云 南 植 物 研 究 2001, 23 (2): 225~230
Acta Botanica Yunnanica

中国紫葳科花粉形态的研究*

韦仲新，王 红，金巧军
(中国科学院昆明植物研究所，云南 昆明 650204)

摘要：对紫葳科18属27种花粉进行了光镜和扫描电镜的观察，其中有些种是第一次观察或报道。紫葳科花粉明显地属多型花粉，萌发孔类型和纹饰特征多种多样。萌发孔基本上可分为3(-4)沟，3(-4)孔沟，3孔，多沟及散沟等类型；纹饰则可分为皱波状纹饰，穴状纹饰，穴-网状纹饰，网状纹饰，刺状纹饰以及表面光滑等。值得注意的是在菜豆树属 *Radermachera* Zoll. et Moritzi 中，菜豆树 *R. sinica* 和滇菜豆树 *R. yunnanensis* 虽为同一个属，但其萌发孔类型和纹饰特征截然不同，菜豆树花粉为3孔，具网状纹饰；而滇菜豆树花粉为3孔沟，具穴状纹饰。就花粉形态学而言，紫葳科也许是多元发生的。

关键词：紫葳科；花粉形态
中图分类号：Q 944 **文献标识码**：A **文章编号**：0253-2700(2001)02-0225-12

Pollen Morphology of Bignoniaceae in China*

WEI Zhong-Xin, WANG Hong, JIN Qiao-Jun
(*Kunming Institute of Botany, Chinese Academy of Sciences*, Kunming 650204, China)

Abstract: The pollen grains of 27 native and introduced species belonging to 18 genera of Bignoniaceae were examined by light and scanning electron microscopes. Some of which were reported or examined by scanning electron microscope for the first time. Though, the Bignoniaceae are conspicuously eurypalynous, their apertures can be divided into 3(-4) colpate, 3(-4) colporate, 3-porate, stephanocolpate and pantocolpate types. The exine sculptures include foveolate, rugulate, reticulate (fine and coarse reticulations) and spinulate, or psilate. Most pollen grains exist as monads but a few are tetrad. In the genus of *Radermachera*, the pollen aperture and sculpture are different between *R. sinica* and *R. yunnanensis*. The pollen of R. sinica is 3-porate and reticulate sculpture, but that of R. yunnanensis is 3-colpate and foveolate sculpture. In the family of Bignoniaceae, the pollen morphology is valuable both in generic delimitation and in the study of systematic relationships, especially aperture and the exine sculpture.

Key words: Bignoniaceae; Pollen morphology

The Bignoniaceae is a large family including about 120 genera, 650 species distributed mainly in tropical areas, a few in temperate regions and one genus (*Catalpa*) common to both the Old and New worlds. Generally they are divided into four tribes, Bignonieae, Tecomeae, Eccremocarpeae and Crescentieae (Willis, 1973). In China there are about 22 genera (including native and introduced ones)

* Foundation items: This work was supported jointly by the Knowledge Innovation Project of CAS, the National Natural Science Foundation of China 39870088 and the Natural Science Foundation of Yunnan Province 98C091M
Received date: 2000-04-27, Accepted date: 2000-07-27

(How, 1982), of which the genera *Catalpa*, *Incarvillea*, *Dolichandrone*, *Oroxylum*, *Radermachera* and *Stereospermun* are very important for their wood and aesthetic values. Because there are too many monotypic genera and due to taxonomic over-splitting, the genera delimitation of the family is still a problem, and even more importantly a few genera like *Wightia* and *Pauldopia* have been put into different family, Bignoniaceae or Scrophulariaceae according to the author's preference. In the family of Bignoniaceae, pollen morphology gives important data for their classification and systematics (Buurman, 1977; Gentry & Tomb, 1979), however, this paper does not intend to discuss the classification of the family but only to present some palynological data which would be useful for taxonomists who studied or will study the family.

Pollen morphology of Bignoniaceae had been studied by some researchers (Buurman, 1977; Ferguson & Santisuk, 1973; Gentry & Tomb, 1979; Institute of Botany and South China Institute of Botany, 1982; Mitra, 1968; Suryakanta, 1973; Huang, 1972; Wang et al, 1960, 1997; Wei, 1989). But most of the studies only made general observation with light microscope except Ferguson and Gentry who made detailed studies on the pollen sculpture with scanning electron microscope. In this paper, we selected 27 native and introduced species belonging to 18 genera for study, aiming at summing up their pollen morphological characters and proving some useful data for taxonomists who are interested in the Bignoniaceae.

1 Material and Methods

Species examined here are listed in the appendix.

Pollen grains were obtained from specimens in the herbarium of Kunming Institute of Botany, the Chinese Academy of Sciences (KUN), or collected directly from cultivated plants at Kunming Botanical Garden. Pollen for light microscope was acetolysed by Erdtman'method and mounted in glycerine jelly. Measurements were based on 10 to 15 pollen grains per sample. For SEM observation, acetolysed pollen grains were dehydrated in EtOH series from 50% to 95% and than pipeted onto the stubs with double-sided tape. After coating, they were observed and photographed under SEM.

2 Description of Pollen Morphology

Campsis Lour. 2 species, one in E. As., the other one in E. US.

Species examined: C. grandiflora (plate I: 1-3; II: 3-4). The pollen grains spheroidal to subprolate; 3-colpate; size (25-40) 30 × 25 (23-30) μm; sexine reticulate.

Catalpa scop. 11-13 species, distributed in E. As and Am., 5 in China.

Species examined: Catalpa ovata (plate VI: 1-2), C. speciosa (plate I: 5) and C. fargesii (plate I: 4) The pollen grains are all aggregated into tetrad with diameter of 48-75.9μm; inaperturate; sexine in reticulate pattern, and with various sizes and shapes of lumina. The difference among these species is mainly in the size of the pollen tetrads. The tetrad of C. speciosa is the largest one, from 68.3 to 73.9μm, the tetrad of *C. ovata* is the smallest, from 45 to 57μm, and that of *C. fargesii* is interwediate, from 53.1 to 60.1μm in diameter. Their sculptures are not obviously different.

Chilopsis D. Don. Only one species. distributed in S. US. and Mexico.

Species examined: *Chilopsis linearis* (plate VI: 3 – 4, 6). The pollen aggregated into tetrad with diameter 48 – 75μm; inaperturate; sexine coarsely reticulate.

Cresentia L. 5 species, distributed in trop. Am.

Species examined: *C. alata* (plate II: 5 – 6). The pollen grains subspheroidal to oblate; 3 – colpate, and the colpi were usually covered with protruded colpal membrane; size (28 – 42) 35 × 40 (35 – 45) μm; sexine reticulate.

Dolichandrone (Fenzl) Seem. 9 species, trop. E. Afr., Madag., trop. As. (2 in China) and Austr.

Species examined: *Dolichandrone. sp* (plateII: 7 – 8). The pollen grains subprolate; 3 – colpate; size (40 – 65) 55 × 48 (38 – 52) μm; sexine reticulate, the lumina nearly rounded and well – distributed on the surface of the pollen.

Incarvillea Juss. 11 – 14 species, distributed in C. & E. As., Himal., there are 12 in China.

Species examined: *Incarvillea arguta* (plate I: 6). *I. lutea* and *I. younghusbandii* (plate I: 7; VI: 5, 7). The pollen grains oblate to subspheroidal; stephanocolpate, usually 8 – 9 colpate, but the colpi unequal in length; size (50 – 65) 58 × 65 (55 – 75) μm, and there is no obviously different in size among species; the exine covered with spiniform protuberances (subspinuloses) which can be seen only under SEM.

Jacaranda Juss. 50 species, distributed in C. & S. Am. and W. I.

Species examined: *J. acutifolia* (plate III: 5 – 6). The pollen grains subspheroidal to suboblate; 3 – colporate, usually with protuberant colpal membrane; size (32 – 46) 38 × 42 (34 – 46) μm; sexine psilate.

Mayodendron Kurz one to two (?) species in Burma and SW. China.

Species examined: *M. igneum* (plate I: 8 – 9, III: 1 – 2) and *M. longispatha* (?) (plate III: 3 – 4). The pollen grains subprolate to subspheroidal; 3 – colpate, and the colpi are deep and zigzag; size (28 – 35) 32 × 26 (22 – 28) μm; sexine coarsely reticulate and with different sizes of lumina.

Millingtonia L. f. only one species in SE. As.

Species examined: *M. hortensis* (plateIII: 7 – 8). The pollen grains suboblate to subspheroidal; 3 – colpate, syncolpate; size (25 – 30) 28 × 30 (28 – 34) μm; sexine rugulate to rugulate – reticulate.

Nyctocalos Teijsm. et Binnend. 5 species, from Assam & SW. China (2 species) to W. Malaysia.

Species examined: *Nyctocalos shanicus* (plate I: 11; VI: 8 – 9), *N. brunfelsiiflorus* and *N. pinnatus* (plate I: 10). The pollen grains subspheroidal; size from 85 to 108μm in diameter; 3 – colpate; sexine coarsely reticulate pattern which is very peculiar by having very coarse and irregular rugae and a lot of gemmate structures on the surface of lumina (VI: 8 – 9). There are no obvious difference in pollen morphology especially in sculpture among various species.

Oroxylum Vent. 2 species in S. China, SE. As. and Indomal.

Species examined: *O. indicum* (plate V: 7 – 8). The pollen grains subprolate; 3 – colpate; size (58 – 70) 65 × 55 (45 – 62) μm; sexine coarsely reticulate, the lumina with nearly the same sizes and shapes (usually rounded).

Pauldopia van Steenis as only one species, distributed in NE. India, SW. China, SE. As.

Species examined: *P. ghorta* (plate I: 17, V: 5 – 6). The pollen grains subspheroidal; 3 – colpate; size (30.6 – 32) 31.5 × 33 (31 – 34.5) μm; sexine foveolate to finely reticulate.

Pyrostegia Presl. 5 species, distributed in trop. Am.

Species examined: *Pyrostegia ignea* (plate I: 12 – 15) and *P. venusta* (plate IV: 1 – 2). The pollen grains subspheroidal: 3 – colpate, occasionally to 6 – colpate, and with multi – folded (wrinkled) colpal membrane; size (48 – 65) 60 × 54 (46 – 58) μm; sexine reticulate, with various sizes of lumina which were distributed sparsely on the surface of the pollen.

Radermachera Zoll. et Mor. 40 species, distributed in India to China, Philipp. Is.

Species examined: *R. sinica* (plate I: 20 – 21, V: 1 – 2) and *R. yunnanensis* (plate I: 18 – 19, V: 3 – 4). The pollen grains subspheroidal to suboblate; 3 – colpate (*R. yunnanensis*) or 3 – porate (*R. sinica*); size (20 – 27.7) 25 × 27 (20.5 – 30) μm; sexine foveolate (*R. yunnanensis*) to reticulate (*R. sinica*).

Spathodea Beauv. 2 species, distributed in trop. Afr.

Species examined: *S. campanulata* (plate I: 23 – 24). The pollen grains spheroial; 3 – colpate; size 32 – 45μm in diameter; sexine coarsely reticulate.

Stereospermum Cham. 24 species, distributed in trop. Afr. and As.

Species examined: *S. tetragonum* (plate I: 25 – 26). The pollen grains spheroidal with complex aperture structure of pantocolpi; size 30 – 42μm in diameter; sexine reticulate and the lumina with the same shape and size. The pollen grains of Stereospermum were also looked as polyad by others (Institute of Botany and South Institute of Botany, CAS, 1982).

Tecoma Juss. 16 species, distributed in Florida of USA and W. I.

Species examined: *Tecoma stans* (plate II: 1 – 2). The pollen grains subspheroidal to suboblate; 3 – colpate; size (27.5 – 35) 34 × 36 (28.5 – 36.5) μm; sexine finely reticulate, and the lumina with different sizes and shapes.

Tecomaria Spach. 2 species, distributed in trop. E. & S. Afr.

Species examined: *Tecomaria capensis* (plate I: 22, IV: 3 – 4) and *Tecomaria* sp. (plate IV: 5 – 8). The pollen grains subprolate to prolate; 3 – colpate and some are syncolpate, colpi very deep; size (34.5 – 48) 40 × 32 (28 – 36) μm; sexine reticulate, the lumina with different sizes and shapes; The difference of these two species is that *Tecomaria* sp. has syncolpate pollen but the pollen of *T. capensis* is non – syncolpate.

3 Conclusion

3.1 Bignoniaceae are conspicuously eurypalynous, showing diversities both in aperture and sculpture, but their apertures can be divided into 3 – 4 colpate, 3 or 4 colporate, 3 porate, stephanocolpate and pantocolpate types; the sculpture includes psilate, foveolate, rugulate, reticulate and spinulate and so on, but reticulate pattern is the common one.

3.2 The result from comparison showed that the sculpture difference of various tribes is not necessarily greater than that of the same tribe. For example, in the tribe of Tecomeae, the sculpture varies very much from psilate (*Jacaranda*, plate III: 5 – 6) to reticulate (*Campsis*, plate II: 3 – 4) and even to spinulate (*Incarvillea*, plate VI: 5, 7 – 8). Therefore it is difficult to elucidate the systematic relationships between different tribes by sculpture.

3.3 In most case, the pollen morphology, especially the aperture and sculpture are constant within one genus, but the genus *Radermachera* has different aperture and sculpture between different species. The pollen of *R. sinica* is 3 – porate and with reticulate sculpture (plate I: 20 – 21, V: 1 – 2), while that of *R. yunnanensis* is 3 – colpate and with foveolate sculpture (plate I: 18 – 19, V: 3 – 4). In the family, *Radermachera* is the only one genus which has significant variations in aperture and sculpture types between different species.

3.4 As far as pollen morphology is concerned, Bignoniaceae may be polyphyletic on account of its great diversities in pollen types (monad in most genera, tetrad in *Catalpa* and *Chilopsis*), shapes, aperture types, sculptures and the presence of both putatively primitive and advanced pollen types; perhaps the pollen types of *Catalpa*, *Chilopsis*, *Incarvillea*, *Jacaranda*, *Millingtonia*, *Stereospermum* and *Nyctocalos* may have evolved independently in several evolutionary lineages.

Acknowledgments We wish to thank the staff at the Herbarium of Kunming Institute of Botany (KUN) for allowing to use the palynological materials from their collections. Special thanks to senior staff Yu Shaowen, Liu Xianzhang and Yuan Huikun for providing us with some pollen grains from living collections plants at Kunming Botanical Garden.

APPENDIX: voucher specimens

The pollen grains were removed from the specimens deposited at the herbarium of Kunming Institute of Botany (KUN) or collected directly by the authors from cultivated plants in Kunming Botanical Garden. For each species, the name, locality, collector and the collection number are given as follows:

Campsis grandiflora (Thunb.) Loisel. ex K. Schumann, Yunnan, Yunnan Exploration Team 57027

Catalpa fargesii Bureau. *f. duclouxii* (Dode) Gilmour, cultivated in Kunming Botanical Garden.

C. ovata G. Don., cultivated in Kunming Botanical Garden.

C. speciosa Warder ex Barney, cultivated in Kunming Botanical Garden.

Chilopsis linearis Sweet., San Diego, U. S. A., Roger Harm 013.

Crescentia alata H. B. K., Guangzhou, Tao Deding 83116.

Dolichandrone sp, Menglun, Mengla, Yunnan, Tao Deding 84 – 005.

Incarvillea arguta (Royle) Royle, Daguan, Yunnan, Sun Bixing et al 0707.

I. lutea Bur. et Franch. Lijiang, Yunnan, KUN – Kew Garden Exploration Team 85 – 532

I. younghusbandii Sprague, Tibet, Wu Zhengyi et al 75 – 430.

Jacaranda acutifolia Humb. et Bonpl., Menglun, Mengla, Yunnan, Tao Deding 84 – 003.

Mussaenda longispatha D. D. Tao, locality? M. K. Li 3139

M. igneum (Kurz) Kurz, Menghai, Yunnan, China – Soviet Exploration Team 5616.

Millingtonia hortensis L. f., Jinghong, Yunnan. Tsai Xitao 80031.

Nyctocalos brunfelsiiflora Teijsm et Binn, Cangyuan, Yunnan, Li Yanhui 012624

N. pinnata van Steenis, Hekou, Yunnan, Liu Weixin 320.

N. shanica, MacGregor et W. W. Smith, Mengla, Yunnan, Tsai Xitao 59 – 10713.

Oroxylum indicum (Linn.) Vent. Jinghong, Yunnan, collection number?

Pauldopia ghorta (Buch. – Ham. ex G. Don) van Steenis, Mengzhi, Yunnan, China – Soviet Exploration Team 2233

Pyrostegia venusta (Ker) Miers, Menglun, Yunnan, Li Yanhui 004516.

Radermachera sinica (Hance) Hemsl., Luktung, Guangdong, S. K. Lau 26890

R. yunnanensis C. Y. Wu et W. C. Yin, Jinghong, Yunnan, Wu Quanan 9030.

Spathodea campanulata Beauv. Cuba, Kim 0241175

Stereospermum tetragonum (Wall.) DC., Jinping, Yunnan, Luchun Team 1043.

Tecoma stans (L.) H. B. K. Mengla, Yunnan, Tao Deding 84 – 002.

Tecomaria capensis (Thunb.) Spach, cultivated in Kunming Botanical Garden.

Tecomaria sp. cultivatedat in Kunming Botanical Garden.

References:

Bunerman J, 1977. Contribution to the pollen morphology of the Bignoniaceae with special reference to the tricolpate type [J]. *Pollen & Spores*, **19**: 447 – 519

Ferguson I K, Santisuk T, 1973. Notes on the pollen morphology of some Asiatic Bignoniaceae [J]. *Kew Bull*, **28**: 187 – 194

Gentry A H, 1974. Flowering phenology and diversity in tropical Bignoniaceae [J]. *Biotropica*, **6**: 64 – 68

Gentry A H, & Tomb A F, 1979. Taxonomic implications of Bignoniaceae palynology [J]. *Ann Missouri Bot Gard*, **66**: 756 – 777

How Foon – Chew, 1982. A Dictionary of the Families and Genera of Chinese Seed Plants [M]. Beijing: Science Press, 60 – 61

Huang T C, 1972. Pollen Flora of Taiwan [M]. National Taiwan University: Bot. Dept. Press, 68

Institute of Botany and South China Institute of Botany, 1982. Angiosperm Pollen Flora of Tropic and Subtropic China [M]. Beijing: Science Press, 60 – 65

Mitra K, 1968. Pollen morphology in Bignoniaceae in relation to taxonomy [J]. *Bull Bot Surv India*, **10**: 319 – 326

Suryakanta, 1973. Pollen morphological studies in the Bignoniaceae [J]. *J Palynol*, **9**: 45 – 82

Wang F S, Chen N F, Zhang Y L, *et al*, 1997. Pollen Flora of China [M]. (2nd ed.) Beijing: Science Press, 97 – 101

Wei Z X, 1989. Pollen morphology of *Wightia* and its taxonomic significance. *Acta Botanica Yunnanica*, **11** (1): 65 – 70

Willis J C, 1973. A Dictionary of the Flowering Plants and Ferns [J] (8th ed). Cambridge: The University Press, 138 – 139

Explanation of Plates

Plate I 1 – 3 *Campsis grandiflora*; 4 *Catalpa fargesii*; 5 *C. speciosa*; 6 *Incarvillea arguta*; 7 *Incarvillea younghusbandii*; 8 – 9 *Mussaenda igneum*; 10 *Nyctocalos pinnata*; 11 *N. shanica*; 12 – 15 *Pyrostegia ignea*; 16 – 17 *Pauldopia ghorta*; 18 – 19 *Radermachera yunnanensis*; 20 – 21 *R. sinica*; 22 *Tecomaria capensis*; 23 – 24 *Spathodea campanulata*; 25 – 26 *Stereospermum tetragonum*. (4, 5, 10 and 11 × 500; 16, 17, 18 and 19 × 1200; others × 1000)

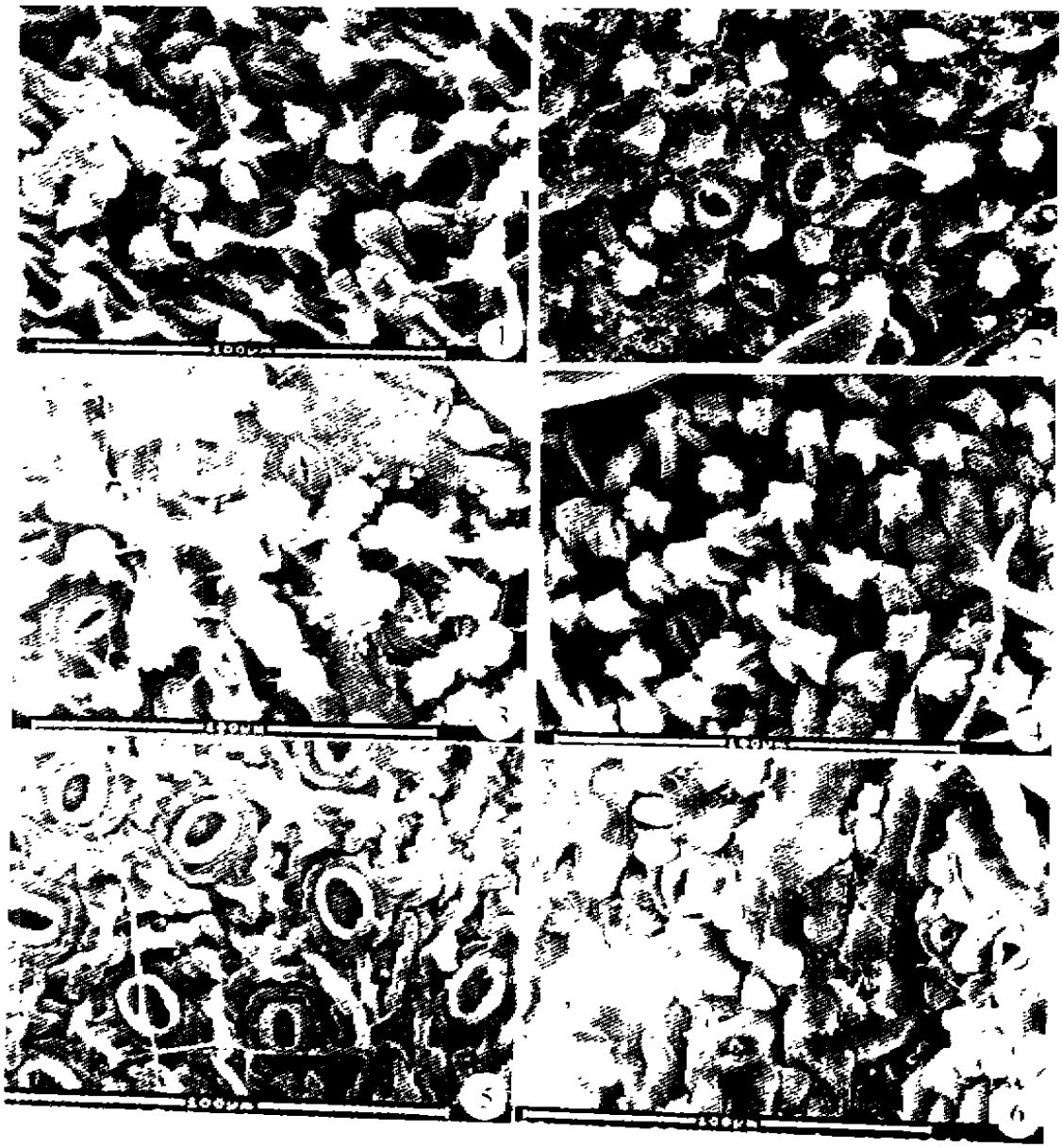
Plate II 1 – 2 *Tecoma stans*; 3 – 4 *Campsis grandiflora*; 5 – 6 *Crescentia alata*; 7 – 8 *Dolichandrone sp.*

Plate III 1 – 2 *Mussaenda igneum*; 3 – 4 *M. longispatha*; 5 – 6 *Jacaranda acutifolia*; 7 – 8 *Millingtonia hortensis*

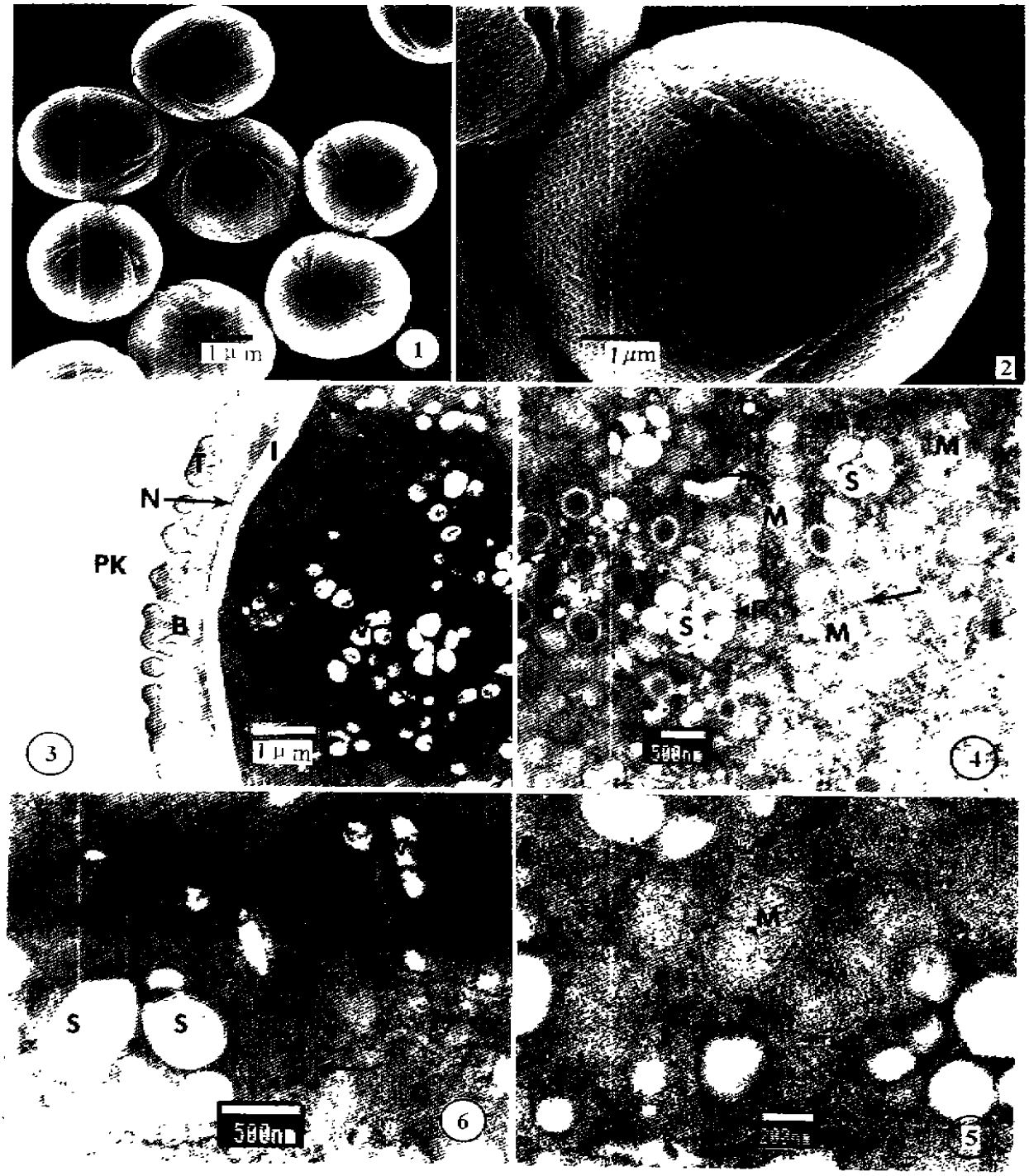
Plate IV 1 – 2 *Pyrostegia venusta*; 3 – 4 *Tecomaria capensis*; 5 – 8 *T. sp.*

Plate V 1 – 2 *Radermachera sinica*; 3 – 4 *R. yunnanensis*; 5 – 6 *Pauldopia ghorta*; 7 – 8 *Oroxylum indicum*

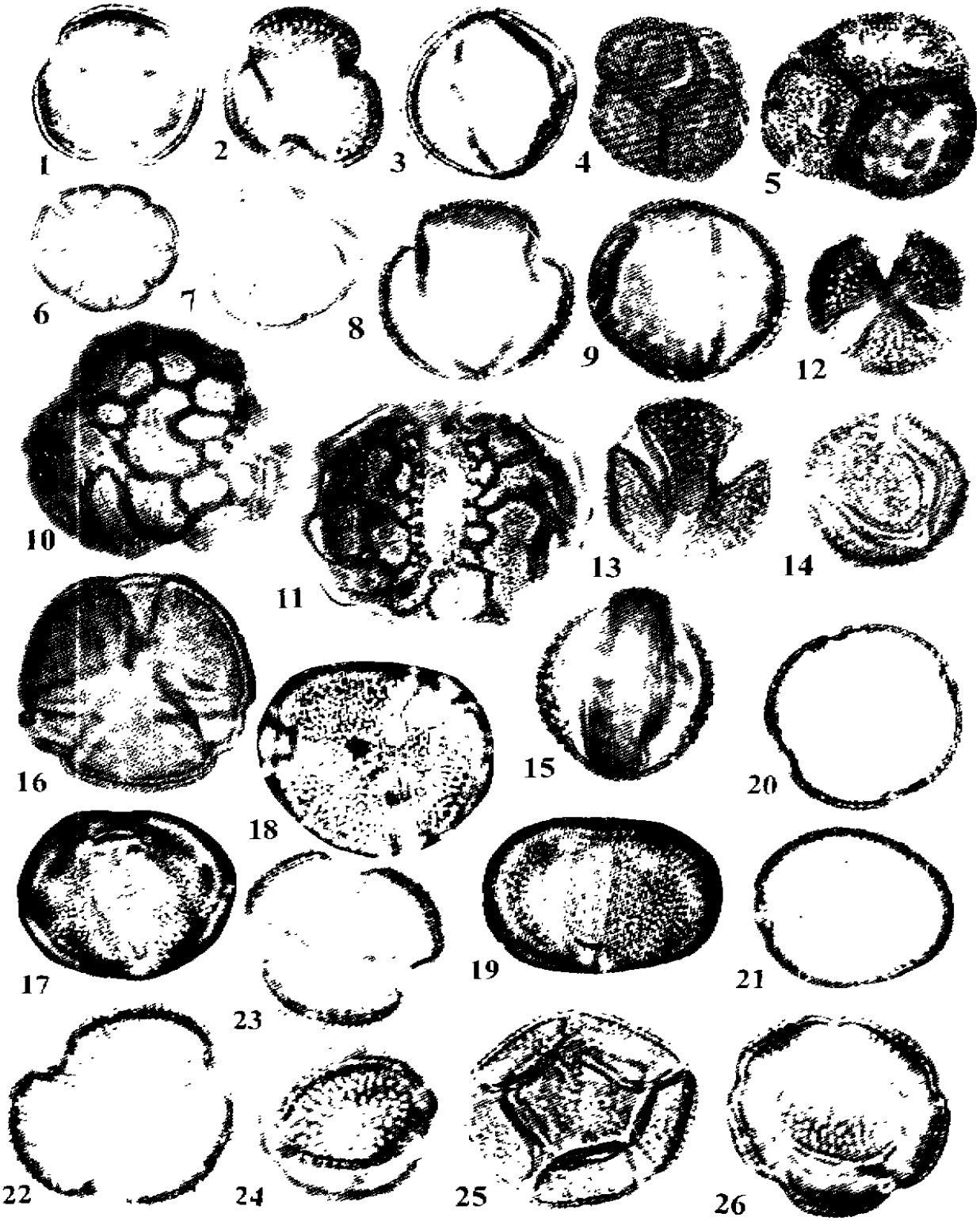
Plate VI 1 – 2 *Catalpa ovata*; 3 – 4, 6 *Chilopsis linearis*; 5, 7 *Incarvillea younghusbandii*; 8 – 9 *Nyctocalos shanica*



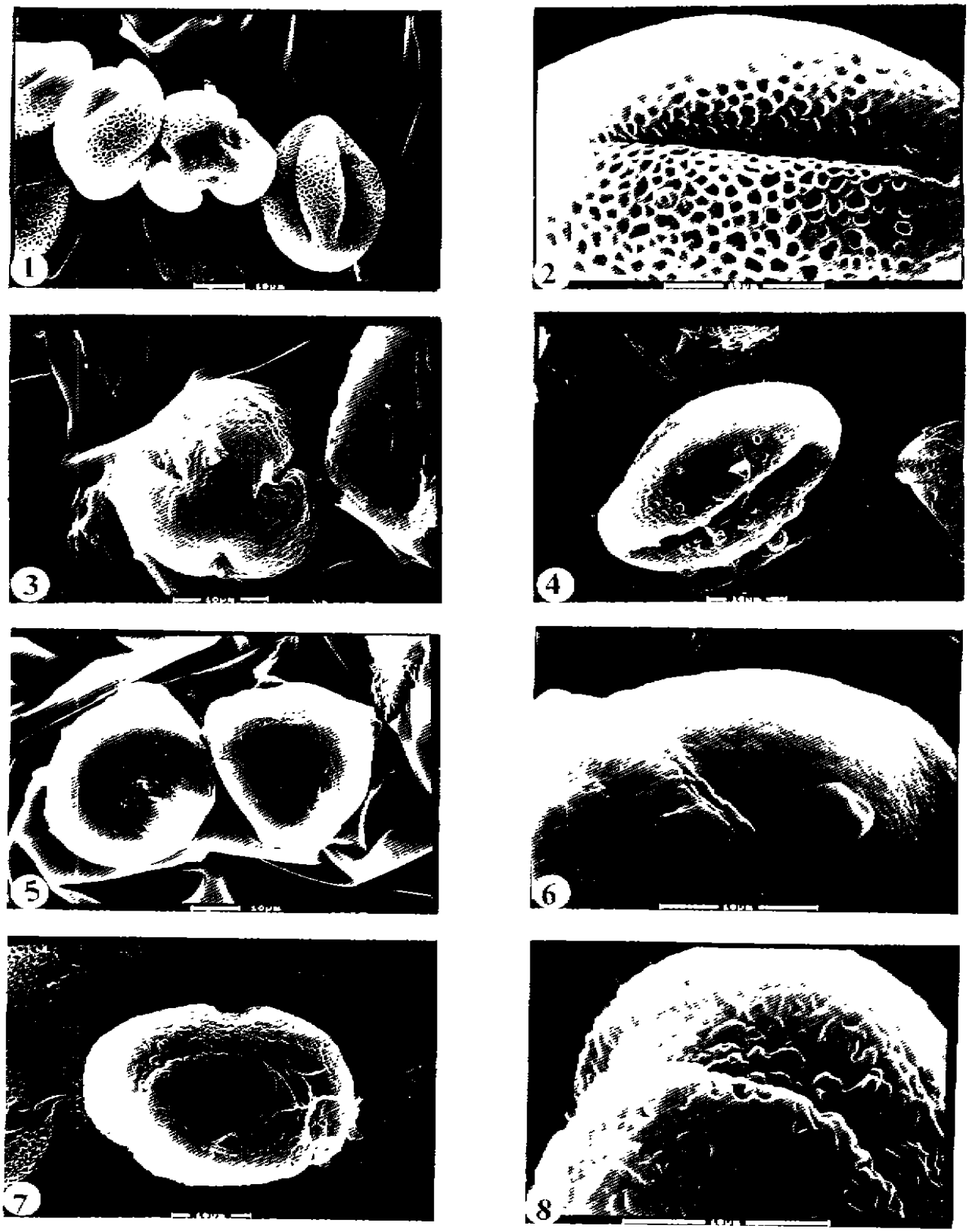
图版说明：Figs. 有关名称模式材料的叶下表皮扫描电镜结构：
1. *C. microphyllus*, 2. *C. schlechtendali*, 3. *C. cochleatus* (Franch.) Klotz, 4. *C. elatus* Klotz, 5. *C. kweitschoviensis* Klotz. 6. *C. poluninii*



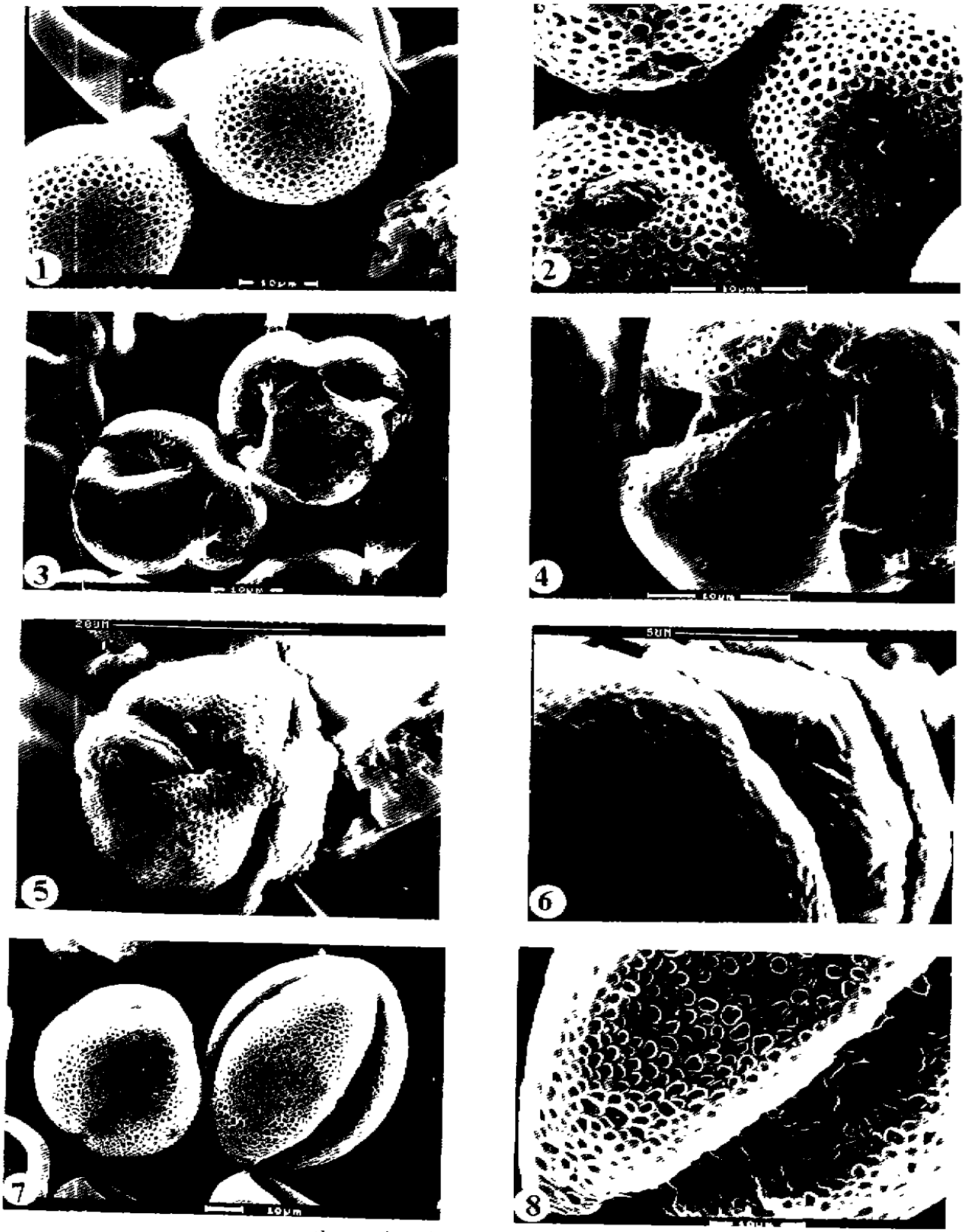
See explanation at the end of text



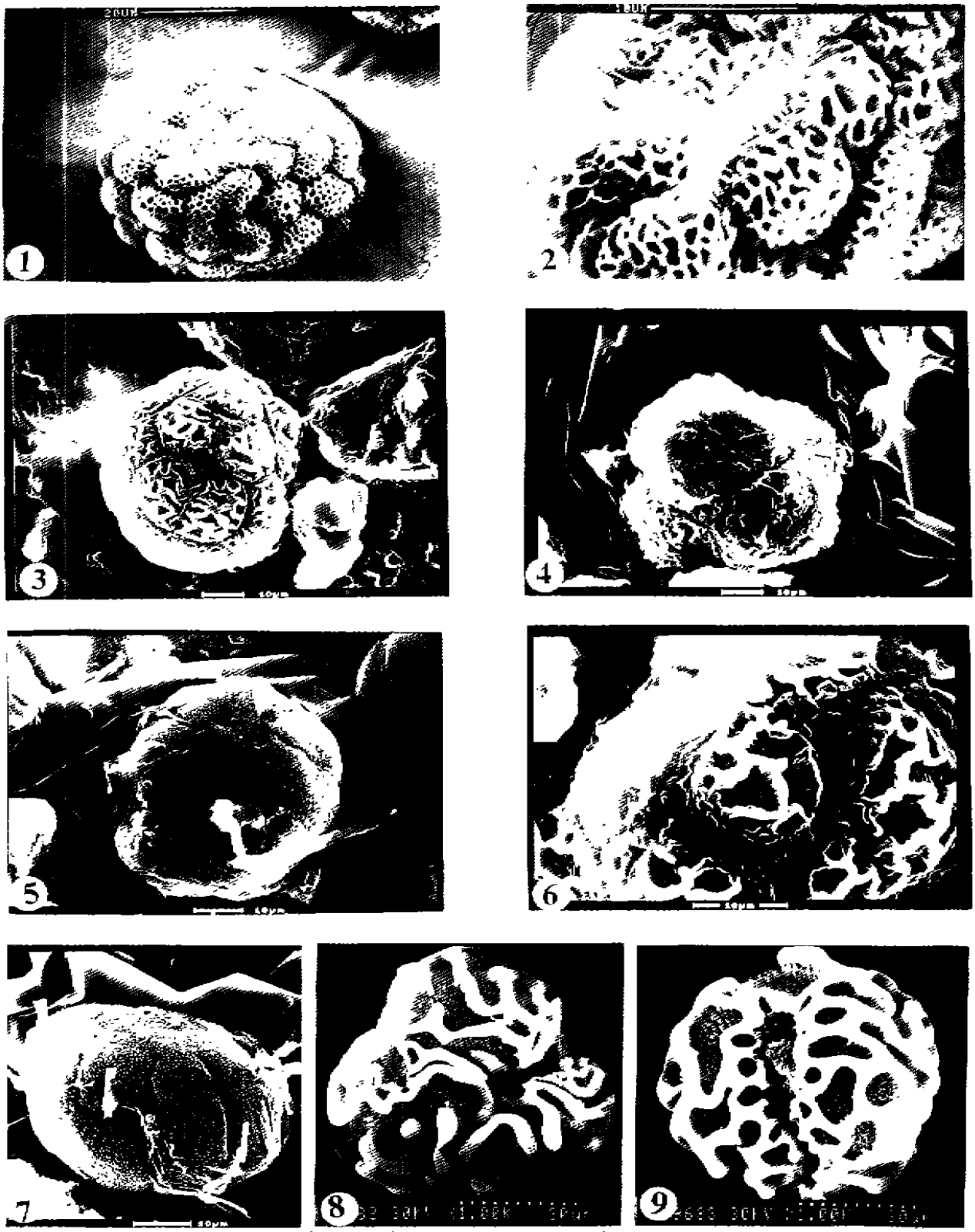
See explanation at the end of text



See explanation at the end of text



See explanation at the end of text



See explanation at the end of text