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PALYNOLOGY IN PONDICHERRY

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With the creation of the Palynology Laboratory in November 1960, the French Institute of Pondicherry launched itself out on one more line of investigation, viz. pollen studies. In spite of the valuable works done by Erdtman, Van Campo, Wodehouse and others, palynology in the tropics remained practically unattempted. It had therefore been decided that the new laboratory would devote itself to tropical palynology.

As a first step it had been planned to build a reference collection of pollen grains representative of the tropical species and to publish scientific descriptions of them. With the kind and precious cooperation of several herbaria all over the world we were able to collect pollen materials from herbarium specimens identified by competent botanists. Some plant materials of South-East Asia collected by our colleagues were also made use of. Through a regular exchange of our duplicate pollen preparations with the many botanical and palynological laboratories we could further augment our collection of pollen slides. Pollen materials of about 12,000 species have been collected during the past ten years and incorporated in our sporotheca.

Every pollen material is studied critically and an illustrated pollen morphological description is prepared. While studying the pollen material of a species, particular attention has been paid to the previous literature if any. This is made possible because we receive most of the palynological publications in exchange of our publications. Not all the studies done in this laboratory are published in our collection: "Travaux de la Section Scientifique et Technique de l'Institut Francais de Pondichery". Some of them are also reported in well known scientific journals.

Soil borings are made as a part of the detailed ecological studies carried out by the French Institute. By analysing the pollen grains found in these borings, interesting information on the past changes in climate and human occupation is obtained. Such studies are made possible through an active collaboration of our colleagues specialized in Bioclimatology, Phytogeography, Pedology and Archaeology.

In the following lines, a resumé of the published results of the works carried out, either completely or partly, in this laboratory is given in chronological sequence.

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1961. Ph. Guinet (in collaboration with Mme Van Campo) : "Les pollens Composés. L'exemple des Mimosacées". Pollen et spores, 3(2) : 201-218.

Based on the study of Mimosaceae, particularly the Indian members, the terms concerning the compound pollen grains are redefined. The new idea of "calymmate" (covered with a continuous layer of ectexine), and "acalymmate" (ect-

exine developing over every pollen grain but not forming a membrane continuing from one grain to another) has been introduced. 3 hypotheses have been put forth to explain the transition from a compound grain to a simple grain :

(1) Four separate pollen grains are formed in the mother cell and are liberated independently into the atmosphere (e.g. *Desmanthus virgatus*).

(2) The grains of a tetrad or a polyad are not liberated independently except by accident and there is but a feeble cohesion between them (e.g. *Prosopis spicigera, Entada scandens*).

(3) In a tetrad, at the beginning of its formation, the internal walls separating the grains may fail to develop and give rise to a "pseudotetrad" evolving into a "pseudomonad". (e.g. *Neptunia oleracea*).

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1962. Ph. Guinet—Pollen d'Asie Tropicale.—Inst. Fr. Pondicherry, Trav. Sec. Sci. Tech., 5 (1) : 1-8, 52 pl.

Illustrated pollen morphological descriptions of 52 species of south Indian plants are given. Special emphasis has been given to the variation of the pollen grains observed within a species. The characteristic fold in the endoaperture of *Hippocrateaceae* pollen grains has been found to occur in other families too.

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1963. P. Legris—La vegetation de 1' Inde : Ecologie et Flore.—Inst. Fr. Pondichery, Trav. Sec. Sci. Tech., 6 : 1-596, 32 fig. 21 cartes, 20 pl.

Two borings have been made in the peaty soil of Palnis and Nilgiris with a view to analyse their pollen content and to throw some light on the question of the past history of the sholas of these regions. According to Mr. Guinet who made these analyses (see page 222) some forests have existed since a very long time on these plateaus, occupying vast stretches of land which are now under the savannas and they have been destroyed by fire.

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1966. Ph. Guinet—What may afford Palynology to Archaeology and Ancient history in India—Jour. M.S. Univ. Baroda, 15 (1): 15—19.

Studies of archaeological samples taken from the dry parts of peninsular India yield no good result because they contain very few pollen which again are mostly not well-preserved. On the other hand, we may expect good results if we examine samples taken from areas where the rain fall is high and well distributed throughout the year. Since it is difficult to distinguish the wild South Indian grasses from the cultivated grasses on the basis of their pollen size, it is impossible to draw a definite palynological conclusion on the agricultural operations of an archaeological past.

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1965. G. Thanikaimoni—Contribution to the pollen morphology of Eriocaulaceae.—Pollen et Spores, 7 (2) : 181-191.

Pollen grains of 54 species belonging to 7 genera have been described. In most of the species of *Eriocaulon* the endocracks are many in number, but they are narrow and elongated. In the species of *Lachnocaulon, Leiothrix, Paepalanthus, Syngonanthus* and *Tonina* the endocrack is single, short and

narrow. Thus there exists a tendency towards reduction of the number and size of endocracks resulting in pollen grains with a single spiral endocrack. On acetolysis, most of the pollen grains get torn in areas overlying the endocracks. Pollen grains similar to those of Eriocaulaceae are also found in *Aphyllanthus monspeliensis* and *Crocus speciosus*.

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1966. G. Thanikaimoni—Pollen morphology of the genus *Utricularia*—Pollen et Spores, 8(2): 265-284.

The pollen morphology of 22 Indian species of *Utricularia* has been studied. In *U. punctata* the pollen grains are always found in tetrads. The pollen grains of aquatic species are 11-28 colporate and those of terrestrial species are 3-5 colporate with elongated ectoapertures. The epiphytic species produce 3-4 colporate pollen grains with short ectoapertures. An important correlation between the habit, seed character and pollen character has been pointed out.

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1966. G. Thanikaimoni—Contribution a l'etude palynologique de Palmiers.—Inst. Fr. Pondichery, Trav. Sec. Sci. Tech., 5 (2): 1-92, 2 tabl. 20pl.

Pollen morphological characters of 161 genera of *Palmae* have been outlined. A tentative interpretation has been given on the evolution of the aperture. 128 original photographs of the pollen grains have been published.

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1966. G. Thanikaimoni—(in collaboration with D.M.A. Jayaweera) - Pollen morphology of Sonneratiaceae - Inst. Fr. Pondichery, Trav. Sec. Sci. Tech. 5 (3); 1-12, 3 pl.

Pollen grains of *Duabanga* and *Sonneratia* have been described. The occurrence of Sonneratiaceous pollen in some genera of Lythraceae has been pointed out.

The fossil pollen grains of *Sahnipushpam shuklai* do not resemble those of Sonneratiaceae. The pollen morphological affinnities of another fossil species. *Sahnianthus parijai* are equal to both Sonneratiaceae and Lythraceae.

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1968. G. Thanikaimoni—Morphologie des pollens des Menispermacées.- Inst. Fr. Pondichery, Trav. Sec. Sci. Tech., 5(4): 1-57, 16 pl.

Pollen description of 104 species belonging to 48 genera accompanied by 394 illustrations of pollen grains. An extensive bibliographic reference to the family is also given.

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1969. G. Thanikaimoni—Esquisse palynologique des Aracées.- Inst. Fr. Pondicherry, Trav. Sec. Sci. Tech., 5(5): 1-32, 20 pl.

An outline of palynology of Araceae drawn from a study of about 500 species belonging to 98 genera. The different pollen types found in this family are illustrated with 495 photographs. The classifications by Engler and Krause (1905-1920) and by Hutchinson (1959) are discussed in the light of pollen morphology. The characters of pollen in combination with those of the flowers could be used to characterize

the different tribes or groups of tribes recognized by Engler. There is no palynological affinity between Leguminosae and *Pistia* variability suggests that the Mimosaceae might have been derived from the Rosales-Myrtales independently of the Caesalpin-

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1969. Ph. Guinet—Les Mimosacees. Etude de palynologie fondamentale, correlations, Evolution.- Inst. Fr. Pondicherry, Trav. Sec. Tech., 9 : 1-293, 27 fig. 30 Sci. tabl., 20 pl.

In Mimosaceae a transition is established from heteropolarity, linked with the simplest pollen features, to isopolarity associated with most complex pollen features. The transition from compound to simple grains is preceded by a reduction in the number of apertures in the compound grains. Groups in which the apertures inside each tetrad (making up the polyad) face each other in groups of three (Garside law) are the most primitive. Compound acalymmate pollen grain types are more primitive than calymmate ones; the latter in turn are generally more primitive than simple pollen grains.

1970. G. Thanikaimoni (in collaboration with W.C. Elsik)- *Bomarea lyncina* Herb. (Amaryllidaceae and Auricultiidites Elsik.- Pollen et Spores, 12(2) : 177-180.

Pollen grains of *B. lyncina* are monosulcate with an auricula at either end of the sulcus. The auriculae are equatorial modifications of the exine and not an integral part of the sulcus. None of the other species of *Bomarea* or those of *Alstroemeria* and *Leontochir* studied so far have auriculate pollen. Auriculate pollen of *B. lyncina* very much resembles those of the fossil species *Auriculiidites reticulatus* reported from the Upper Cretaceous of Peru. An emended diagnosis of the latter is given.

1971. F. Blasco-Montagnes du Sud de l'Inde : Savanes, Forets, Ecologie. - Inst. Fr. Pondichery, Trav. Sect. Sci. Tech., 10 : 1-436,

found that throughout the profile there is a clear dominance of the "herbaceous group" (65-80% in Pykara and 66-89% in Pearson's valley).

Pollen grains belonging to forest elements are scarce in all the samples (rarely exceeding 5%). The members of Acanthaceae, *Lycopodium*, Melastomaceae and Rubiaceae are found both inside and at the margin of the forest and also on bare rocks. Unless their pollen grains or spores are identified upto the species level, it is not possible to know their ecological affinity.

The constantly high percentage of pollen belonging almost exclusively to the savanna plants suggests that the savanisation, partial or total, near the place where the sediments are accumulated, has been realised at least 3000 years ago. [carbon^{14} dating obtained for some samples collected at Mannavanur, where a pit (2 m wide and 25 m long) excavated upto the mother rock did not yield any macrofossil of woody plants].

1971. G. Thanikaimoni-Les Palmiers : Palynologie et Systematique. - Inst. Fr. Pondichery, Trav. Sec. Sci. Tech., 11 : 1-286, figs. I-XXX and figs. 1-443. (see also Adansonia, ser. 2, 10(3) : 347-365. 1970).

800 species belonging to 193 genera of palms were investigated with the help of Wild M 20 microscope, Hitachi HU 11B Electron microscope and Scanning Electron microscope.

There are 27 types of pollen grains. The phylogenetic study of palms reveals how the equatorial aperture, an Angiosperm feature, is obtained. The monosulcate condition through "extensive-sulcate" condition may lead either to dicolpate condition or "meridionosulcate" one. The monosulcate pollen type by reduction of the aperture may give rise to ulcerate pollen type. Likewise the diporate and triulcerate types may result from dicolpate type and trichotomosulcate type respectively. There are two distinct tendencies of evolution of exine quite independent of aperture evolution: (1) the perforations in the tectum by fusion may give rise to fossulate and areolate exine types; (2) the development of sculptural elements.

In the pollen grains of Palmae, the endexine is practically absent. A thick foot layer is however present in all the species investigated.

Malesia and New Guinea are the centres of maximum diversifications of palms. When we consider the distribution of the various pollen types in each of the nine sub-families, we note that the Lepidocaryoideae are the most diversified of all. In the case of Arecoideae having 124 genera, there is a very limited palynological diversification. Perhaps many of the genera of this subfamily do not merit the rank of a distinct genus.

Palynology supports the treatment of the following genera in the wide sense: *Cocos*, *Elaeis*, *Attalea*, *Bactris*, *Mauritia*. A new classification based on correlations between morphological and pollen characters has been proposed.

The following phylogenetic tendencies are exemplified in *Palmae:*

Pericarp: not scaly → scaly. Fruit: simple → multiple. Endocarp : woody, perforated → membraneous, not perforated. Vernation: induplicate → reduplicate. Leaf : palmate → pinnate → bipinnate. Flowers : bisexual → unisexual Ovary : apocarpus → syncarpous → (multicellular unicellular). Seedling : remotive → admotive → viviparous. Stem :

arborescent→climbing or arborescent→ acaulescent→rhizomatic.

When we study a great number of palms, we are caught more by their resemblances than by their differences. All the nine subfamilies studied seem to belong to a very natural family showing a number of overlapping tendencies. None of the subfamilies could be considered as entirely primitive because every one of them has at least some evolved characters.

The palynological affinities of Palmae are more with the Liliaceae (*s.l.*) than with the Arales.

A synoptic resume of the monocotyledonous pollen types has been presented to evaluate the stellar concept of Good and to enable a palynological discussion on the different classifications of monocotyledons, for example that of Hutchinson.

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1972. G. Thanikaimoni—Index bibliographique sur la morphologie des pollens d'Angi-

Extracts from pages 47, 187, 330.

MANTISIA
Sharma, M. (1968).

MANULEA
Mohl (1835).

MAOUTIA
Kuprianova (1965), Nair, P.K.K. (1965c), Nair & Sharma (1965b).

PITYOPUS
Copeland (1935), Nowicke (1966).

PITYRODIA
El-Gazzar & Watson (1970).

PLACEA
Heusser (1971).

PLACODISCUS
Erdtman (1952a), Merville (1965).

PLA DALMAU, J.M. 1961.—Polen.—Talleres graficos D.C.P.—Gerona.

PLANCHAIS, N. 1962.—Le pollen de quelques chenes du domaine mediterraneen occidental.—Pollen et Spores, 6(2): 515-526.

POKROVSKAIA, I.M. 1950-Analyse pollinique (Traduction par E. BOLTENHAGEN). Annales du Service d' Information geologique du B.R.G.G.M. Numero 24,1958. 1-435.

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1972. G. Thanikaimoni & G. Vasanthy — *Sarraceniaceae, Palynology and Systematics.* Pollen et ~~Sporie~~ spores 14—155.

Pollen grains are 3-6 colporate in *Heliamphora.* 4-6 colporate in *Darlingtonia* and 6-9 colporate in *Sarracenia.* There is no correlation between number of chromosomes and the number of pollen apertures. The intergeneric relationship within this family has been brought out on the basis of the morphological correspondences. From the palynological point of view,

—*Pollen analysis of the cave of Laang Spean* (Cambodia). The scarcity of Gramieae pollen grain in the samples may lend support to the view that the people of preceramic pebble tool industry in Thailand did not know agriculture. The almost continuous presence of the pollen grains of arborescent elements (*Bombax, Ceiba, Duabanga*) suggests that the climate of this region had remained constant during the entire duration of the occuptation of the cave. Since there is no guano in the cave it is possible that the pollen grains shed from the trees of the summit of the "phnom' 'could have been brought by run down water and deposited into the cave through the vents.

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