BULL. BOT. SURV. INDIA
Vol. 10, Nos. 3 & 4 : pp. 319-326, 1968

POLLEN MORPHOLOGY IN BIGNONIACEAE IN RELATION TO TAXONOMY

KRISHNA MITRA

Botanical Survey of India, Calcutta

ABSTRACT

Palonological investigation of 49 species of the family Bignoniaceae distributed over 32 genera has been made. There is a great diversity in pollen morphological characters. The pollen grains may be united in tetrad as in *Chilopsis saligna* or free as in rest of the species.

The pollen grains may be atreme 3,4,7 zonocolpate, 3 zonocolporoidate, 3,4, zonocolporate, parasyncolpate, monoporate, pantoporate, pantocolpate or anomotreme. Similarly the exine pattern varies from obscure to reticulate with occasional occurrence of retipilate, baculate types. Taking aperture as major and exine pattern as subsidiary characters as many as twelve distinct pollen types have been recognised.

INTRODUCTION

Pollen grains of Bignoniaceae have attracted attention over a century. Mohl (1834) described pollen grains of *Cobea scandens* Cav. (now Polygonaceae), *Tecoma australis* R. Br., *Bignonia capensis* Thunb. and *Bignonia venusta* Ker.-Gawl. along with beautiful sketches. Urban (1916) pointed out for the first time that the species *Crescentia alata* H. B. K. should be separated from *Crescentia cujete* L. on palynological character. He described *C. cujete* L. "furchenlosen sehr feinnetziger Pollen" and *C. alata* H. B. K. "3 furchigen Pollen mit schön nitziger Exine." On palynological and other morphological ground *C. alata* is transferred to *Parmentiera alata* Miers. Erdtman (1952) has described about 25 species and Natarajan (1957) described few species along with other tubiflore.

MATERIAL AND METHOD

The polliniferous materials of the species were collected fresh from the Indian Botanic Garden, Sibpur (I.B.G.), and from the herbarium sheets of the Indian Botanic Garden (I.B.G.H.) and Central National Herbarium, Sibpur (C.N.H.). Accession number of the herbarium sheets, where available, and pollen slide numbers have been given at the end.

The pollen grains slides were prepared by acetolysis method (*Erdtman*, 1952).

OBSERVATION

The pollen grains, in general, are spheroidal or sub-spheroidal. The grains are atreme, zonocolpate, zonocolporate, zonocolporoidate, monoporate, pantoporate, pantocolpate, parasyncolpate and anemotreme. In case of zonocolporoidate grains the 'os' is represented by irregular tubuli on the colpi membrane. Exine is reticulate in most cases, sometimes fine or sometimes coarsely reticulate. Retipilate, baculate and obscure ornamentation are also observed in few cases. The muri in reticulate grains are simplibaculate or in few cases dupli- or multibaculate, tegillate. Exine is crassis-exineous, margin entire.

Basing on detailed morphology of aperture in particular and exine ornamentation in general, the pollen grains are graded into following distinct types :

1. *Tetrad type :*

Chilopsis saligna D. Don

New Mexico, 333524 ; C.N.H., 8850.

Pollen grains in tetrad (54 μ), individual grains parasyncolpate (38.8 μ). Exine areolate, retipilate, simplibaculate. Exine 2 μ. Tetrad outline wavy. (Text fig. 6 ; Pl. I, Fig. 1 ; Text fig. 14).

2. *Atreme type :*

Adenocalyma comosum DC.

I.B.G., 1 ; Palyn. H. 8818.

Pollen non aperturate, spheroidal (53.1 × 64 μ). Exine reticulate, lumina studded with bacula, muri simplibaculate. Exine 3 μ. (Text fig. 3 ; Pl. I, Fig. 2 ; Text fig. 13).

3. *Zonocolpate type :*

a. *3-zonocolpate :*

Bignonia brachypoda DC.

Colambia, 333337 ; C.N.H., 8821.

Pollen prolate spheroidal (27.5 × 31 μ) (goniotreme), colpi (34 × 3.3 μ). Apocolpium 9.72 μ. Exine 2.2 μ, retipilate. Polar field index 3.8.

B. unguiscati Linn.

Ahamadabad, 333331 ; C.N.H., 8890.

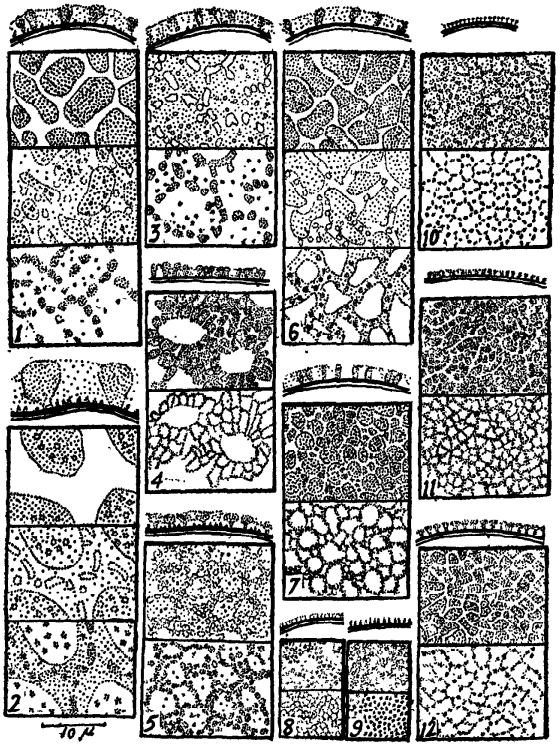
Pollen oblate spheroidal (32 × 30 μ) (goniotereme),

colpi (30×4μ). Apocolpium 4μ. Exine 1μ, ornamentation obscure. Polar field index 7.5.

Deplanchea tetraphylla (R. Br.) F.O.M.

Australia, 334350; C.N.H., 8832.

Pollen spheroidal (34.88×34.88μ) (goniotreme), colpi (33.57×4.5μ), apocolpium 5.5μ. Exine 1.5μ. Polar field index 6.3.



Text figs. 1-12: Exine and Lo analysis of :
1. *Amphilophium mutisi*. 2. *Nyctocalos cuspidatus*. 3. *Adenocalymna comosum*. 4. *Bignonia magnifica*. 5. *Pyrostegia venusta*. 6. *Chilopsis saligna*. 7. *Dolichandrone spathacea*. 8. *Dolichandrone atrovirens*. 9. *Stereospermum fimbriatum*. 10. *Stereospermum personatum*. 11. *Crescentia cujete*. 12. *Kegelia pinnata*.

Heterophragma quadriloculare (Roxb.) K. Schum.

N. India, 333873; C.N.H., 8836.

Pollen prolate spheroidal (30.82×33.82μ) (goniotreme), colpi (26.6×4.6μ), apocolpium 4.8μ. Exine 2μ. Polar field index 6.4

Millingtonia hortensis L. f.

I.B.G.H., 9001.

Pollen prolate spheroidal (37.63×41.4μ) (goniotreme), colpi (34×3.3μ). Apocolpium 9.72μ. Exine 2.2μ, retipilate. Polar field index 3.8 (Fig. 15).

Nyctocalos cuspidatus (Bl.) Miq.

India, 333418; C.N.H., 9010.

Pollen subprolate (80.5×94.5μ) (pleurotreme), big pollen, colpi (77.5×18.75μ). Apocolpium 25μ. Exine 10μ. Reticulate grains, lumina studded with bacula. Polar field index 3.2 (Text fig. 2).

Oroxylum indicum (L.) Vent.

Kashmir, 333457; C.N.H., 9011.

Pollen prolate spheroidal (52×57μ), colpi (50×6μ) (goniotreme), apocolpium 8μ. Exine 2μ, reticulate, beaded, bacula loosely arranged, duplibaculate. Polar field index 6.5.

Parmentiera alata Miers

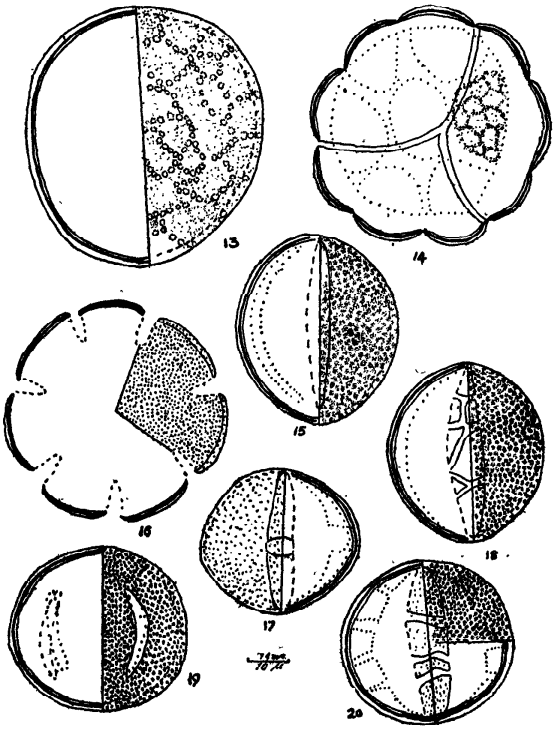
I.B.G., 13; Palyn. H. 5818.

Pollen suboblate (48.4×40.5μ) (goniotreme), colpi (38.8×7μ), apocolpium 12.4μ. Exine 1.5μ. Polar field index 3.9.

P. cerifera Seem.

I.B.G., 14; Palyn. H. 8992.

Pollen oblate spheroidal (33.7×32.2μ) (goniotreme), colpi (26.4×5.8μ), apocolpium 6.9μ. Exine 1.5μ. Polar field index 4.8.



Text figs. 13-20: Camera lucida of :
13. *Adenocalymna comosum*. 14. *Chilopsis saligna*. 15. *Millingtonia hortensis*. 16. *Incarvillea emodii*. 17. *Lundia longa*. 18. *Tecomaria capensis*. 19. *Dolichandrone atrovirens*. 20. *Tabebuia chrysantha*.

Phyllarthron comorens DC.

I.B.G.H., 8685.

Pollen suboblate (37.06 × 30.16 μ) (peritreme), colpi (28.7 × 4.5 μ), apocolpium 6.1 μ. Exine 1 μ. Polar field index 6.

Radermachera gigantea (Blume) Miq.

Java, 334194; C.N.H., 8854.

Pollen oblate spheroidal (28.1 × 27 μ) (goniotreme), colpi (24 × 3 μ), apocolpium 5 μ. Exine 1.5 μ. Polar field index 5.6.

R. pinnata (Blanco) Seem.

Philippine, 334288; C.N.H., 8846.

Pollen spheroidal (21.8 × 21.6 μ) (goniotreme), colpi (20 × 2.5 μ), apocolpium 4 μ. Exine 2 μ. Polar field index 5.4.

R. xylocarpa (Roxb.) K. Schum.

Allahabad, 1381; C.N.H., 8999.

Pollen spheroidal (24.5 × 24.6 μ), (goniotreme) colpi (20 × 2.5 μ), apocolpium 4.5 μ. Exine 2 μ. Polar field index 5.4 (Pl. I, Fig. 12).

b. *4-Zonocolpate type:*

Dolichandrone atrovirens (Heyne ex Roth) Sprague I.B.G., 8. Palyn. H. 8825.

Pollen oblate spheroidal (37.25 × 36.6 μ), colpi (20.6 × 2.3 μ), apocolpium 2.5 μ. Colpi loxocolpate, brevicolpate not exceeding to the poles. Colpi membrane psilate ends rounded. Exine reticulate, 1.5 μ. Polar field index 1.48 (Text figs. 8 & 19).

c. *7-Zonocolpate type:*

Pollen 7-zonocolpate, suboblate or oblate spheroidal; colpi long, ends tappering, margin smooth membrane ± ornamentated. Exine finely reticulate or coarsely reticulate, tegillate, muribaculate, angustimurate. Margin entire.

Incarvillea diffusa Royle.

Nepal, 4979; C.N.H., 8878.

Pollen subprolate (50.1 × 42 μ) (goniotreme), colpi (27.7 × 2 μ), apocolpium 21.1 μ. Exine 1.5 μ. Polar field index 2.8.

I. emodi (Lindley) Chatt.

Himalaya, 334407; C.N.H., 8718.

Pollen suboblate (47.75 × 41 μ) (goniotreme), colpi (29.25 × 1.75 μ), apocolpium 17 μ. Exine 1 μ. Polar field index 2.8 (Pl. I, Fig. 4; Text fig. 16).

I. olgae Regel.

Turkastania, 334454; C.N.H., 8724.

Pollen suboblate (46.18 × 38.9 μ) (goniotreme), colpi (34.3 × 3 μ), apocolpium 22.9 μ. Exine 1 μ. Polar field index 2.1.

Amphilophium mutisii H.B.R.

I.B.G.H., 8681.

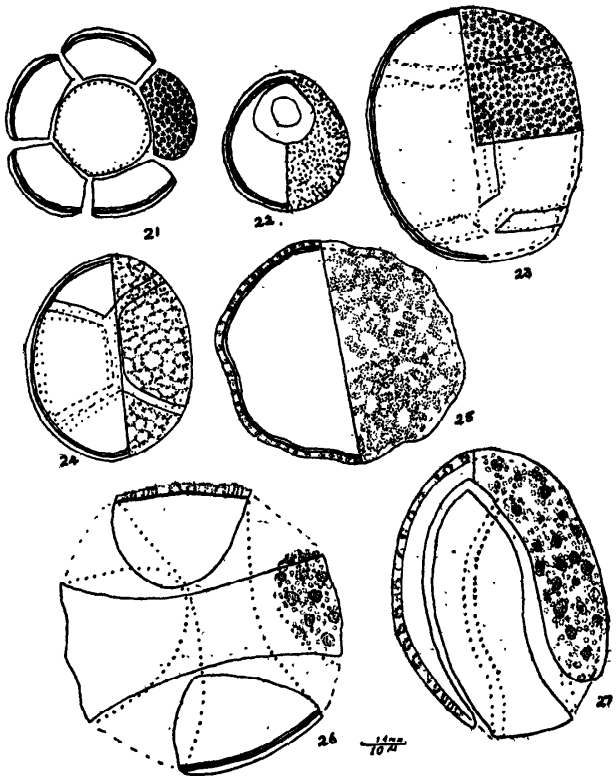
Pollen oblate spheroidal (56.3 × 56 μ) (ptychotreme), colpi (30.6 × 5 μ), apocolpium 21 μ. Exine 4 μ, reticulate heterobrochte. Reticulate lumina studded with bacula. Bacula loosely arranged. Polar field index 2.6 (Text fig. 1; Pl. I, Figs 7 & 8).

4. *Zonocolporate type:*

Lundia longa DC.

Upsaliense, 333297; C.N.H., 8830.

Pollen prolate spheroidal (33.34 × 25 μ) (goniotreme), colpi (25.4 × 5 μ), apocolpium 7 μ. Exine 1 μ Ornamentation ± obscure. Polar field index 4.9 (Pl. I, Fig. 11; Text fig. 17).



Text figs. 21-27: Camera lucida of:
21. *Stereospermum personatum.* 22. *S. fimbriatum.* 23. *Crescentia cujete.* 24. *Bignonia chamberlaynii.* 25. *B. magnifica.* 26 & 27. *Pyrostegia venusta:*

Arrabidaea blanchetii DC.

America, 333280; C.N.H., 8720.

Pollen spheroidal (24.4 × 24.4 μ) (goniotreme), colpi (21.1 × 4.2 μ), apocolpium 8.3 μ. Exine 1.5 μ, reticulate. Polar field index 5.

5. *Zonocolporoidate type:*

Campsis grandiflora (Thunb.) K. Schum.

I.B.G.H., 8666.

Pollen prolate spheroidal (36.08 × 34.5 μ) (goniotreme), colpi (30.6 × 6.9 μ), apocolpium 7.1 μ. Exine 1.5 μ, retipilate. Polar field index 5.

Dolichandrone spathacea (Linn. f.) K. Schum.

I.B.G., 9. Palyn. H. 6276.

Pollen prolate spheroidal (41.36×46.6μ) (goniotreme), colpi (42.1×6.7μ), apocolpium 8.9μ. Exine 3μ, reticulate, foveolate heterobrochte. Polar field index 4.6 (Text fig. 7; Pl. I, Figs. 13 & 14).

Haplophragma adenophyllum (Wall. ex G. Don) P. Dop.

I.B.G.H., 6773.

Pollen prolate spheroidal (43.3×46.3μ) (goniotreme), colpi (40.1×6.9μ), apocolpium 10.2μ. Exine 2.5μ. Polar field index 4.2.

Jacaranda mimosifolia D. Don

I.B.G., 12; Palyn. H. 9012.

Pollen prolate spheroidal (36.6×36.5μ) (goniotreme), colpi (28.2×6.4μ), apocolpium 9μ, finely reticulate. Exine 1μ. Polar field index 4.

Kigelia pinnata (Jacq.) A. DC.

I.B.G., 16; Palyn. H. 6792.

Pollen subprolate (46×55.75μ) (goniotreme), colpi (47×3μ), apocolpium 10.5μ. Exine 2μ; reticulate heterobrochte, beaded. Polar field index 4.3 (Text fig. 12).

Markhamia stipulate (Wall.) Seem.

Burma, 2740; C.N.H., 8997.

Pollen prolate spheroidal (48.6×52.1μ) (goniotreme), colpi (50.8×6μ), apocolpium 6.6μ. Exine 1.8μ, reticulate, smaller towards colpi. Polar field index 7.3.

Mayodendron igneum (Kurz) Kurz

Tenasserim, 334312; C.N.H., 8856.

Pollen prolate spheroidal (28.6×28.9μ) (goniotreme), colpi (27.5×5μ), apocolpium 5μ. Exine 1.5μ, retipilate. Polar field index 5.7.

Pajanelia longifolia (Willd.) K. Schum.

I.B.G.H., 8691.

Pollen oblate spheroidal (38.5×36.5μ) (goniotreme), colpi (46.75×7.4μ), apocolpium 8.3μ. Exine 1.5μ. Polar field index 5.7.

Spathodea campanulata P. Beauv.

I.B.G., 11; Palyn. H. 8672.

Pollen prolate spheroidal (39.8×41μ) (goniotreme), colpi (36.28×7μ), apocolpium 6.8μ. Exine 2μ. Polar field index 4.6.

Stereospermum suaveolens DC.

Orissa, 18428; C.N.H., 8745.

Pollen oblate spheroidal (26.8×26μ) (goniotreme), colpi (22.6×3.3μ), apocolpium 6.8μ. Exine 2μ. Polar field index 5.5.

Tabebuia chrysantha Nichols.

I.B.G., 2; Palyn. H. 8095.

Pollen oblate spheroidal (35.66×31.7μ) (pleurotreme), colpi (40.66×4μ), apocolpium 6.3μ. Exine 1μ. Polar field index 5.5 (Text fig. 20).

T. donnelsmithii J. N. Rose

I.B.G., 3; Palyn. H. 6240.

Pollen prolate spheroidal (35.66×31.7μ) (pleurotreme), colpi (20×5.1μ), apocolpium 3.7μ. Exine 1.5μ. Polar field index 6.4.

T. pallida Miers

I.B.G., 5; Palyn. H. 5725.

Pollen oblate spheroidal (49.25×48.20μ) (goniotreme), colpi (43.40×10μ), apocolpium 10.7μ. Exine 3μ, reticulate, heterobrochte. Polar field index 4.5 (Pl. I, Figs. 15 & 16).

T. pentaphylla Hemsl.

I.B.G., 6; Palyn. H. 6780.

Pollen subprolate (39.6×32.6μ) (goniotreme), colpi (35×5.2μ), apocolpium 6μ. Exine 2.5μ. Polar field index 5.4.

T. rosea DC.

I.B.G., 4; Palyn. H. 3033.

Pollen oblate spheroidal (33.66×30.75μ) (goniotreme), colpi (27×4.4μ), apocolpium 5μ. Exine 1μ. Polar field index 6.

Tanaecium jaroba Swartz.

Singapore, 333417; C.N.H., 9009.

Pollen subprolate (46×53.6μ) (goniotreme), colpi (50×1.8μ), apocolpium 6μ. Exine 3μ. Polar field index 7.6.

Tecoma serratifolia G. Don

I.B.G., 7; Palyn. H. 9002.

Pollen oblate spheroidal (32.7×35.3μ) (goniotreme), colpi (21.9×4.4μ), apocolpium 4.5μ. Exine 1μ. Polar field index 5.6.

T. stans (Linn.) H.B.K.

Rajasthan, 10342; C.N.H., 9006.

Pollen prolate spheroidal (32.7×35.3μ) (goniotreme), colpi (33×4.9μ), apocolpium 5.5μ. Exine 1μ. Polar field index 6.

Tecomaria capensis (Thunb.) Fenzl.

Nilgiris, 2606; C.N.H., 8755.

Pollen subprolate (34.75×41.28μ) (goniotreme), colpi (36.83×6.5μ), apocolpium 7.5μ. Exine 1.5μ, heterobrochte, beaded. Polar field index 4.6 (Text fig. 18).

Tecomella undulata (Sm.) Seem.

Dumraon Garden, India, 333579; C.N.H., 9008.

Pollen prolate spheroidal (30.85×34.4μ) (goniotreme), colpi (29.6×5μ), apocolpium 4.28μ. Exine 1μ. Polar field index 7.

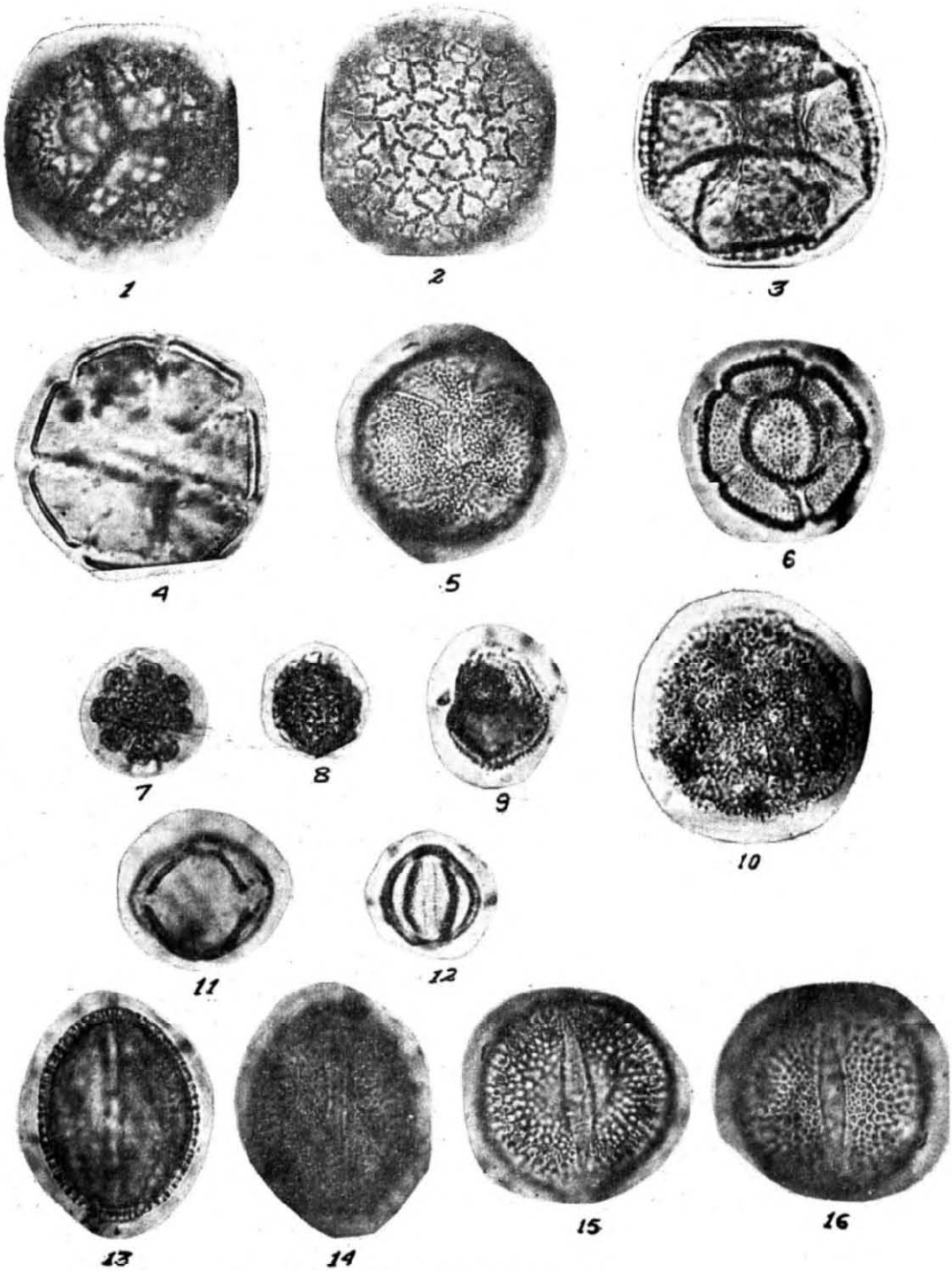


Plate I (Figs. 1-16): Photomicrographs of:

Figs. 1-16 : 1. *Chilopsis saligna.* 2. *Adenocalymna comosum.* 3. *Pyrostegia venusta.* 4. *Incarvillea emodii.* 5. *Crescentia cujete.* 6. *Stereospermum personatum.* 7 & 8. *Amphilophium mutisii.* 9. *Stereospermum fimbriatum.* 10. *Bignonia magnifica.* 11. *Lundia longa.* 12. *Radermachera xylocarpa.* 13 & 14. *Dolichandrone spathacea.* 15 & 16. *Tabebuia pallida.* (All figs. ×1000 except figs. 7 & 8 ×500)

6. *Parasyncolpate type :*

Bignonia chamberlaynii Sims

Allahabad, 1381 ; C.N.H., 8990.

Pollen spheroidal (40×41μ). Exine 2μ retipilate (Text fig. 24).

Stereospermum personatum (Hassk.) Chatt.

I.B.G., 10 ; Palyn. H. 5771.

Pollen spheroidal (35-42μ). Exine 1μ (Text fig. 10 ; Pl. I, Fig. 6 ; Text fig. 21).

S. chelonoides DC. (non l.f.)

India, 33944 ; C.N.H., 8885.

Pollen spheroidal (31-37.5μ). Exine 1μ.

7. *Monoporate type :*

Stereospermum fimbriatum (Wall.) DC.

I.B.G.H., 8675.

Pollen spheroidal (28.8×26μ), monoporate, pore 3μ with annulus thickening (10μ). Exine 1.5μ, baculate. (Text fig. 9 ; Pl. I, Fig. 9 ; Text fig. 22).

8. *Pantoporate type :*

Bignonia magnifica Bull.

Calcutta, 333319 ; C.N.H., 8715.

Pollen spheroidal (43×43μ), pantoporate, pore circular or slightly elongated. Exine 2μ, reticulate. Margin wavy. (Text fig. 4 ; Pl. I, Fig. 10 ; Text fig. 25).

9. *Pantocolpate type :*

Crescentia cujete Linn.

I.B.G., 15 ; Palyn. H. 5220.

Oblate spheroidal (45×40.6μ), colpi (20×5μ), 5.6 or more pantocolpate, different types of orientations have been observed. Exine 2μ, reticulate, with fine streaks. (Text fig. 11 ; Pl. I, Fig. 5 ; Text fig. 23).

10. *Spiraperturate type :*

Pyrostegia venusta (Ker.) Miers.

Shillong, 3947 ; C.N.H. 8750.

Pollen spheroidal (54×65μ) spiraperturate. Exine reticulate, scrobiculate, latimurate, muri dupli or multibaculate, bacula loosely arranged. Exine 3μ. (Text fig. 5 ; Pl. I, Fig. 3 ; Text figs. 26 & 27).

DISCUSSION

The family Bignoniaceae is eurypalynous. The 49 species investigated in the present study include mostly indigenous, introduced and a few foreign species.

The pollen grains are medium in size with few small and large types. The size ranges from 23.75 ×25.37μ in *Tabebuia donnel-smithii*, to 53.1-64μ in *Adenocalymna comosum*, 50.1×42μ in *Incarvillea diffusa*. One exceptionally large pollen type in comparison to rest is 80.5×94.5μ in *Nyctocalos cuspidatus*. The shape in general sub-spheroidal. The apertures in monotreme pollen types are monozonotreme, parasyncolpate, pantocolpate, pantoporate and monoporate. Beside one each of the types atreme, anomotreme and polyads have been observed. Guinet (1962) reported different pollen types correlated with staminal diamorphism in *Millingtonia hortensis*.

Colpi generally long, extends from pole to pole, with tappering ends, middle portion is broadest. In colporoidate grains the 'os' is not well defined as lalongate or lolongate type, but are mostly irregular sometimes there are 3 or more lalongate 'os' sometimes fine tubuli bifurcate the colpi-membrane forming irregular patterns. These patterns are not constant in shape in between two species or even between grains of the same species. Probably they just represent weak points for the pollen tube growth.

In *Dolichandrone atrovirens*, the grain is 4 loxocolpate and brevicolpate. The grains in *Bignonia chamberlaynii*, *Stereospermum personatum* and *S. chelonoides* are parasyncolpate. They give a general appearance of polyads but critical examination reveals that they are simple grains. This is further strengthened by the occurrence of polyads in *Chilopsis saligna* (Pl. I, Fig. 1) with individual grains as parasyncolpate type (5 mesocolpium and 2 apocolpium). *Crescentia cujete* (Pl. I, Fig. 5) represents 5, 6 or more pantocolpate type.

Pollen grains in *Bignonia magnifica* (Pl. I, Fig. 10) are pantoporate type. Monoporate grains have been observed in *Stereospermum fimbriatum* (Pl. I, Fig. 9). It is rather uncommon type in dicotyledons and characteristic pollen type of monocotyledons.

Only representatives of atreme (inaperturate) and anomotreme (spiraperturate) grains are *Adenocalymna comosum* (Pl. I, Fig. 2) and *Pyrostegia venusta* (Pl. I, Fig. 3) respectively.

The exine ornamentation (Figs. 1-12) in most of the pollen types is reticulate, tegillate simplibaculate, very finely reticulate in *Jacaranda mimosifolia ; Radermachera* ; *Incarvillea* and most of the species of the tribe tecomeae. Big reticulation are found in *Adenocalymna comosum, Nyctocalos cuspidatus*. In *Adenocalymna* (Fig. 3) the bacula is sometimes branched and protruded in the lumina. The reticulation may be homobrochte as cited above or heterobrochte as in *Amphilophium mutisii, Dolichandrone spathacea* (Fig. 7), *Kigelia pinnata* (Fig. 12), *Tabebuia pallida* etc. Reticulation is smaller

towards colpi in *Markhamia stipulata*. In *Crescentia cujete* reticulation is with fine streaks (Fig. 11).

In *Oroxylum indicum* exine ornamentation is reticulate, beaded, dupli or multibaculate with loosely arranged bacula. *Pyrostegia venusta* has reticulate with scorobiculate latimurate dupli or multibaculate ornamentation (Fig. 5).

Retipilate is found in *Millingtonia hortensis* and *Stereospermum personatum*. LO pattern present. *Stereospermum fimbriatum* has baculate ornamentation (Fig. 9).

Ornamentation is obscure in *Lundia longa* and *Bignonia unguiscati*.

Like varied apertural pattern Bignoniaceae is characterised by varied exine ornamentation which can be grouped as Reticulate, Retipilate, Baculate, and Obscure.

The sporoderm in Bignoniaceae is clearly differentiated into an uniform nexine and an outer sexine (Figs. 1-12). Sexine is further differentiated into ecto- and endo-sexine. Ecto-sexine is tegillate formed by the fusion of bacula heads. Sometimes bacula instead of fusing remains free to form baculate ornamentation. The thickness of sporoderm ranges from 1 to 3.5 μ and exceptionally thick 9 μ in *Nyctocalos cuspidatus* (Fig. 2).

In the tribe Bignoneae varied thickness of sporoderm is met with from 1 to 4 μ. In two species of this tribe *Lundia longa* and *Bignonia unguiscati* ecto and endosexine is not well differentiated, being granular.

In the tribe Tecomeae and Crescentieae the sporoderm is thin compared to Bignoniae.

Sporoderm with well defined sexine and nexine are treated as advanced condition. More or less obscure type as in *L. longa* and *B. unguiscati* with undifferentiated exine presents primitive types and the aperture along with such exine pattern are also treated as primitive types (*Raj*, 1961).

SIGNIFICANCE OF POLLEN FIELD INDEX

It is a ratio between the most widely separated furrow apices and the equatorial diameter. When the ratio has 0 value there is no polar field.

The polar field index ranges between 1.48 in *Dolichandrone atrovirens* to 7.8 in *Bignonia brachypoda*. It has been observed in Bignoniaceae that the polar field index is approximately close in related species for *e.g.*, In *Incarvillea diffusa* 2.7; *I. emodi* 2.8 and *I. olgae* 2.0. Similarly in the three species of *Radermachera* viz. *R. gigantea* 5.6, *R. pinnata* 5.4 and *R. xylocarpa* 5.4. In *Tecoma serratifolia* 5.6 and *T. stans* 6.

How far these results are significant need detail studies in the polar field index. Its limitation and delimitation in eury and stenopalynous families.

NPC formula

Recent trend in palynology has utilised this formula or classification for the better understanding of relationship and evolution. NPC denotes number, position and character of the aperture respectively (*Erdtman & Straka* 1961). Bignoniaceae represents as many as ten different NPC formulae as ooo (atreme) : 134 (monozonoporate) : 343 (3 zonocolpate); 345 (3 zonocolporate); 443 (4 zonocolpate); 543 (parasyncolpate); 743 (7 zonocolpate); 763 (pantocolpate); 764 (pantoporate) and 800 (anomotreme). Thus shows an assemblage of both primitive and advanced pollen types. It is supposed that NPC 343 is characteristic of primitive genera or family, from this has evolved in one or two direction composite aperture (345) and to a greater number of simple apertures in panto position either colpi (763) or pori (764).

TAXONOMICAL SUGGESTIONS

The species investigated in the present report belongs to the following tribe by Schumann in Martius flora Brazilensis (*Schumann* 1894).

1. Bignoneae,
2. Tecomeae and
3. Crescentieae.

In the family, 3-zonocolporoidate type predominates and most of the species of the tribe Tecomeae come under this.

As regard exine ornamentation also reticulate type is predominant and represented by most of the species of Tecomeae.

Palynological evidences are in support of abolition of the artificial genus *Amphicome* and inclusion of its species under the genus *Incarvillea* as suggested by Chatterji (1947). The aperture, exine ornamentation and polar field index of these two species now *I. diffusa* and *I. emodii* are quite similar to that of *I. olgae*.

Similarly *Radermachera* and *Stereospermum* are two separate genera. *Radermachera* species with 3 zonocolpate aperture and fine reticulation where as in *Stereospermum* parasyncolpate *e.g.*, *S. personatum* and *S. chelonoides* and 3 zonocolporoidate type *e.g.*, *S. suaveolens*.

Pollen morphology indicates that *S. personatum*

and *S. chelonoides* are very closely related having same types of pollen grains. Taxonomically also the plants were mistaken for a long time. *S. chelonoides* is a pubescent plant, (based on *Bignonia chelonoides* Linn. f.) whereas *S. personatum* is a glabrous plant often mistaken for *S. chelonoides*. Haines (1922) called this plant as *S. tetragonum* A. DC. Earlier name of this plant was *Dipterospermum personatum* Hass. Chatterji renamed as *S. personatum* (Hassk.) Chatterji comb. nov. Cytotaxonomy may help in revealing true relationship of these two species.

EVOLUTION IN POLLEN TYPES

The trend of general evolution in pollen types are differently interpreted by various workers from time to time (*Wodehouse* 1936; *Erdtman* 1964; *Vishnu Mittra* 1964; *Nair* 1964). If we consider taxonomical and palynological evolution might have taken place on the same line and thus treat Magnoliaceae and Annonaceae as the primitive families and Leguminosae and Compositae as highly evolved and compare their pollen grains, it is found that atreme, monocolpate, monoporate, colpoid or with ± irregular anastomosing aperturoid streaks and tetrad grains in Magnoliaceae and Annonaceae, whereas colporate and colporoidate types along with pantocolpate or pantoporate, tetrads and polyads in Leguminosae, Compositae and other higher families. The probable evolution may be from atreme, monoporate or colpate, from colpate to colporoidate type on one hand and pantoporate and pantocolpate, parasyncolpate types on the other hand.

van Steenis (1927) described Bignoniaceae as a multiforme family characterised by monotypic or small genera. This is further supported by the occurrence of varied apertural types and exine ornamentation in the species investigated here. The manifestation of different pollen characters both advanced and primitive, as we assume, indicate that the evolution of the family is polyphyletic. Cytological evidences also show heterogeny within the family (*Darligton & Wylie* 1955).

van Steenis (*l.c.*) is not inclined to accept the polyphyletic origin of the family as the species of Bignoniaceae are quite allied to one another and sharply separated from the allied families. Pollen morphology on the contrary shows resemblances with Acanthaceae, Labiatae and Pedaliaceae.

ACKNOWLEDGEMENTS

I express my deep sense of gratitude to late Dr. J. Sen for his interest and encouragement. I thank the authorities of Botanical Survey of India and the staff of Palynology Section for necessary facilities.

REFERENCES

CHATTERJEE, D. A review of Bignoniaceae of India & Burma. *Bull. bot. Soc. Beng.* 2 : 62-67, 1948.

——Amphicome—A superflous genus of Bignoniaceae. *Kew Bull.* 183-185, 1948.

DARLINGTON C. D. AND A. P. WYLIE. *Chromosome atlas of flowering plants.* 2nd ed. London, 1955.

ERDTMAN, G. *Pollen morphology and plant taxonomy.* Stockholm, 1952.

——"*Palynology*"—*Advances in Botanical Research.* Vol. 1: 149-208, 1963.

——On classification of pollen grains and spores. *Palynological Bull.* 1, 1964.

—— AND H. STRAKA. Cormophyte spore classification. *Geol. Fören. Forhandl.* B. D. 83H. 1: 65-78, 1961.

*GUINET, PH. Pollen d' Asie tropicale. Inst. fr. Pondichery, *Tran. Sect. Sci. Tech.* 5 : 1, 1962.

HAINES, H. H. *Botany of Bihar & Orissa.* 1922.

MOHL. H. Beitrage Zur Anatomie und Physiology der Gewächse. *Anal. Sci. Nat.* 2 Ser. 3: 86, 1834.

NAIR, P. K. K. Trends in the morphological evolution of pollen and spores. *J. Indian bot. soc.* xliv (4): 468-478, 1964.

NATARAJAN, A. T. Studies in the morphology of pollen grains Tubiflorae. *Oyton* 8 (1) : 21-42, 1957.

RAJ, B. Pollen morphological studies in the Acanthaceae. *Grana-Palynologia* 3: 1-108, 1961.

SCHUMANN, K. *Bignoniaceae in Martius, flora Brasiliensis* Vol. VIII Par. II, Leipzig, 1894.

STEENIS, C. G. G. J. VAN. Malayan Bignoniaceae. Their taxonomy, Origin & Geographical distribution. *Recueil des Travaux botaniques Neerlandiscs* 24 : 787-1049, 1927.

URBAN, I. Uber Ranken und Pollen der Bignoniaceae. *Ber. dtsch. Bot. Ges.* 34, 1916.

VISHNU MITTRE. Contemporary thought in Palynology. *Phytomorphology*, 14 : 135-47, 1964,

WODEHOUSE, R. P. Evolution of pollen grains. *Bot. Rev.* 2: 67-84, 1936.

*Not seen in original.