

Eocene Angiospermous Palynomorphs of Taiwan (II)

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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.; *Gemmaticolporites pengchiahsuensis* C. L. Shaw sp. nov.; *Triporopollenites scabrinatus* 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.; *Margicolporites 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.

KEY WORDS: Eocene, Angiospermous palynomorphs, Taxonomy, Taiwan area.

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), Wetzelieillaceous 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 ZnCl₂ for flotation (S. G. 1.8-2.2), 30% of HCl for calcite, and 52% of HF for maceration of the laterite pebble samples.

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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 scabrinatus* C. L. Shaw sp. nov.; *Monocolpopollenites pengchiahsuensis* C. L. Shaw sp. nov.; *Retitricolpites verus* C. L. Shaw sp. nov.; *Myrtaceidites vulgaris* 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 (*Striatopolis 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 *Striatopolis* Krutzsch 1959

Type species: *Striatopolis sarstedtensis* Krutzsch 1959

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

1. *Striatopolis 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 tricolporate, subprolate to prolate-spheroidal; 23x 31 μm ; colpi 26 μm long; surface view striate; lateral view scabrate; exine 1 μm thick.

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

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

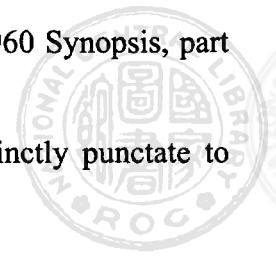
Family 2 JUGLANDACEAE

Genus 1 *Caryapollenites* Raatz (1937) 1938 ex Potonié 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 μm wide; pores circular arranged subequatorially; surface view obscure pattern, lateral view psilate; exine 1 μm 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 μm 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 μm wide; margo 1-1.5 μm thick; pore crassimarginate 7-10 μm wide; surface view granulate; lateral view verrucate; exine about 1 μm 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.

Diagnosis: Grains tricolporate 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 interradial 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).

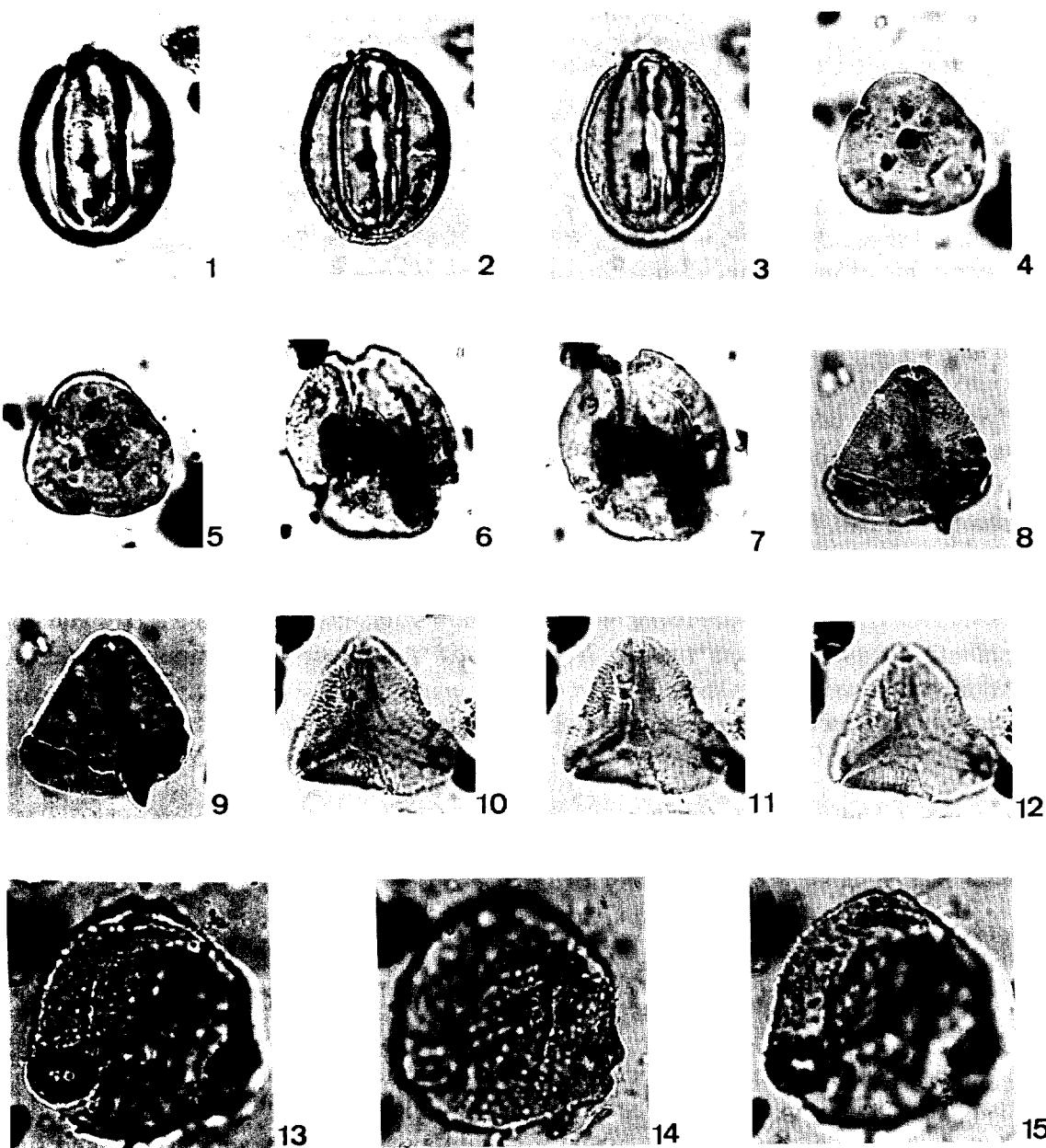
1. *Cranwellia rumseyensis* Srivastava 1966

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 μm wide; colpi 9-14 μm 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 μm 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 $\times 1000$) ACERACEAE, JUGLANDACEAE, LEGUMINOSAE, LORANTHACEAE, PROTEACEAE

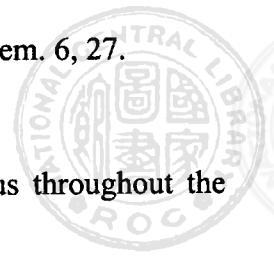
Family 5. MAGNOLIACEAE

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 $0.5-1 \mu\text{m}$ 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-subspheroidal; 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; $18-23 \mu\text{m}$; colpi about $10-12 \mu\text{m}$ 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 issimilar to the extant species of Myrtaceae.

2. *Myrtaceidites vulgatus* C. L. Shaw *sp. nov.*

Figs. 20-21

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

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 μm wide; surface view lopho-reticulate, lacuna 1-2.5 μm wide, muri 1-2 μm thick; lateral view baculate, clavate or echinate; exine 1-2 μm 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 adenanthoides* 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 μm wide; pore crassimarginate, 7-9 μm thick; surface view granulate; lateral view gemmate to clavate; exine 0.5 μm 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

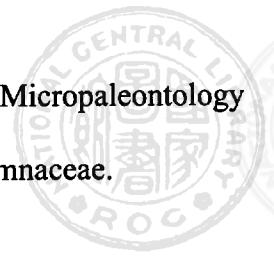
Figs. 31-33

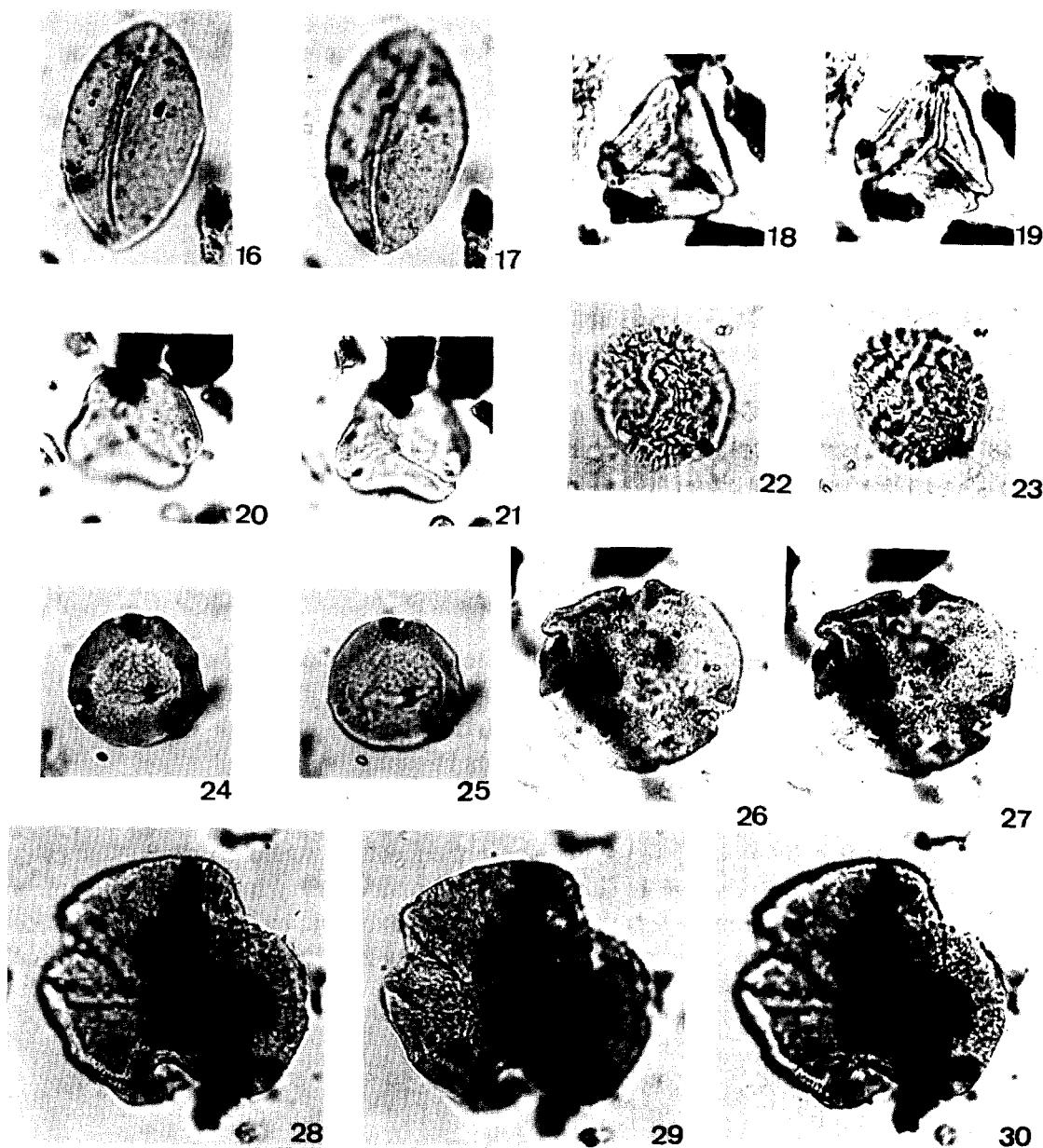
Description: Grains tricolporate, semi-lobate; 19-21 μm ; colpi very pronounced, about 7-10 μm long; pore labrum type, 2.5-3 μm wide; surface view smooth; lateral view psilate; exine about 1 μm thick.

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. *Patriniaipollenites 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 μm ; colpi very pronounced, about 10-14 μm long; pore crassimarginate, about 6-7 μm wide; surface view rough pattern; lateral view scabrate; exine about 1 μm 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 μm ; colpi with line-like band, about 7-11 μm long; pore club type, 1-2 μm wide; surface view smooth; lateral view psilate; exine 1-1.5 μm 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 μm ; colpi with line-like band, 4-8 μm long; pore common type, 3-4 μm wide; surface view smooth; lateral view psilate; exine about 1 μm 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* Potonié 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 μm wide; pore crassimarginate, 2-3 μm thick; surface view reticulate; lateral view scabrate; exine zonate, 3 μm 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 μm wide; pore crassimarginate, 2-4 μm thick; surface view reticulate to finely reticulate; lateral view scabrate; exine 1 μm thick.

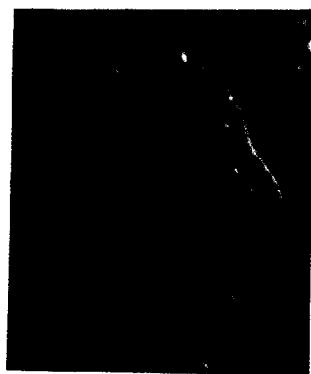
Stratigraphic occurrence: Eocene (OK-1 well, 1955m)



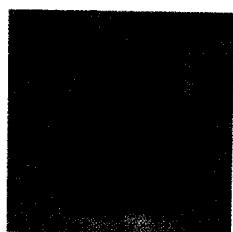
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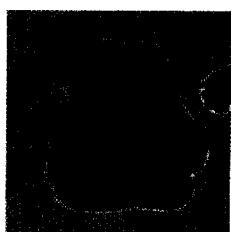
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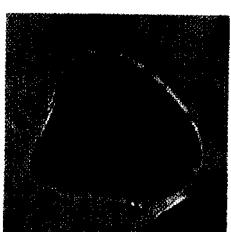
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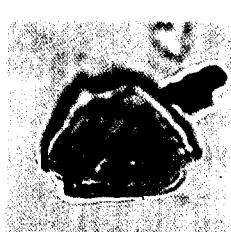
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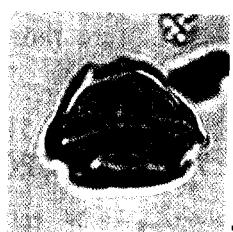
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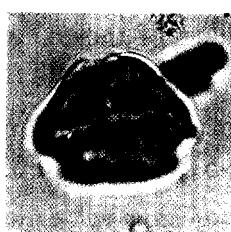
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41



42



43



44



45

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-colporate; exine ca. 2.5 μm thick, with echinate processes (Huang & Huang 1984).



1. ***Patrinia pollenites formosensis*** C. L. Shaw *sp. nov.*

Figs. 28-30

Description: Grains 3-colporate; amb circular, 40-44 μm wide; colpi 15-18 μm ; exine 1.5-2 μm thick, with loosely echinate processes in lateral view, echini 1 x 0.5 μm ; 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 ***Gemmatoxopollenites*** Leidelmeyer 1966

Type species: *Gemmatoxopollenites berbicensis* Leidelmeyer

Diagnosis: Tricolporate pollen grain with a gemmate sculpture.

1. ***Gemmatoxopollenites pengchiahnsensis*** 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 μm ; colpi 7-8 μm long; surface view finely granulate; lateral view gemmate to verrucate; exine 1-1.5 μm 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 pengchiahnsensis*** 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 monosulcate; subellipsoidal; 19x30 μm ; surface view finely granulate; lateral view scabrate; exine 0.5-1 μm thick.

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

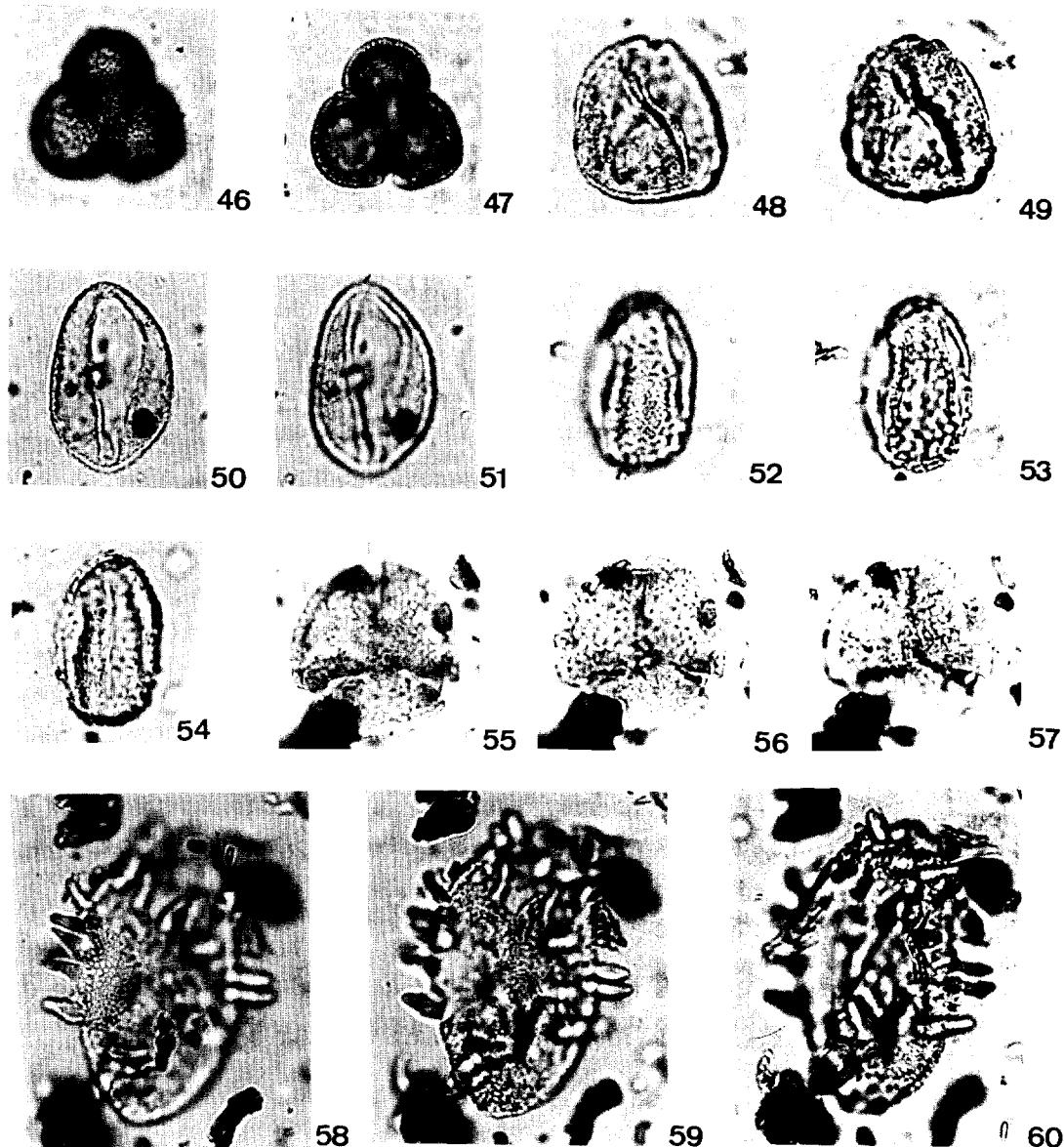
Taxonomic affinity: Unknown.

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

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

Type species: *Triporopollenites coryloides* (Potonié) 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 ektxine 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. *Gemmaticolporites pengchiahsuensis* C. L. Shaw sp. nov. OK-1, 1365m-1, PF63-15, 16; Figs. 48-49. *Triporopollenites scabrus* 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 scabrus* C. L. Shaw sp. nov.

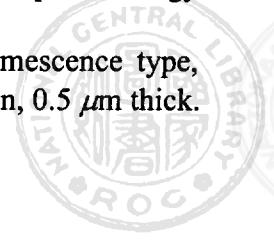
Holotype: Slide OK-1, 1375-1; Figs. 48-49; PF63-25, PF63-26; CPC Micropaleontology Lab.

Description: Grains 3-porate; amb semi-angular; 23-26 μm ; aperture tumescence type, pores 6-7 μm wide; surface view rough pattern; lateral view scabrate; exine thin, 0.5 μm thick.

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

Taxonomic affinity: Unknown.

Figs. 48-49



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 μm .

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 μm ; colpi 8-11 μm long; surface view reticulate; lateral view verrucate to gemmate; exine 1.5 μm 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 tricolporate 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 tricolporate, subprolate- prolate; 16 x 26 μm ; colpi 21-22 μm long; surface view reticulate; lateral view verrucate; exine 1 μm 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 one 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.

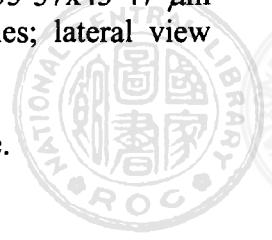
Figs. 58-60

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 μm wide; surface view finely reticulate which is covered with scattered spines; lateral view baculate to echinate; exine 1 μm thick.

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

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



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台灣始新統被子植物化石花粉(II)

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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(*Striatopolis 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。

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