forest on W. Sumatra full of *Calamus* pollen but in the coastal peat swamps of North-West Borneo they are hardly encountered. Anderson and Muller (1975) explain this phenomenon by assuming that in a closed forest type there is hardly any room left for the penetration by rattans.

The luxuriant growth of palms in Malaysia and neighbouring islands lured Smith (see Muller, 1978-79) to postulate that palms originated in this region. Lakhanpal (1970) is of the opinion that Leguminosae evolved in Malaysia and it followed more or less the same route as the Dipterocarpaceae. Moore (1973) has studied the present day distribution of primitive and advanced genera of palms from Malaysia. Though in this region we have *Cocos, Phoenix, Borassus, Eugeissona, Calamus, Nypa,* etc., most of them are highly advanced. The latter genus has only one species, viz. *Nypa fruticans* which is thornless, with unisexual flowers and capitate female inflorescence ; ovary has a single ovule, the fruit is dry and fibrous because of which it could be regarded as one of the most advanced palms. CORNER (1966) presumes that *Nypa* was present in Borneo during Cretaceous from where it spread northwards along the Tethys shores colonising Africa or America and without extending south-east to south Australia and New Zealand.

The fossil pollen of Nypa *Spinizonocolpites* is characterised by zonisulcate condition resulting in the splitting of the pollen grains into two equal halves, additionally it has strong spines. TRALAU (1964) and also MOORE (1973) have studied the present and the past distribution of *Nypa.* The fossil fruits of *Nypa* have been described from South and North America. JARDINE AND MAGLOIRE (1963) recorded fossil pollen of *Nypa* from the Senonian of West Africa and MULLER (1968) also reported the same type of pollen from the undifferentiated Senonian of Borneo. This discrepancy in the past and present distribution of *Nypa*, in the opinion of MULLER (1978-79), indicates the invasion of the mangrove environment rather than the origin of the genus. THANIKAIMONI (1970) thinks that Nypa pollen shows close morphological similarity to some species of *Salacca* as they are also meridionosulcate and spinose. MULLER (1978-79) thinks that the fossil pollen genus *Proxapertites* is related to *Nypa* pollen as in the fossil condition they show similar distribution and occur in the same type of deltaic, near-shore, sediments. *Proxapertites,* like *Spinizonocolpites,* is zonisulcate and splits into two equal halves but is distinctly reticulate. Considering all these aspects it appears plausible that Malaysia was not the craddle of palms. Paucity of palm pollen in the Lower Tertiary sediments of Malaya also corroborates this postulate.

If palms did not originate in Malaysia then we have to look for some other region for their probable origin. As palms show maximum development in tropical conditions it may be assumed that some other tropical countries might have been their homeland.

It should be remembered that original homeland of a particular species may not provide the optimum conditions for its subsequent development as well. Plant species migrate from one place to another to save themselves from extinction in the changed ecological conditions or they evolve new characters to cope up with the changed environment. If this condition is repeated several times then to demarcate the ancestral characters or the homeland of a taxon becomes difficult. The case of *Nypa* already discussed earlier may be cited as one such example.

The palynology of palms does not help much in deciphering the ancestry and evolution within the family. It is very much diversified. Thus, laevigate to finely reticulate and monocolpate pollen grains are found in *Cocos, Phoenix, Raphia, Ptychosperma, Orania, Bactris, Sabal, Washingtonia* and many other genera. Similarly, monocolpate, foveolate-rugulose pollen grains are met with in *Veitchia, Latania, Elaeis, Astrocaryum, Corozo, Manicaria, Thrinax,* etc. The meridionosulcate pollen are found in *Nypa* and *Salacca* while the diporate condition occurs in *Daemonorhops, Eleiodoxa* and *Korthalsia.*

RAVEN AND AXELROD (1974) assumed that palms as well as other angiosperms evolved in South America, South Africa and Antarctica. At the time when the palms originated, these continents were juxtaposed to each other. The presence of primitive palm genera in South America speaks with eloquence in favour of this hypothesis.

HERNGREEN (1975) recorded palm like pollen referrable to *Monosulcites*, *Retimonocolpites* and *Scabramonocolpites* from Albian to Lower Cenomanian of Brazil. VAN HOEKEN KLINKENBERG (1964—1966) reported palm like pollen as *Longapertites* from the Maestrichtian of Nigeria. BOLTENHAGEN (1976) was able to recover pollen assignable to palm from Coniacian of Gabon. JARDINE AND MAGLOIRE (1963) after studying the Cretaceous palynology of Senegal came to the conclusion that monocolpate palm pollen are encountered only from the Upper Cretaceous in West Africa. This synchronous development of palms in Brazil and West Africa indicates a land connection between the two and thus supports the hypothesis advocated by RAVEN AND AXELORD (1974). According to MULLER (1978-79) the primitive palm pollen was less ornamented, monocolpate with extended colpate and trichomosulcate. This was followed by more spiny ornamented and broadly reticulate forms and some with zonisulcate condition. The development of calamoid dicolpate pollen in Borneo indicates a later sequence according to MULLER.

In NE India, the Upper Cretaceous rocks are exposed as a thin veneer along the southern fringes of the Shillong Plateau of Meghalaya. The Gumaghat Formation, which according to SAH AND SINGH (1979-80) is most probably Senonian in age, yielded laevigate, monocolpate pollen referred by them as *Palmaepollenites*. The Mahadeo Formation (Maestrichtian) of Meghalaya also yielded laevigate pollen designated as *Palmidites* by SAH AND SINGH (1979-80).

BAKSI (1972) and BAKSI AND DEB (1981) studied Upper Cretaceous subsurface sediments from Bengal basin. They proposed a lower *Aquilapollenites indicus*, and upper *Mulleripollis bolpurensis* zones for these sediments. In both these zones, pollen like that of *Nypa*, i.e. *Spinizonocolpites*, is occasionally met with. At the base of Palaeocene, BAKSI (1972) found *Proxapertites* in abundance in the bore core samples.

The report of Santonian—Maestrichtian palm pollen from India points out that India, inhabitated by palms from the Upper Cretaceous, has no record of any palm pollen from Albian to early Cenomanian as has been reported from Brazil.

If palms originated in South America—West Africa, how did they acquire a pantropical distribution? MOORE (1973) thought that palms after originating in the above mentioned regions migrated to Laurasia via Africa and migrated along the Tethys shores towards east and finally reached South-East Asia. If this was the actual route of palm migration then they should have reached Malaysia much later.

DRANSFIELD (1981) postulates that palms in Malaya came via two routes, viz. one from Africa through India and the other from Australia through New Guinea. Some of the palms even today are restricted to the eastern or western parts of the countries of their origin strictly following the Wallace's line.

It has already been mentioned that very few genera of palms have pantropical distribution though as a group they are cosmopolitan. This kind of behaviour indicates that after reaching a particular place, they evolved in new directions to cope up and adjust with the new environment. Perhaps, some flexibility in the genetic constitution played a major role for this kind of development. It is interesting to note that though Africa is regarded as a part of the homeland of palms, it has a poor palm population at present. According to CORNER (1966) the whole continent has only 15 genera and 50 species while America has 92 genera and 1,140 species and Asia-Australia can boast of 107 genera and 1,150 species. The mighty Congo—a typical, tropical river of Africa, is conspicuous by the near absence of palms on its banks while its counterpart in South America—the Amazon, has hundreds of palms all along its course. The reason for this is difficult to understand. MOORE (1973) thinks that the Pleistocene glaciation may be responsible for the extinction of palms in Africa. It is, however, intriguing as to why should only the palms in Africa be adversely affected by this glaciation. MULLER (1978-79) suggests that intensive pre-Pleistocene palynological investigations in West Africa may solve this mystery.

Many fossil woods pertaining to palms have been described from the Deccan Intertrappean beds of India by different workers but only a few could be identified to their living counterparts, e.g. *Palmoxylon sunderam* and *P. coronatum* were probably identifiable with the extant *Cocos* and *Borassus*, respectively. MAHABALE (1959) also identified some Palmoxyla as *Phoenix* and *Nypa*. RAMANUJAM (1953) described *Palmoxylon arcotense* from South India and PRAKASH AND AMBWANI (1980) described *Palmoxylon livistonoides* from the Deccan Intertrappean beds resembling closely the genus *Livistona*. This genus is restricted to tropical Africa and Asia, but a species *L. jenkinsiana* is found in Assam. *Palmoxylon kamalam* (Rode) KULKARNI AND MAHABALE (1973) shows affinities with *Roystonea regia*, a South American genus. AMBWANI AND PRAKASH (in press) have reported the presence of *Palmoxylon ghuguensis* from the Deccan Intertrappeans which resembles *Chrysalidocarpus*. This genus is found only in Madagascar now. TRIVEDI AND VERMA reported *Sabalacaulon intertrappeum*, a petiole of from Sabal (Mandla) M. P. Besides, BANDE AND AMBWANI (in press) have recorded *Sclerosperma*—like pollen grains from the Neyveli lignites, Tamil Nadu, which now grows in tropical West Africa.

The fossil wood *Cyclanthodendron* studied by SAHNI AND SURANGE (1950, 1953), CHITALEY (1956), RAMANUJAM (1959), TRIVEDI AND VERMA (1972) and others from the Deccan Intertrappean beds of Madhya Pradesh, India according to TRIVEDI AND VERMA (1978) shows certain affinities both with Cyclanthaceae and Palmae but cannot be kept in either of the families as it differs markedly from both in the occurrence of lobed vascular bundles, well developed but unequal dorsal and ventral sheaths in vascular bundles and a fleshy peduncle with embedded fruits which have aerenchymatous wall. The authors have suggested that plants combining the characters of the two families, viz. the Palmae and Cyclanthaceae existed in the Eocene of India from which Cyclanthaceae differentiated in course of time and now continues to flourish in S. America but became extinct in India.

The cytology of palms has been worked out by CHENNAVEERAIAH (1955), SHARMA AND SARKAR (1957), MAHABALE (1966), READ (1966), READ AND MOORE (1967) and others. MAHABALE AND CHENNAVEERAIAH (1957) postulated that in palms two basic chromosomal series exist which correspond to the two leaf types. Thus $n=16$ is most prevalent in the pinnate and $n=18$ in the palmate palms. According to CHENNAVEERAIAH (1981) if the original base numbers of palm are accepted as $n=8$ and 9 then most of the palms may be considered as of polyploid origin, having undergone diploidization in course of evolution. If this hypothesis is accepted then *Nypa* should be regarded as primitive as it has chromosome number $n=8$.

Palms in general are bestowed with vigorous growth from the seedling stage. No other group of plants has been so adored, appreciated and utilised for most diversified human purposes. Palms are associated with human migration and culture, mystified as well as personified in folk-lore, festivals and mythologies. The intricate structure, stately height, occurrence in very dense thorny junlges fascinated the early explorers who endured innumerable hardships to know these interesting plants. Unfortunately, botanists of countries stretching from Brazil to Borneo do not fully appreciate the bounty that nature has offered them. It is suggested that various problems pertaining to palms may be studied with zeal and devotion so that many facets of their life which are yet little understood may be better known and new vistas of knowledge may be opened. We may join Shakespeare in saying.

" Our doubts are traitors
and make us lose the good
We oft might win
by fearing to attempt".

I take pleasure in thanking Dr. R. N. Lakhanpal for critically going through the manuscript and Drs. R. K. Kar and K. Ambwani for help in the preparation of the text of this address.

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