THE EARLY PLIOCENE POLLEN FLORA OF THE LOWER ERHCHIU FORMATION, SANHSIA, NORTHERN TAIWAN[1]

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Abstract: In order to elucidate the palaeoecology of the lower Erhchiu Formation, the early Pliocene, Sanhsia, northern Taiwan, an effort has been made to analyse the pollen fossil assemblage and reconstruct the depositional environment of that area.

In this pollen analysis, 65.7 per cent angiosperms pollen, 17.2 per cent gymnosperms pollen, 17.1 per cent bryophytous and pteridophytic spores were obtained.

In this pollen assemblage, four new genera, eight new species and five new records have been found. In the eight new species, except the *Retitricolpitrites taiwanensis* and *Malvacearumpollis majus* which can not be confirmed, the six new species are herbaceous angiosperm pollen.

INTRODUCTION

The paleopalynology study of the Pliocene in Taiwan is very limited. There are only four papers published (Huang & Tsou, 1984; Huang & Huang, 1984; Shaw, 1984, 1985) and the further investigation is highly required. Therefore, the lower Erhchiu Formation of the early Pliocene, Sanhsia, northern Taiwan has been chosen to analyse the pollen fossil assemblage and reconstruct the depositional environment of that area.

MATERIAL AND METHODS

(1) Material

Along the road from Sanhsia to Tachi, 47 samples were collected from the roadside outcrop of the lower Erhchiu Formation, c. a. 250 meters long, between Sanyuantantze and Youfu Elementary School.

Approximately 500 g of fresh rock per sample was taken and put into labeled bags. The outcrop mainly consists of interbedded shaly-sandstone and sandstone.

(2) Method

The preparation procedure for palynological slides varies depending on the nature of the rock. Referring to the methods of Brown (1967), Chung & Huang (1972), Traverse (1988), the following treatment (Fig. 1) is used in this analysis.

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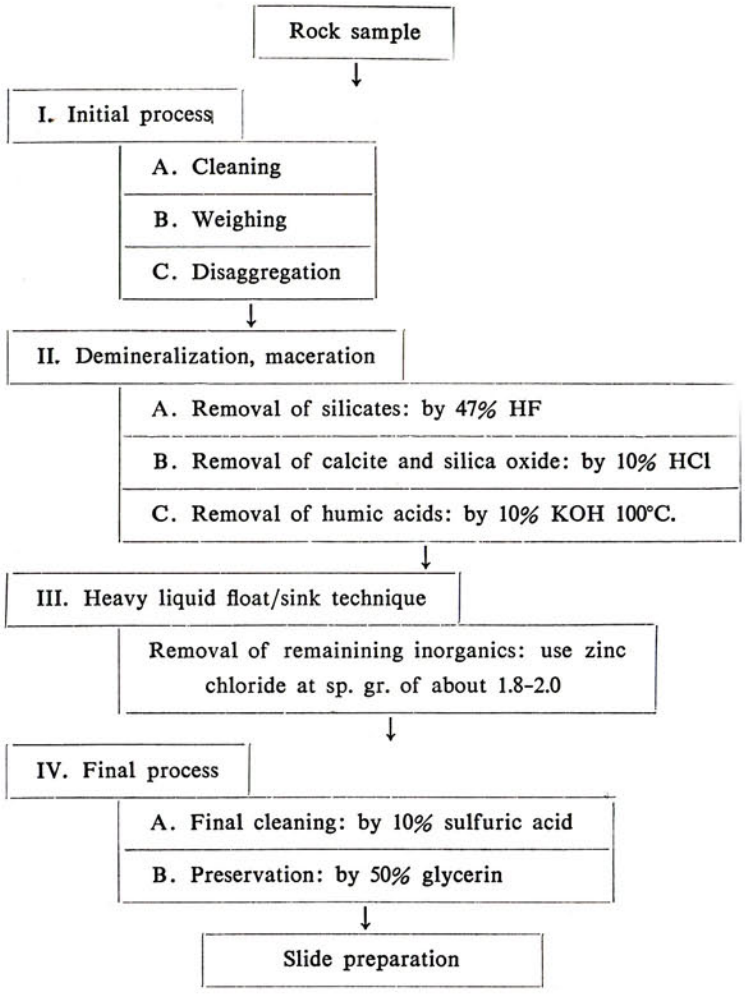


Fig. 1. Palynological slides preparation process.

Prepared slides were studied and photographed with a Nikon Optiphot-type microscope providing magnification up to ×1000. The spore photographs were all magnified to ×1000.

Identification was done by consulting with references of Huang, C. L. & Huang, T. C., 1984; Huang, T. C., 1972, 1978a, 1978b, 1979, 1980, 1981; Jansonius & Hills, 1976; Song *et al.*, 1985; Nakamura, 1980.

The description follows the Huang's treatment (1972) which is widely known, is not accepted universally.

RESULT

(1) Taxonomy of Palynomorphs

47 samples were counted, and 16,362 pollen grains and spores were identified. The percentage of the identified bryophytous and pteridophytic spores was 17.1%,

includins 29 genera, 52 species and one variety, 2,805 spores recorded; gymnospermous pollen grains 17.2%, including 12 genera and 26 species, 2,811 pollen grains recorded and angiospermous pollen grains 65.7%, including 54 genera, 73 species and one variety, 10,746 pollen grains recorded (Plates 1-21).

Four new genera, eight new species and five new records of angiospermous pollen grains were found and are described as follow:

1. Hypoestespollenites *gen. nov.* 槍刀菜粉屬

Type species: *Hypoestespollenites taiwanensis* Li & Huang
Diagnosis: "Heterocolpate pollen, with negatively reticulate sexine."

(1) Hypoestespollenites taiwanensis *sp. nov.* 臺灣槍刀菜粉

"Grains heterocolpate, prolate, 47×25 μ; sexine: surface view negatively reticulate, lumina regularly rectangular; sectional view (muri) verrucate."
Locality: Erhchiu, Sanhsia in the Erhchiu Formation.
Slide: 26-4R (Pl. 14: 1-2)
Taxonomic affinity: This species is similar to the extant *Hypoestes cumingiana* Benth. & Hook. of the Acanthaceae (Huang 1972, Pl. 4: 15-18).

2. Evolvuluspollenites *gen. nov.* 土丁桂粉屬

Type species: *Evolvuluspollenites taiwanensis* Li & Huang
Diagnosis: "Pantocolpate pollen, with short colpi and granulate sexine."

(2) Evolvuluspollenites taiwanensis *sp. nov.* 臺灣土丁桂粉

"Grains pantocolpate, spheroidal to polygonal, 20 μ wide; colpi short, 7-8 μ long; sexine: surface view granulate; sectional view psilate to scabrate."
Locality: Erhchiu, Sanhsia in the Erhchiu Formation.
Slide: 21-3R (Pl. 15: 14)
Taxonomic affinity: this species is similar to the extant *Evolvulus alsinoides* L. of the Convolvulaceae (Huang 1072, Pl. 50: 1-4).

3. Galiumpollenites *gen. nov.* 豬殃殃粉屬

Type species: *Galiumpollenites taiwanensis* Li & Huang
Diagnosis: "4-colpate pollen, with narrow colpi and finely reticulate sexine."

(3) Galiumpollenites taiwanensis *sp. nov.* 臺灣豬殃殃粉

"Grains 4-colpate, oblate to spheroidal, 18×19 μ; sexine: surface view finely reticulate; sectional view psilate."
Locality: Erhchiu, Sanhsia in the Erhchiu Formation.
Slide: 57-1R (Pl. 20: 11)
Taxonomic affinity: This species is similar to the species of *Galium* of the Rubiaceae (Huang 1972, Pl. 132: 8-15).

4. Portulacapollenites *gen. nov.* 馬齒莧粉屬

Type species: *Portulacapollenites taiwanensis* Li & Huang 臺灣馬齒莧粉

Diagnosis: Pantocolpate (pericolpate) pollen; sexine granulate.

(4) Portulacapollenites taiwanensis *sp. nov.* 臺灣馬齒莧粉

"Grains pantocolpate (5-colpate), 38×33 μ; sexine: surface view granulate; sectional view subpsilate-scabrate."

Locality: Erhchiu, Sanhsia in the Erhchiu Formation.

Slide: 57-2R (Pl. 20: 12).

Taxonomic affinity: This species is similar to the extant *Portulaca pilosa* L. of the Portulacaceae (Huang 1972, Pl. 122: 21-23)

5. Impatiensidites Sah 1967 鳳仙花粉屬

Type species: *Impatiensidites brevicolpus* Sah 1967; Mus. Roy. Afrique Gentr., Tervuren; Ann., ser. in 8, Sci., geol., no. 57, p. 68, pl. 6, fig. 27.

Diagnosis: "Pollen grains 4-colpate, medium-sized; amb rectangular, sometimes rounded, angulaperturate; colpi usually very short; sexine finely reticulate in surface view."

(5) Impatiensidites taiwanensis *sp. nov.* 臺灣鳳仙花粉

"Grains 4-colpate; colpi 4 μ long; amb rectangular; 35-33×23-26 μ; sexine: surface view reticulate; sectional view scabrate."

Locality: Erhchiu, Sanhsia in the Erhchiu Formation.

Slide: 2-2R, S15-3R (Pl. 14: 10-11)

Taxonomic affinity: This species is similar to species of *Impatiens* of the Balsaminaceae (Huang 1972, Pl. 21: 5-17).

6. Rousea Srivastava 1969 青牛膽粉屬

Type species: *Rousea subtilis* Srivastava 1969; J. Sen Memorial Vol., p. 53, pl. 1, fig. 7.

Diagnosis: "Grains tricolpate, angulaperturate; colpi long, reaching polar area; amb subtriangular or rounded, sides convex; sexine thick, reticulate, lumina larger in mesocolpia becoming smaller at colpi margins and apocolpia."

Note: Differs from *Tricolpites* in having reticulation wider than 1 μ in mesocolpia but finer at apocolpia and near margins of colpi; forms with uniform reticulations should not be assigned to *Rousea*.

(6) Rousea taiwaniana *sp. nov.* 臺灣青牛膽粉

"Grains tricolpate, colpi 30 μ long; amb subtriangular-circular, 61-62 μ wide; sexine: surface view lopho-reticulate, muri 2.5 μ high, but rugulate near polar area; sectional view clavate."

Locality: Erhchiu, Sanhsia in the Erhchiu Formation.

Slide: 39-2L, 6-3R (Pl. 15: 16-17).

Taxonomic affinity: This species is similar to the species of *Thladiantha* of the Cucurbitaceae (Huang 1972, Pl. 58: 5-14).

7. Retitricolpites taiwanensis *sp. nov.* 網面三溝粉屬

Type species: *Retitricolpites ornatus* (Van der Hammer) Pierce, 1961; Minnesota Geol. Surv., Bull. 42, p. 50, 24.

Diagnosis: "Grains tricolpate, with reticulate sexine."

(7) **Retitricolpites taiwanensis *sp. nov.*** 臺灣網面三溝粉

"Grains 3-colpate, subprolate, 24-28×15-20 μ; sexine: surface view reticulate; sectional view scabrate."

Locality: Erhchiu, Sanhsia in the Erhchiu Formation.

Slide: 6-5R, 17-2L, 54-1R (Pl. 17: 1-5).

Taxonomic affinity: unknown.

8. Malvacearumpollis Nagy 1962 錦葵粉屬

Type species: *Malvacearumpollis bakonyensis* Nagy 1962; Acta Bot. Acad. Sci. Hung., Vol. 8, p. 159, pl. 5, fig. 13-14.

Diagnosis: "Large globular grains, the surface psilate and covered with spines in fairly regular, 8-14 μ large intervals, the spines are conical, tapering to acuminate tips, 6-12 μ long, rising on a bulging base."

(8) **Malvacearumpollis majus *sp. nov.*** 大型錦葵粉

"Grains pantoporate, 135 μ wide; exine 5-8 μ thick, with conical processes, the spines prominently dilated at basal part, 15 μ long."

Locality: Erhchiu, Sanhsia in the Erhchiu Formation.

Slide: 43-2R (Pl. 19: 1).

Taxonomic affinity: This species is similar to species of *Hibiscus* of Malvaceae (Huang 1972, Pl. 103: 8-9, Pl. 104: 1-4).

9. Cichoreacidites Sah 1967 擬菊苣粉屬

Type species: *Cichoreacidites spinosus* Sah 1967, Mus. Roy. Afrique Centre., Tervuren; Ann. in 8°, sci. geol., no. 57, p. 95, pl. 8, fig. 29.

Diagnosis: "Pollen grains fenestrate, usually with composite apertures; occasionally 3-zonaperturate, having ± lalongate ora; apertures situated in between lacuna; depressions and flanked by high bridges which form a polygonal pattern; amb subspheroidal to oblate-spheroidal: grains lophate, echinate, spines on the ridges, dupli-retipilariate, pila compactly arranged, usually forming a reticuloid pattern in surface view."

(9) **Cichoreacidites gracilis** (Nagy) Zheng *ex* Song Z. C. *et al.* 1985; A Research on Cenozoic Palynology of the Longjing Structural Area in the Shelf Basin of the East China Sea (Donghai) Region. Anhui Sci. Tech. Publ., p. 103 纖細擬菊苣粉

"Grains fenestrate (3-colporate), spheroidal to polygonal, 28-32 μ wide; exine echinolophate, exhibiting hexagonal arrangement of cristae (reticulations hexagonal), large reticulations composed of 12-14 small reticulations; muri with echini, echini 2.5-4 μ long."

Locality: Erhchiu, Sanhsia in the Erhchiu Formation.

Slide: 86-1R, 87-2R (Pl. 15: 12-13).

Taxonomic affinity: This species is similar to species of *Ixeris* and *Lactuca* of the compositae (Huang 1972, Pl. 40: 1-19, Pl. 41: 1-4).

10. Slowakipollis (Pacl.) Krtz. 1962 胡頹子粉屬

Type species: *Slowakipollis cechovici* (Pacl.) Krtz. 1962 Geologie, Jahrg. 11, no. 3, p. 273.

Diagnosis: "Grains tricolporate (amb more or less triangular); polar axis and equatorial diameter approx. equal in length; wall multiple layered, smooth or with weak structure; pole not or only slightly prominent."

Note: Morphologically closest in *Pentapollis* which differs in structure of wall and pores, in the length of the colpi and in other characters. Recent pollen of similar morphology are found in the Elaeagnaceae.

(10) **Slowakipollis cechovici** (Pacl.), ibid. 胡頹子粉

"Grains tricolporate; amb more or less triangular with convex sides, 27-30 μ wide; aperture vestibulum type, sexine smooth or finely reticulate."

Locality: Erhchiu, Sanhsia in the Erhchiu Formation.

Slide: 26-1R (Pl. 17: 10-11).

Taxonomic affinity: This species is similar to the species of Elaeagnaceae (Huang 1972, Pl. 61: 7-16)

11. Euphorbiacidites (Zaklinskaya) Li, Sung & Li, 1978 大戟粉屬

Type species: *Euphorbiacidites wallensensis* (Pflug) Li, Sung & Li 1978, Bull. Nanjing Institutue Geol. Palaeontol., Acad. Sin., No. 3.

Diagnosis: "Grains 3-colporate; pores lage and round; colpi reaching to the pole; prolate; sexine: surface view regularly reticulate; sectional view scabrate."

(11) **Euphorbiacidites formosus** Zheng 1985 *ex* Song Z. C. *et al.* A Research Cenozoic Palynology of the Longjing Structural Area in the Shelf Basin of the East China Sea (Songhai) Region. Anhui Sci Tech. Publ., P. 109-110. 美麗大戟粉

"Grains 3-colporate; prolate, 24-34×15-25 μ; colpi reaching to the pole; ora circular, medium-sized; sexine: surface view regularly reticulate; sectional view (muri) scabrate."

Locality: Erhchiu, Sanhsia in the Erhchiu Formation.

Slide: 2-2R (Pl. 16: 2-4).

Taxonomic affinity: This species is similar to the extant *Euphorbia tashiroi* Hayata of the Euphorbiaceae (Huang 1972, Pl. 67: 10-14).

12. Tricolporopollenites Pflug & Thomson, 1953 三溝孔粉屬

(12) **Tricolporopollenites rosaeformis** Zheng *ex* Song Z. C. *et al.* 1985; 薔薇型三溝孔粉

A Research on Cenozoic Palynology of Longjing Structural Area in the Shelf Basin of the East China Sea (Donghai) Region. Anhui Sci. Tech. Publ., p. 159.

"Grains 3-colporoidate; prolate to perprolate, 20-30×17-20 μ; colpi reaching to

the pole, sexine: surface view granulate to finely reticulate; sectional view scabrate."

Note: Differs from other *Tricolporopollenites* species with colporoidate furrows and arrangement of the granules (with some direction).

Locality: Erhchiu, Sanhsia in the Erhchiu Formation.

Slide: 2-1R, 21-5R, 2-4R, 26-1R (Pl. 16: 5-10).

Taxonomic affinity: This species is similar to the species of Euphorbiaceae (Huang 1972, Pl. 64: 22-34).

13. Graminidites Cookson 1947 *ex* Potonié 1960 禾草粉屬

Type species: *Graminidites media* Cookson 1947 *ex* Potonié 1960
1947 B. A. N. Z. A. R. E., Reps, ser. A, v. 2, pt. 8, p. 134.
1960 Synopsis III, p. III.

Diagnosis: "More or less spherical spores with one pore which is surrounded by an annulus; exine thin, finely granulate."

Note: Larger than *Sparganiaceaepollenites*, and with thinner and less sculpture exine, hence with more secondary folds.

(13) **Graminidites media** Cookson 1947 *ex* Potonié 1960; ibid. 中型禾草粉

"Grains much flattened, approximately circular in outline, with a diameter of 29-45 μ wide (holotype 42 μ wide) with one pore which is surrounded by an annulus; sexine finely granulate."

Locality: Erhchiu, Sanhsia in the Erhchiu Formation.

Slide: 2-4L (Pl. 21: 11).

Taxonomic affinity: This species is similar to species of the Gramineae (Huang 1972, pl. 171: 10-22).

(2) Checklist

I. Alete 無裂溝孢綱

1. *Corrusparis* Krutzch 1967 褶凸孢屬
   Corrusporis taiwanensis Huang & Huang 臺灣褶凸孢 (Pl. 1: 1-2)

II. Monolete 單裂溝孢綱

2. *Echinosporis* Krutzsch 1967 長刺單裂孢屬
   E. taiwanensis Huang 臺灣長刺單裂孢
3. *Gemmamonoletes* Pierce 1961 顆粒紋單裂孢屬
   G. formosensis Huang 寶島顆粒紋單裂孢 (Pl. 1: 4)
   G. oblongo-lunatus Huang 長月狀顆粒紋單裂孢 (Pl. 1: 5)
4. *Gemmatosporis* Krutzsch 1959 短棒紋單裂孢屬
   G. lato-apertus Huang 闊裂短棒紋單裂孢 (Pl. 1: 6)
   G. taiwanensis Huang 臺灣短棒紋單裂孢 (Pl. 1: 7)
5. *Laevigatosporites* Ibrahim 1933 平滑單裂孢屬
   L. gracilis Wilson & Webster 細小形平滑單裂孢 (Pl. 1: 8-9)
   L. reniformis Huang 腎形平滑單裂孢 (Pl. 1: 10)
   L. sexangulariformis Huang 六角形平滑單裂孢
   L. taiwanensis Huang 臺灣平滑單裂孢
   L. tenui-lunatus Huang 溝月形平滑單裂孢

6. *Perinomonoletes* Krutzsch 1967 外膜單裂孢屬
   P. lato-reticulatus Huang 巨網紋外膜單裂孢 (Pl. 2: 2)
7. *Schizaeosporites* Potonié 1951 *ex* Delcourt & Sprument 1935 莎草蕨孢屬
   S. taiwanensis Huang 臺灣莎草蕨孢
8. *Verrucatosporites* Pflug & Thomson 1953 半圓紋單裂孢屬
   V. balticoides Huang 玻羅的海半圓紋單裂孢
   V. balticoides Huang var. *minor* Huang 小玻羅的海半圓紋單裂孢
   V. lunatus Huang 月狀半圓紋單裂孢 (Pl. 2: 3)
   V. reniformis Huang 腎形半圓紋單裂孢

III. Triletes 三裂溝孢綱

9. *Anthocerisporis* Krutzsch 1963 角蘚孢屬
   A. formosensis Huang & Huang 寶島角蘚孢
   A. taiwanensis Huang & Huang 臺灣角蘚孢 (Pl. 1: 3)
10. *Cicatricosisporites* Potonié & Gelletich 1933 環肋孢屬
    C. australiensis (Cookson) Potonié 澳洲環肋孢
    C. taiwanensis Huang 臺灣環肋孢
11. *Cingulatisporites* Thomson in Thomson & Pflug 1953 整環孢屬
    C. taiwanensis Huang 臺灣整環孢
12. *Convolutispora* Holfmeister, Staplin & Malloy 1955 交錯圓紋三裂孢屬
    Convolutispora taiwaniana Huang 臺灣交錯圓條紋三裂孢
13. *Crassoretriletes* Germeraad, Hopping & Muller 1968 厚壁三叉裂孢屬
    C. vanraadshooveni G. H. M. 泛厚壁三叉裂孢 (Pl. 2: 7)
14. *Foveotriletes* Potonié 1956 孔紋三叉裂孢屬
    F. serratus Huang 石松孔紋三叉裂孢 (Pl. 3: 1)
15. *Leiotriletes* Naumova 1939 *ex* Ishchenlo 1952 平滑徑三裂孢屬
    L. ellipitus Huang 橢圓平滑徑三裂孢
    L. obovatus Huang 倒卵形平滑徑三裂孢 (Pl. 3: 5)
    L. sphaerotriangulus (L.) Potonié & Kremp 圓三角形平滑徑三裂孢
    L. taiwanensis Huang 臺灣平滑徑三裂孢
    L. wolffi Krutzsch 小烏氏平滑徑三裂孢 (Pl. 3: 2-4)
16. *Magnastriatites* Germeraad, Hopping & Muller 1968 水蕨孢屬
    M. grandiosus Duenas 大形水蕨孢
    M. howardii G. H. M. 侯瓦第水蕨孢 (Pl. 3: 7)
17. *Microreticulatisporites* Knox 1950 小網紋三裂孢屬
    M. taiwanensis Huang & Huang 臺灣小網紋三裂孢 (Pl. 3: 8-9)
18. *Osmundacites* Coupêr 1953 擬紫萁孢屬
    O. taiwanensis Huang 臺灣擬紫萁孢
19. *Polypodiaceoisporites* Potonié 1951 鳳尾蕨孢屬
    P. baculatus Huang 棒紋鳳尾蕨孢 (Pl. 4: 1)
    P. emarginatus Huang 凹角鳳尾蕨孢 (Pl. 4: 2-3)
    P. intrabalticus Huang 內玻羅的海鳳尾蕨孢 (Pl. 4: 4-6)
    P. venustus Huang 爪哇鳳尾蕨孢 (Pl. 4: 8-9)
    P. wallichianus Huang 瓦氏鳳尾蕨孢 (Pl. 4: 7)
20. *Pterisporis* Huang 1978 類鳳尾蕨孢屬
    P. concavus Huang & Huang 凹邊類鳳尾蕨孢 (Pl. 4: 10-11)
    P. taiwanensis Huang 臺灣類鳳尾蕨孢 (Pl. 4: 12)
21. *Retitriletes* Pierce 1961 厚網紋徑三裂孢屬
    R. taiwanensis Huang 臺灣厚網紋徑三裂孢

22. *Saxosporis* Krutzsch 1963 劍刺孢蕨屬
S. taiwanensis Huang & Huang 臺灣劍刺孢
23. *Semiretisporis* Reinhardt 1962 半網紋孢屬
S. taiwanensis Huang & Huang 臺灣半網紋孢 (Pl. 5: 1)
24. *Sphaerina* Maljavkina 1949 *ex* Delcourt & Sprumont 1959 突刺孢屬
S. taiwanensis Huang & Huang 臺灣突刺孢
25. *Toricingulatisporites* Simonesies 1964 向心面脊整環孢屬
T. taiwanensis Huang 臺灣向心面脊整環孢 (Pl. 5: 2)
26. *Toroisporis* Krutzsch 1959 向心面脊三叉孢屬
T. taiwanensis Huang 臺灣向心面三叉孢 (Pl. 5: 3-4)
27. *Triplanosporites* Pflug in Thomson & Pflug 楊桃形三叉裂孢屬
T. magnus Shaw & Huang 大楊桃形三叉裂孢
T. medius Shaw & Huang 中楊桃形三叉裂孢 (Pl. 2: 5)
T. minor Shaw & Huang 小楊桃形三叉裂孢 (Pl. 2: 4)

IV. Incertae 未定孢綱

28. *Monogemmites* Krutzsch 1970 錐刺單口孢粉屬
M. formosensis Huang & Huang 寶島錐刺單口孢粉
M. taiwanensis Huang & Huang 臺灣錐刺單口孢粉 (Pl. 2: 1)
29. *Schizosporis* Cookson & Dettmann 1959 半裂圓孢粉屬
S. taiwanensis Huang 臺灣半裂圓孢粉 (Pl. 13: 1)

V. Gymnospermous pollen grains

1. *Cycadopites* Wodehouse 1933 蘇鐵狀粉屬 (*Cycas* or *Ginkgo*)
C. ellipticus Huang 橢圓形蘇鐵狀粉 (Pl. 5: 5-6)
C. gracilis Krutzsch 常見蘇鐵狀粉 (Pl. 5: 7-8)
2. *Psophosphaera* Naumova 1939 *ex* Ishchenlo 1952 皺球粉屬
Psophosphaera chuchuangkeniana Chaw & Huang 出磺坑皺球粉 (Pl. 7: 2)
3. *Classopollis* Pflug 1953 內環粉屬
C. taiwanensis Huang 臺灣內環粉 (Pl. 5: 9-11)
4. *Abiespollenites* Thiergart in Raatzz (1937) 1938 冷杉粉屬 (*Abies*)
A. formosensis Huang 臺灣冷杉粉 (Pl. 8: 2)
A. oblongus Huang 橫長體冷杉粉 (Pl. 7: 5, Pl. 8: 1)
5. *Keteleeriaepollenites* Huang 1979 油杉粉屬 (*Keteleeria*)
K. tainwanensis Huang 臺灣油杉粉 (Pl. 9: 1-2)
6. *Longicorpuspollenites* Huang 1979 縱長體杉粉屬
L. taiwanensis Huang 臺灣縱長體杉粉 (Pl. 7: 1)
7. *Piceapollis* Krutzsch 1971 雲杉粉屬 (*Picea*)
P. acutosaccatus Huang 宏囊雲杉粉 (Pl. 10: 1-2)
8. *Pityosporties* Seward 1914 松粉屬 (*Pinus*)
P. acutus Huang 銳體松粉 (Pl. 11: 1-2)
P. massoniana Huang 馬尾松粉 (Pl. 11: 3-4)
P. morrisonicola Huang 玉山松粉 (Pl. 11: 5-6)
P. oblongus Huang 橫長體松粉 (Pl. 11: 7-8)
P. scabratus Huang 波緣體松粉 (Pl. 12: 1-2)
P. triangulatus Huang 三角體松粉 (Pl. 12: 3-4)
9. *Zonalapollenites* Pflug in Thomoson & Pflug 1953 環翼鐵杉粉屬 (*Tsuga*)
Z. chinensis Huang 中國環翼鐵杉粉 (Pl. 13: 2)
Z. taiwanensis Huang 臺灣環翼鐵杉粉 (Pl. 13: 3)

10. *Dacrydiumites* Cookson 1955 *ex* Harris 1965 陸均松粉屬 (*Podocarpus*)
    D. magnus Huang & Huang 巨型陸均松粉 (Pl. 6: 4-5)
    D. taiwanensis Huang 臺灣陸均松粉 (Pl. 6: 1-3)
11. *Podocarpidites* Cookson *ex* Couper 1953 羅漢松粉屬 (*Podocarpus*)
    P. beugii Huang 波義羅漢松粉 (Pl. 6: 6-7)
    P. conjunctus Huang & Huang 連結羅漢松粉
    P. taiwanensis Huang 臺灣羅漢松粉 (Pl. 6: 8-9)
12. *Ephedripites* Seward 1914 麻黃粉屬 (*Ephedrus*)
    E. ellipticus Huang 橢圓麻黃粉 (Pl. 5: 12-13)
    E. multus Huang & Huang 多肋麻黃粉
    E. tertiarius Krutzsch 第三紀麻黃粉 (Pl. 5: 15-16)
    E. taiwanensis Huang 臺灣麻黃粉 (Pl. 5: 14)

VI. Angiospermous pollen grains

1. *Aceripollis* Huang 1980 槭樹粉屬 (Aceraceae)
   A. taiwanensis Huang 臺灣槭樹粉 (Pl. 14: 3-4)
2. *Hypoestespollenites* Li & Huang 1989 槍刀菜粉屬 (Acanthaceae)
   H. taiwanensis Li & Huang 臺灣槍刀菜粉 (Pl. 14: 1-2)
3. *Tricolpopollenites* Pflug & Thomson in Thomson & Pflug 1953 三溝粉 (Aizoaceae)
   T. ellipticus Huang 橢圓三溝粉
   T. elongatus Huang 長形三溝粉
4. *Trachelospermumpollenites* Huang & Huang 絡石粉屬 (Apocynaceae)
   T. taiwanensis Huang & Huang 臺灣絡石粉
5. *Ilexpollenites* Thiergart 1937 *ex* Potonié 1960 冬青粉屬 (Aquifoliaceae)
   I. asprella Huang 燈稱冬青粉 (Pl. 14: 5-6)
   I. kusanoi Huang 粗紋冬青粉 (Pl. 14: 7-8)
6. *Impatiensidites* Sah 1967 鳳仙花粉屬 (Balsaminaceae)
   I. taiwanensis Li & Huang 臺灣鳳仙花粉 (Pl. 14: 10-11)
7. *Alnusalispollenites* Huang 1980 三孔桤木粉屬 (Betulaceae)
   A. taiwanensis Huang 三孔桤木粉
8. *Carpinipites* Srivastava 1966 千金榆粉屬 (Betulaceae)
   C. taiwanensis Huang 臺灣千金榆粉
9. *Myricaceoipollenites* Potonié 1951 *ex* Potinié 1960 榛木類粉屬 (Betulaceae)
   M. megagranifer (Potonie) Potonié 榛木類粉 (Pl. 14: 17)
10. *Alnipollenites* Potonie 1932 *ex* Potonié 1960 桤木粉屬 (Betulaceae)
    A. formosensis (Huang) Huang 臺灣桤木粉 (Pl. 15: 1-5)
11. *Triporopollenites* Pflug & Thomson in Thomson & Pflug 1953 三孔粉屬 (Betulaceae)
    T. coryloides Pflug 榛木粉 (Pl. 14: 14-16)
    T. coryloides var. *abnormalis* Huang 變形榛木粉 (Pl. 14: 12-13)
12. *Trivestibulopollenites* Pflug in Thomson & Pflug 1953 三腔粉屬 (Betulaceae)
    T. taiwanensis Huang 臺灣三腔粉 (Pl. 15: 6)
13. *Chenopodiopollis* Krutzsch 1966 藜粉屬 (Chenopodiaceae)
    C. taiwanensis Huang 臺灣藜粉 (Pl. 15: 8-9)
14. *Artemisiaepollenites* Nagy 1969 茵陳蒿粉屬 (Compositae)
    A. annus Huang & Huang 茵陳蒿粉 (Pl. 15: 10-11)
15. *Cichorieacidites* Sah 1967 刀傷草粉屬 (Compositae)
    C. gracilis (Nagy) Zheng 刀傷草粉 (Pl. 15: 12-13)

16. *Dichrocephalapollenites* Huang 1980 豕草粉屬 (Compositae)
    D. taiwanensis Huang 臺灣豕草粉
17. *Evolvuluspollenites* Li & Huang 1989 土丁桂粉屬 (Convolvulaceae)
    E. taiwanensis Li & Huang 臺灣土丁桂粉 (Pl. 15: 14)
18. *Tricopopollenites* Pflug & Thomson in Thomson & Pflug 1953 三溝粉屬 (Crucifera)
    T. morrisonensis Huang & Huang 玉山芥菜粉
19. *Rousea* Srivastava 1969 青牛膽粉屬 (Curcubitaceae)
    R. taiwaniana Li & Huang 臺灣青牛膽粉 (Pl. 15: 16-17)
20. *Daphniphyllumpollenites* Huang 1980 交讓木粉屬 (Daphniphyllaceae)
    D. ignotus Huang 擬交讓木粉
    D. oldhamii Huang 交讓木粉 (Pl. 15: 15)
21. *Slowakipollis* Krutzsch 1962a 胡頹子粉屬 (Elaeagnaceae)
    S. cechovini (Pacl.) Krutzsch 胡頹子粉 (Pl. 17: 10-11)
    S. taiwanensis Huang & Huang 臺灣胡頹子 (Pl. 17: 12-14)
22. *Elaeocarpollenites* Huang 1980 杜英粉屬 (Elaeocarpaceae)
    E. taiwanensis Huang 臺灣杜英粉 (Pl. 16: 1)
23. *Euphorbiacidites* (Zakl.) Li, Sung & Li 1978 大戟粉屬 (Euphorbiaceae)
    E. formosus Zheng 美麗大戟粉 (Pl. 16: 2-4)
24. *Tricolporopollenites* Pflug & Thomson in Thomson & Pflug 1953 三溝孔粉屬 (Euphorbiaceae)
    T. rosaeformis Zheng 薔薇型三溝孔粉 (Pl. 16: 5-10)
    T. taiwanensis Huang 臺灣三滯孔粉 (Pl. 16: 11)
25. *Wilsonipites* Srivastava 1969 蓖麻粉屬 (Euphorbiaceae)
    W. communis Huang & Huang 蓖麻粉
26. *Tricolporopollenites* Pflug & Thomson in Thomson & Pflug 1953 三滯孔粉 (Fagaceae)
    T. amygdalifolius Huang 校力粉 (Pl. 16: 21-23)
    T. minus Huang 細體校力粉 (Pl. 16: 17-19)
    T. perprolatus Huang 長體校力粉 (Pl. 16: 20)
    T. scabratus Huang 波體校力粉
    T. subprolatus Huang (Pl. 16: 13-16)
    T. uraiensis Huang 烏來柯粉 (Pl. 16: 24-26)
27. *Quercipollenites* Wolff 1934 麻櫟粉屬 (Fagaceae)
    Q. glabratus Huang 麻櫟粉 (Pl. 16: 27-28)
28. *Peripollenites* Pflug & Thomson in Thosom & Pflug 1953 楓樹粉屬 (Hamamelidaceae)
    P. formosensis Huang 臺灣楓樹粉 (Pl. 20: 2-4)
    P. minus Huang 微體楓樹粉 (Pl. 20: 1)
29. *Caryapollenites* Raatz (1973) 1938 *ex* Potonié 1960 山核桃粉屬 (Juglandaceae)
    C. taiwanensis Huang & Huang 臺灣山核桃粉 (Pl. 16: 30)
30. *Engelhardtioipollenites* Potonié 1951 *ex* Potonié 1960 黃杞粉屬 (Juglandaceae)
    E. taiwanensis Huang & Huang 臺灣黃杞粉 (Pl. 16: 29)
31. *Juglanspollenites* Raatz 1939 胡桃粉屬 (Juglandaceae)
    J. taiwanensis Huang 臺灣胡桃粉 (Pl. 16: 31-32)
32. *Polyatriopollenites* Pflug 1953 楓楊粉屬 (Juglandaceae)
    P. taiwanensis Huang 臺灣楓楊粉 (Pl. 15: 7)
33. *Paraphlomipollenites* Huang & Huang 1984 舞子草粉屬 (Labiatae)
    P. taiwanensis Huang & Huang 臺灣舞子草粉 (Pl. 17: 6-7)

34. *Retihexacolpites* Mathur 1966 鼠尾草粉屬 (Labiatae)
R. taiwanensis Huang & Huang 鼠尾草粉
35. *Retitricolpites* Van der Hammen *ex* Pierce 1961 網面三溝粉屬
R. taiwanensis Li & Huang 臺灣網面三溝粉 (Pl. 17: 1-5)
36. *Assamialetes* Huang & Huang 1984 灰莉粉屬 (Loganiaceae)
A. taiwanensis Huang & Huang 臺灣灰莉粉 (Pl. 17: 8-9)
37. *Magnolipollis* Krutzsch 1970 木蘭粉屬 (Magnoliaceae)
M. longiformis Huang 長型木蘭粉 (Pl. 18: 10)
M. taiwanensis Huang 臺灣木蘭粉 (Pl. 18: 1-9)
38. *Malvacearumpollis* Nagy 1962 錦葵粉屬 (Malvaceae)
M. majus Li & Huang 大型錦葵粉 (Pl. 19: 1)
39. *Pericampyluspollenites* Huang 1980 蓬萊藤粉屬 (Menispermaceae)
P. formosensis Huang 1980 臺灣蓬萊藤粉
40. *Triatriopollenites* Pflug in Thomson & Pflug 1953 楊梅粉屬 (Myricaceae)
T. taiwanensis Huang 臺灣楊梅粉 (Pl. 18: 13-14)
41. *Myrtaceidites* Cookson & Pike 1954 桃金孃粉屬 (Myrtaceae)
M. taiwanensis Huang 臺灣桃金孃粉 (Pl. 18: 15-16)
42. *Polygonacidites* Sah & Dutta 1968 蓼粉屬 (Polygonaceae)
P. densoreticulatum Huang 突網蓼粉 (Pl. 20: 5-8)
P. vulgaris Huang 常見蓼粉 (Pl. 20: 9-10)
43. *Portulacapollenites* Li & Huang 1989 馬齒莧粉屬 (Portulacaceae)
P. taiwanensis Li & Huang 臺灣馬齒莧粉 (Pl. 20: 12)
44. *Galiumpollenites* Li & Huang 1989 豬殃殃粉屬 (Rubiaceae)
G. taiwanensis Li & Huang 臺灣豬殃殃粉 (Pl. 20: 11)
45. *Margoaperturates* Huang 1984 厚口緣粉屬 (Rubiaceae)
M. taiwanensis Huang & Huang 蛇根草粉 (Pl. 21: 1-2)
46. *Rutaceoipollenites* Sun 1978 芸香粉屬 (Rutaceae)
R. taiwanensis Huang & Huang 臺灣芸香粉 (Pl. 20: 13-16)
47. *Tricolporopollenites* Pflug & Thomson in Thomson & Pflug 1953 三溝孔粉屬 (Saxifragaceae)
T. asper Huang & Huang 繡球粉 (Pl. 18: 11-12)
48. *Symplocacites* Mtchedlishvili in Samollovich & Mtchedlishvili 1961 灰木粉屬 (Symplocaceae)
S. caudata Huang 尾葉灰木粉 (Pl. 21: 3-4)
S. modesta Huang 小葉灰木粉
49. *Tiliaepollenites* Potonié 1931 田麻粉屬 (Tiliaceae)
T. taiwanensis Huang 臺灣田麻粉 (Pl. 21: 5-7)
50. *Zelkovaepollenites* Nagy 1969 鷄油粉屬 (Ulmaceae)
Z. taiwanensis Huang 鷄油粉
51. *Tricolporopollenites* Pflug & Thomson in Thomson & Pflug 1953 三溝孔粉屬 (Vitaceae)
T. repens Huang 虎葛粉 (Pl. 16: 12)
52. *Graminidites* Cookson 1974 *ex* Potonié 1960 禾草粉屬 (Gramineae)
G. glabratus Huang 光體禾草粉 (Pl. 21: 12-14)
G. media Cookson *ex* Potonié 中型禾草粉 (Pl. 21: 11)
53. *Arecipites* Wodehouse 1933 山棕粉屬 (Palmaceae)
A. taiwanensis Huang 臺灣山棕粉 (Pl. 21: 8)
54. *Couperipollis* Venkatachala & Kar 1969 刺棕粉屬 (Palmaceae)
C. taiwanensis Huang & Huang 臺灣刺棕粉

55. *Monosulcites* Cookson *ex* Couper 1953 椰子粉屬 (Palmaceae)
M. taiwanensis Huang 臺灣椰子粉 (Pl. 21: 9)
56. *Eucomidites* Erdtman 1948 *ex* Potonié 1958 不齊滯粉屬
E. taiwanensis Huang 臺灣不齊滯粉 (Pl. 21: 10)
57. *Neotriangulipollis* Goczan, Groot & Krutzsch in Goczan, Groot, Krutzsch & Pacltova 1967 新三角粉屬
N. taiwanensis Huang & Huang 臺灣新三角粉
58. *Riestediipollis* Krutzsch 1969 雷斯太德粉屬
R. polycolpites Krutzsch 雷斯太德粉

CONCLUSION

The *Tricolporopollenites* pollen, having affinity with the living Fagaceae, are dominated in angiosperms pollen, occuping about 35 per cent of the total palynomorphs and 53 per cent of the the angiosperms pollen. The *Pityosporites* pollen, having affinity with the living *Pinus* species, are domiated in gymnosperms pollen, occuping about 9.5 per cent of the total palynomorphs and 55 per cent of the gymnosperms pollen.

ACKNOWLEDGMENTS

The authors are grateful to Mr. S. F. Huang, K. C. Yang and Miss S. J. Chen, for their help in the field; to Miss F. Y. Chen for her help with pollen identification. We also want to thank Mr. C. L. Shaw for help in the disaggregation of rock samples.

LITERATURE CITED

BROWN, C. A., 1967. Palynological techniques. Baton Rouge, La. 188 pp.

CHUNG, T. F. and T. C. HUANG, 1972. Paleoecological study of Taipei Basin (1) Taipei botanical garden. *Taiwania*, **17**(2): 117-141.

HUANG, C. L. and T. C. HUANG, 1984. Pliocene pollen analysis of Taiwan: Yunshuichi section. *Taiwania*, **29**: 15-110.

HUANG, T. C., 1972. Pollen flora of Taiwan. Botany Department, NTU, Taipei, 297 pp.

———, 1978a. Miocene palynomorphs of Taiwan (1) Pteridaceae and schizaeaceae. *Bot. Bull. Academia Sinica*, **19**: 13-1.

———, 1978b. Miocene palynomorphs of Taiwan (3) Spores. *Taiwania*, **23**: 7-55.

———, 1979. Miocene palynomorphs of Taiwan (4) Gymnospermous grains. *Taiwania*, **24**: 81-105.

———, 1980. Miocene palynomorphs of Taiwan (5) Angiospermous grains. *Taiwania*, **25**: 57-103.

———, 1981. Spores flora of Taiwan. Privately published, Taipei, 114 pp.

——— and C. H. TSOU, 1984. Pollen analysis of Taiwan pliocene (1) Chuhuangkeng section. *Taiwania*, **29**: 1-14.

JANSONIUS, J. and L. V. HILLS, 1976. Genera file of fossil spores. Geology Department, University of Calgary, Canada.

NAKAMURA, J., 1984. Diagnostic characters of pollen grains of Japan. Special publications from the Osaka Museum of National History, Vol. 13, 91 pp.

SHAW, C. L., 1984. Fossil sporomorphs of some anthocerotaceae in the plio-pleistocene of south Taiwan. *Yushania*, **1**(3): 17-28.

———, 1985. The plio-pleistocene palynomorphs from Kuanmiao section, south Taiwan. *J. Taiwan Museum*, **38**(1): 53-74.

SONG, Z.C., X.T. GUAN, Z.R. LI, Y.H. ZHENG, W.M. WANG and Z.H. HU, 1985. A research on cenozoic palynology of the Longjing structural area in the shelf basin of the east China sea (Donghai) region. Anhui Science Tech. Pub. House. 209 pp.
TRAVERSE, A., 1988. Paleopalynology. Allen & Unwin Inc., Mass., U.S.A., 491 pp.

臺灣北部三峽地區上新世早期二鬮層底部孢粉羣誌

李麗秋　黃增泉

摘　要

本文著重於分析古植物社會之組成，而以沉積環境之研究，來探討上新世早期三峽地區二鬮層底部之古生態環境，將以另文報告。

分析本地區之孢粉化石植物羣，發現此孢粉化石組合，被子植物化石花粉佔65.7%，裸子植物化石花粉佔17.2%，苔蘚與蕨類植物化石孢子佔17.1%。

於此孢粉組合中，發現了四個新屬，八個新種及五個新記錄種。新發現之八個新種中，除了臺灣網面三溝粉及大型錦葵粉不能確定其性狀外，其餘六種爲具草本性狀植物科羣之花粉化石。

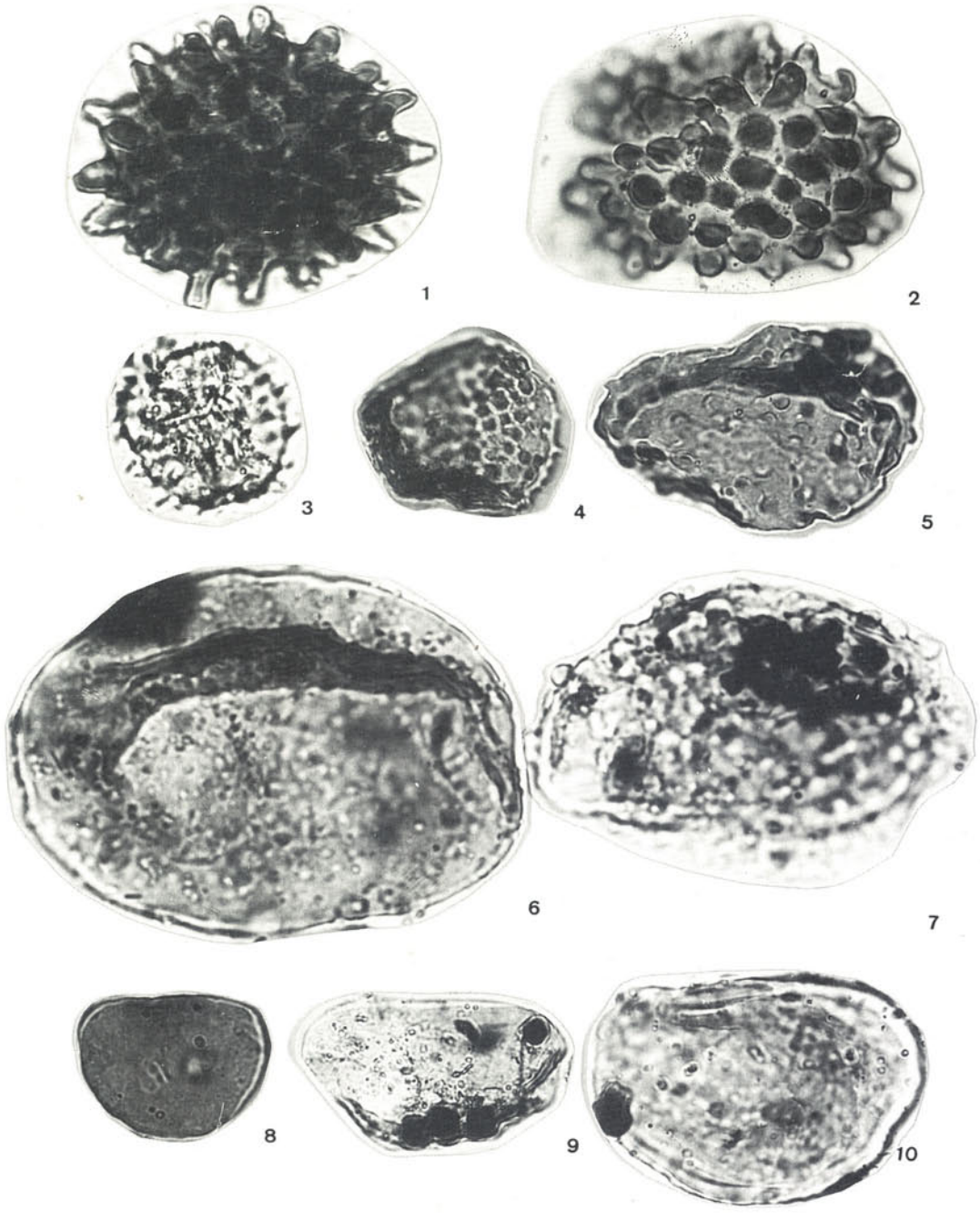


Plate 1. All figures, ×1000.

1-2. *Corrusporis taiwanensis* Huang & Huang (2-2L, 64-R); 3. *Anthocerisporis taiwanensis* Huang & Huang (6-3L); 4. *Gemmamonoletes formosensis* Huang (2-5L); 5. *G. oblongo-lunatus* Huang (53-2R); 6. *Gemmatosporis lato-apertus* Huang (6-2R); 7. *G. taiwanensis* Huang (16-2R); 8-9. *Laevigatosporites gracilis* Wilson & Webster (53-2R, 69-2R); 10. *L. reniformis* Huang (16-1R).

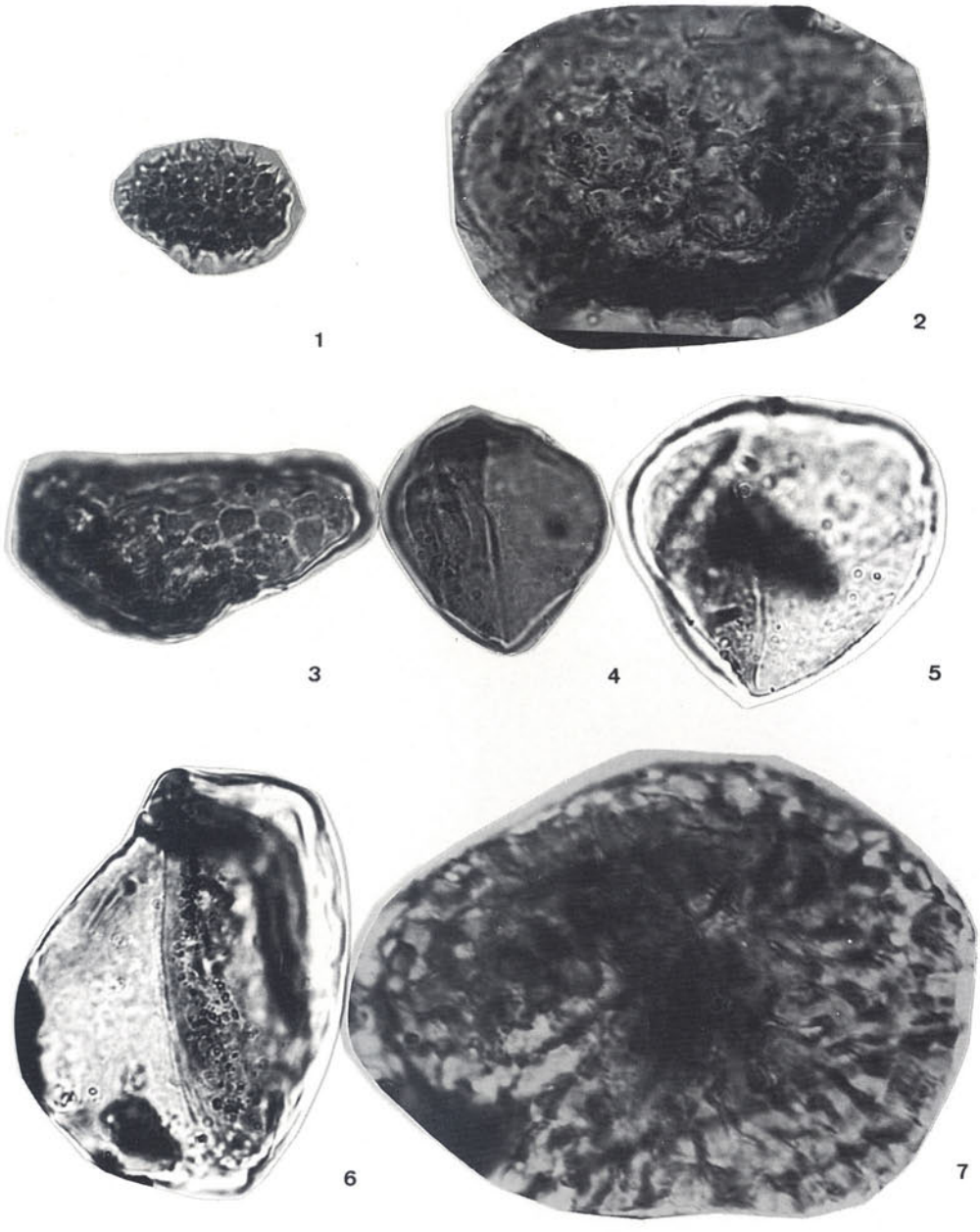


Plate 2. All figures, ×1000.

1. *Monogemmites taiwanensis* Huang & Huang (57-2L); 2. *Perinomonoletes latoreticulatus* Huang (2-5R); 3. *Verrucatosporites lunatus* Huang (16-1L); 4. *Triplanosporites minor* Shaw & Huang (26-1R); 5. *T. medius* Shaw & Huang (6-6R); 6. *T. magnus* Shaw & Huang (6-4R); 7. *Crassoretitriletes vanraadshooveni* G. H. M. (6-2R).

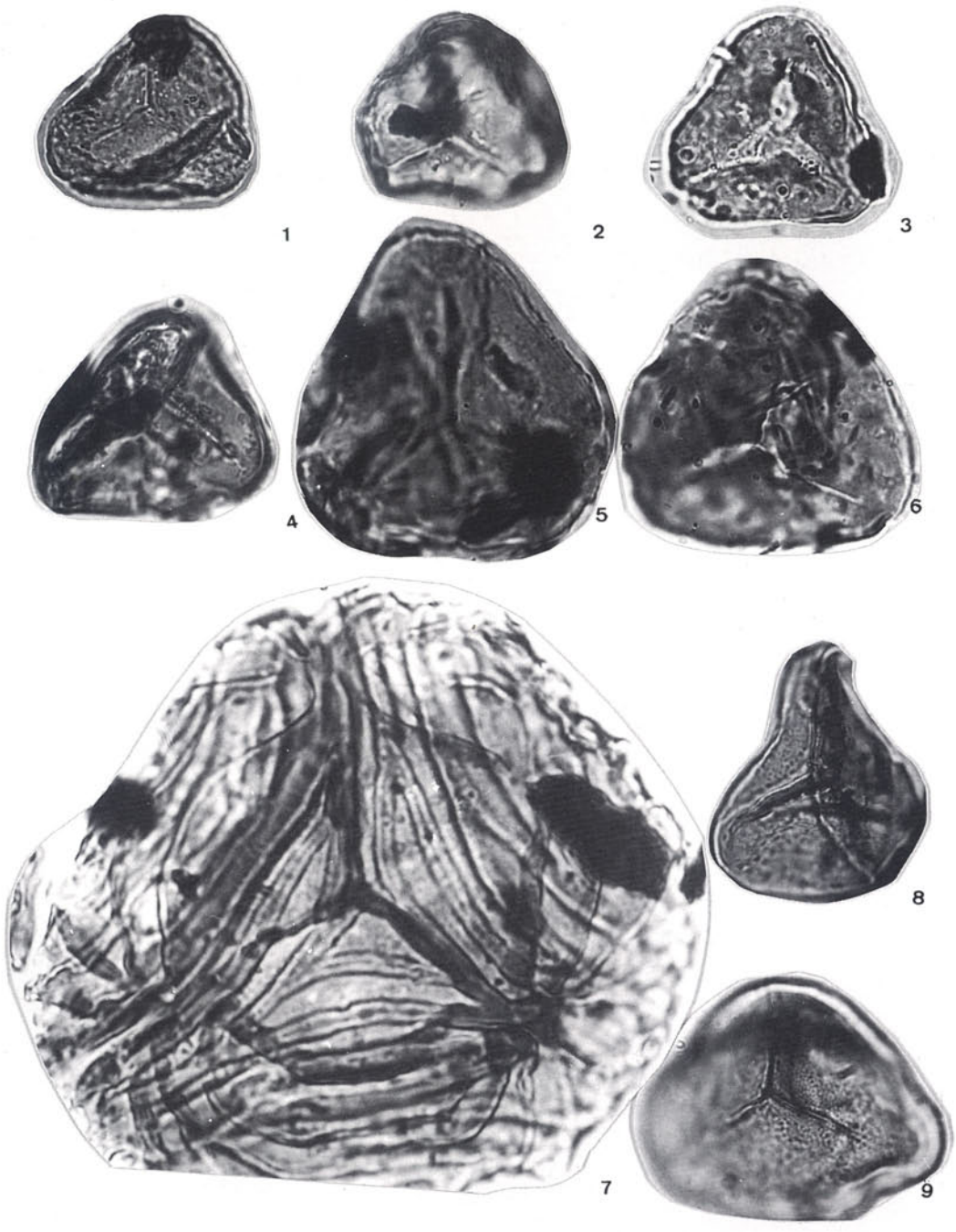


Plate 3. All figures, ×1000.

1. *Foveotriletes serratus* Huang (57-2L); 2-4. *Leiotriletes wolffi* Kr. (16-2R, 1-1R, 2-2L); 5. *L. obovatus* Huang (6-2R); 6. *L. sphaerotriangulus* (L.) Potonié & Kremp (6-5R); 7. *Magnastriatites howardii* G.H.M. (53-5R); 8-9. *Microreticulatisporites taiwanensis* Huang & Huang (6-2R, 64-7R).

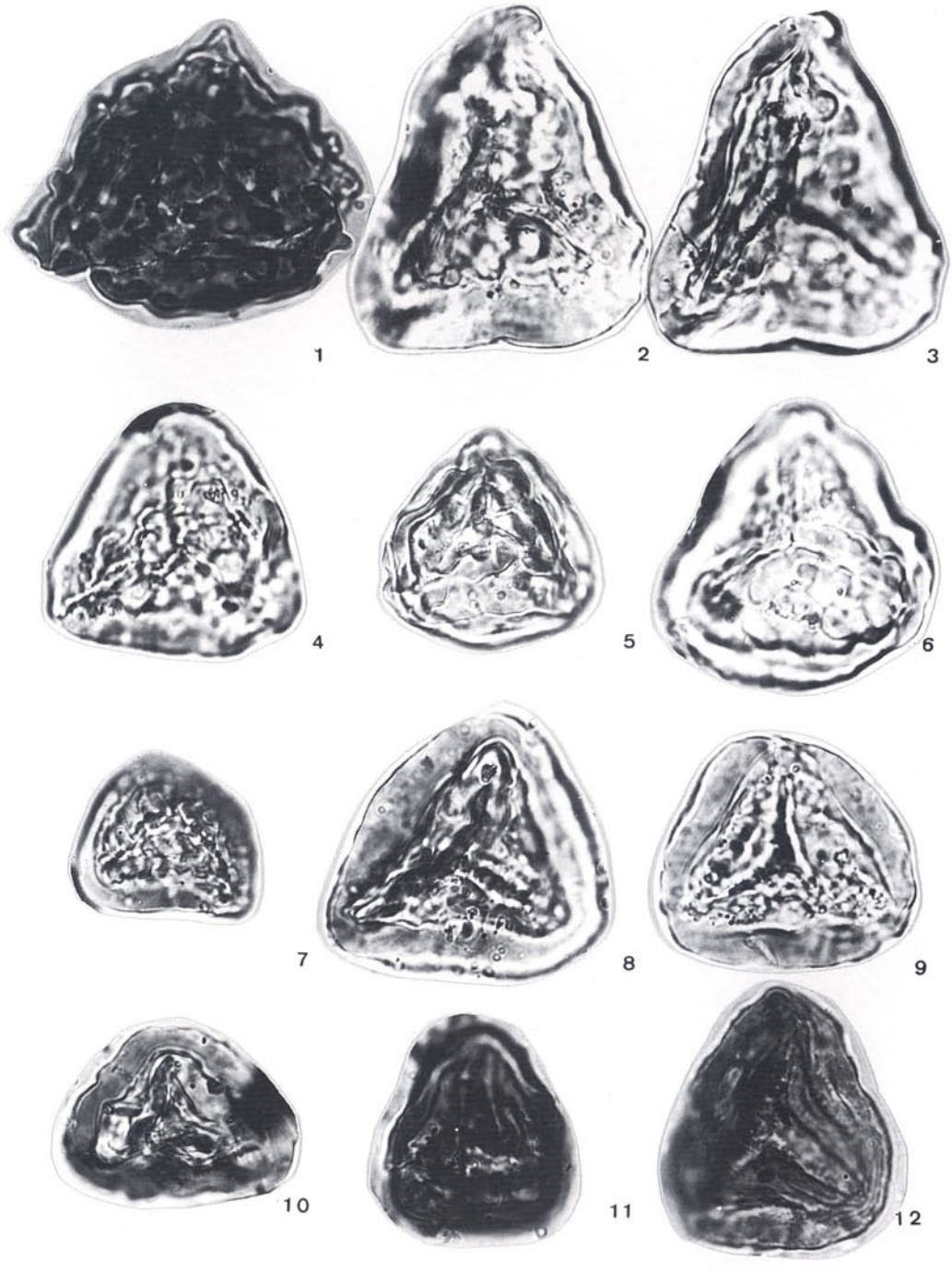


Plate 4. All figures, ×1000.

1. *Polypodiaceoisporites baculatus* Huang & Huang (6-3R); 2-3. *P. emarginatus* Huang (6-6R); 4-6. *P. intrabaticus* Huang (6-3R, 91-3R, 6-6R); 7. *P. wallichianus* Huang (64-3R); 8-9. *P. venustus* Huang (6-6R, 6-3R); 10-11. *Pterisporis concavus* Huang (6-5R, 2-1R); 12. *P. taiwanensis* Huang (16-7R).

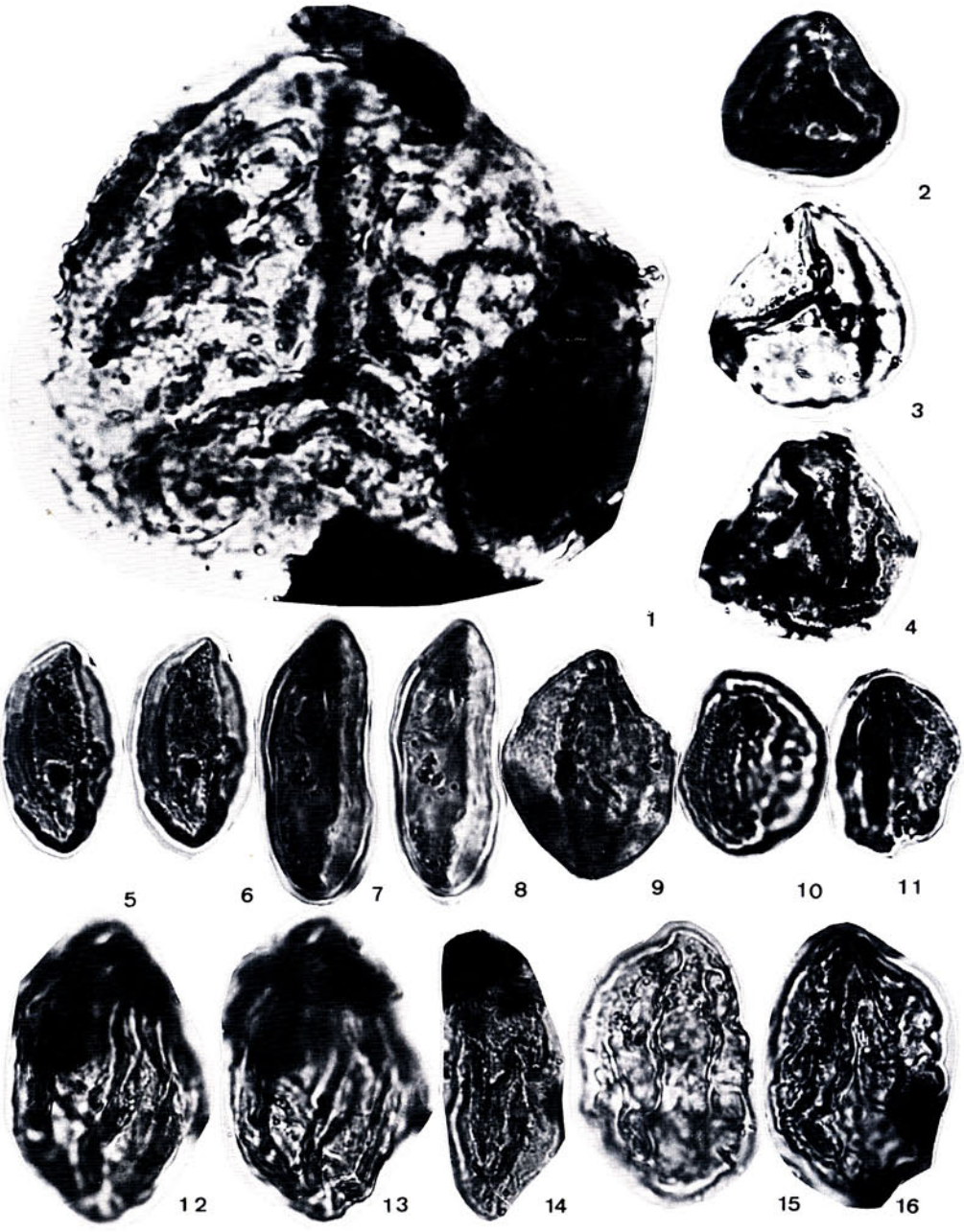


Plate 5. All figures, ×1000.

1. *Semioretisporis taiwanensis* Huang & Huang (6-5R); 2. *Toricingulatisporites taiwanensis* Huang (6-5); 3-4. *Toroisporis taiwanensis* Huang (6-5R, 2-1R); 5-6. *Cycadopites ellipticus* Huang (16-5L); 7-8. *C. gracilis* Krutzsch (16-5L); 9-11. *Classopollis taiwanensis* Huang (6-2R, 6-6R, 6-2R); 12-13. *Ephedripites ellipticus* Huang (2-2L); 14. *E. taiwanensis* Huang (21-2L); 15-16. *E. tertiarius* Krtz. (16-10R, 21-5L).

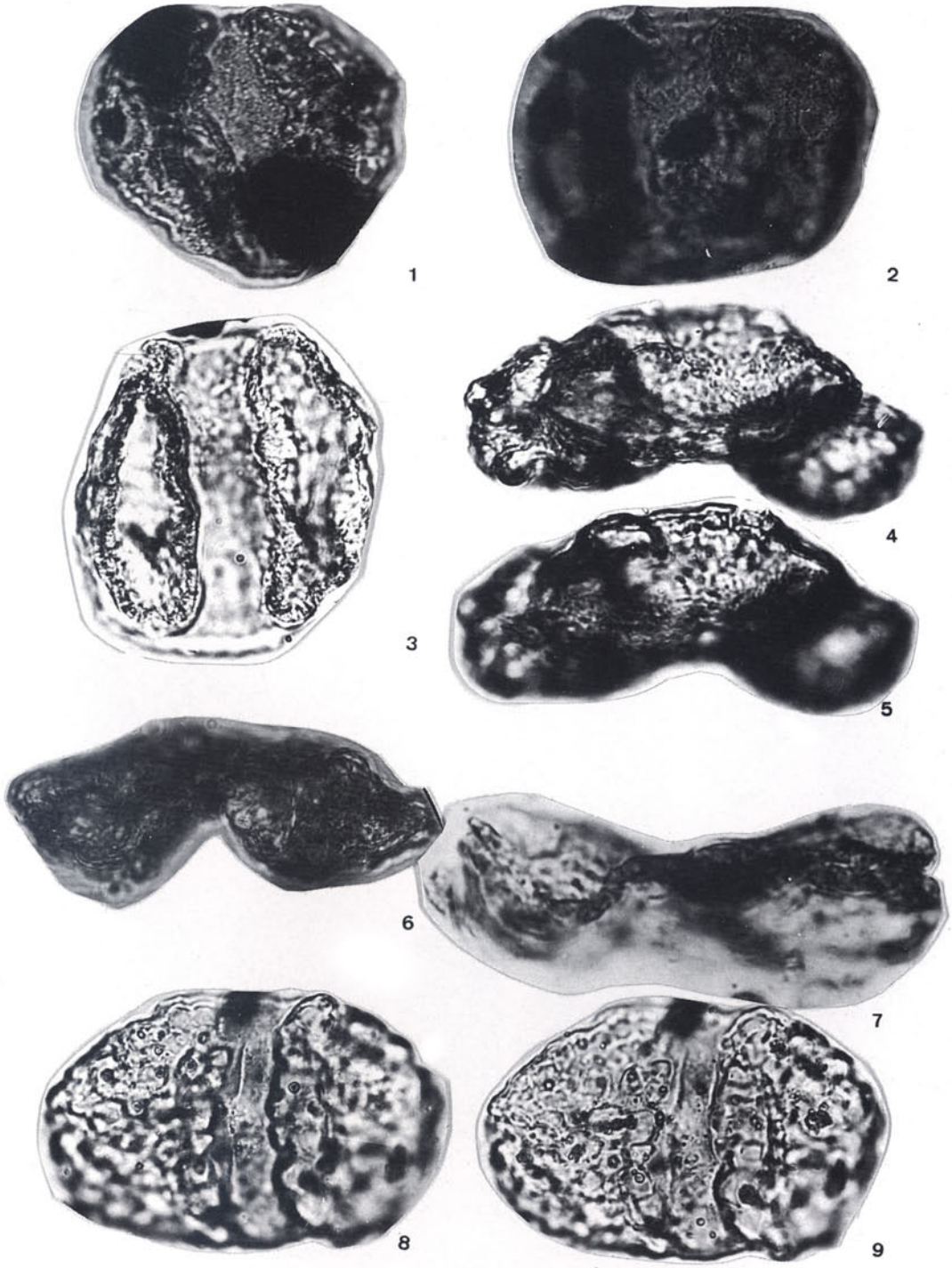


Plate 6. All figures, ×1000.

1-3. *Dacrydiumites taiwanensis* Huang (16-2R, 2-2R, 6-5); 4-5. *D. magnus* Huang & Huang (6-3R); 6-7. *Podocarpidites beugii* Huang (16-L, 6-5R); 8-9. *P. taiwanensis* Huang (6-5R).

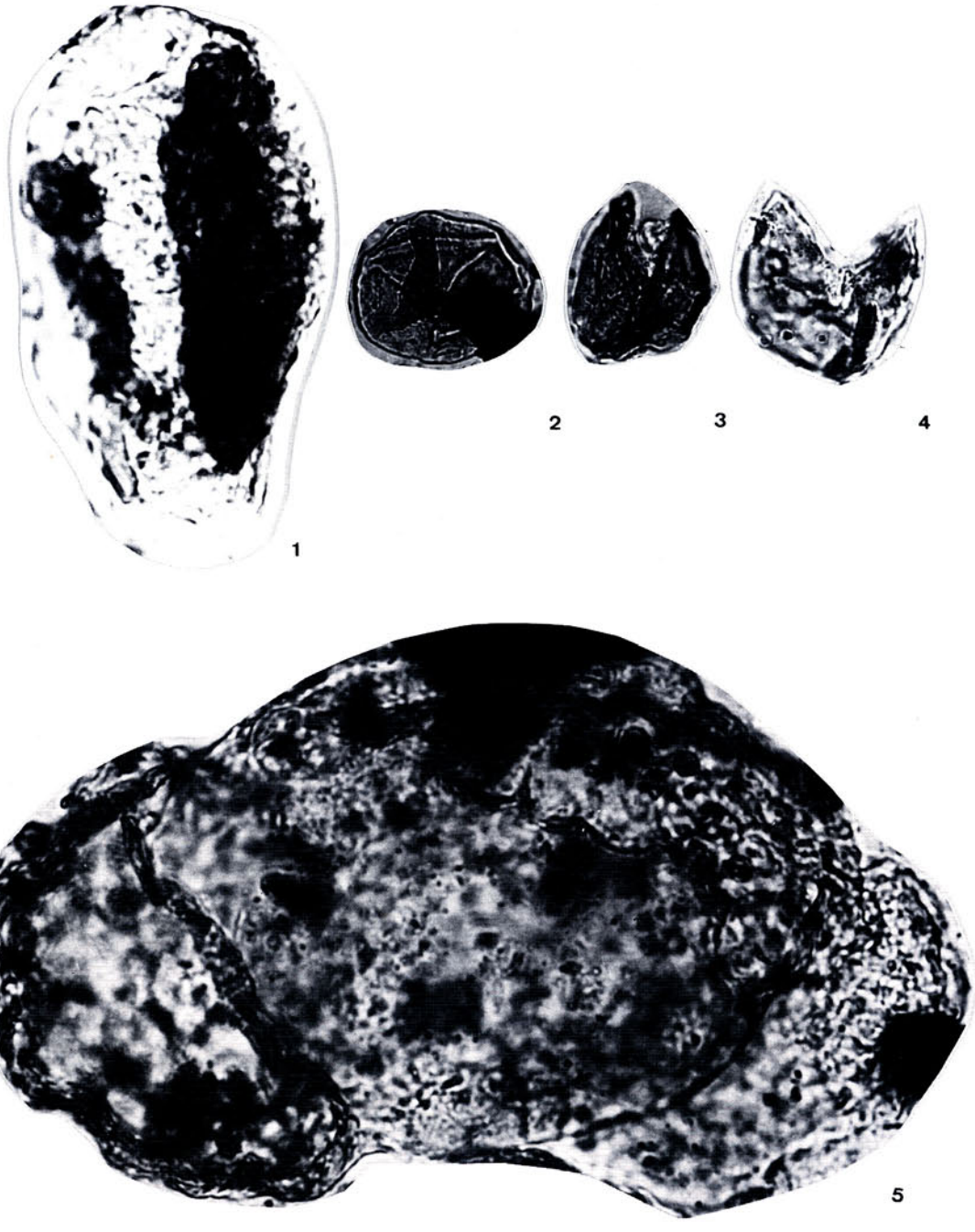
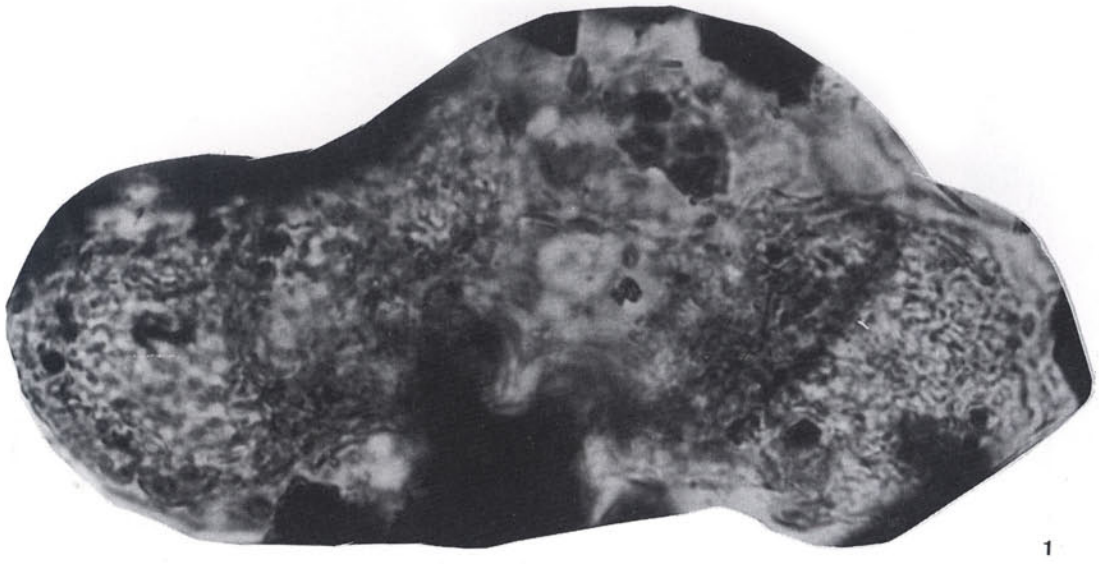


Plate 7. All figures, ×1000.

1. *Longicorpuspollenites taiwanensis* Huang (6-2R); 2. *Psophosphaera chuhuangkeniana* Chaw & Huang (66-7L); 3-4. Taxodiaceae-Cupressaceae-Taxaceae (106-7R, 16-8L); 5. *Abiespollenites oblongus* Huang (90-6L).



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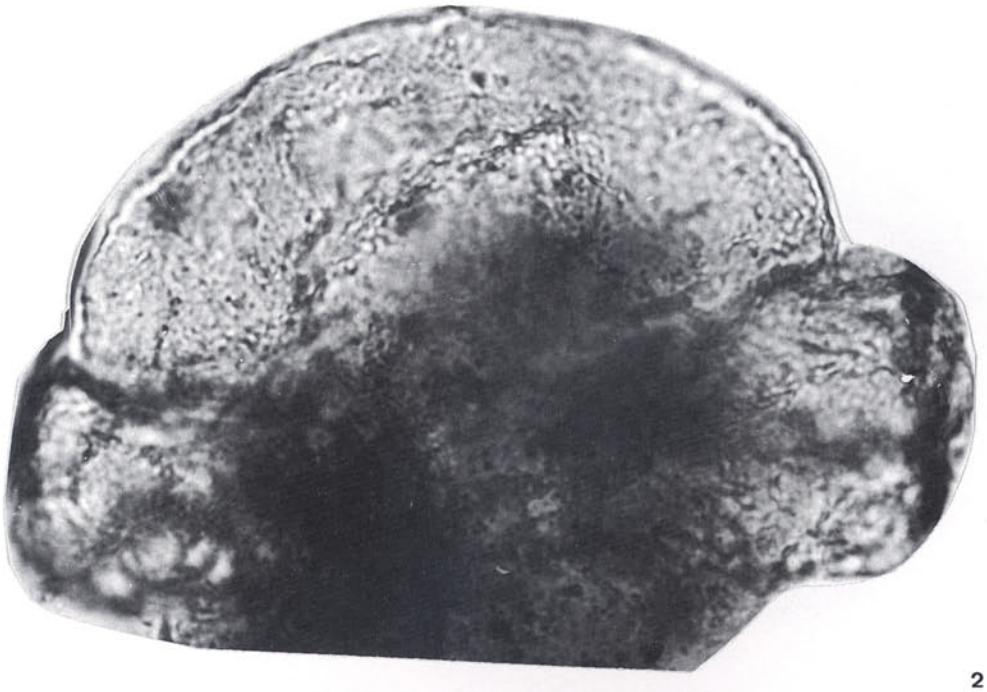

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Plate 8. All figures, ×1000.

1. *Abiespollenites oblongus* Huang (16-7R); 2. *A. formosensis* Huang (90-3R).

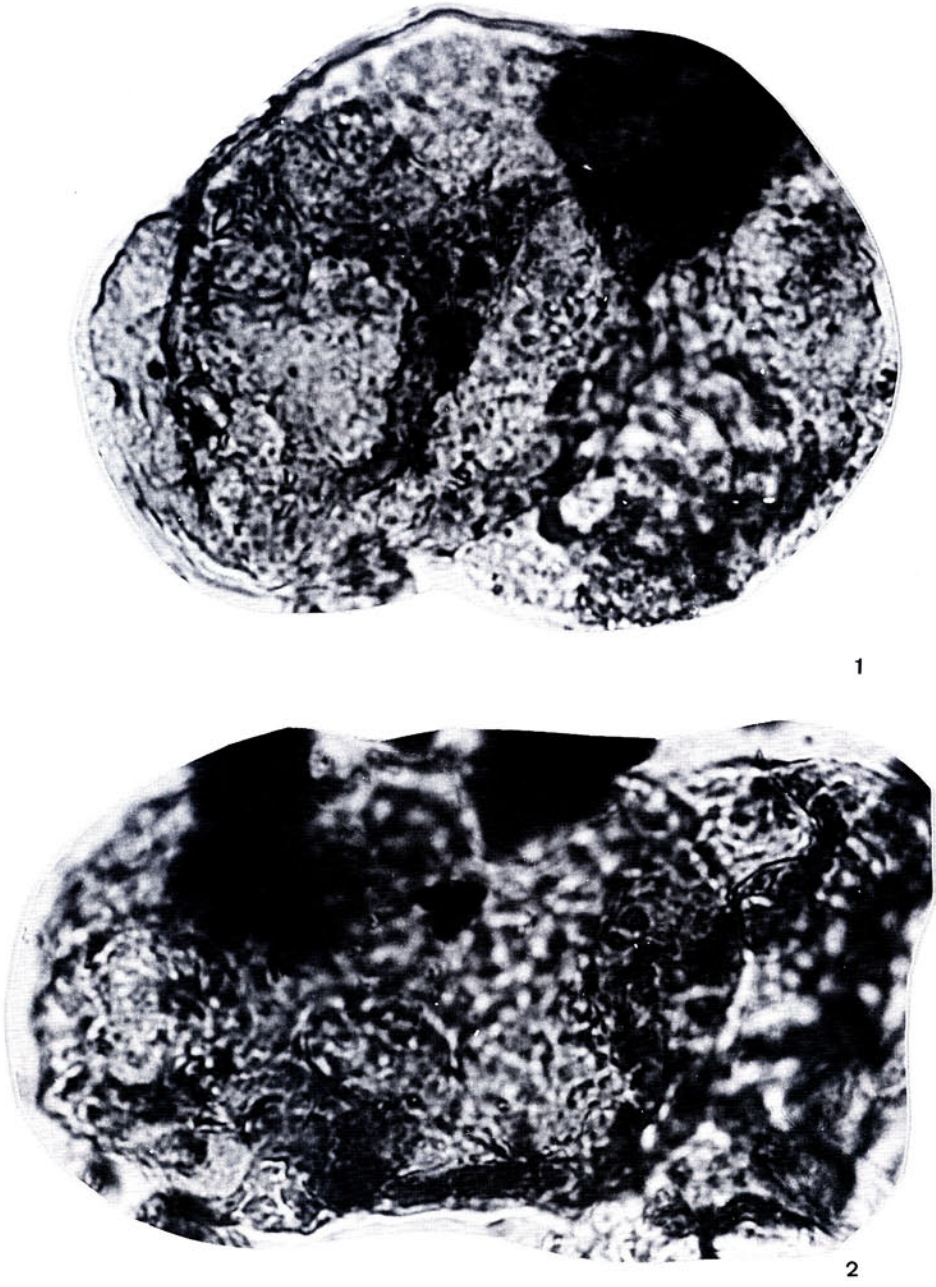
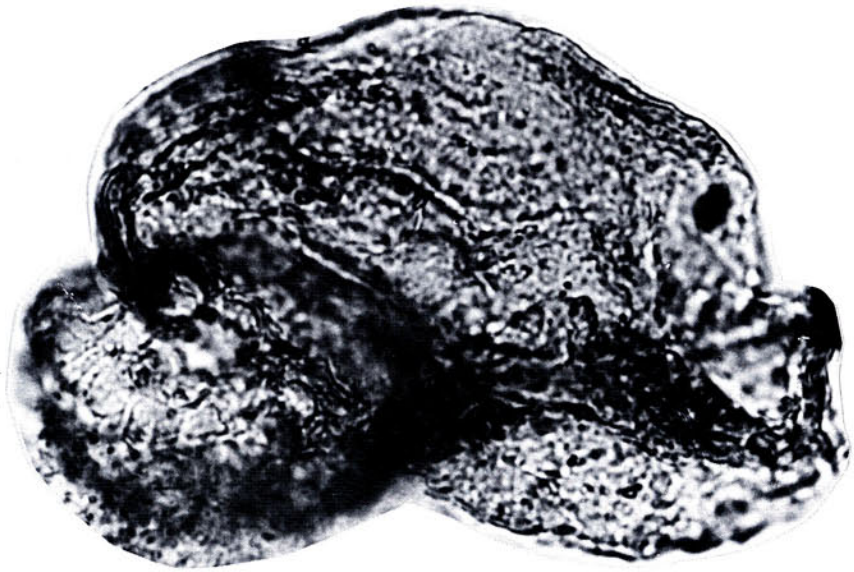
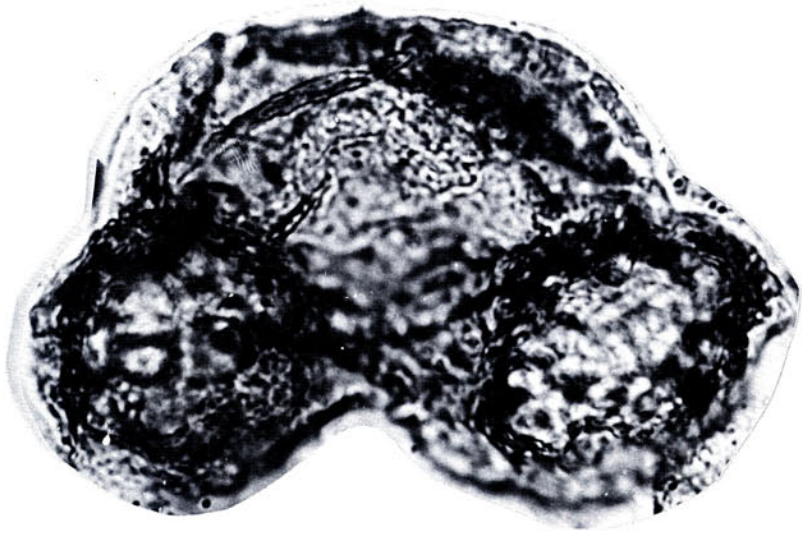


Plate 9. All figures, ×1000.

1-2. *Keteleeriaepollenites taiwanensis* Huang (90-8R, 26-3R).



1



2

Plate 10. All figures, ×1000.

1-2. *Piceapollis acutosaccatus* Huang (90-7R, 90-6R).

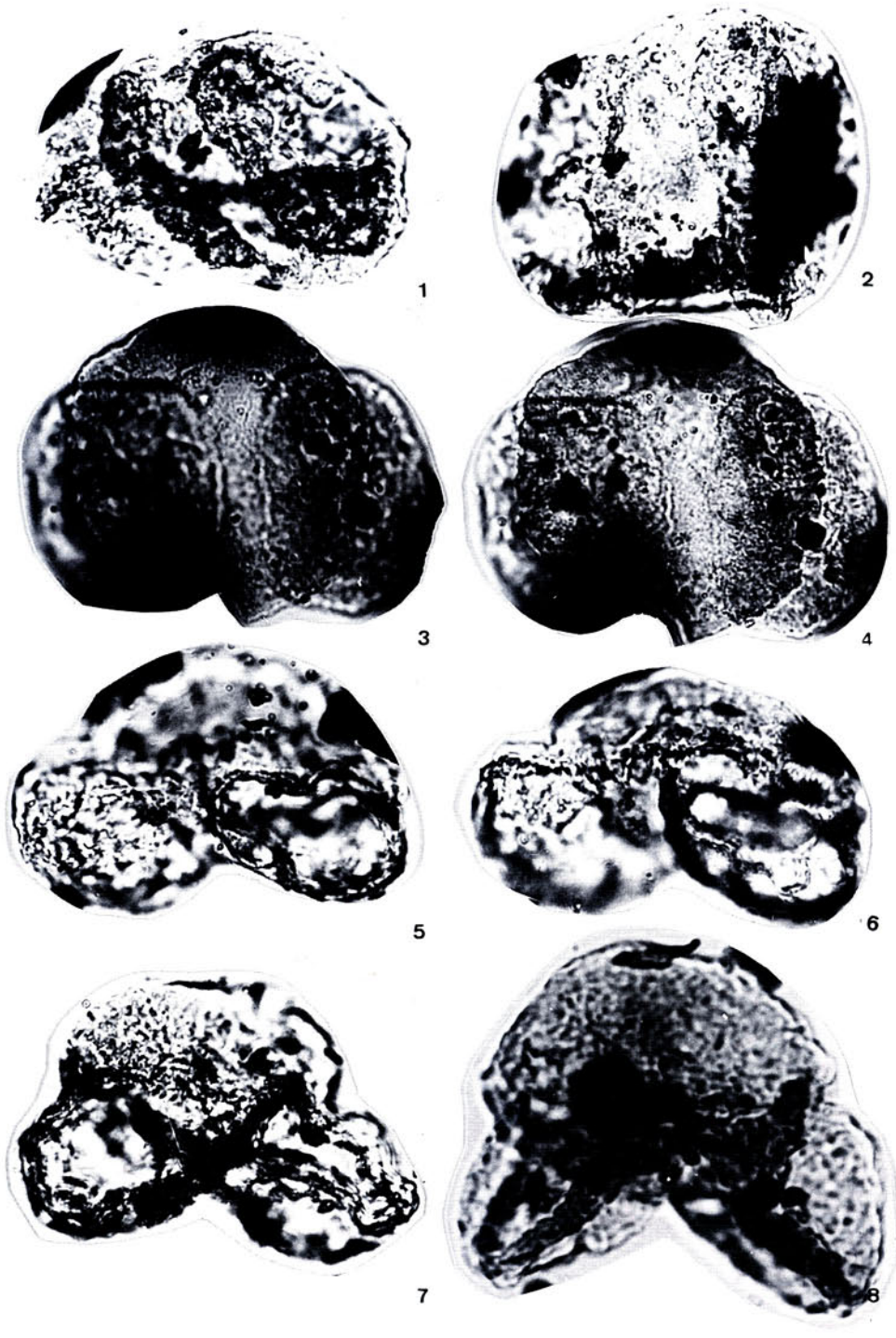


Plate 11. All figures, ×1000.

1-2. *Pityosporites acutus* Huang (2-1R, 6-5R); 3-4. *P. massoniana* Huang (16-7R); 5-6. *P. morrisonicola* Huang (6-5R); 7-8. *P. oblongus* Huang (6-4R, 53-6R).

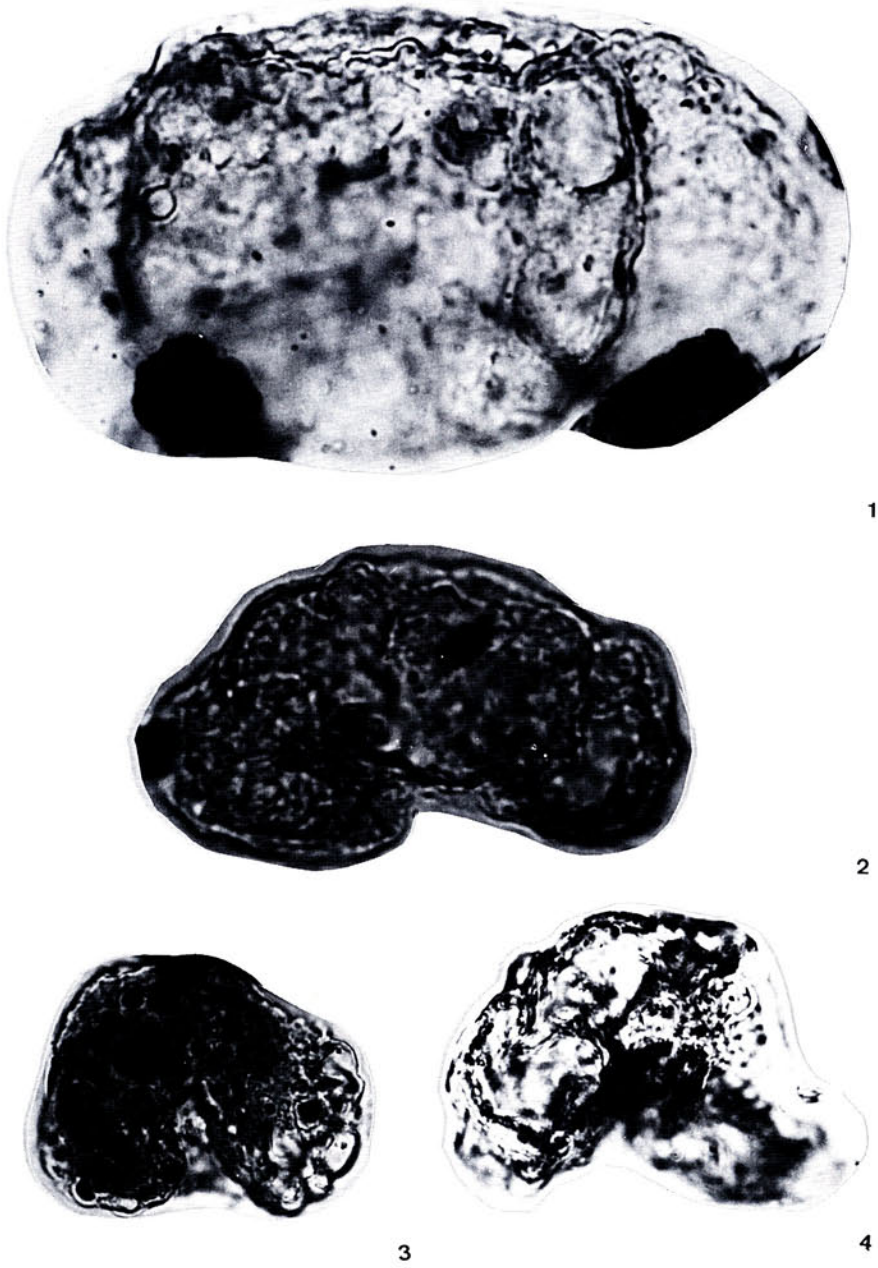


Plate 12. All figures, ×1000.

1-2. *Pityosporites scabratus* Huang (6-5R, 6-6R); 3-4. *P. triangulatus* Huang (16-2L, 6-4R).

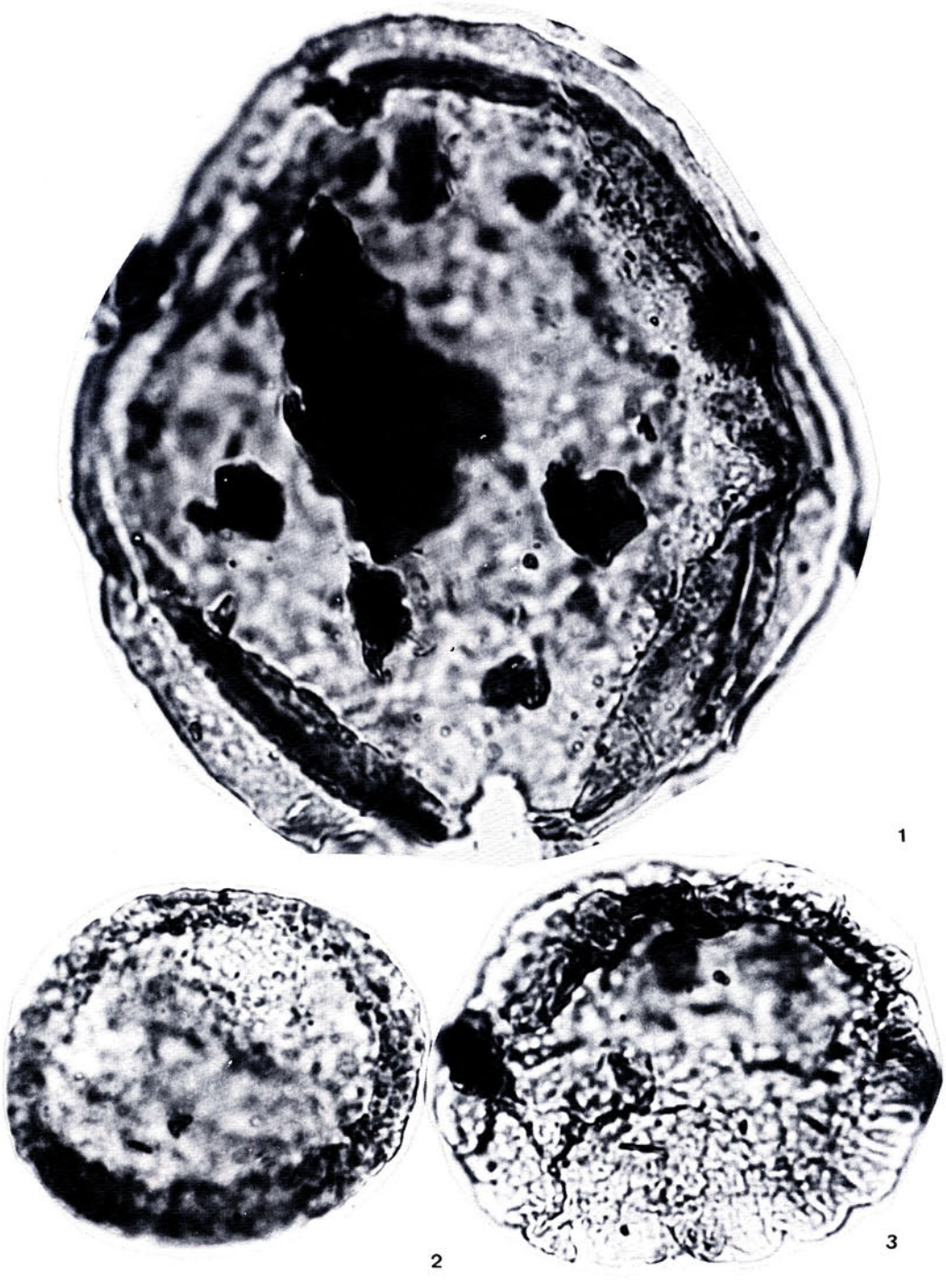


Plate 13. All figures, ×1000.

1. *Schizosporis taiwanensis* Huang (64-1R); 2. *Zonalapollenites chinensis* Huang (6-5R); 3. *Z. taiwanensis* Huang (21-1R).

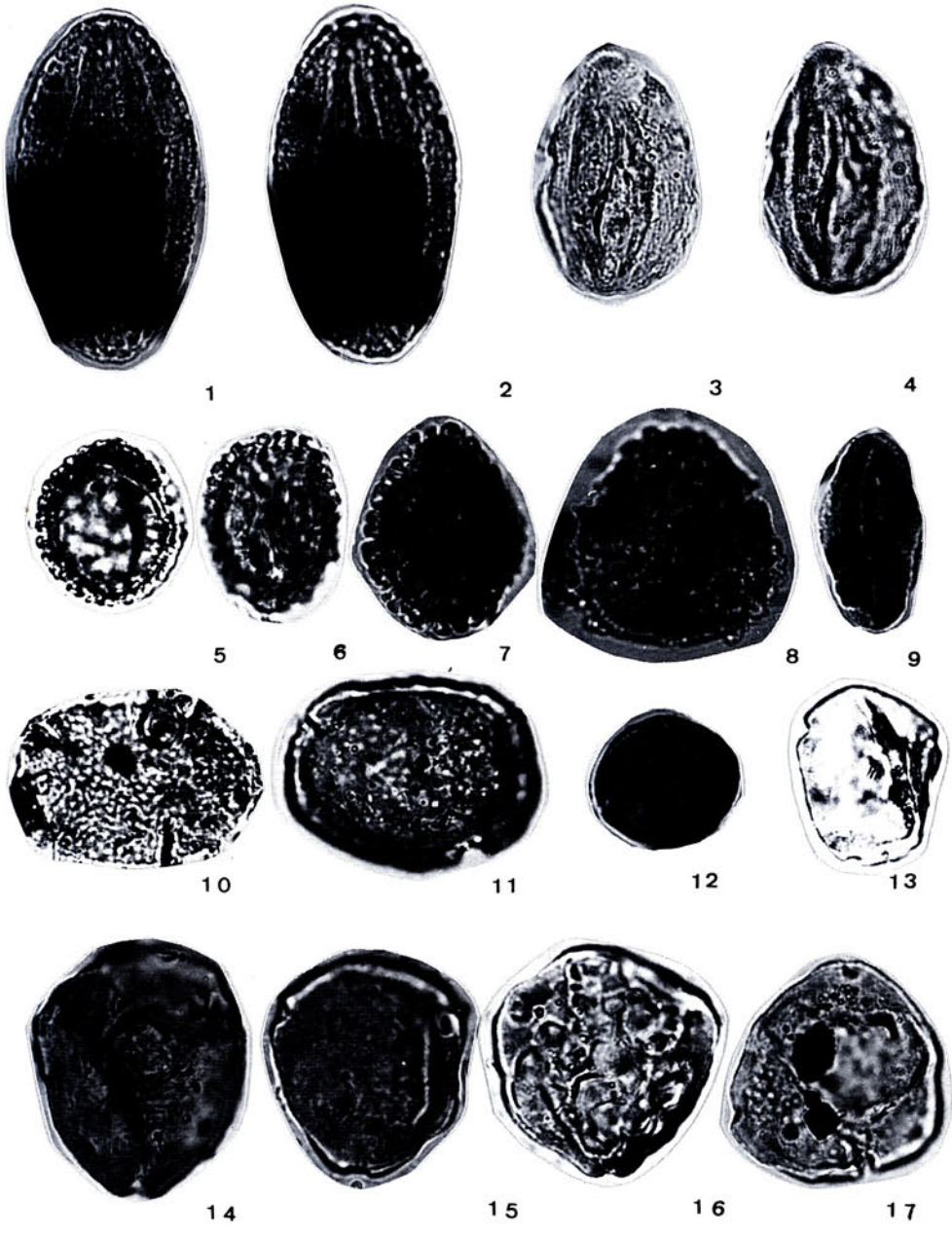


Plate 14. All figures, ×1000.

1-2. *Hypoestespollenites taiwanensis* Li & Huang (S26-4R); 3-4. *Aceripollis taiwanensis* Huang (2-4L); 5-6. *Ilexpollenites asprella* Huang (6-5R, 6-2R); 7-8. *I. kusanoi* Huang (2-2L, 2-2L); 9. *Tricolpopollenites ellipticus* Huang (21-5R); 10-11. *Impatiensidites taiwanensis* Li & Huang (2-2R, 6-3R); 12-13. *Triporopollenites coryloides* Pfl. var. *abnormalis* Huang (17-1R, 6-5R); 14-16. *T. coryloides* Pfl. (64-4L, 6-5R, 6-5R); 17. *Myricaceoipollenites megagranifer* (Pot.) Potonié (16-1R).

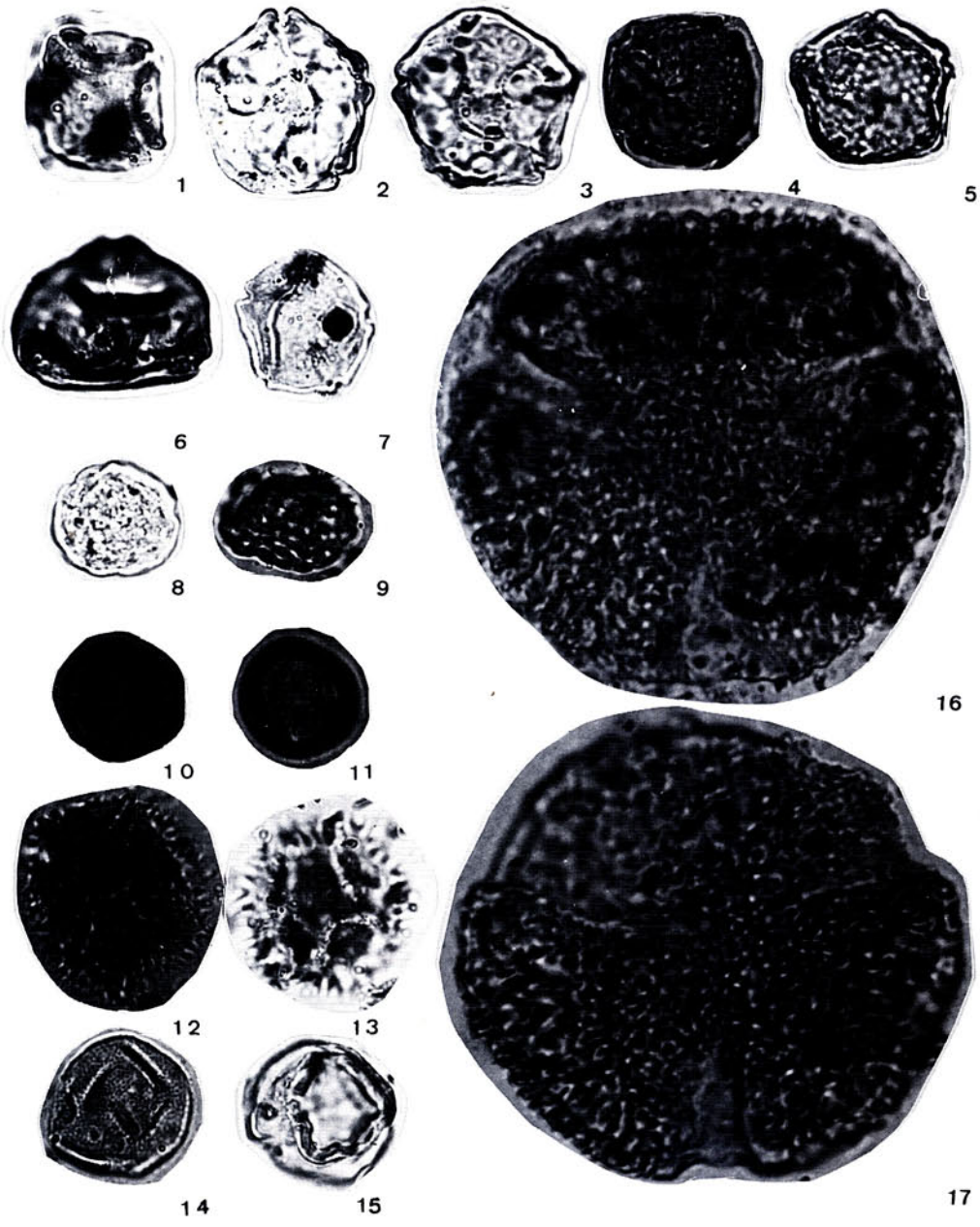


Plate 15. All figures, ×1000.

1-5. *Alnipollenites formosensis* Huang (106-1R, 6-5R, 1-1R, 6-3R); 6. *Trivestibulopollenites taiwanensis* Huang (6-6R); 7. *Polyatriopollenites taiwanensis* Huang (64-4L); 8-9. *Chenopodiopollis taiwanensis* Huang (4-1L, 64-6L); 10-11. *Artemisiaepollenites annus* Huang & Huang (2-2L); 12-13. *Cichorieacidites gracilis* (Nagy) Zheng (86-1R, 87-2R); 14. *Evolvuluspollenites taiwanensis* Li & Huang (21-3R); 15. *Daphniphyllumpollenites oldhamii* Huang (6-2L); 16-17. *Rousea taiwaniana* Li & Huang (39-2L, 6-3R).

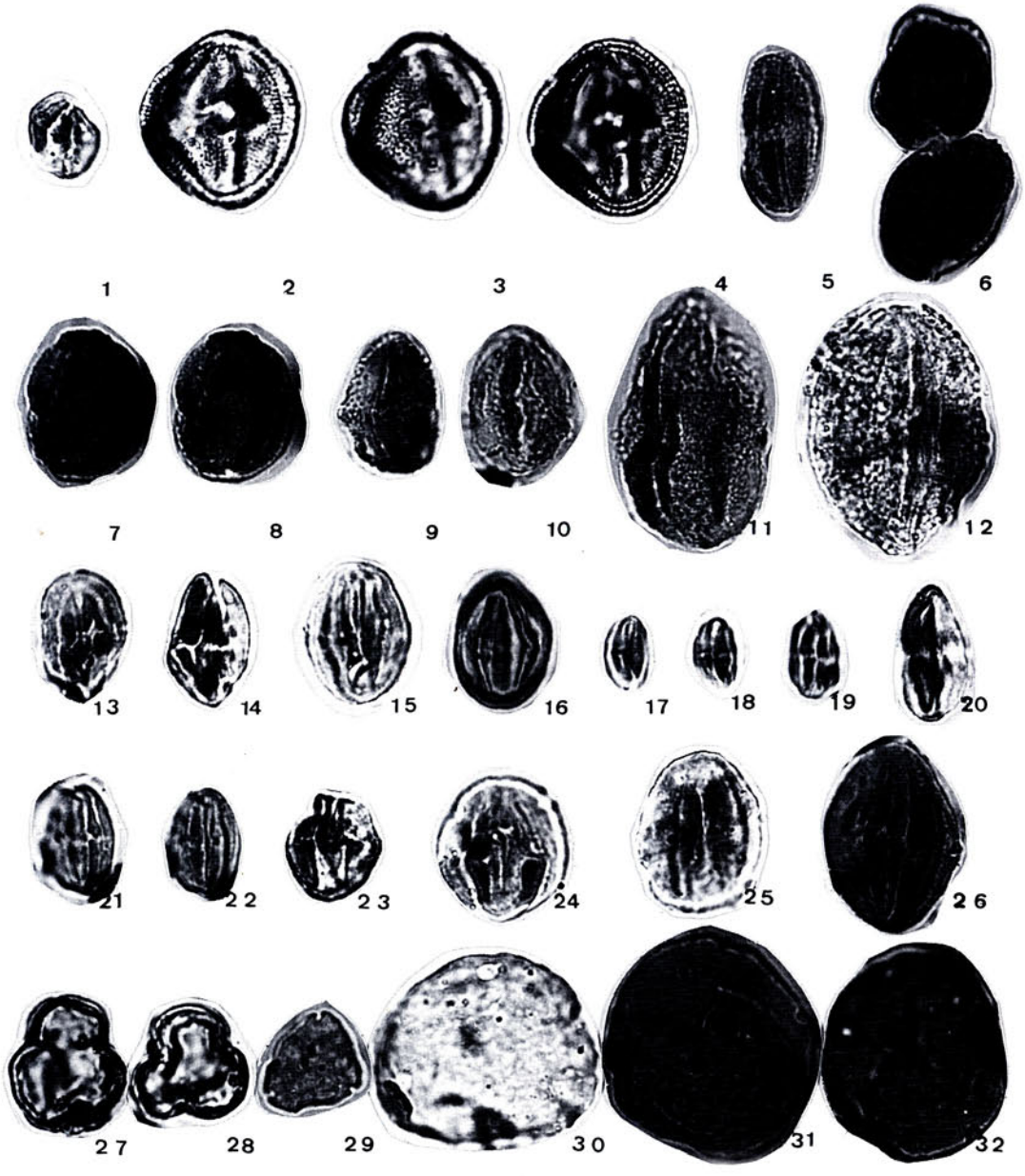


Plate 16. All figures, ×1000.

1. *Elaeocarpollenites taiwanensis* Huang (6-2R); 2-4. *Euphorbiacidites formosus* Zheng (2-2R); 5-10. *Tricolporopollenites rosaeformis* Zheng (2-1R, 21-5R, 2-4R, 64-4L, 26-1R); 11. *T. taiwanensis* Huang (2-4R); 12. *T. repens* Huang (2-5L); 13-16. *T. subprolatus* Huang (6-2R, 16-2R, 6-2R, 2-5R); 17-19. *T. minus* Huang (6-5R, 6-2R); 20. *T. perprolatus* Huang (6-2R); 21-23. *T. amygdalifolius* Huang (6-5R, 6-3R); 24-26. *T. uraiensis* Huang (21-2R, 64-1R, 6-3R); 27-28. *Quercipollenites glabratus* Huang (6-2R, 6-4R); 29. *Engelhardtioipollenites taiwanensis* Huang & Huang (6-3R); 30. *Caryapollenites taiwanensis* Huang & Huang (2-1R); 31-32. *Juglanspollenites taiwanensis* Huang (16-2L, 86-2L, 26-2R).

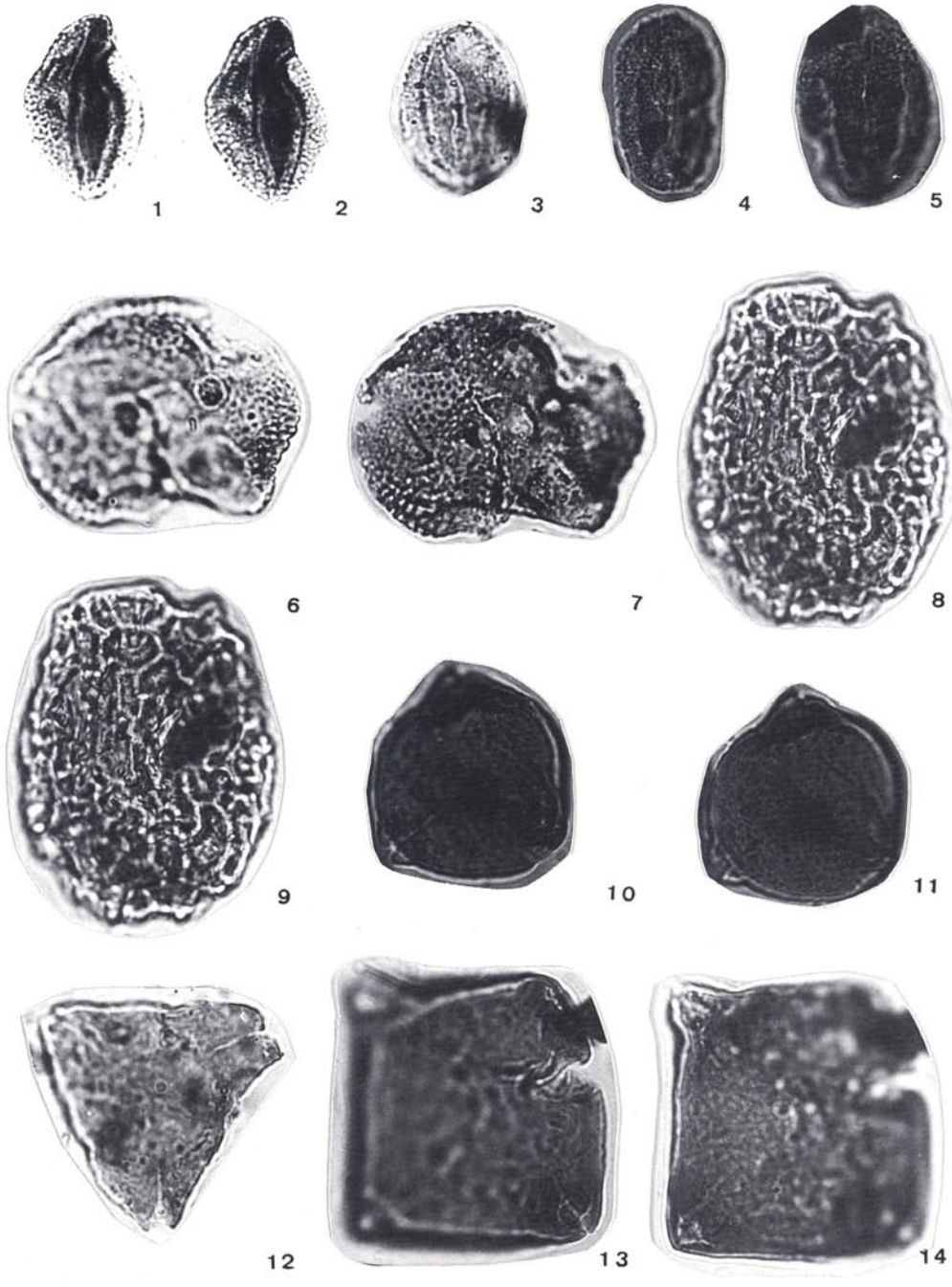


Plate 17. All figures, ×1000.

1-5. *Retitricolpites taiwanensis* Li & Huang (6-5R, 17-2L, D54-1R, 6-5R); 6-7. *Paraphlomipollenites taiwanensis* Huang & Huang (6-2R); 8-9. *Assamialetes taiwanensis* Huang & Huang (102-1R); 10-11. *Slowakipollis cechovici* (Pacl.) Krtz. (26-1R); 12-14. *S. taiwanensis* Huang & Huang (106-1R, 80-9L).

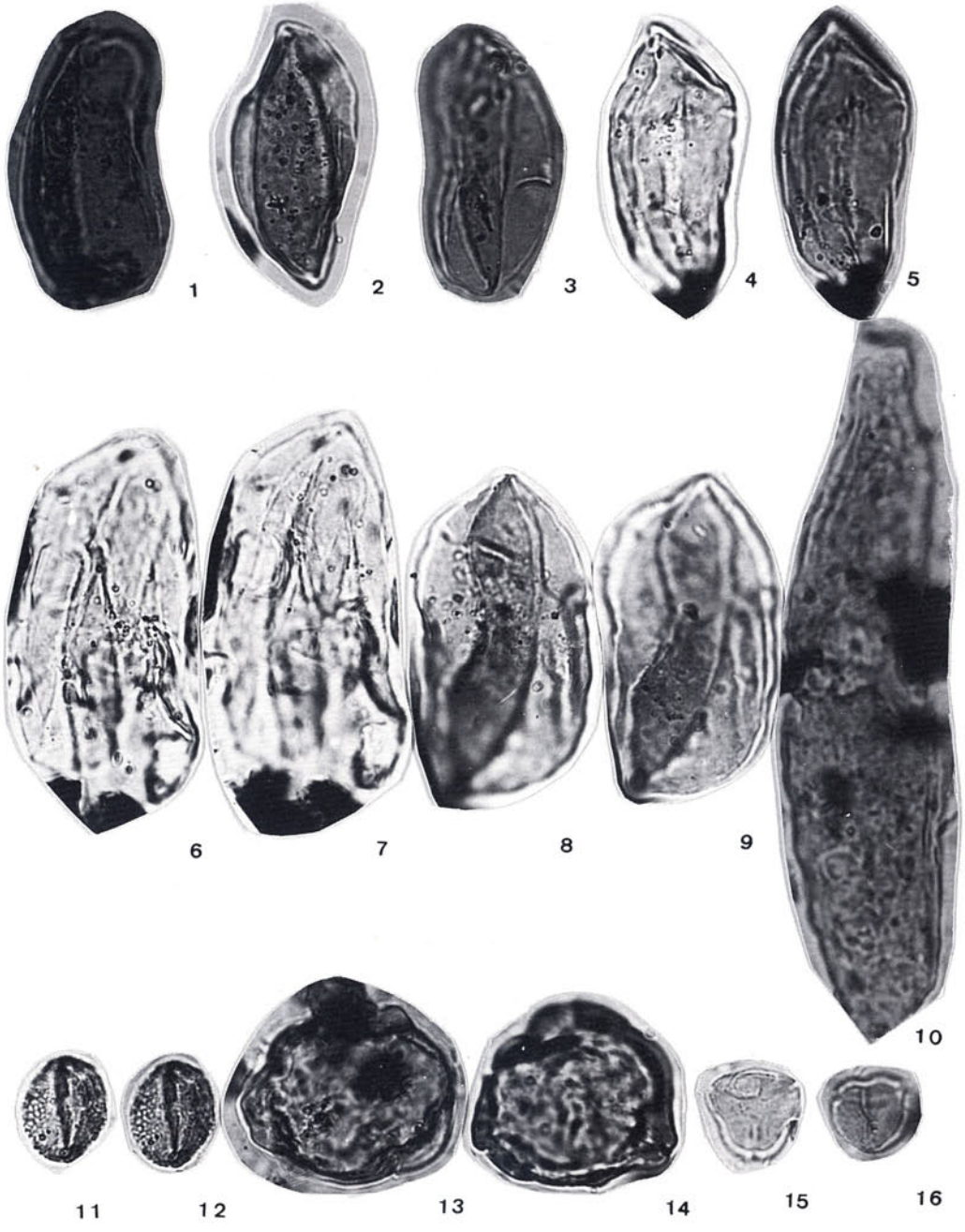


Plate 18. All figures, ×1000.

1-9. *Magnolipollis taiwanensis* Huang (2-2L, 53-1R, 26-1R, 6-2R, 6-6R, 16-2R); 10. *M. longiformis* Huang (16-2L); 11-12. *Tricolporopollenites asper* Huang & Huang (6-5R); 13-14. *Triatriopollenites taiwanensis* Huang (2-5R, 6-3R); 15-16. *Myrtaceidites taiwanensis* Huang & Huang (6-2R, 106-1R).

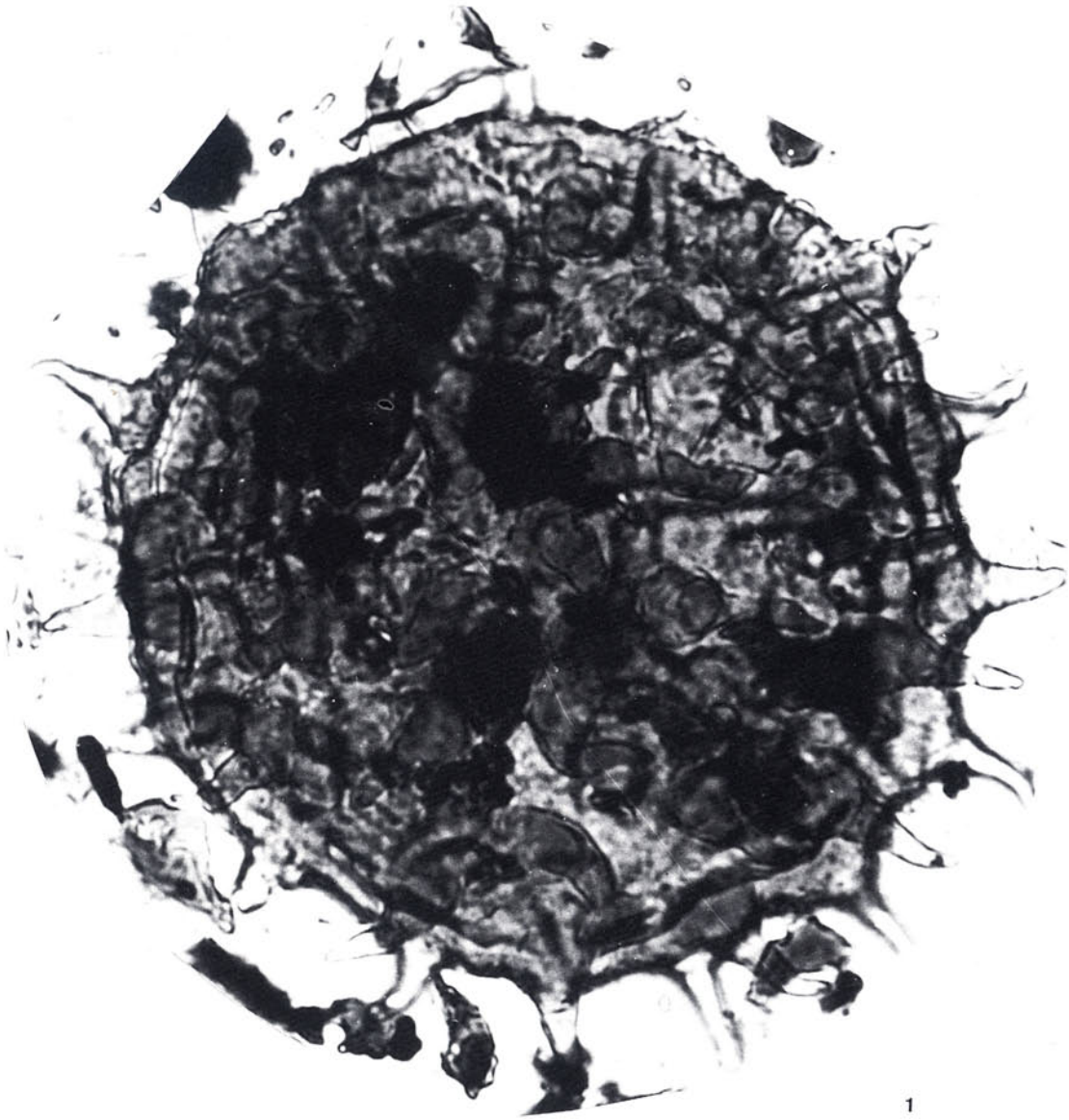


Plate 19. All figures, ×1000.

1. *Malvacerumpollis majus* Li & Huang (43-1R).

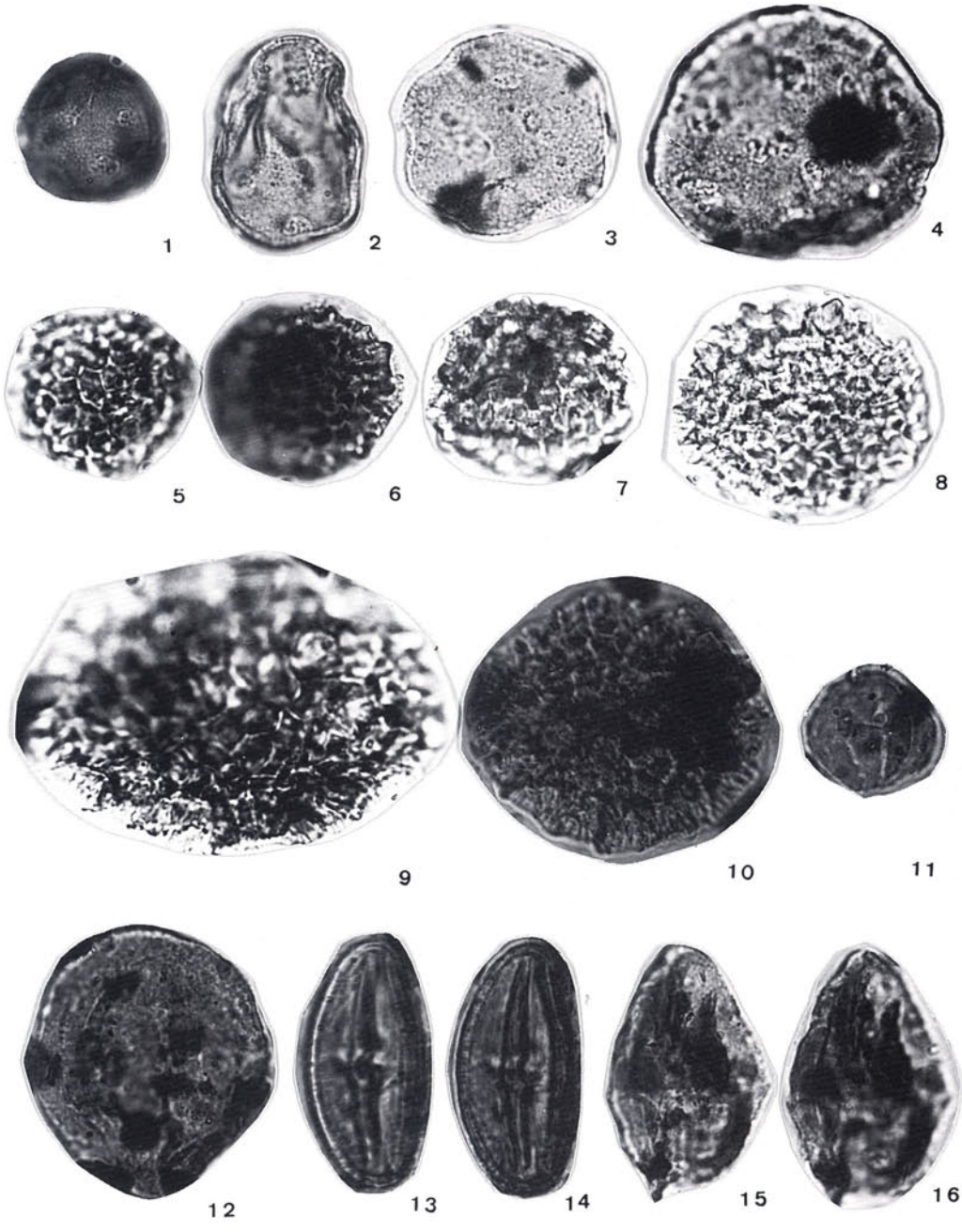


Plate 20. All figures, ×1000.

1. *Peripollenites minus* Huang (16-2R); 2-4. *P. formosensis* Huang (24-1R, 91-3R, 53-3R); 5-8. *Polygonacidites densoreticulatus* Huang (2-2R, 6-5R, 64-1L, 64-7); 9-10. *P. vulgaris* Huang (6-3R, 2-2L); 11. *Galiumpollenites taiwanensis* Li & Huang (57-1R); 12. *Portulacapollenites taiwanensis* Li & Huang (57-2R); 13-16. *Rutaceoipollenites taiwanensis* Huang & Huang (43-1R, 21-2R).

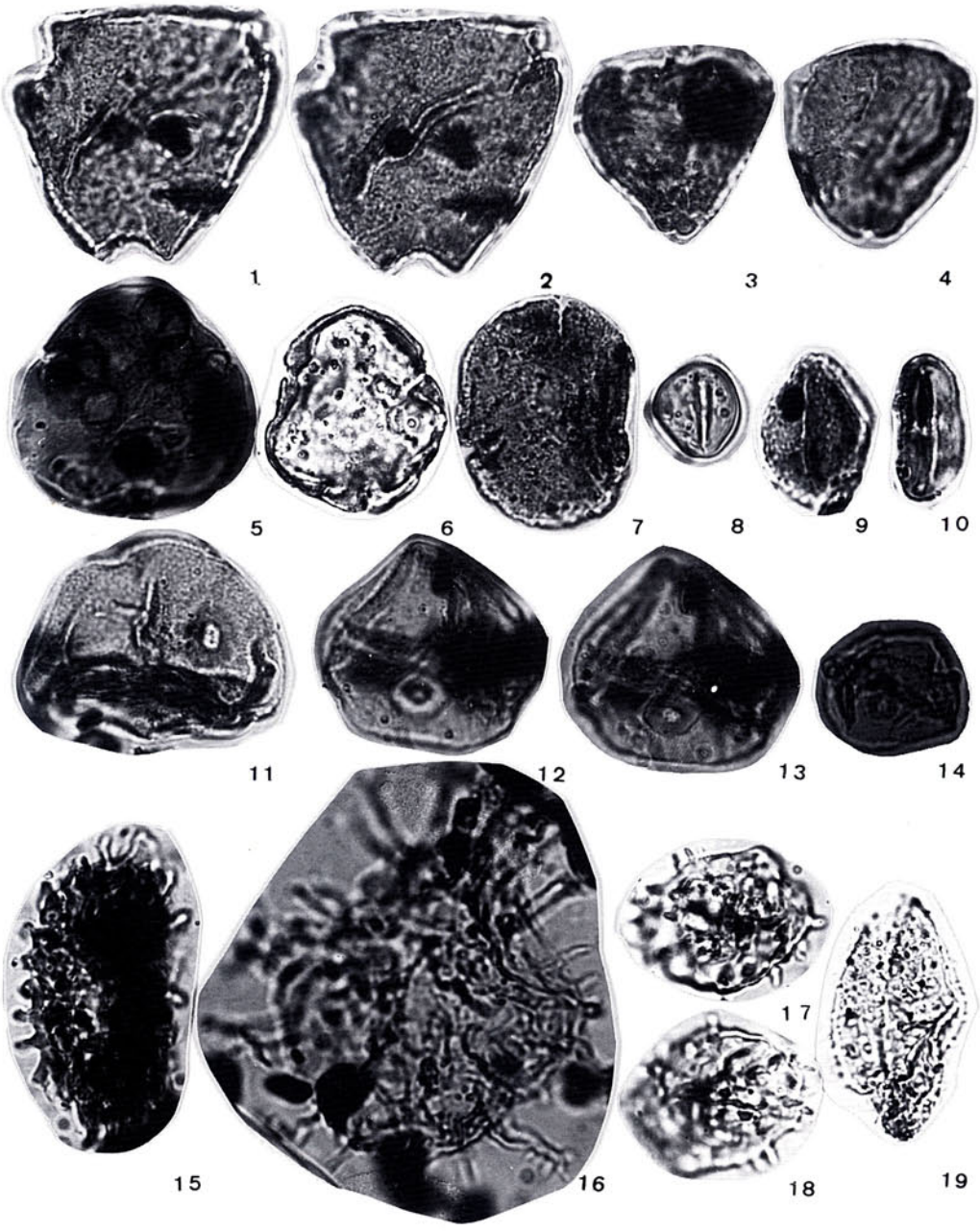


Plate 21. All figures, ×1000.

1-2. *Margoaperturates taiwanensis* Huang & Huang (69-1L); 3-4. *Symplocaccites caudata* Huang (69-1L, S30-6R); 5-7. *Tiliaepollenites taiwanensis* Huang (2-5R, 6-4R, 21-1R); 8. *Arecipites taiwanensis* Huang (2-4R); 9. *Monosulcites taiwanensis* Huang (6-6R); 10. *Eucomidites taiwanensis* Huang (6-2R); 11. *Graminidites media* Cooks. *ex* Potonié (2-4L); 12-14. *G. glabratus* Huang (2-5R, 2-2L); 15-19. Dinoflagellates and algae (6-2R, 1-1R, 6-5R, 6-4R).