

## Eocene Angiospermous Palynomorphs of Taiwan (II)

Cheng-Long Shaw<sup>(1)</sup>

(Manuscript received 27 March, 2000; accepted 30 April, 2000)

**ABSTRACT:** Twenty-two taxa of Eocene fossil angiospermous palynomorphs were reported as an on-going effort to document the Eocene microflora of Taiwan. They belong to two classes, thirteen families, seventeen form genera; namely sixteen form genera and twenty-one taxa for the class Dicotyledoneae; and one form genera and one taxa for the class Monocotyledoneae. Thirteen new species (*Confertisulcites pengchiahsuensis* C. L. Shaw sp. nov.; *Rhamnacidites pengchiahsuensis* C. L. Shaw sp. nov.; *Gemmatricolporites pengchiahsuensis* C. L. Shaw sp. nov.; *Tripoporollenites scabratus* C. L. Shaw sp. nov.; *Monocolpopollenites pengchiahsuensis* C. L. Shaw sp. nov.; *Retitricolpites verus* C. L. Shaw sp. nov.; *Myrtacidites vulgatus* C. L. Shaw sp. nov.; *Rhamnacidites psilatus* C. L. Shaw sp. nov.; *Wilsonipites taiwanensis* C. L. Shaw sp. nov.; *Margocolporites taiwanensis* C. L. Shaw sp. nov.; *Patrinipollenites formosensis* C. L. Shaw sp. nov.; *Tiliaepollenites zonatus* C. L. Shaw sp. nov.; *Spinizonocolpites pengchiahsuensis* C. L. Shaw sp. nov. ), two new combination (*Striatopollis reticulatus* (Nagy) C. L. Shaw comb. nov.; *Persicarioipollis minus* (Huang) C. L. Shaw comb. nov.) are described from well samples in offshore Keelung of northern Taiwan.

**KEY WORDS:** Eocene, Angiospermous palynomorphs, Taxonomy, Taiwan aera.

### INTRODUCTION

This paper is the eighth installment reporting the palynological flora from wells drilled in offshore Keelung in northern Taiwan. Most of the taxonomical treatment of the Eocene palynomorphs of Taiwan have been published. There are still many new fossil palynomorphs to be identified and taxonomically classified. The previous installments include reporting Tiliaeous palynomorphs (Shaw, 1997), Ephedraceous (Shaw, 1998), Wetzeliellaceous dinoflagellate (Shaw, 1999a), fossil dinocysts (Shaw, 1999b), pteridophytic spores (Shaw, 1999c), angiospermous palynomorphs (Shaw, 1999d), and gymnospermous palynomorphs (Shaw, 2000). More reports which deal with the taxonomy and complete checklist will come in the immediate future.

In this paper, the artificial form genera nomenclature for the taxonomic treatment was adapted.

### MATERIAL AND METHOD

Core samples from the OK-1, OK-2, OK-3 (Shaw, 1999a), YKL-6, YKL-3 and YKL-1 (Shaw, 1996) wells from offshore Keelung in northern Taiwan were made available. A total of fifty-five cores and one cutting sample were prepared by the Chinese Petroleum Corporation Micropaleontological Laboratory for the palynological study.

The extraction method followed Shaw (1990), including the treatment of 10% KOH for the dissolution of humic material, heavy liquid solution of ZnCl<sub>2</sub> for flotation (S. G. 1.8-2.2), 30% of HCl for calcite, and 52% of HF for maceration of the laterite pebble samples.

---

1. Associate Curator, National Museum of Prehistory, Taitung 950, Taiwan, Republic of China.

Photomicrographs were taken with a Zeiss Universal microscope using Kodak Gold (ASA 100) film. For fossil identification, the references of Huang (1972, 1978, 1980, 1981), Shaw (1995a, 1995b), Jansonius and Hills (1976), Kremp, Spackman, Ames and Kovar (1957-1972), Song Z., X. Guan, Z. Li, Y. Zheng, W. Wang and Z. Hu (1985), Zhu Z., and Wu L., Xi P., Song Z., & Zhang Y. were used (1985). The fossil slides are catalogued and stored at the Micropaleontology Laboratory, Chinese Petroleum Corporation.

## RESULTS

An accurate taxonomic treatment is important for biostratigraphy. As an on-going effort in documenting the Eocene microflora of Taiwan, twenty-two angiospermous taxa are reported. They belong to two classes, thirteen families, seventeen form genera; namely sixteen form genera and twenty-one taxa for the class Dicotyledoneae; only one form genera and one taxa for the class Monocotyledoneae. Thirteen new species (*Confertisulcites pengchiahsuensis* C. L. Shaw sp. nov.; *Rhamnacidites pengchiahsuensis* C. L. Shaw sp. nov.; *Gemmatricolporites pengchiahsuensis* C. L. Shaw sp. nov.; *Triporopollenites scabratus* C. L. Shaw sp. nov.; *Monocolpopollenites pengchiahsuensis* C. L. Shaw sp. nov.; *Retitricolpites verus* C. L. Shaw sp. nov.; *Myrtaceidites vulgatus* C. L. Shaw sp. nov.; *Rhamnacidites psilatus* C. L. Shaw sp. nov.; *Wilsonipites taiwanensis* C. L. Shaw sp. nov.; *Margocolporites taiwanensis* C. L. Shaw sp. nov.; *Patriniapollenites formosensis* C. L. Shaw sp. nov.; *Tiliaepollenites zonatus* C. L. Shaw sp. nov.; *Spinizonocolpites pengchiahsuensis* C. L. Shaw sp. nov.), two new combination (*Striatopollis reticulatus* (Nagy) C. L. Shaw comb. nov.; *Persicarioipollis minus* (Huang) C. L. Shaw comb. nov.) are described from well samples in offshore Keelung of northern Taiwan.

### CLASS 1. DICOTYLEDONEAE

#### Family 1 ACERACEAE

##### Genus 1 *Striatopollis* Krutzsch 1959

Type species: *Striatopollis sarstedtensis* Krutzsch 1959

Diagnosis: Pollen grains tricolpate, subprolate to prolate in equatorial view, circular in polar view; tectum subsilate to finely verrucate; sexine striate (Jansonius and Hill, 1976).

#### 1. *Striatopollis reticulatus* (Nagy) C. L. Shaw comb. nov. Figs. 1-3

*Aceripollenites reticulatus* Nagy 1969, p. 413, pl. 43, figs. 5, 6.

Selected slide: OK-1 1375-(1); Figs. 1-3; film PF63-31, PF63-32, PF63-33; CPC Micropaleontology Lab.

Description: Grains tricolpate, subprolate to prolate-spheroidal; 23x 31  $\mu\text{m}$ ; colpi 26  $\mu\text{m}$  long; surface view striate; lateral view scabrate; exine 1  $\mu\text{m}$  thick.

Stratigraphic occurrence: Eocene (OK-1 well, 1375m)

Taxonomic affinity: This form species resembles the species of *Acer*.

#### Family 2 JUGLANDACEAE

##### Genus 1 *Caryapollenites* Raatz (1937) 1938 ex Potonie 1960

1938 Abhandl., Preuss. Geol. Landesanst., 1937, n.s., H. 183, p. 19, 1960 Synopsis, part III, p.123.

Type species: *Caryapollenites simplex f. communis* Raatz.

Diagnosis: Shape more or less globular; outline smooth, surface distinctly punctate to

granulate; exine two-layered; pores circular, arranged subequatorially (Jansonius and Hill, 1976).

1. **Caryapollenites minor** M. R. Sun 1989

Figs. 4-5

Description: Grains 3-porate; amb circular to semi-angular, about 21-24  $\mu\text{m}$  wide; pores circular arranged subequatorially; surface view obscure pattern, lateral view psilate; exine 1  $\mu\text{m}$  thick.

Stratigraphic occurrence: Eocene (OK-1 well, 1955m).

Selected slide: OK-1 1955-(4); Figs. 4-5; film W97-34, 35; CPC Micropaleontology Lab.

Taxonomic affinity: This form species resembles the species of *Carya*.

**Family 3 LEGUMINOSAE**

**Genus 1 Margocolporites** Ramanujam 1966, ex Srivastava 1969

Type species: *Margocolporites tsukadai* Ramanujam 1966

Diagnosis: Pollen grains isopolar, oblate to suboblate, 3-zoni-margocolporate, 37-56  $\mu\text{m}$  long, margocolpus smooth, granular or micro-reticulate. Exine reticulate or retipilate (Jansonius and Hill, 1976).

1. **Margocolporites taiwanensis** C. L. Shaw *sp. nov.*

Figs. 6-7

Description: Grains 3-zoni-margo-colporate, amb intersubangular; 25-28  $\mu\text{m}$  wide; margo 1-1.5  $\mu\text{m}$  thick; pore crassimarginate 7-10  $\mu\text{m}$  wide; surface view granulate; lateral view verrucate; exine about 1  $\mu\text{m}$  thick.

Stratigraphic occurrence: Eocene(OK-1 well, 1955m)

Holotype: Slide OK-1 1955-(5); Figs. 6-7; film TL21-8, TL21-9; CPC Micropaleontology Lab.

Taxonomic affinity: This species is similar to the species of Leguminosae.

**Family 4 LORANTHACEAE**

**Genus 1 Cranwellia** Srivastava 1966.

Pollen et Spore, vol.8, no. 3, p. 537.

Type species: *Cranwellia striata* (Coup.) Sriv.

Dagnosis: Grains tricolpate or tricolporate; amb triangular with concave, straight or slightly convex sides; pore conspicuous to inconspicuous; colpi short, equatorial angular protrusions are well developed; exine granulate, granules arranged in a line pattern, giving a striate appearance, striations starting from the middle of each interradian region and running across to the middle of the inter-radial region of the adjacent side, striations parallel to each other and perpendicular to the radius from the pole to the apex of each equatorial angular protrusion (Jansonius and Hill, 1976).

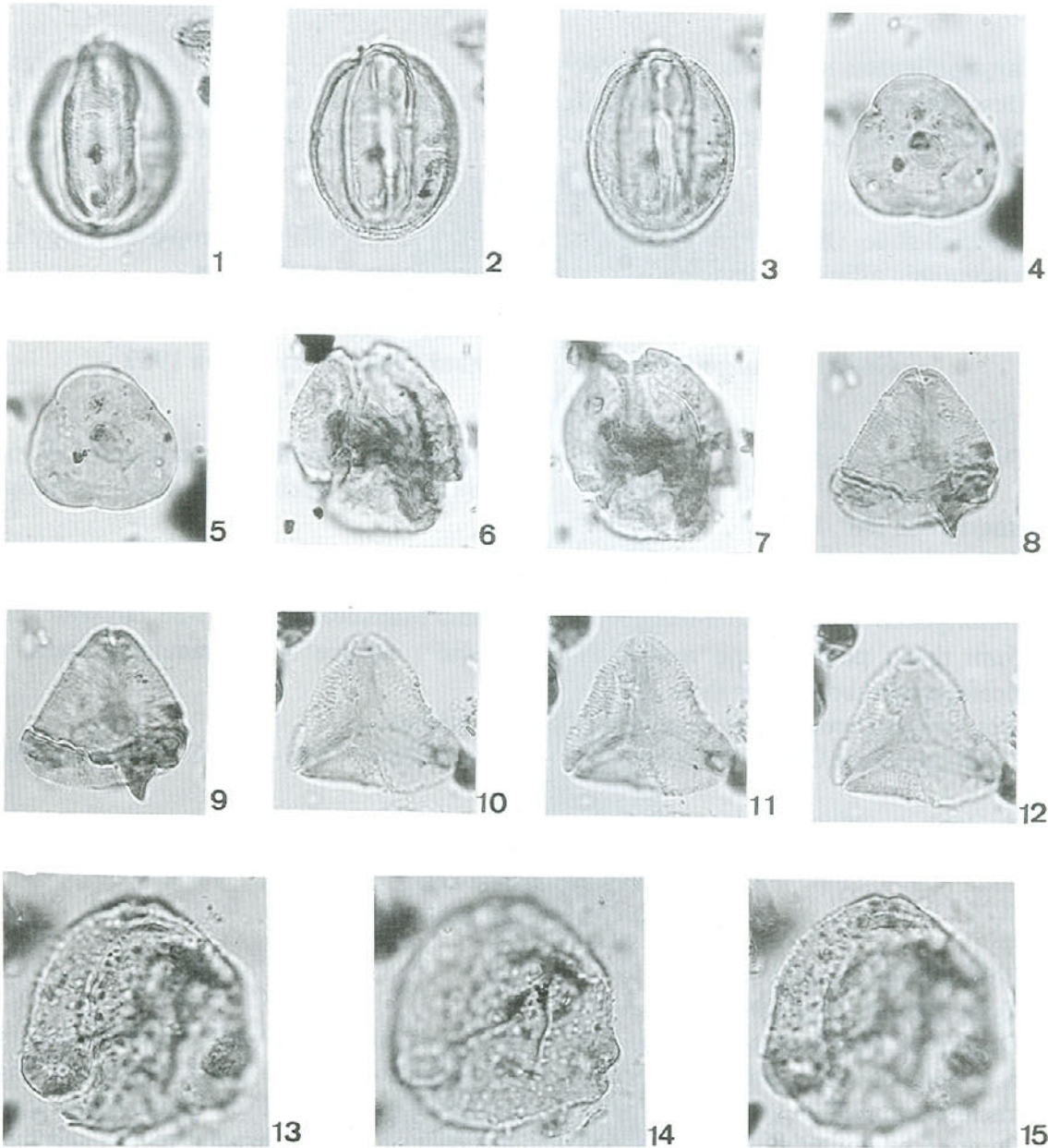
1. **Cranwellia rumseyensis** Srivastava 1966

Figs. 8-12

Selected slide: OK-1 1638-(3); Figs. 10-12; OK-2 1760-(1); Figs. 8-9; CPC Micropaleontology Lab.

Description: Grains tricolporate to tri-syncolporate, amb angular to subangular; 25-27  $\mu\text{m}$  wide; colpi 9-14  $\mu\text{m}$  long; surface view striate, the striae parallel to each other and perpendicular to the radius from the pole to the apex of each equatorial angular protrusion; lateral view scabrate; exine 1  $\mu\text{m}$  thick.

Stratigraphic occurrence: Eocene (OK-1 well, 1638m; OK-2 well, 1760m)



Figs. 1-3. *Striatopollis reticulatus* (Nagy) C. L. Shaw *comb. nov.* OK-1, 1375m-1, PF63-31, 32, 33; Figs. 4-5. *Caryapollenites minor* M. R. Sun OK-1, 1955m-4, W97-34, 35; Figs. 6-7. *Margocolporites taiwanensis* C. L. Shaw *sp. nov.* OK-1, 1955m-5, TL21-8, 9; TL21-8, TL21-9; Figs. 8-12 *Cranwellia rumseyensis* Srivastava OK-3, 1760m-1, PF60-1, 2; OK-1, 1638m-3, PF67-20, 21, 22; Figs. 13-15. *Proteacidites spiniformis* Ke et Shi OK-1, 1365m-1, PF63-17, PF63-18, PF63-19 (All figures x1000) ACERACEAE, JUGLANDACEAE, LEGUMINOSAE, LORANTHACEAE, PROTEACEAE

### Family 5. MAGNOLIACEAE

#### Genus 1 *Confertisulcites* And. New Mexico. inst. Min. Technol., Mem. 6, 27.

*Magnolipollis* Krutzsch 1970.

Type species: *Confertisulcites knowltoni* And.

Diagnosis: Elongate, bilateral, monosulcate pollen with a closed sulcus throughout the

length or broadly overlapping or easily capable of overlapping; sulcus extending to the ends of the grain; sculpture usually psilate to faintly scabrate or flecked (Jansonius and Hill, 1976).

1. **Confertisulcites pengchiahsuensis** C. L. Shaw *sp. nov.* Figs. 16-17

Description: Grains 1-sulcate; subellipsoidal, sharp at both ends;  $23 \times 37 \mu\text{m}$ ; sulcus as long as the length; lateral view scabrate; surface view rough pattern; exine  $0.5\text{-}1 \mu\text{m}$  thick.

Holotype: Slide OK-2 1400-(5); Figs. 16, 17; film W99-17, 18; CPC Micropaleontology Lab.

Stratigraphic occurrence: Eocene (OK-2 well, 1400m)

Taxonomic affinity: This form resembles the species of Magnoliaceae.

**Family 6 MYRTACEAE**

**Genus 1 Myrtaceidites** Cookson & Pike 1954.

Type species: *Myrtaceidites mesonesus* Cookson & Pike

Diagnosis: Grains small-medium, triangular-subtriangular in polar view with straight, slightly concave or slightly convex sides; tricolporate; angulaperturate; oblate-sub-spheroidal; arcus distinct, enclosing more or less distinctly developed polar fields; exine smooth, granular or finely-indistinctly patterned, never clearly reticulate (Jansonius and Hill, 1976).

1. **Myrtaceidites granulatus** Ke & Shi Figs. 18-19

Description: Grains tri-syncolporate, subangular;  $18\text{-}23 \mu\text{m}$ ; colpi about  $10\text{-}12 \mu\text{m}$  long, ora indistinct; surface view granulate; lateral view scabrate to subpsilate; exine about  $1 \mu\text{m}$  thick.

Stratigraphic occurrence: Eocene (OK-1 well, 1719m)

Selected slide: OK-1 1894-(2); Figs. 18-19; film TL21-9, 10; CPC Micropaleontology Lab.

Taxonomic affinity: This species is similar to the extant species of Myrtaceae.

2. **Myrtaceidites vulgatus** C. L. Shaw *sp. nov.* Figs. 20-21

Description: Grains tri-syncolporate, semi-lobate;  $17\text{-}20 \mu\text{m}$ ; colpi about  $10\text{-}12 \mu\text{m}$  long, ora indistinct; surface view smooth to obscure pattern; lateral view psilate; exine  $1\text{-}1.5 \mu\text{m}$  thick.

Stratigraphic occurrence: Eocene (OK-1 well, 1894m)

Holotype: Slide OK-1 1894- (2); Figs. 20-21; film TL21-12, 13; CPC Micropaleontology Lab.

Taxonomic affinity: This species is similar to the extant species of Myrtaceae.

**Family 7 POLYGONACEAE**

**Genus 1 Persicarioipollis** Krutzsch 1962. Geologie, Jahrg. 11, no. 3, p. 282; Krutzsch 1966 Geologie, Beih. 55, p. 29.

Type Species: *Persicarioipollis meusell* Krutzsch.

*Polygonacidites* Sah & Dutta 1968; Huang in Taiwania 25: 94. 1980.

New diagnosis in Krutzsch 1966 (Geologie, Beih. 55, p. 29): Amb circular to oval, figure broadly lenticular to globular; surface with reticulum palisades (=polyforate) with a covering reticulum; underneath the major sculpture often a double row of "verrucae" that is fused in part; further verrucae may occur in the foramina; pores small, only one in every 2-5 foramina open and thus strongly variable in number; inner wall layer distinctly smooth (Jansonius and Hill, 1976)

1. *Persicarioipollis minus* (Huang) C. L. Shaw *comb. nov.*

Figs. 22-23

*Polygonacidites minus* Huang, in *Taiwania* 25: 95. 1980.

Selected slide: OK-2 1901-(4); Figs. 22-23; film TL19-16, TL19-17; CPC Micropaleontology Lab.

Description: Grains pantoporate; spheroidal to subspheroidal; 15-23  $\mu\text{m}$  wide; surface view lopho-reticulate, lacuna 1-2.5  $\mu\text{m}$  wide, muri 1-2  $\mu\text{m}$  thick; lateral view baculate, clavate or echinate; exine 1-2  $\mu\text{m}$  thick.

Stratigraphic occurrence: Eocene (OK-2 well, 1901m).

Taxonomic affinity: This species is similar to the extant species of *Polygonum* of Polygonaceae.

**Family 8 PROTEACEAE****Genus 1 Proteacidites** Cookson ex Couper 1953

New Zealand Geol. Surv., Paleont. Bull. 22, p. 42.

Type species: *Proteacidites adenantoides* Cookson 1950

Austr. J. Sci. Res., ser. B, v. 3, no. 2, p. 172, pl. 2, fig. 21

Diagnosis: Free, isopolar or sub-isopolar, triporate, occasionally diporate; grain triangular to subtriangular, sides concave to convex between ora in polar view; exine clearly differentiated into nexinous and sexinous layers. Sexine baculate, clavate, or tuberculate, forming a very variable pitted-reticulate, reticulate or pseudo-reticulate sculpture in surface view (Jansonius and Hill, 1976).

1. *Proteacidites spiniformis* Ke et Shi 1978

Figs. 13-15

Selected slide: OK-1 1365-(1); Figs. 13-15; film PF63-17, PF63-18, PF63-19; CPC Micropaleontology Lab.

Description: Grains 3-porate; amb circular; 34-37  $\mu\text{m}$  wide; pore crassimarginate, 7-9  $\mu\text{m}$  thick; surface view granulate; lateral view gemmate to clavate; exine 0.5  $\mu\text{m}$  thick.

Stratigraphic occurrence: Eocene (OK-1 well, 1365m)

**Family 9 RHAMNACEAE****Genus 1 Rhamnacidites** Chitaley ex Potonie 1960

Beih. Geol. Jahrb., H. 39 (Synopsis III), p. 105.

Type species: *Rhamnacidites brandonensis* (Trav.) Pot. *ibid.*

Diagnosis: "Suboblate to subprolate, equator very triangular; differs from *Vitipites* in that the germinal regions more or less protrude in the equatorial outline." Tricolporate pollen (Jansonius and Hill, 1976).

1. *Rhamnacidites triangulus* Song et Zheng 1981

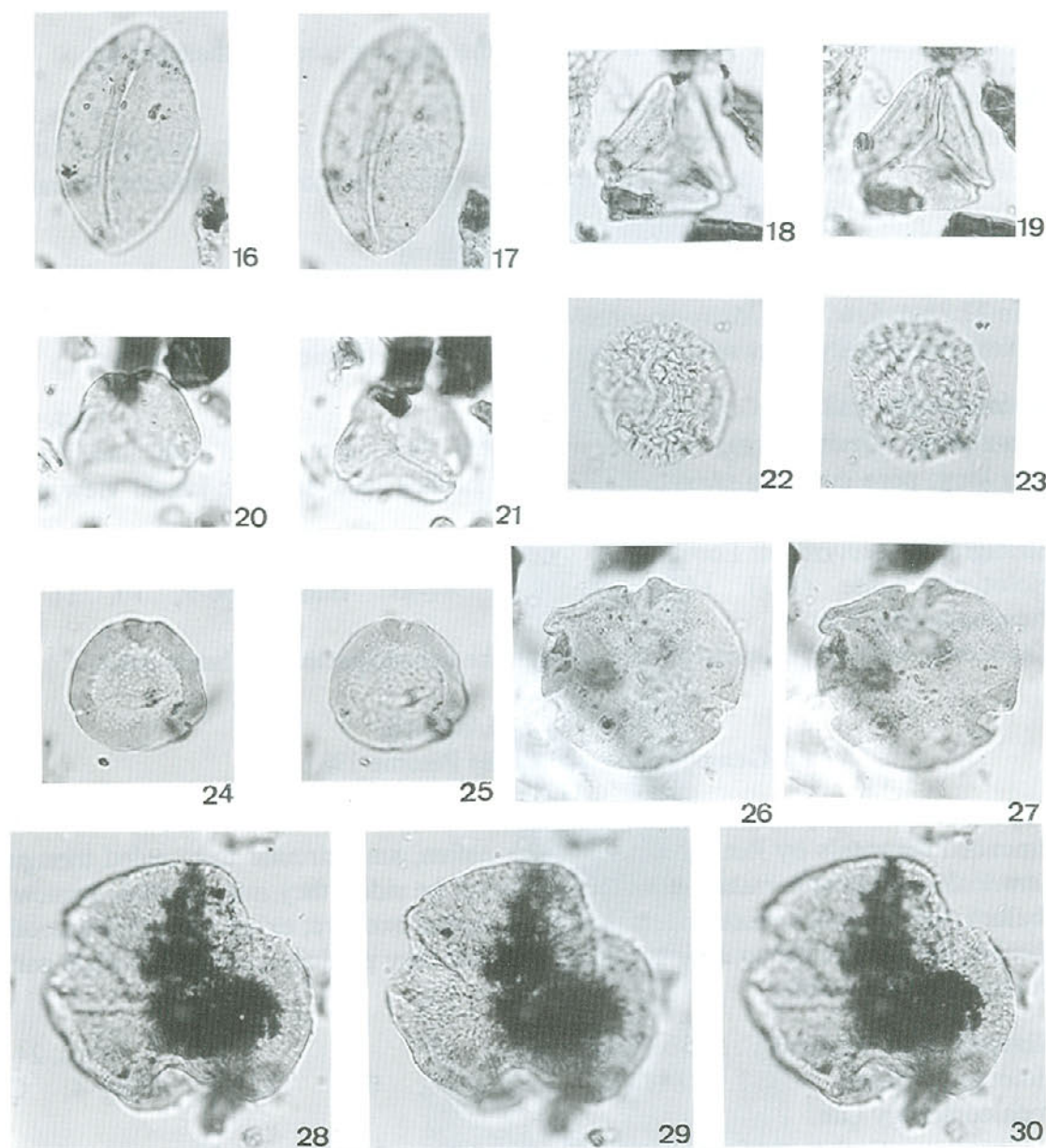
Figs. 31-33

Description: Grains tricolporate, semi-lobate; 19-21  $\mu\text{m}$ ; colpi very pronounced, about 7-10  $\mu\text{m}$  long; pore labrum type, 2.5-3  $\mu\text{m}$  wide; surface view smooth; lateral view psilate; exine about 1  $\mu\text{m}$  thick.

Stratigraphic occurrence: Eocene (OK-1 well, 1955m)

Selected slide: OK-1 1955- (5); Figs. 31-33; film W98-8, 9, 10; CPC Micropaleontology Lab.

Taxonomic affinity: This species is similar to the extant species of Rhamnaceae.



Figs. 16-17. *Confertisulcites pengchiahsuensis* C. L. Shaw *sp. nov.* OK-2, 1400m-5, W99-17, 18; Figs. 18-19. *Myrtaceidites granulatus* Ke & Shi OK-1, 1894m-2, TL21-9, 10; Figs. 20-21. *Myrtaceidites vulgatus* C. L. Shaw *sp. nov.* OK-1, 1894m-2, TL21-9, 10; Figs. 22-23. *Persicarioipollis minus* (Huang) C. L. Shaw *comb. nov.* OK-2, 1901m-4, TL19-16, 17; Figs. 24-25. *Tiliaepollenites zonatus* C. L. Shaw *sp. nov.* OK-2, 1810m-4, TL19-3, 4; Figs. 26-27. *Tiliaepollenites instructus* (Pot.) Potonie OK-1, 1955m-4, W97-20, 21; Figs. 28-30. *Patriniapollenites formosensis* C. L. Shaw *sp. nov.* OK-1, 1638m-3, PF67-23, 24, 25 (All figures x1000) MAGNOLIACEAE, MYRTACEAE, POLYGONACEAE, TILIACEAE, VALERIANACEAE

## 2. *Rhamnacidites pengchiahsuensis* C. L. Shaw *sp. nov.*

Figs. 34-35

Description: Grains tricolporate, semi-angular, angular to semi-lobate; 30-40  $\mu\text{m}$ ; colpi very pronounced, about 10-14  $\mu\text{m}$  long; pore crassimarginate, about 6-7  $\mu\text{m}$  wide; surface view rough pattern; lateral view scabrate; exine about 1  $\mu\text{m}$  thick.

Stratigraphic occurrence: Eocene (OK-3 well, 1780m)

Holotype: Slide OK-3 1780- (1); Figs. 34-35; film PF61-9, PF61-10.; CPC Micropaleontology Lab.

Taxonomic affinity: This species is similar to the extant species of Rhamnaceae.

3. **Rhamnacidites nanhaiensis** Song, Li et Zheng 1986 Figs. 36-40

Description: Grains tricolporate, angular to semi- angular; 17-21  $\mu\text{m}$ ; colpi with line-like band, about 7-11  $\mu\text{m}$  long; pore club type, 1-2  $\mu\text{m}$  wide; surface view smooth; lateral view psilate; exine 1-1.5  $\mu\text{m}$  thick.

Stratigraphic occurrence: Eocene (OK-1 well, 1955m)

Selected slide: OK-1 1955- (1); Figs. 36-37; film W98-36, 37; OK-1 1955- (3); Figs. 38-40; film TL21-4, 5, 6; CPC Micropaleontology Lab.

Taxonomic affinity: This species is similar to the extant species of Rhamnaceae.

4. **Rhamnacidites psilatus** C. L. Shaw *sp. nov.* Figs. 41-45

Description: Grains tricolporate, semi- angular; 13-21  $\mu\text{m}$ ; colpi with line-like band, 4-8  $\mu\text{m}$  long; pore common type, 3-4  $\mu\text{m}$  wide; surface view smooth; lateral view psilate; exine about 1  $\mu\text{m}$  thick.

Stratigraphic occurrence: Eocene (OK-1 well, 1955m)

Holotype: Slide OK-1 1435- (2); Figs. 41-43; film PF66-9, 10, 11 CPC Micropaleontology Lab.

Taxonomic affinity: This species is similar to the extant species of Rhamnaceae.

### Family 10 TILIACEAE

#### Genus 1 *Tiliaepollenites* Potonie 1931.

Type species: *Tiliaepollenites indubitabilis* Pot

Emended diagnosis by Pot. 1960: Lenticular pollen, amb circular to rounded triangular; the germinals not in the corners, but in the middle of the sides; they may protrude somewhat, vestibulum distinct, exine more or less thickened around exopore; exine on outline smooth to roughened; the columellae so arrange that in topview they produce an infrareticulate pattern (Jansonius and Hill, 1976).

1. ***Tiliaepollenites zonatus*** C. L. Shaw *sp. nov.* Figs. 24-25

Holotype: Slide OK-2 1810-(4); Figs.24-25; film TL19-3, TL19-4; CPC Micropaleontology Lab.

Description: Grains 4-porate; amb circular to quadrigonal; 19-22  $\mu\text{m}$  wide; pore crassimarginate, 2-3  $\mu\text{m}$  thick; surface view reticulate; lateral view scabrate; exine zonate, 3  $\mu\text{m}$  thick.

Stratigraphic occurrence: Eocene (OK-2 well, 1810m)

Note: This variety is similar to the species of *Tiliaepollenites formosensis* Shaw but differs in having zono-exine.

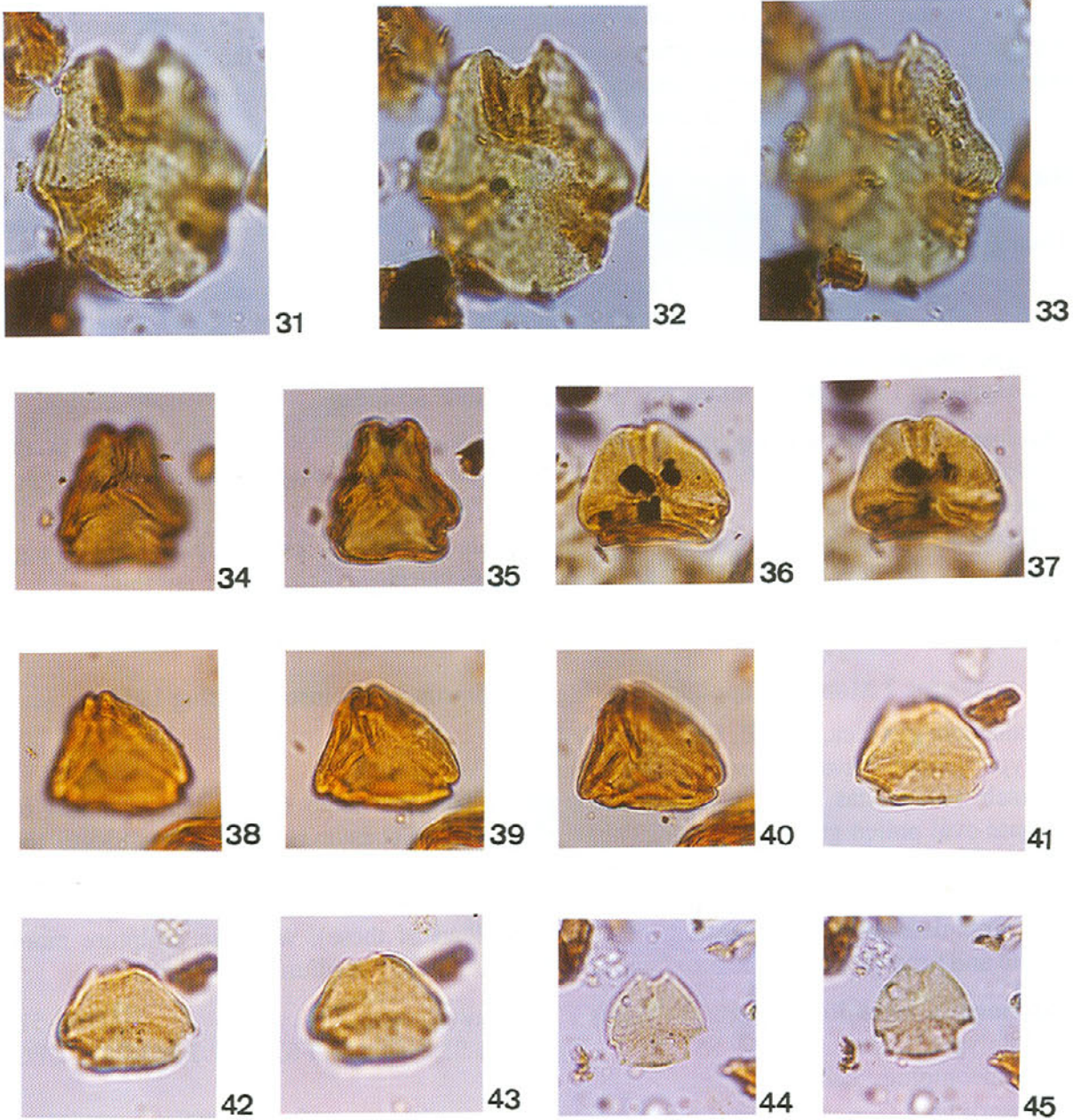
2. ***Tiliaepollenites instructus*** (Pot.) Potonié 1960 Figs. 26-27

Selected slide: OK-1 1955-(1); Figs. 26-27; film W97-20, 21; CPC Micropaleontology Lab.

Description: Grains 3-colporate; amb circular; 30-34  $\mu\text{m}$  wide; pore crassimarginate, 2-4  $\mu\text{m}$  thick; surface view reticulate to finely reticulate; lateral view scabrate; exine 1  $\mu\text{m}$  thick.

Stratigraphic occurrence: Eocene (OK-1 well, 1955m)





Figs. 31-33. *Rhamnacidites pengchiahsuensis* C. L. Shaw *sp. nov.* OK-3, 1780m-1, PF61-8, 9, 10; Figs. 34-35. *Rhamnacidites triangulus* Song et Zheng OK-1, 1955m-4, W97-34, 35; Figs. 36-40. *Rhamnacidites nanhaiensis* Song, Li et Zheng OK-1, 1955m-1, W98-36, 37; OK-1, 1955m-3, TL21-4, 5, 6; Figs. 41-45. *Rhamnacidites psilatus* C. L. Shaw *sp. nov.* OK-1, 1435m-2, PF66-9, 10, 11; OK-1, 1545m-1, PF66-36, 37 (All figures x1000)  
RHAMNACEAE

### Family 11 VALERIANACEAE

#### Genus 1 *Patriniapollenites* Huang & Huang 1984

Type species: *Patriniapollenites taiwanensis* Huang & Huang 1984

Diagnosis: Grains 3-colpate; exine ca. 2.5  $\mu\text{m}$  thick, with echinate processes (Huang & Huang 1984).

1. **Patriniapollenites formosensis** C. L. Shaw *sp. nov.*

Figs. 28-30

Description: Grains 3-colpate; amb circular, 40-44  $\mu\text{m}$  wide; colpi 15-18  $\mu\text{m}$ ; exine 1.5-2  $\mu\text{m}$  thick, with loosely echinate processes in lateral view, echini 1 x 0.5  $\mu\text{m}$ ; surface view extravermiculate to striate, echini un conspicuous.

Stratigraphic occurrence: Eocene (OK-1 well, 1638m)

Holotype: Slide OK-1 1638-(3); Figs. 28-30; film PF67-23, PF67-24, PF67-25; CPC Micropaleontology Lab.

Taxonomic affinity: This species is similar to the extant *Patrinia* of the Valerianaceae (Huang 1972, pl. 159: 3-6).

**Family 12 INCERTAE****Genus 1 Gemmatricolporites** Leide Meyer 1966

Type species: *Gemmatricolporites berbicensis* Leide Meyer

Diagnosis: Tricolporate pollen grain with a gemmate sculpture.

1. **Gemmatricolporites pengchiahsuensis** C. L. Shaw *sp. nov.*

Figs. 46-47

Holotype: Slide OK-1 1365-(1); Figs. 46-47; film PF63-15, PF63-16; CPC Micropaleontology Lab.

Description: Grains tricolporate, amb circular-lobate; 22-24  $\mu\text{m}$ ; colpi 7-8  $\mu\text{m}$  long; surface view finely granulate; lateral view gemmate to verrucate; exine 1-1.5  $\mu\text{m}$  thick.

Stratigraphic occurrence: Eocene (OK-1 well, 1365m)

Taxonomic affinity: Unknown.

**Genus 2 Monocolpopollenites** Pflug & Thomson in Thomson & Pflug 1953

Palaeontographica, Abt. B, Bd. 94, p. 62

Type species: *Monocolpopollenites tranquillus* (Pot.) n. comb.

Krutzsch 1970 (Atas, v. 7, p. 27) gives the following restricted diagnosis: "Elliptical to elongate oval pollen grains, in lateral outline often somewhat asymmetrical; monosulcate, the furrow usually of more or less even width and usually not extending over full length, i.e. closed before the end (or ends) of the grain. Exine smooth to finely sculptured (punctate, finely granulate to flat verrucate, occasionally a blend of these), with the sculpture more definite and pronounced on the proximal face. Small to mostly medium sized forms."

1. **Monocolpopollenites pengchiahsuensis** C. L. Shaw *sp. nov.*

Figs. 50-51

Holotype: Slide OK-1 1375-(1); Figs. 50-51; film PF63-27, PF63-28; CPC Micropaleontology Lab.

Description: Grains monosulcates; subellipsoidal; 19x30  $\mu\text{m}$ ; surface view finely granulate; lateral view scabrate; exine 0.5-1  $\mu\text{m}$  thick.

Stratigraphic occurrence: Eocene (OK-1 well, 1375m)

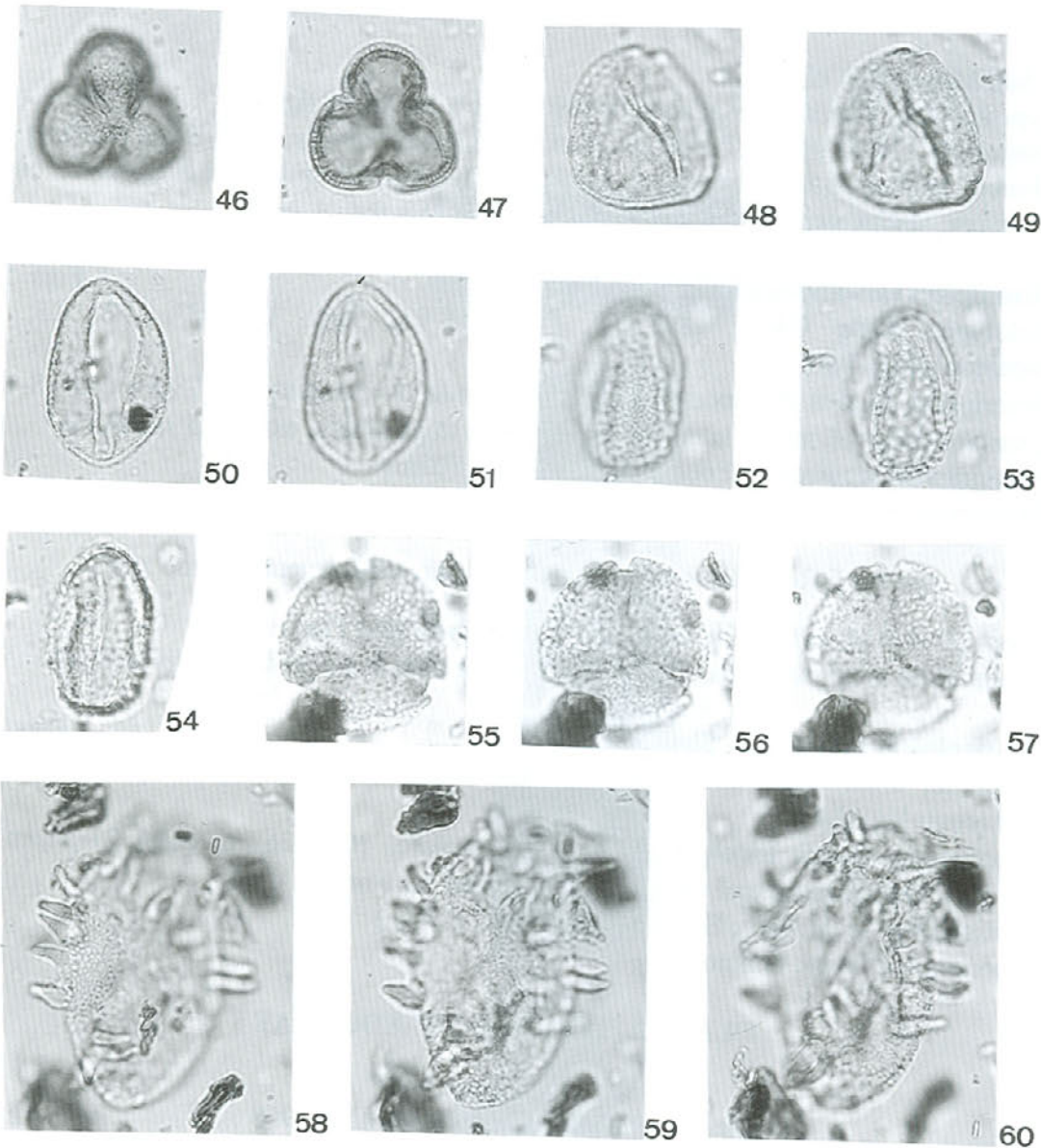
Taxonomic affinity: Unknown.

**Genus 3 Triporopollenites** Pflug & Thomson in Thomson & Pflug 1953

Palaeontographica Bd. 94, Abt. B, 82, Pl. 9. Fig. 2a.

Type species: *Triporopollenites coryloides* (Potonie) Th. & Pfl.

Diagnosis: Grains 3-porate; amb angular to round triangular, never circular; pore equatorial, at the corner, never with atrium, vestibulum or post-vestibulum; endexine and ektexine always tightly appressed; enporus less than three times the exoporus; no interloculum, solution-wedge, oculus, praevestibulum, endanulus; occasionally with anulus or labrum.



Figs. 46-47. *Gemmatricolporites pengchiahsuensis* C. L. Shaw *sp. nov.* OK-1, 1365m-1, PF63-15, 16; Figs. 48-49. *Triporopollenites scabratus* C. L. Shaw *sp. nov.* OK-1, 1375m-1, PF63-25, 26; Figs. 50-51. *Monocolpopollenites pengchiahsuensis* C. L. Shaw *sp. nov.* OK-1, 1375m-1, PF63-27, 28; Figs. 52-54. *Retitricolpites verus* C. L. Shaw *sp. nov.* OK-1, 1375m-1, PF63-34, 35, 36; Figs. 55-57. *Wilsonipites taiwanensis* C. L. Shaw *sp. nov.* OK-1, 1825m-2, TL21-21, 22, 23; Figs. 58-60. *Spinizonocolpites pengchiahsuensis* C. L. Shaw *sp. nov.* OK-3, 1800m-2, WA77-14, 15, 16 (All figures x1000) INCERTAE, PALMAE

1. *Triporopollenites scabratus* C. L. Shaw *sp. nov.*

Figs. 48-49

Holotype: Slide OK-1, 1375-1; Figs. 48-49; PF63-25, PF63-26; CPC Micropaleontology Lab.

Description: Grains 3-porate; amb semi-angular; 23-26  $\mu\text{m}$ ; aperture tumescence type, pores 6-7  $\mu\text{m}$  wide; surface view rough pattern; lateral view scabrate; exine thin, 0.5  $\mu\text{m}$  thick.

Stratigraphic occurrence: Eocene (OK-1 well, 1375m)

Taxonomic affinity: Unknown.

**Genus 4 Wilsonipites** Srivastava 1969

J. Sen Memorial Vol., p. 63

Type species: *Wilsonipites nevisensis* Sriv., l.c., p. 64, pl. 2, fig. 36

Diagnosis: "Tricolporate, oblate to spherical, angulaperturate; colpi long, reaching poles, meridional, narrow; pores equatorial, small, inconspicuous; amb subtriangular to circular, sides convex; sexine very thin, scabrate, reticulations less than 1  $\mu\text{m}$ ."

1. **Wilsonipites taiwanensis** C. L. Shaw *sp. nov.* Figs. 55-57

Holotype: Slide OK-1 1805-(2); Figs. 55-57; film TL21-21, 22, 23; CPC Micropaleontology Lab.

Description: Grains tricolporate, amb semi-angular to circular; 25-27  $\mu\text{m}$ ; colpi 8-11  $\mu\text{m}$  long; surface view reticulate; lateral view verrucate to gemmate; exine 1.5  $\mu\text{m}$  thick.

Stratigraphic occurrence: Eocene (OK-1 well, 1805m)

Taxonomic affinity: Unknown.

**Genus 5 Retitricolpites** van der Hammen 1956 emend. Pierce 1961

Type species: *Retitricolpites ornatus* (van der Hammen) Pierce

Diagnosis: Reticulate tricolpate sporomorphs, subprolate to perprolate; colpi straight.

1. **Retitricolpites verus** C. L. Shaw *sp. nov.* Figs. 52-54

Holotype: Slide OK-1 1375-(1); Figs. 52-54; film PF63-34, PF63-35, PF63-36; CPC Micropaleontology Lab.

Description: Grains tricolpate, subprolate- prolate; 16 x 26  $\mu\text{m}$ ; colpi 21-22  $\mu\text{m}$  long; surface view reticulate; lateral view verrucate; exine 1  $\mu\text{m}$  or less thick.

Stratigraphic occurrence: Eocene (OK-1 well, 1375m)

Taxonomic affinity: Unknown.

**CLASS 2. MONOCOTYLEDONEAE****Family 13 PALMAE****Genus 1 Spinizonocolpites** Muller 1968

Micropaleontology, v. 14, no. 1, p. 11

Type species: *Spinizonocolpites echinatus* Muller. *ibid.*, pl. 3, fig. 3

Diagnosis: "Pollen grains with an encircling colpus of the type occurring in the recent genus *Nypa* (Palmae) and with a finely reticulate wall which is covered with scattered baculate or echinate spines. When dispersed, grains mostly split in two halves."

1. **Spinizonocolpites pengchiahsuensis** C. L. Shaw *sp. nov.* Figs. 58-60

Holotype: Slide OK-3 1800-(2); Figs. 58-60; film W77-14, 15, 16; CPC Micropaleontology Lab.

Description: Grains encircling colpus indistinct; elongated oval shape; 35-37x43-47  $\mu\text{m}$  wide; surface view finely reticulate which is covered with scattered spines; lateral view baculate to echinate; exine 1  $\mu\text{m}$  thick.

Stratigraphic occurrence: Eocene (OK-3 well, 1800m)

Taxonomic affinity: This species is similar to the extant species of Palmae.

## ACKNOWLEDGMENTS

I would like to express my deep appreciation to the Exploration and Research Institute, CPC for providing facilities to conduct this study, the Offshore and Oversea Petroleum Division, CPC for providing subsurface rock samples. This work was supported by National Science Council of the Republic of China under contract NSC89-2116-M-326-001.

## LITERATURE CITED

- Huang, T.-C. 1972. Pollen Flora of Taiwan. 1st. Ed. Botany Dept. NTU.
- Huang, T.-C. 1978. Miocene Palynomorphs of Taiwan (2). Tetrad grains. Bot. Bull. Academia Sinica. **19**: 77-81.
- Huang, T.-C. 1980. Miocene Palynomorphs of Taiwan (5). Angiospermous grains. Taiwania. **25**: 37-103.
- Huang, T.-C. 1981. Miocene Palynomorphs of Taiwan (6). Miscellaneous spores and pollen grains. Taiwania. **26**: 45-57.
- Huang, C.-L. and T.-C. Huang. 1984. Pollen analysis of Taiwan Pliocene (II)-Yunshuichi Section. Taiwania. **29**: 15-110.
- Jansonius, J. and L. V. Hills. 1976. Genera file of fossil spores and pollen. Special Publication, Department of Geology, University of Calgary, Canada.
- Kremp, G. O. W., W. Spackman, H. T. Ames and A. J. Kovar. 1957-1972. Catalog of fossil spores and pollen. The Pennsylvania State University. Vol. 34.
- Shaw, C.-L. 1990. Pollen Analysis of the Cretaceous Sediments of Taiwan. Ph. D. Dissertation of National Taiwan University, Taiwan, 506pp.
- Shaw, C.-L. 1995a. Oligo-Miocene Palynomorphs of Taiwan(2) Angiosperm Grains. J. Taiwan Mus. **48**: 83-104.
- Shaw, C.-L. 1995b. Palynomorphs of Oligo-Miocene of Taiwan. Taiwania **40**: 57-68.
- Shaw, C.-L. 1996. Stratigraphic correlation and isopach maps of the western Taiwan Basin. TAO **7**: 333-360.
- Shaw, C.-L. 1997. Eocene Tiliaceous palynomorphs of Taiwan. Taiwania **42**: 267-273.
- Shaw, C.-L. 1998. Eocene Ephedraceous palynomorphs of Taiwan. Bot. Bull. Acad. Sin. **38**: 69-80.
- Shaw, C.-L. 1999a. Eocene Wetzeliellaceous cysts of Taiwan. Taiwania **44**: 31-48.
- Shaw, C.-L. 1999b. Eocene dinoflagellate cysts of Taiwan. Taiwania **44**: 155-201
- Shaw, C.-L. 1999c. Eocene palynomorphs of Taiwan-Pteridophytic spores. Taiwania **44**: 230-258.
- Shaw, C.-L. 1999d. Eocene angiospermous palynomorphs of Taiwan. Taiwania **44**: 423-478.
- Shaw, C.-L. 2000. Eocene gymnospermous palynomorphs of Taiwan. Taiwania **45**: 13-29.
- Song, Z., X. Guan, Z. Li, Y. Zheng, W. Wang and Z. Hu. 1985. A research on Cenozoic Palynology of the Longjing structural area in the shelf basin of the East China Sea (Donghai) region. Anhui Sci. and Tech. Publishing House.
- Zhu, Z., L. Wu, P. Xi, Z. Song, and Y. Zhang. 1985. A Research on Tertiary Palynology from the Qaidam Basin, Qinghai Province. Research Institute of Explo. & Devel., Qinhai Petrol. Administration and Nanjing Institute of Geol. & Palaeontology, Academia Sinica, The Petroleum Industry Press, 297pp.

## 台灣始新統被子植物化石花粉(II)

蕭承龍<sup>(1)</sup>

(收稿日期：2000年3月27日；接受日期：2000年4月30日)

## 摘 要

本文於台灣基隆北方海域始新世地層中，發現並描述十三科十七形態屬二十二形態種，其中十三種為新種(*Confertisulcites pengchiahsuensis* Shaw sp. nov.; *Rhamnacidites pengchiahsuensis* Shaw sp. nov.; *Gemmatricolporites pengchiahsuensis* Shaw sp. nov.; *Triporopollenites scabratus* Shaw sp. nov.; *Monocolpopollenites pengchiahsuensis* Shaw sp. nov.; *Retitricolpites verus* Shaw sp. nov.; *Myrtaceidites vulgatus* Shaw sp. nov.; *Rhamnacidites psilatus* Shaw sp. nov.; *Wilsonipites taiwanensis* Shaw sp. nov.; *Margocolporites taiwanensis* Shaw sp. nov.; *Patriniapollenites formosensis* Shaw sp. nov.; *Tiliaepollenites zonatus* Shaw sp. nov.; *Spinizonocolpites pengchiahsuensis* Shaw sp. nov.)，二種為新聚合種(*Striatopollis reticulatus* (Nagy) Shaw comb. nov.; *Persicarioipollis minus* (Huang) Shaw comb. nov.)，七種為新記錄種。

關鍵詞：始新統，被子植物化石孢粉，分類，台灣。

1. 國立台灣史前文化博物館籌備處，研究典藏組，台東950，台灣，中華民國。