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Early Tertiary Normapolles and Related Palynomorphs of China (II)

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ABSTRACT: This paper describes the normapolles and other related palynomorphs from Caomuhao Gypsum Mine strata of Otog Banner, Inner Mongolia, Funing Group of northern Jiangsu, and Menli Formation of Sanmenxia Area in Henan. A total of 20 genera, 7 of which are new and 60 species, 44 of which are new, were described. The seven new genera are *Concavitriporites, Ditriangulipollis, Ditriporites, Echibasopollis, Erlianipollis, Neimongolipollis* and *Otogipollis*.

KEY WORDS: Early Tertiary, Normapolles, China.

This is the second part of my work on the Early Tertiary Normapolles and related palynomorphs of China. The first part was published earlier in the same journal (Song, 1996). This part concentrates on the taxonomy. For this paper only 20 genera and 60 species are presented. For identification, the following papers were consulted: Goczan *et al.* 1967; Pflug, 1953; Hao & Chen 1983; Song 1996; Song *et al.* 1981; 1986; Sun *et al.* 1979; Thomson et Pflug, 1953; and Tschcdy, 1975.

All specimens were collected from the Lower Tertiary, the Naomugen Formation of Inner Mangolia unless otherwise stated. All specimens illustrated here were deposited at the Palynological Division of Nanjing Institute of Geology and Palaeontology, Academia Sincia. All figures are at a magnification of x 800 unless otherwise stated.

BASOPOLLIS PFLUG, 1953

Type species: *Basopollis orthobasalis* (Pflug) Pflug 1953

Basopollis basalis (Pflug & Thoms.) Pflug 1953 Pl. 9. figs. 12-15

Basopollis basalis, Pflug, S. 110, Taf. 21, Fige. 51, 52 1953

Amb triangular, diamater 25-30 μm.

Occurrence: Otog Banner, Inner Mongolia; Lower Tertiary.

Basopollis concavus *sp. nov.* Pl. 1, figs. 1-3

Amb triangular, with concave sides and elongated angles, 25-35 μm, in diameter,

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(holotype 30 μm); triporate, pore with long atrium formed only by sexine, inner sides uneven, pore canal index over 0.4; exopore round, 2-3 μm wide, endopore over 5 μm wide; exine over 2 μm thick, sexine thicker than nexine and slightly thickening in pore area, nexine extending only to the base of pore, vestibula unclear; granulate, outline uneven.

In pore structure, the new species is similar to *B. atumescens* (Pflug) Pflug (1953, Taf. 21, Fig. 47, 48), but the former differs from the latter in having thin exine and granulate ornamentation. While latter has a smooth surface, with exine *ca.* 4 μm thick.

Occurrence: Otog Banner, Inner Mongolia; Lower Tertiary.

Type: Pl. 1, fig. 3; Slide no.: *685(8-5)*.

Basopollis granulatus *sp. nov.* Pl. 1, figs. 4-6

Amb triangular, with straight or slightly concave sides and rounded angles, diameter 25-40 μm (holotype 34 μm); triporate, pore with praevestibula; exine 3 μm thick, nexine thin and only extending to base of pore; sexine several times thicker than nexine, thickened at base of vestibula and then becoming thinner and thicker again along pore margin to form a long-cylindrical vestibula, with its inner sides denticulate; pore canal tube-shaped, pore canal index 0.4, exopore small, *ca.* 2-3 μm wide and endopore 5 μm wide; granulate.

This species is characterized by its long-cylindrical vestibula and granulate ornamentation.

Occurrence: Otog Banner, Inner Mongolia; Lower Tertiary.

Type: Pl. 1, fig. 5; slide no.: *683(C-11)*.

Basopollis major *sp. nov.* P1. 1, figs. 7-10

Amb triangular, with convex sides and cylindrically elongated angles, type specimen 42 μm in diameter; triporate, pore with praevestibula situated in posterior part of atrium, pore canal index over 0.5, exopore round, 2-3 μm wide, endopore over 5 μm wide, praevestibula large, *ca* 5-6 μm wide; exine 2-3 μm thick, sexine twice thicker than nexine, nexine encircling a round area of body, about 22-25 μm in diameter; surface smooth to microgranulate.

This species is characterized by its large size and solid annulus of pores.

Occurrence: Otog Banner, Inner Mongolia; Lower Tertiary.

Type: Pl. 1, fig. 10; slide no.: *683(12-2)*.

Basopollis obscurocostatus Tschudy 1975 Pl. 9, fig. 16

Basopollis obscurocostatus Tschudy, P. 8. Pl. 1. Figs. 1-12, textfis. 1, 1975

Amb triangular, diameter 30-35 μm.

Occurrence: Otog Banner, Inner Mongolia; Lower Tertiary.

Basopollis orthobasalis (Pflug) Pflug 1953 Pl. 9, fig. 11

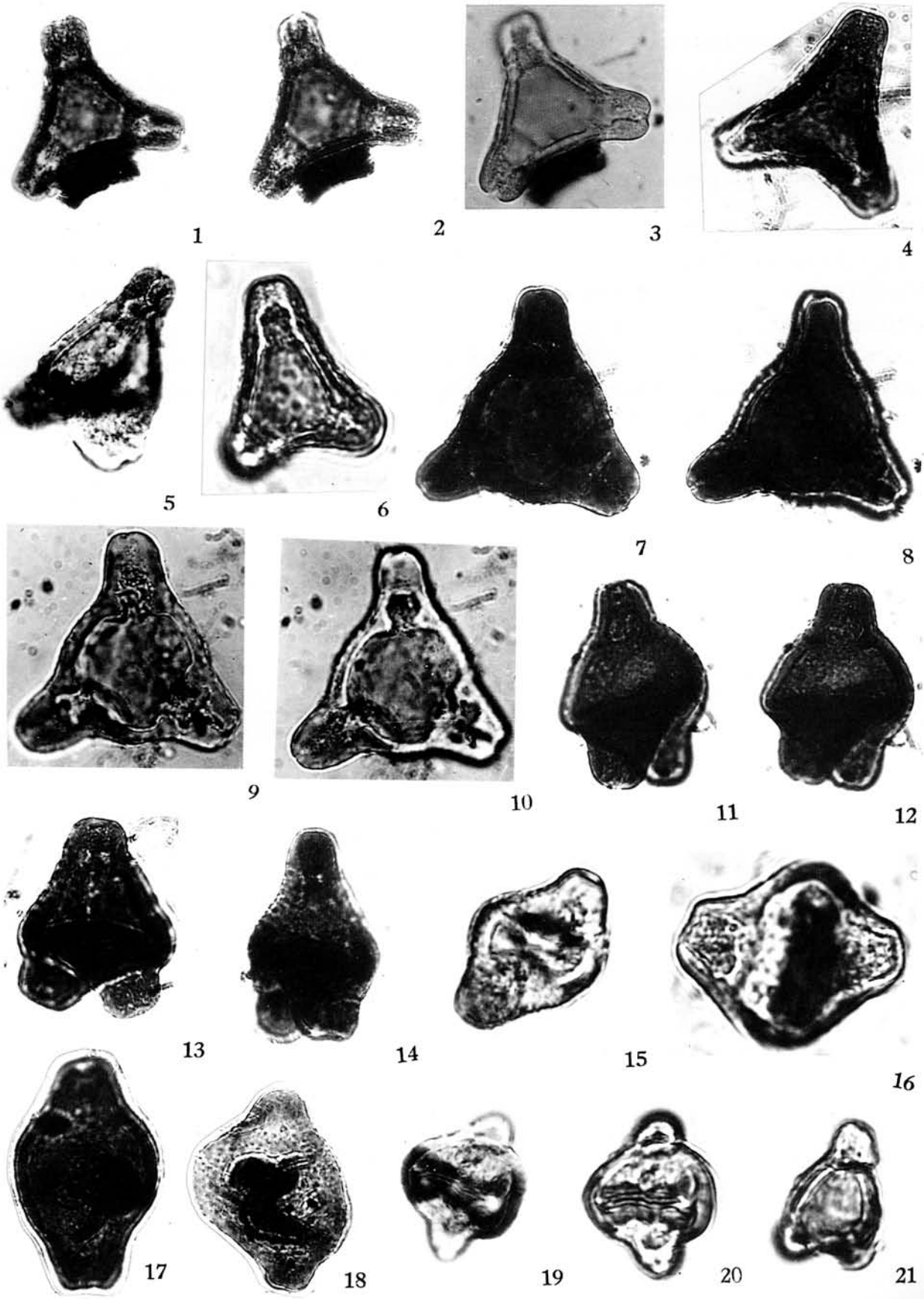
Basopollis orthobasalis (Pflug) Pflug, S. 110, Taf. 21, Figs. 45, 46, 1953

Amb triangular,diameter 40 μm.

Occurrence: Otog Banner, Inner Mongolia; Lower Tertiary.

Basopollis periodus (Pflug) Pflug 1953 Pl. 9, figs. 17-18

Basopollis periodus (Pflug) Pflug, S. 110, Taf. 21, Figs. 49, 50, 1953



Pl. 1. Normapolles sporomorphs, figs.1-3. *Basopollis concavus*, 685(8-5); figs. 4-6. *Basopollis granulatus*, 479(D-6), 683(C-11), 683(A-3); figs. 7-10. *Basopollis major*, 683(12-2); figs. 11-18. *Brosipollis major*, 683(4-5), 683(11-6), 683(B-6), 479(D-12), 523(4-7), Men3(2-2), San1(13-1); figs. 19-21. *Brosipollis solidus*, 479(D-2), 683(1-4), 687(19-5).

Amb triangular, diameter 23-35 μm
Occurrence: Otog Banner, Inner Mongolia; Lower Tertiary.

BROSIPOLLIS Krutzsch, 1968

Type Species: Bro*sipollis salebrosus* (Pflug) Krutzsch 1968

Brosipollis major *sp. nov.* Pl. 1. figs. 11-18

Specimens preserved in lateral view, outline rounded, 35-45 μm and holotype 35 μm (including projection) in diameter; triporate, equato-angulaperturate, pore with praevestibula, protruding about 9 μm high; exine 2.5-3.5 μm thick, nexine thin and extending only to base of pore, sexine several times thicker than nexine, separated at base of pore to form praevestibula, and then extending to and becoming slightly thinner along pore margin; pore canal index nearly 0.4; exopore oval and 3-5 μm wide, endopore 5-8 μm wide; microgranulate.

The new species is characterized by large size and clear praevestibula, in which it differs from the Eocene German specimens of *B. salebrosus*; the latter is small (less than 30 μm) and without praevestibula.

Occurrence: Otog Banner, Inner Mongolia, Lower Tertiary; Shanmenxia Area, Henan, Menli Formation.

Type: Pl. 1, fig. 11; slide no.: *683(4-5)*.

Brosipollis solidus *sp. nov.* Pl. 1, figs. 19-21; pl. 2, figs. 1-5

Amb roundedly triangular, outline in lateral view oval to round, 25-35 μm (holotype 30 μm) in diameter; triporate, pore with praevestibula or atrium, protruding 5-6 μm high; exine 2.5-3 μm thick, sexine several times thicker than nexine and slightly separated at base of pore to form praevestibula, pore canal unclear; pore canal index 0.4; exopore oval and 2-3 μm wide, endopore 4-5 μm wide; scabrate to finely granulate.

The new species difffers from *B. major* in its small size and relatively thicker exine, and from *B. salebrosus* in the praevestibula and unclear atria.

Occurrence: Otog Banner, Inner Mongolia, Lower Tertiary; Shanmenxia Area, Henan, Menli Formation.

Type: Pl. 2, fig. 1; slide no.: *479(7-3)*.

CERCIDIPHYLLITES Mtchedlishvili, 1961

Type Species: *Cercidiphyllites brevicolpatus* Mtched. 1961

Cercidiphyllites tuberculatus *sp. nov.* P1. 2, figs. 6-7

Amb roundedly triangular, holotype 40 μm in diateter; tribrevicolpate, colpi 18-25 μm wide, terminal ends rounded; ornamentation tuberculate and punctate between tubercula.

This species differs from the type species in having tuberculate ornamentation, instead of the punctate ornamentation.

Occurrence: Otog Banner, Inner Mongolia, Lower Tertiary.

Type: Pl. 2, fig. 7; slide no.: *San1(1-1)*.

CONCAVITRIPORITES *gen. nov.*

Type species: *Concavitriporites concavus gen. et sp. nov.*

Diagnosis: pollen oblate; amb triangular with deeply concave sides; triporate, equato-angulaperturate, pore small, without vestibula and stria; exine solid, sexine thicker than nexine; arc thickened bands on concave sides extending along equator; granulate or microspinate.

Remarks: This new genus is characterized by the deeply concave sides and simple pore. It differs in the simple pore and arc thickening from *Concavipollis* Krutzsch 1967 which has vestibula but without arc thickening.

Occurrence: China, Lower Tertiary.

Concavitriporites concavus *gen. et sp. nov.* Pl. 2, figs. 8-9

Amb triangular with concave sides, which in one hemisphere are deeper than others, forming arc thickened bands at pole area, diameter of holotype 40 μm; triporate, pore round, *ca.* 4 μm wide; exine *ca.* 3 μm thick, sexine several times thicker than nexine, up to 6 μm in pore area; scabrate to granulate, outline rough.

Occurrence: Otog Banner, Inner Mongolia, Lower Tertiary.

Type: Pl. 2, fig. 9; slide no.: *479(4-1)*.

Concavitriporites baculatus *sp. nov.* P1. 2, figs. 10-14

Amb triangular with concave sides, 35-45 μm (holotype 42 μm) in diameter; triporate, pore round, 2-5 μm and *ca.* 4 μm wide in holotype; exine 2-3 μm thick, sexine thicker than nexine, with baculate structure; granulate, outline rough.

This species differs from *C. concavus* in the absence of annulus at pore and the presence of baculate structure on exine.

Occurrence: Otog Banner, Inner Mongolia, Lower Tertiary; Sanmenxia Area, Henan, Menli Formation.

Type: Pl. 2, figs. 12; slide no.: *San 1(9-1)*.

DERMATOBREVICOLPORITES Kar, 1985 emend. herein

Type Species: *Dermatobrevicolporites dermatus* (Sah *et* Kar) Kar 1985

The emendation of this genus is only on the ornamentation, which is laevigate, granulate, and even tuberculate and striate in appearance.

Dermatobrevicolporites baculatus *sp. nov.* P1. 2, figs. 15-18

Amb triangular to roundedly triangular, holotype 25 μm in diameter; tricolporate, pore with atrium and thickened bands at base of atrium, as annulus around it, colpi slit, slightly longer than the atrium; exine 1-1.5 μm thick, sexine thicker than nexine, with baculate structure, clear in some area; ornamentation scabrate to punctate.

The size of this new species is intermediate between *B. dermatus* kar and *D. minor*, but differs from them in the sexine with baculate structure.

Occurrence: Otog Banner, Inner Mongolia, Lower Tertiary.
Type: Pl. 2, fig. 15; slide no.: *687(17-1)*.

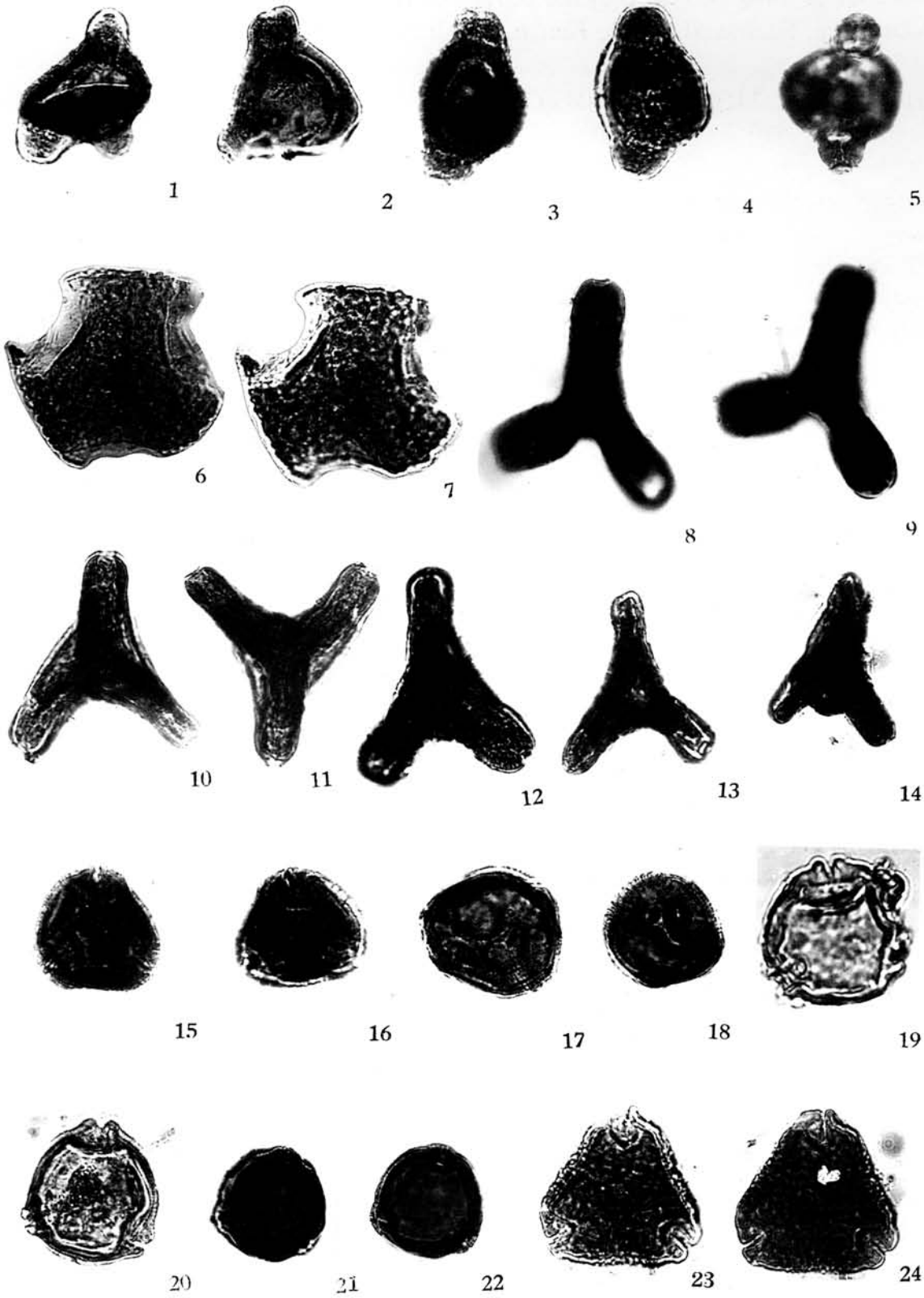
Dermatobrevicolporites dermatus (Sah *et* Kar.) Kar 1985 Pl. 2, figs. 19-20
Dermatobrevicolporites dermatus (Sah *et* Kar) Kar, P. 89. Pl. 15, Figs. 4, 5, 1985
Amb roundedly triangular, diameter 30 μm.
Occurrence: Otog Banner, Inner Mongolia, Lower Tertiary.

Dermatobrevicolporites minor *sp. nov.* P1. 2, figs. 21-22
Amb roundedly triangular, holotype 20 μm in diameter; tricolporate, equato-angulaperutrate, pore with small atrium and thickened bands at base of atrium; colpi slit, short, including the atrium; exine 1.5 μm thick, with microbaculate structure; surface smooth.
This new species is characterized by the small size.
Occurrence: Otog Banner, Inner Mongolia, Lower Tertiary.
Type: Pl.2, fig. 22; slide no.: *687(6-3)*.

Dermatobrevicolporites striatus *sp. nov.* P1.2, figs. 23-24; pl. 3, figs. 1-4
Amb triangular, with straight or convex sides and rounded angles, 25-40 μm (holotype 30 μm) in diameter; tricolporate, equato-angulaperturate, pore with atrium, colpi slit and short, including the atrium; exine 2-3 μm thick, nexine thin, sexine twice thicker than nexine in middle part of each side, becoming thinner and protruding in pore area; ornamentation striate, developed in polar area and middle part of each side, and nearly psilate or punctate in pore area; baculate structure visible, outline uneven.
This species is characterized by the striate ornamentation.
Occurrence: Sanmenxia Area, Henan, Menli Formation; Otog Banner, Inner Mongolia, Lower Tertiary.
Type: Pl. 2, fig. 23; slide no.: *523(C-2)*.

Dermatobrevicolporites tuberculatus *sp. nov.* P1. 3, figs. 5-10
Amb triangular to roundedly triangular, 25-40 μm (holotype 25 μm) in diameter; tricolporate; exine 1.5-2 μm thick, sexine thicker than nexine; ornamentation tuberculate or verruco-rugualate, undeveloped in pore area.
This species is characterized by the tuberculate ornamentation.
Occurrence: Sanmenxia Area, Henan, Menli Formation; Otog Banner, Inner Mongolia, Lower Tertiary.
Type: Pl. 3, fig. 10; slide no.: *San1(12-1)*.

Dermatobrevicolporites verrucosus *sp. nov.* P1. 3, figs. 11-12
Amb roundedly triangular to rounded, 26-30 μm and holotype 30 μm in diameter; tricolporate, pore with atrium and clear thickened bands at base of atrium; colpi slit and short, not open; exine 1.5-2 μm thick, sexine thicker than nexine; ornamentation verrucate or verruco-striate, outline microundulate.



Pl. 2. Normapolles sporomorphs, figs. 1-5. *Brosipollis solidus*, 479(7-3), 683(9-1), 479(17-8), 479(20-3), 479(D-22); figs. 6-7. *Cercidiphyllites tuberculatus*, San1(1-1); figs. 8-9. *Concavitriporites concavus*, 479(4-1); figs. 10-14. *Concavitriporites baculatus*, San1(9-1), San1(10-4), 479(D-9), San2(11-3); figs. 15-18. *Dermatobrevicolporites baculatus*, 687(17-1), 687(3-5), 687(8-4); figs. 19-20. *Dermatobrevicolporites dermatus*, 687(B-5), 687(C-3); figs. 21-22. *Dermatobrevicolporites minor*, 687(6-3); figs. 23-24. *Dermatobrevicolporites striatus*, 523(C-2), 523(15-1).

This species is characterized by the verrucate ornamentation.

Occurrence: Sanmenxia Area, Henan, Menli Formation; Otog Banner, Inner Mongolia, Lower Tertiary.

Type: Pl. 3, fig. 11; slide no.: *San 2(15-2)*.

DIERVILLAPOLLENITES Nagy *et* Rakosi, 1964

Type species: *Diervillapollenites hungaricus* Nagy *et* Rokosi 1964

Diervillapollenites echinatus (Song et Zheng) Song, Li *et* Zhong 1986 Pl. 10, fig. 14

Diervillapollenites echinatus (Song *et* Zheng) Song *et al.*, P. 104, Pl. 29, figs. 13, 15, 16; Pl. 30, fig. 16, 1986

Amb triangular, diameter 42-48 μm.

Occurrence: Otog, Banner, Inner Mongolia; Lower Tertiary.

Diervillapollenites echiverrucatus *sp. nov.* Pl. 3, figs. 13-15

Amb triangular with convex sides and rounded or truncate anlges, diameter of holotype *ca.* 40 μm; triporate, equato-angulaperturate, pore 4-5 μm wide; exine 2-3 μm thick in the middle part of each side, sexine twice thicker than nexine and gradually thickening to 5 μm in pore area, nexine extending only to the base of pore and forming a large atrium about 10-12 μm wide; echinate, base of spinae with polygonal verrucae, which taper rapidly and become sharpened at the upper part, *ca.* 3 μm long and 3-5 μm in diameter at base.

This species is characterized by its ornamentation.

Occurrence: Otog Banner, Inner Mongolia; Lower Tertiray; Sanmenxia Area, Henan, Menli Formation.

Type: Pl. 3, fig. 13; slide no.: *687(4-4)*.

Diervilapollenites magniatrium Hao 1983 Pl. 10, figs. 12-13

Diervillapollenites magniatricum Hao, P. 294, Pl. 2, fig. 15. 1983

Amb triangular, diameter 50-66 μm

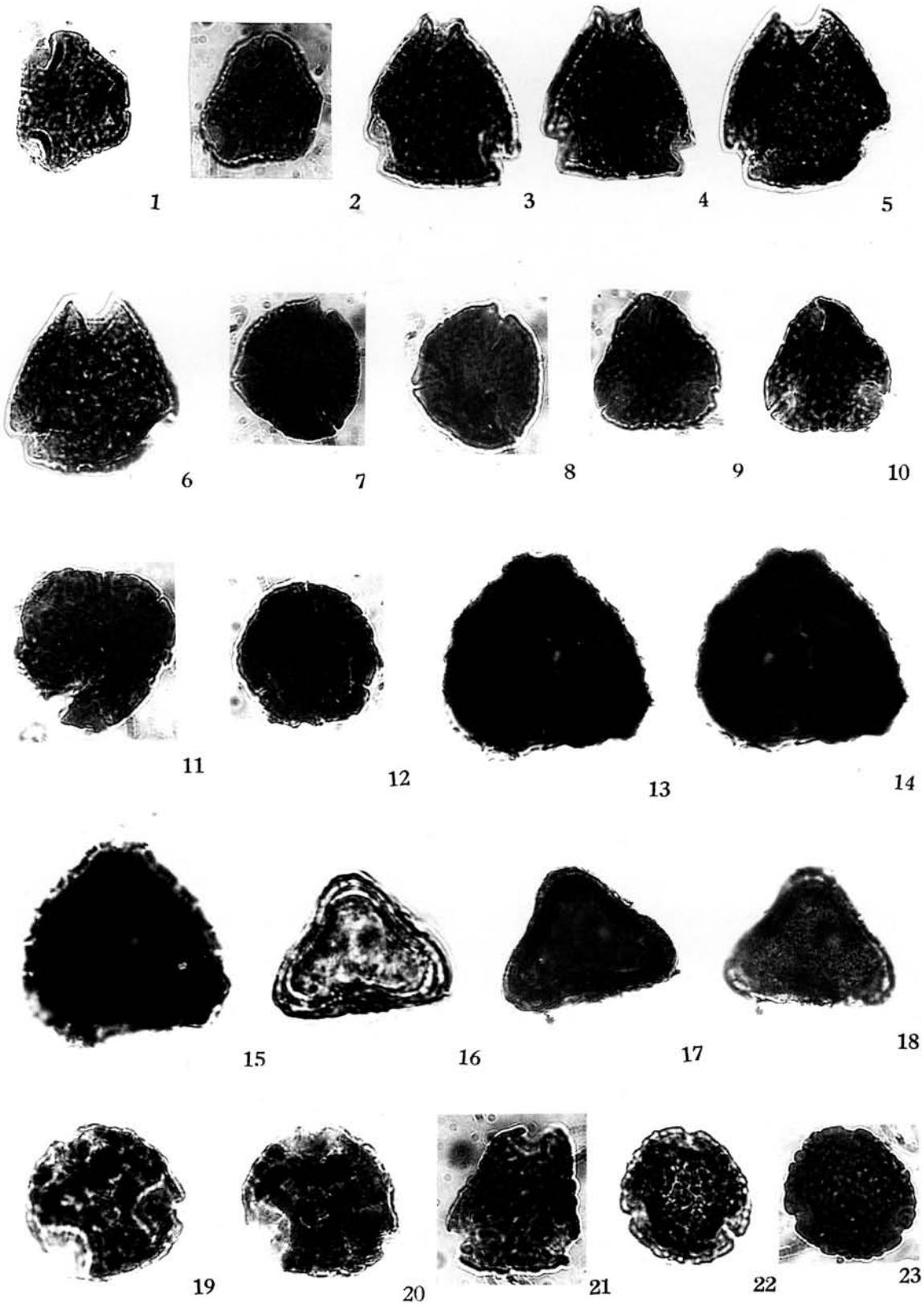
Occurrence: Otog Banner, Inner Mongolia; Lower Tertiray; Sanmenxia Area, Henan, Menli Formation.

DITRIANGULIPOLLIS *gen. nov.*

Type species: *Ditriangulipollis microconcavus gen. et sp. nov.*

Diagnosis: Pollen oblate or nearly spherical, concave in middle part; amb triangular when compressed, showing two exine layers of same thickness and structure; exine moderately thick, nexine thin and with perforate structure, sexine thicker than nexine; triaperturate, probably porate, pore unclear as break of exine; granulate, brevibaculate, breviechinate or rugulate.

Occurrence: China; Lower Tertiary.



Pl. 3. Normapolles sporomorphs, figs.1-4. *Dermatobrevicolporites striatus*, Men2(2-2), San 1(6-1), San 2(15-1); figs. 5-10. *Dermatobrevicolporites tuberculatus*, San1(16-1), San1(9-2), San1(12-1); figs. 11-12. *Dermatobrevicolporites verrucosus*, San2(15-2), San2(6-1); figs. 13-15. *Diervillapollenites echiverrucatus*, 687(4-4); figs. 16-18. *Ditriangulipollis microconcavus*, 687(B-7); figs. 19-21. *Ditriporites verrucosus*, Men2(3-1), San2(11-3), figs. 22-23. *Ditriporites tuberculatus*, San1(7-7), San1(7-22).

Ditriangulipollis microconcavus *gen. et sp. nov.* Pl. 3, figs. 16-18

Amb triangular with slightly concave sides and rounded angles, holotype 30 μm in diameter; two exine layers of the same thickness and structure shown on outline, 1.5 μm thick, nexine thin, with perforate structure, sexine thicker than nexine; triaperturate, angulaperturate, porate, pore formed by break of exine, simple and indistinctive; ornamentation mixedly granulate and microechinate; radiately distributed near outline; outline uneven.

Occurrence: Otog Banner, Inner Mongolia; Lower Tertiary.

Type: Pl. 3, fig. 16; slide no.: *687(B-7)*.

DITRIPORITES *gen. nov.*

Type species: *Ditriporites verrucosus gen. et sp. nov.*

Diagnosis: Pollen spherical, amb rounded; triaperturate or tridiporate, endo-germinal atrium-porate and exine thickened at base, exogerminal also porate instead of colpate; exine thin, granulate to verrucate.

Remarks: The new genus differs from *Dermatobrevicolporites* in the porate exo-germinal, instead of the slit exogerminal in the latter, It differs from *Magnoporopollis* Krutzsch 1967 which lacks exine thickening at the atrium base and possesses annulus.

Occurrence: China; Lower Tertiary.

Ditriporites verrucosus *gen. et sp. nov.* Pl. 3, figs. 19-21

Amb triangular to rounded, holotype 30 μm in diameter; triaperturate, aperture composed of large atrium and porate exogerminal, atrium semi-circular and large, *ca.* 10 μm wides and exogerminal *ca.* 4 μm wide in holotype; exine 2 μm thick, becoming slightly thinner at exogerminal; verrucate, smaller in atrium area, microundulate in outline; body hexagonal in shape, with straight and concave sides alternately formed by exine thickening at the base of atrium.

Occurrence: Sanmenxia Area, Henan, Menli Formation.

Type: Pl. 3, fig. 19; slide no.: *Men 2(3-1)*.

Ditriporites tuberculatus *gen. et sp. nov.* Pl. 3, figs. 22-23

Amb roundedly triangular, holotype 26 μm in diameter; triaperturate, aperture composed of atrium in semi-lunar-shape, *ca.* 7 μm wide, and exogerminal *ca.* 2 μm wide in holotype; exine 1-1.5 μm thick; tuberculate, tubercula *ca.* 2 μm wide, outline microundulate.

This species differs from the preceding species in the smaller size and ornamentation.

Occurrence: Sanmenxia Area, Henan, Menli Formation.

Type: Pl. 3, fig. 22; slide no.: *San 1(7-7)*.

ECHIBASOPOLLIS *gen. nov.*

Type species: ***Echibasopollis funingensis*** *gen. et sp. nov.*

Diagonsis; pollen oblate; amb triangular with straight or convex sides and obtuse or rounded angles; triporate, equatoangulaperturate; exine thick, sexine thicker than nexine and separated or split to form praevestibula and atria; nexine thin, extending to base of pore; pore canal index 0.4-0.5; echinate, spinae strong and over 2 μm long, with some other ornamentations such as grana, microspinae distributed between spinae; medum to large in size.

Remarks: The new genus is similar to *Basopollis* Pflug 1953 in the pore structure, but differs only in the presence of echinate ornamentation. It differs from *Echitriporites* which has no vestibula, from *Diervillapollenites* which has only atria, and from *Spinotriporites* which is microechinate, with spinae less than 2 μm in length. In *Propylipollis* Martin *et* Harris 1975 the vestibula and atria are forme by nexine, but in the new genus they are formed by sexine.

Occurrence: China; Upper Cretaceous--Lower Tertiary.

Echibasopollis funingensis *gen. et sp. nov.* P1. 4, figs. 1-3

Amb triangular, with straight or slightly convex sides and rounded angles, 40-50 μm (holotype 45 μm) in diameter; triporate, equato-angulaperturate, pore with praevestibula and atrium formed only by sexine, exopore 5-6 μm and endopore 6-12 μm wide; exine 3-4 μm thick, sexine twice thicker than nexine and slightly thickened at pore; ornamentation baculo-echinate, spinae 3-5 μm long and ca. 1.5 μm wide at base, with puncta between spinae.

Occurrence: Northern Jiangsu, Funing Group; Sanmenxia Area, Henan, Menli Formation.

Type: Pl. 4, fig. 3; slide no.: *887*.

Echibasopollis echinoverrucosus *sp. nov.* P1. 4, figs. 4-5

Amb triangular with slightly convex sides and rounded angles, holotype about 66 μm in diameter; triporate, pore with praevestibula like a large atrium; exine 2-3 μm thick, sexine twice thicker than nexine and gradually thickening toward pore, to 7 μm thick along pore margin to form annulus, pore canal 2 μm wide; ornamentation echinate-verrucate; verrucae nearly 10 μm in diameter in surface view, tapering rapidly and becoming sharpened to baculate or echinate at upper part in optical section view, greater than 2 μm long.

This species is characterized by the large size and echinate-verrucate ornamentation.

Occurrence: Otog Banner, Inner Mongolia; Lower Tertiary.

Type: Pl. 4, fig. 4; slide no.: *523(18-1)*.

Echibasopollis minor *gen. et sp. nov.* P1. 4, figs. 6-13

Amb triangular with straight sides and rounded angles, diameter 32-40 μm (holotype 32 μm); triporate, pore with praevestibula and atrium formed by sexine; exine *ca.* 2 μm thick, sexine thicker than nexine and thickened at pore to 3 μm thick, indistinctive baculate structure developed in pore area; echinate, spinae sparsely distributed, about 3 μm long and 1.5-2 μm wide at base, with puncta between spinae and cleaner in pore area.

This species is characterized by triangular outline and smaller size.

Occurrence: Otog Banner, Inner Mongolia; Lower Tertiary; Sanmenxia Area, Henan, Menli Formation.

Type: Pl. 4, fig.6; slide no.: *542(D-2)*.

Pl. 4. Normapolles sporomorphs, figs.1-3. *Echibasopollis funingensis*, 431, 440, 887; figs. 4-5. *Echibasopollis echinoverrucosus*, 523(18-1); figs. 6-13. *Echibasopollis minor*, 542(D-2); 683(1-3); 687(8-6); 687(18-1).

Echibasopollis mongoliensis *gen. et sp. nov.* Pl. 5, figs. 1-6

Amb triangular with straight or slightly convex sides and rounded angles, diameter 45-50 μm (holotype 48 μm); triporate, pore with praevestibula and atrium formed by sexine, exopore round, *ca.* 6 μm wide, endopore 10-15 μm wide; exine 2-3 μm thick and increased to 5 μm thick in pore area; baculoechinate ornamentation, spinae *ca.* 3 μm long and 2 μm wide at base, sparsely distributed, with puncta between spinae and developed in pore area, indistinctive baculate structure shown on sexine of pore area.

This species differs from *E. funingensis* in its thinner exine and shorter but stronger spinae.

Occurrence: Otog Banner, Inner Mongolia, Lower Tertiary; Sanmenxia Area, Henan, Menli Formation.

Type: Pl. 5, fig. 4; slide no.: *523(10-1)*.

ECHITRIPORITES Van der Hammen *ex* Van Hoeken-Klinkenberg, 1964

Type species: Echitriporites trianguliformis Van Hoeken-Klinkenberg 1964

Echitriporites crassispinus *sp. nov.* Pl. 5, fig. 7

Amb triangular with slightly convex sides and rounded or concave angles, holotype about 65 μm in diameter; triporate, pore probably with large atrium, *ca.* 10 μm wide; exine greater than 3 μm thick, sexine thicker than 2.5 μm and without distinctive baculate structure; echinate, spinae cylindrical and over 5 μm long, sparsely distributed, with puncta in between.

The species is characterized by its strongly echinate ornamentation.

Occurrence: Sanmenxia Area, Henan, Menli Formation.

Type: Pl. 5, fig. 7; slide no.: *San 1(10-1)*.

Echitriporites laxaspinulus *sp. nov.* Pl. 5, figs. 8-9

Amb triangular with slightly convex sides and rounded or concave angles, 45-55 μm (holotype 52 μm) in diameter; triporate, pore large, 5-8 μm wide; exine *ca.* 2 μm thick, sexine thicker than nexine; echinate, spinae *ca.* 2 μm long, some spinae strong, sparsely distributed, with puncta between spinae.

This species resembles *Diervillapollenites echinatus* in the size and form, but differs from the latter in the smaller and sparsely distributed spinae.

Occurrence: Sanmenxia Area, Henan, Menli Formation; Otog Banner, Inner Mongolia, Lower Tertiary.

Type: Pl. 5, fig. 9; slide no.: *San 2(7-3)*.

Echitriporites magnus Sun *et* Zhanug 1979 Pl. 10, fig. 15

Echitriporites magnus Sun *et* Zhang, P. 290, pl. 2, fig.4, 1979

Amb triangular, diameter 50-70 μm.

Occurrence: Otog Banner, Inner Mongolia; Lower Tertiary.

ERLIANIPOLLIS *gen. nov.*

Type species: *Erlianipollis regularis gen. et sp. nov.*

Diagnosis: Pollen oblate or lenticulate, amb triangular with slightly convex / concave sides and rounded angles; triporate, equato-angulaperturate, pore with praevestibula or atrium formed by sexine, pore canal index nearly 0.3; exopore small and oval, endopore large; exine moderately thick, sexine thicker than nexine, thickening along pore margin and mixed together thus pore canal becoming indistinctive, nexine only extending to base of pore; ornamentation scabrate to granulate, probably with trilete scar thickening on one surface.

Remarks: The new genus differs from *Neimongolipollis* in the lack of arc thickening; from *Extratriporopollenites*, *Endopollis*, *Nudopollis*, *Extremipollis* and *Oculapollis* in the presence of praevestibula, and from *Basopollis* which has a distinctive pore canal.

Occurrence: China; Upper Cretaceous to Lower Tertiary.

Erlianipollis regularis *gen. et sp. nov.* Pl. 5, fig. 10

Amb triangular with straight or slightly concave sides, angles elongated and terminal ends rounded, 25-30 μm (holotype 28 μm) in diameter; triporate, pore with praevestibula in rounded-square form, pore canal index nearly 0.5, exopore round, 1-2 μm wide and endopore *ca.* 4 μm wide, pore canal indistinctive; exine *ca.* 2 μm thick, sexine thicker than nexine, thickened and mixed together along pore margin to form annulus ca. 4-5 μm thick; nexine extending only to base of pore and incurved to form endopore; scabrate to granulate, outline nearly smooth; with one round area where exine becomes thinner at polar area.

Occurrence: Northern Jiangsu, third Formation of Funing Group.

Type: Pl. 5, fig.10; slide no.: *293.*

Erlianipollis granulatus *gen. et sp. nov.* Pl. 5, figs. 11-13

Atlantopollis sp., Zhao *et al.*, Pl. 1, fgis. 18, 19. 1981

Amb triangular with slightly concave sides and rounded angles, holotype 30 μm in diameter; triporate, pore with praevestibula in oval-square form or with atrium, pore canal index over 0.3; exopore round and 2 μm wide, endopore larger; exine *ca.* 2.5 μm thick, nexine thin and extending to base of pore, sexine several times thicker than nexine and separated at base of pore to form praevestibula, then broadening and mixed together to form annulus about 5 μm thick, pore canal invisible; granulate, grana densely distributed.

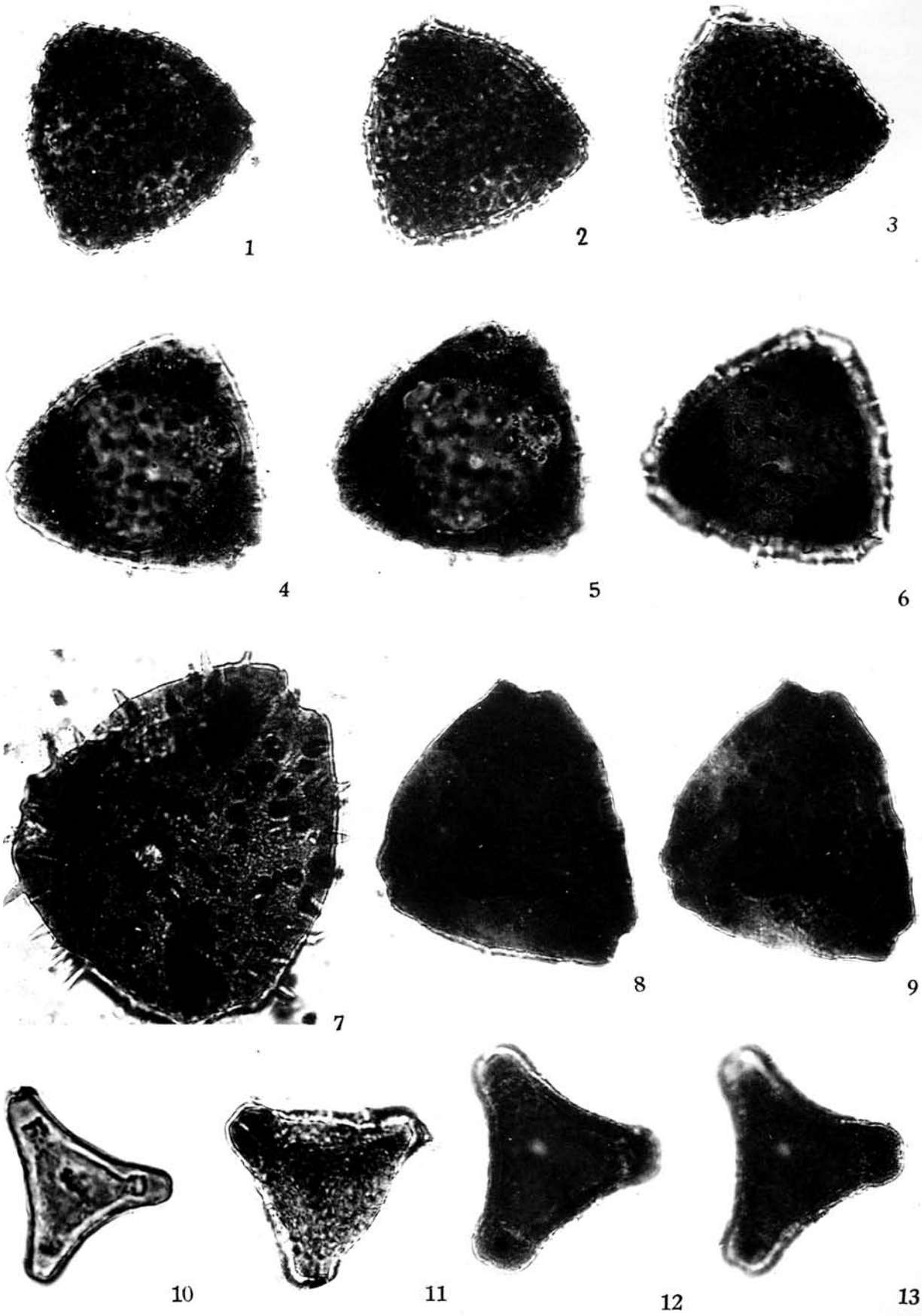
This species differs from *E. regularis* in having densely granulate ornamentation, and from *E. tuberculatus* in having unelongated angles and granulate ornamentation (the latter is tuberculate).

Occurrence: Otog Banner, Inner Mongolia, Lower Tertiary.

Type: Pl. 5, fig. 12; slide no.: *687(8-2)*.

Erlianipollis medius *gen. et sp. nov.* Pl. 6, figs. 1-3

Amb triangular with nearly straight sides and acute-rounded angles, holotype 24 μm in diameter; lateral view oblate, 28 x 20 μm in size; triporate, pore with praevestibula formed by separated sexine, praevestibula oval and situated at posterior part of pore, pore canal index over 0.3, exopore round, 1-2 μm wide, endopore 3-5 μm wide; exine *ca.* 3 μm thick, nexine thin and extending to base of pore, sexine slightly thickened and mixed along pore margin to form annulus about 5 μm thick, pore canal indistinctive; scabrate to microgranulate.



Pl. 5. Normapolles sporomorphs, figs. 1-6. *Echibasopollis mongoliensis*, 523(11-2), 523(18-3), 523(10-1); fig. 7. *Echitriporites crassispinus* San1(10-1); figs. 8-9. *Echitriporites laxaspinulus*, San2(7-3); figs. 10. *Erlianipollis regularis*, 293; figs. 11-13. *Erlianipollis granulatus*, 479(18-3), 687(8-2).

This species differs from *E. minor* in having larger size (greater 30 μm) and the microgranulate sculpture ;the latter has psilate ornamentation and is under 20 μm in size.

Occurrence: Otog Banner, Inner Mongolia, Lower Tertiary; Sanmenxia Area, Henan, Menli Formation.

Type: Pl.6, fig.3; slide no.: *479(1-1)*.

Erlianipollis minor *gen. et sp. nov.* Pl. 6, figs. 4-7

Amb triangular with straight or slightly convex sides and rounded angles, holotype 19 μm and commonly less than 20 μm in diameter; triporate, pore with praevestibula formed by separated sexine, praevestibula triangular in shape and situated at posterior part of pore; pore canal index over 0.3, exopore round and small, *ca.* 1 μm wide, endopore larger, 2-3 μm wide; exine 2.5 μm thick, sexine thicker than nexine,slightly thickened at base of pore, becoming thinner and then strongly thickened along pore margin to form annulus, *ca.* 3-4 μm thick; nexine extending to base of pore and incurved to form endopore; pore canal indistinctive; surface smooth or showing microstructure when eroded.

Occurrence: Otog Banner, Inner Mongolia, Lower Tertiary; Sanmenxia Area, Henan, Menli Formation.

Type: Pl. 6, fig. 7; slide no.: *523(A-7)*.

Erlianipollis plicatus *gen. et sp. nov.* Pl. 6, figs. 8-9

Amb triangular with nearly straight or slightly concave sides, angles long-cylindrical; holotype about 40 μm in diameter; triporate, pore probably with praevestibula situated at posterior part of pore, exopore oval, 4-5 μm wide; exine *ca.* 3 μm thick, sexine several times thicker than nexine and thickening along pore margin (*ca.* 5 μm thick) to form annulus, pore canal *ca.* 2 μm wide; granulate to tuberculate; with thickened plicate and triletoide scar, extending from pole to angles.

This species is characterized by thick exine and thickened triletoid scar.

Occurrence: Otog Banner, Inner Mongolia, Lower Tertiary.

Type: Pl. 6, fig. 9; slide no.: *479(11-1)*.

Erlianipollis projectus *gen. et sp. nov.* Pl. 6, fig. 10-11

Amb triangular with straight sides and rounded angles, holotype 25 μm in diameter; triporate, pore protruding about 5 μm high; exine *ca* 1.2 μm thick, sexine slightly thicker than nexine thickened and mixed in pore area to form three projections; nexine extending to base of pore; pore canal index over 0.3, exopore round, 1-2 μm wide, endopore indistinctive; granulate ornamentation.

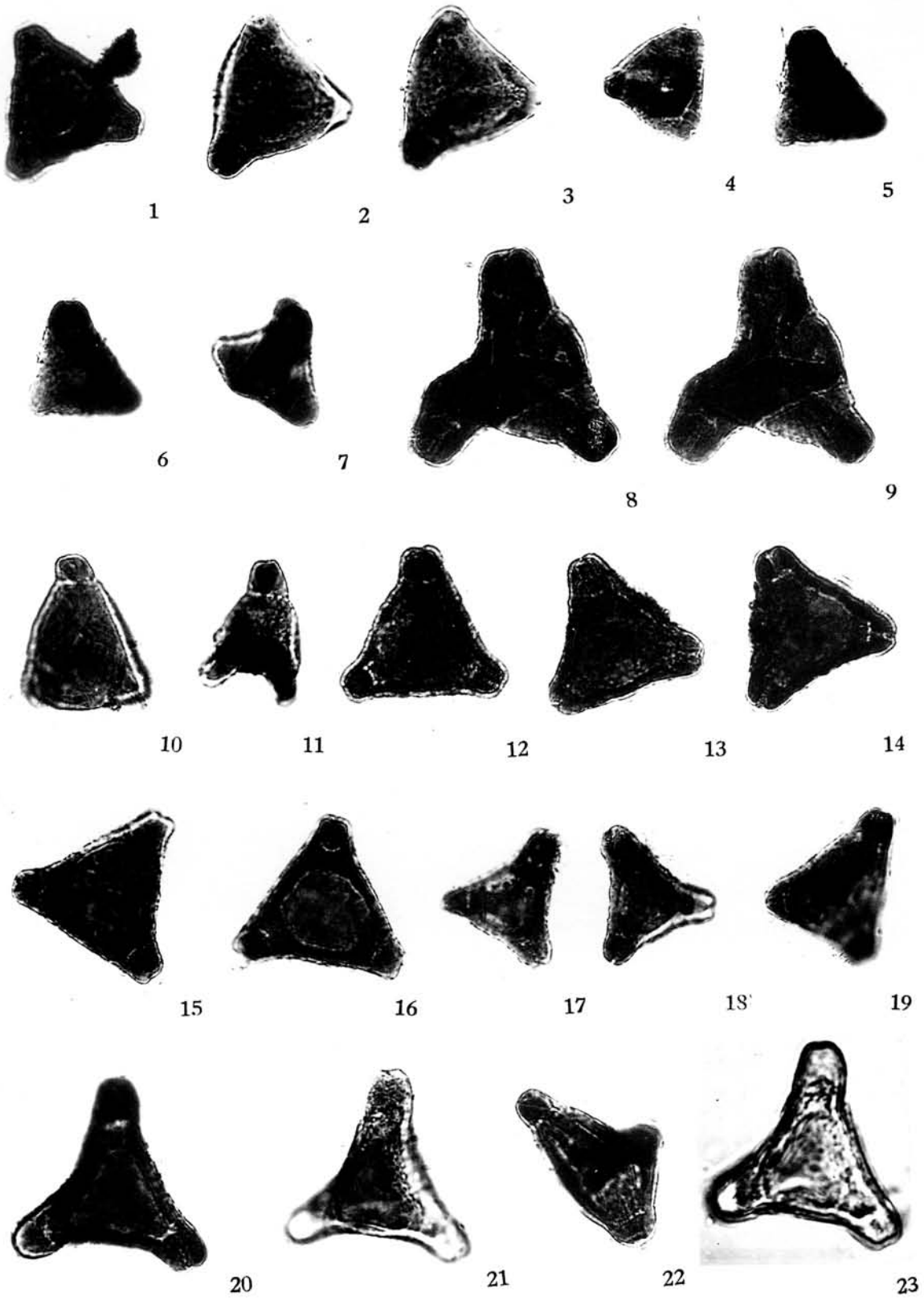
This species is characterized by the three projections with homogenous matter in pore area, which distinguish it from other species of this genus.

Occurrence: Otog Banner, Inner Mongolia, Lower Tertiary.

Type: Pl. 6, fig. 11; slide no.: *687(6-1)*.

Erlianipollis triangulatus *gen. et sp. nov.* Pl. 6, figs. 12-16

Atlantopollis sp., Zhao *et al.*, Pl. 1, fig. 14, 1981



P1. 6. Normapolles sporomorphs, figs. 1-3. *Erlianipollis medius*, Men3(3-2),479(1-1); figs. 4-7. *Erlianipollis minor*, 687(6-3), 479(C-14), 523(A-7); figs. 8-9. *Erlianipollis plicatus*, 479(11-1); figs. 10-11. *Erlianipollis projectus*, 479(17-3), 687(6-1); figs. 12-16. *Erlianipollis triangulatus*, 687(12-4), 479(17-6), 523(6-1); figs. 17-19. *Erlianipollis triletoidus*, 687(10-3), 687(7-2); figs. 20-23. *Erlianipollis tuberculatus*, 479(C-2), San1(2-5).

Amb triangular with straight or slightly convex / concave sides and roundedly acute angles, 25-30 μm (holotype 26 μm) in diameter; triporate, pore with praevestibula formed by separated sexine, situated at posterior part of pore, praevestibula oval, pore canal index over 0.3, exopore 1-2 μm and endopore 3-4 μm wide in holotype; exine 2.5-3 μm thick, sexine several times thicker than nexine, thickened at base of pore and then thinning to form praevestibula, sexine strongly thickened and mixed along pore margin (ca. 4-5 μm thick) to form annulus, pore canal slit and unclear; granulate.

This species differs from *E. regularis* in the straight sides, unelongated angles and smaller praevestibula.

Occurrence: Otog Banner, Inner Mongolia, Lower Tertiary; Sanmenxia Area, Henan, Menli Formation.

Type: Pl. 6, fig. 16; slide no.: *523(6-1)*.

Erlianipollis triletoidus *gen. et sp. nov.* Pl. 6, figs. 17-19

Amb triangular with straight or slightly convex / concave sides and rounded angles, 20-30 μm (holotype 20 μm) in diameter; triporate, pore with oval praevestibula, pore canal index over 0.3, exopore 1-2 μm and endopore 3-4 μm wide; exine 2.5-3 μm thick, sexine several times thicker than nexine, slightly thickened at base of pore, and then thinning to form praevestibula, sexine strongly thickened along pore margin to form annulus (about 4-5 μm thick); nexine extending to base of pore; pore canal slit and visible; thickened bands *ca.* 4-5 μm wide extending from pole to angles as trilete in form and possibly go into pore area; microgranulate.

This species resembles *E. triangulatus* in shape and structure, but differs from the latter only in the presence of thickened bands extending from pole to angles.

Occurrence: Otog Banner, Inner Mongolia, Lower Tertiary; Sanmenxia Area, Henan, Menli Formation.

Type: Pl. 6, fig. 17; slide no.: *687(10-3)*.

Erlianipollis tuberculatus *gen. et sp. nov.* Pl. 6, figs. 20-23

Atlantopollis sp., Zhao *et al.*, pl. 1, figs. 21, 24.1981

Amb triangular with concave sides, angles elongated and terminal ends rounded, 25-30 μm (holotype 30 μm) in diameter; triporate, pore with praevestibula, pore canal index over 0.3; exopore round, *ca.* 2 μm wide, endopore larger; exine 2.5-3 μm thick, nexine thin, not extending into pore area, sexine several times thicker than nexine, thickened and mixed along pore margin to form annulus (about 5-6 μm wide), pore canal slit, inner sides of praevestibula and canal uneven; granulate to tuberculate.

This species resembles *E. regularis* in shape and structure, but differs from the latter in strongly thickened sexine in pore area and tuberculate ornamentation.

Occurrence: Otog Banner, Inner Mongolia, Lower Tertiary; Sanmenxia Area, Henan, Menli Formation.

Type: Pl. 6, fig. 20; slide no.: *479(C-2)*.

LONICERAPOLLIS Krutzsch, 1962

Type Species *Lonicerapollis gallwitzii* Krutzsch 1962

Lonicerapollis minutus *sp. nov.* Pl. 7, figs. 1-2

Amb nearly rounded, holotype 20 μm in diameter; tricolporate, colpi short and being located immediately over atrium, pore with large atrium; exine *ca.* 3 μm thick, tectum and nexine thin, sexine thick and with microbaculate structure, nexine enclosed a circular area about 14 μm in diameter; surface smooth.

This species is characterized by the small size.

Occurrence: Otog Banner, Inner Mongolia, Lower Tertiary.

Type: Pl. 7, fig. 2; slide no.: *522(A-1)*.

Lonicerapollis intrabaculatas Song & Zheng 1980 Pl. 7, figs. 3-4

Lonicerapollis intrabaculatus, Song *et al.*, P. 152-153, Pl. 44, figs. 10-15. 1981

Amb roundedly triangular, diameter 35 μm

Occurrence: Otog Banner, Inner Mongolia, Lower Tertiary.

MINORPOLLIS Krutzsch

Type species *Minorpollis minimus* Krutzsch 1959

Minorpollis sp. (cf. *M. minimus* Krutzsch 1959) Pl. 7, figs. 17-19

cf. *Minorpollis minimus* Krutzsch. P. 141, Pl. 32; Figs. 10-14. 1959

Amb triangular. diameter less than 20 μm.

Occurrence: Otog Banner, Inner Mongoli, Lower tertiary.

NEIMONGOLIPOLLIS *gen. nov.*

Type species: ***Neimongolipollis annulatus*** *gen. et sp. nov.*

Diagnosis: Pollen oblate, amb triangular with concave sides and elongated angles; triporate, equato-angulaperturate, pore probably with atrium but without vestibula, pore canal index under 0.3, atrium formed by sexine only and nexine not extending to base of pore; exopore samll and round, endopore larger; exine thick, sexine thicker than nexine and strongly thickened in pore area to form annulus, pore canal slit; arc bands extending along equator and into pore area; scabrate to tuberculate.

Remarks: This genus differs from *Basopollis*, *Oculopollis*, *Pseudoculopollis*, *Osculapollis* and *Plicapollis* in having strongly thickened exine which forms annulus in pore area and in the absence of vestibula; from *Nudopollis*, *Extratriporopollenites* in the equatoral arc bands; and from *Otogipollis* in the strong annulus and equatorial arc bands.

Occurrence: China, Upper Cretaceous--Lower Tertiary.

Neimongolipollis annulatus *gen. et sp. nov.* Pl. 7, figs. 5-6

Amb triangular with slightly concave or nearly straight sides, angles projected in dome-shape, diameter 25-30 μm (holotype 28 μm); triporate, pore without vestibula, probably with atrium, pore canal index under 0.3; exopore round and small, *ca.* 2 μm wide, endopore larger;

exine 3-4 μm thick, nexine thin, sexine several times thicker than nexine and strongly thickened in pore area which form dome-shape annulus; arc bands extending along equator and into pore area; granulate, outline uneven.

This species is characterized by the dome-shaped annulus.

Occurrence: Otog Banner, Inner Mongolia, Lower Tertiary.

Type: Pl. 7, fig. 6; slide no.: *479(A-4)*.

Neimongolipollis concavus *gen. et sp. nov.* P1. 7, figs. 7-10

Amb triangular with slightly convex / concave sides and rounded angles, 30-40 μm and holotype 32 μm in diameter; triporate, pore with atrium but without vestibula, pore canal index under 0.3; exopore round and small, *ca.* 2 μm wide, endopore larger; exine 2.5-3 μm thick, sexine several times thicker than nexine and broadened to 5 μm wide in pore area with punctate structure; 3 arc-bands extending along equator to base of pore; granulate.

This species differs from *N. annulatus* in having broadened but not thickened exine in pore area, and from *N. elongatus* in having rounded angles.

Occurrence: Otog Banner, Inner Mongolia, Lower Tertiary.

Type: Pl. 7, fig. 10; slide no.: *683(D-8)*.

Neimongolipollis elongatus *gen. et sp. nov.* P1. 7, figs. 11-12

Amb triangular with concave sides, angles elongated and terminal ends acute, diameter of holotype 25 μm; triporate, pore probably with atrium but without vestibula, pore canal index under 0.3; exopore round and small, 1-2 μm wide, endopore wider, pore canal slit; exine 2-2.5 μm thick, sexine thicker than nexine and broadened to 4 μm wide in pore area; nexine enclosing a triangular inner body; arc bands extending along equator but not into pore area; granulate.

This species is similar to *Concavitriporites baculatus* in shape, but differs from the latter in having broadened exine in pore area which is absent in the latter.

Occurrence: Otog Banner, Inner Mongolia, Lower Tertiary.

Type: Pl.7, fig.11; slide no.: *683(8-1)*.

NUDOPOLLIS Pflug, 1953

Type species: *Nudopollis endangulatus* (Pflug) Pflug 1953

Nudopollis endangulatus (Pflug) Pflug 1953 Pl. 10, figs. 1-4

Nudopolis endangulatus (Pflug) Pflug, S108, Taf.25, Figs. 20-24. 1953

Amb triangular,diameter 30 μm.

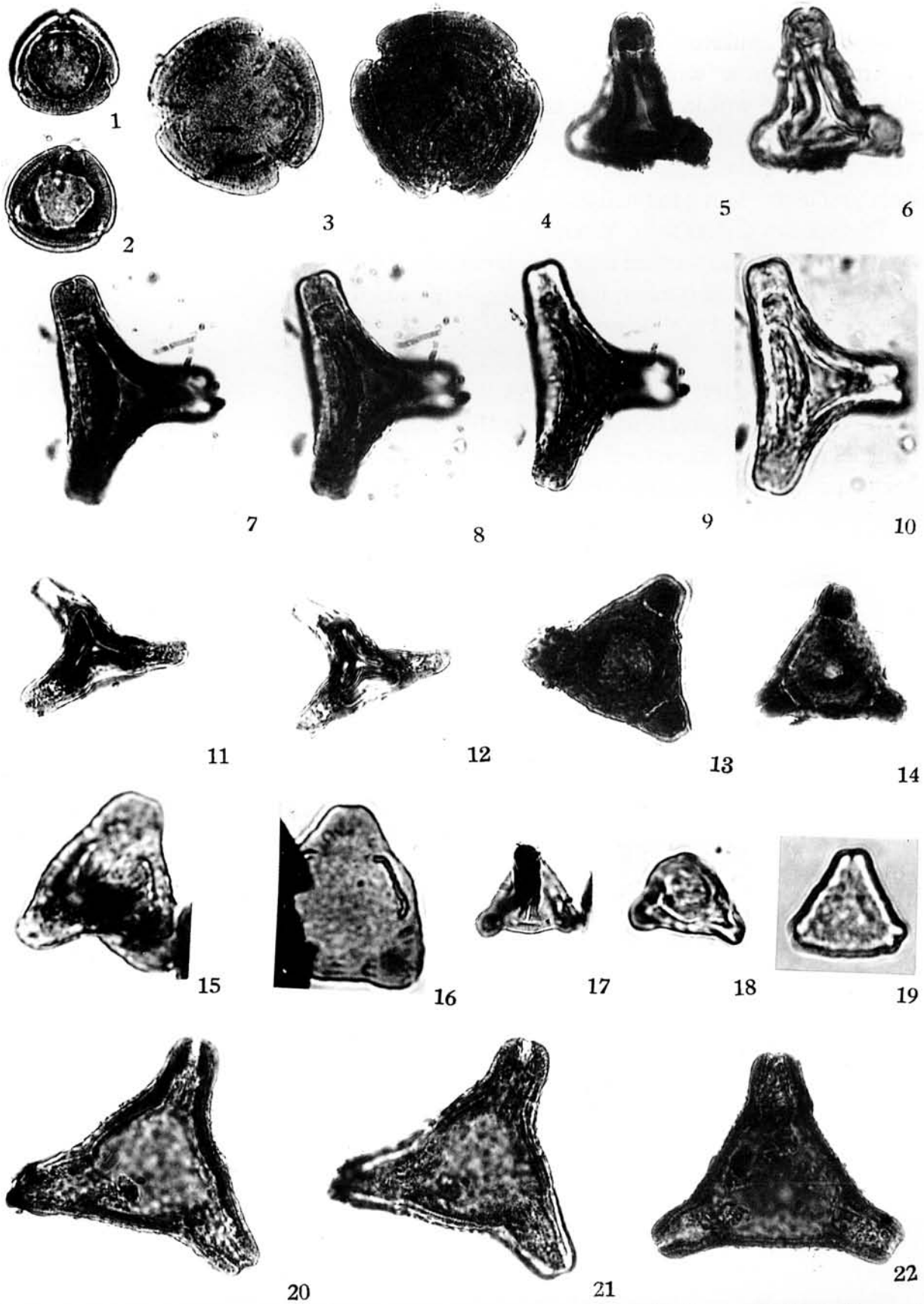
Occurrence: Otog Banner, Inner Mongolia, Lower Tertiary; Sanmenxia Area, Henan, Menli Formation.

Nudopollis terminalis (Pflug & Thoms.) Pflug 1953 Pl. 10, figs. 9-11

Nudopollis terminalis (Pflug & Thoms.) Pflug. S.161, Taf. 22, Figs. 1-6. 1953

Amb triangular, diameter 20-25 μm.

Occurrence : Otog Banner, Inner Mongolia, Lower Tertiary.



P1. 7. Normapolles sporomorphs, figs. 1-2. *Lonicerapollis minutus*, 522(A-1); figs. 3-4. *Lonicerapollis intrabaculatus*, 683(14-1), 479(9-4); figs. 5-6. *Neimongolipollis annulatus*, 479(A-4); figs. 7-10. *Neimongolipollis concavus*, 683(D-8); figs. 11-12. *Neimongolipollis elongatus*, 683(8-1); figs. 13-14. *Nudopollis granulatus*, 479(18-1), 687(3-4); figs. 15-16. *Osculapollis granulatus*, 617; 950; figs. 17-19. *Minorpollis* sp. (cf. *M.minmus*), 523(D-2), 479(D-5), 479(4-4); figs. 20-22. *Otogipollis tuberculatus*, 479(7-5).

Nudopollis granulatus *sp. nov.* Pl. 7, figs. 13-14

Amb triangular with nearly straight sides, angles slightly elongated and projected, holotype *ca.* 25 μm in diameter; triporate, angulaperturate, pore with indistinctive atrium; exine *ca.* 2 μm thick, sexine thicker than nexine and thickened to 5 μm at pore area to form annulus; pore canal index under 0.3; pore canal slit, exopore 1-2 μm wide; ornamentation finely granulate, with a thinned area in each polar area.

This species differs from *N. terminalis* in the strongly thickened exine in pore area, elongated angles and thinned area in polar area.

Occurrence: Otog Banner, Inner Mongola, Lower Tertiary.

Type: Pl. 7, fig. 14; slide no.: *687(3-4).*

Nudopollis thiergarti (Pot.) Pflug 1953 Pl. 10, figs. 5-8

Nudopollis thiergatti (Pof.) Pflug, S. 109, Taf. 25, Figs. 25-48. 1953

Amb triangular, diameter 2 μm.

Occurrence: Otog Banner, Inner Mongola, Lower Tertiary.

OSCULAPOLLIS Tschudy, 1975

Type species : *Osculapollis aequalis* Tschudy 1975

Osculapollis granulatus *sp. nov.* Pl. 7, figs. 15-16

Amb triangular with slightly concave / convex sides and rounded angles, 30-35 μm (holotype 30 μm) in diameter; triporate, equato-angulaperturate, pore with vestibula, pore canal index nearly 0.3; exopore round about 2 μm and endopore about 8 μm wide; exine 3 μm thick, sexine twice thicker than nexine and with interlocum between them, nexine extending to base of pore, sexine divided into two layers in pore area, with outer layer homogeneous and inner layer bearing baculate structure; coarse to granulate.

This species differs from *O. aequalis* and *O. perspectus* (Tschudy, 1975, p.29, pl. 18, figs. 18-20, 21-27) in the granulate ornamentation, the latter two species possess smooth exine, and occur in the Upper Cretaceous of the coastal plain of the Gulf of Mexico, America.

Occurrence: Northern Jiangsu, Funing Group.

Type: Pl. 7, fig. 15; slide no.: *617.*

OTOGIPOLLIS *gen. nov.*

Type species: ***Otogipollis tuberculatus*** *gen. et sp. nov.*

Diagnosis: Pollen oblate, amb triangular with concave sides and elongated angles in arm-shaped; triporate, equatoangulaperturate, pore with atrium formed by sexine and without vestibula, exopore oval and small, endopore larger and without clear boundary with body, pore canal index 0.4-0.5; exine moderately thick, sexine thicker than nexine; granulate, microechinate and tuberculate.

Remarks: the genus differs from *Concavitriporites* and *Trimagnaporites* which have with deeply concave sides, from *Proteacidites* and *Propylipoolis* in having the pore which is composed mainly of nexine; from *Extratriporopollenites* which has with thickened annulus, and from *Vacuopollis* and *Pseudovacuopollis* which have slitting exogerminal structure and multilayered nexine.

Occurrence: China, Upper Cretaceous--Lower Tertiary.

Otogipollis tuberculatus *gen. et sp. nov.* Pl. 7, figs. 20-22; Pl. 8, figs. 1-3

Amb triangular with slightly concave sides and elongated angles with rounded ends, diameter 40-50 μm (holotype 43 μm); triporate, pore with tubular atrium, pore canal index over 0.4, exopore oval, *ca.* 3-4 μm wide, endopore over 5 μm wide; exine 2-3 μm thick, sexine twice thicker than nexine, with inner side uneven, probably with baculate structure visible in pore area; ornamentation tuberculate and punctate, outline microundulate.

This species is characterized by the tuberculate ornamentation and the exine with baculate structure. *O. solidus* has smooth surface and exine without baculate structure, *O. elegans* is small in size and exoproe, *O. longus* has granulate ornamentation, and *O. curvatus* has microgranulate-microspinate ornamentation.

Occurrence: Otog Banner, Inner Mongolia, Lower Tertiary; Sanmenxia Area, Henan, Menli Formation.

Type: Pl. 7, fig. 20; slide no.: *479(7-5).*

Otogipollis curvatus *gen. et sp. nov.* Pl. 8, figs. 4-8

Amb tiangular with straight or slightly concave sides and rounded or obtuse angles, diameter of holotype 35 μm; triporate, pore with atrium and indistinctive praevestibula; exine 1.5-2 μm thick, sexine thicker than nexine, slightly thickened at base of atrium, then becoming curved and thinned, extending to pore margin, to form a curved praevestibula, nexine thin and extending to base of atrium, pore canal index over 0.3, exopore oval, 3-5 μm wide, endopore *ca.* 8 μm wide; microgranulate-microspinate, outline microspinate.

This species is characterized by the sexine curved at base of atria and the microspinate ornamentation.

Occurrence: Otog Banner, Inner Mongolia, Lower Tertiary; Sanmenxia Area, Henan, Menli Formation.

Type: Pl. 8, fig. 4; slide no.: *683(6-2).*

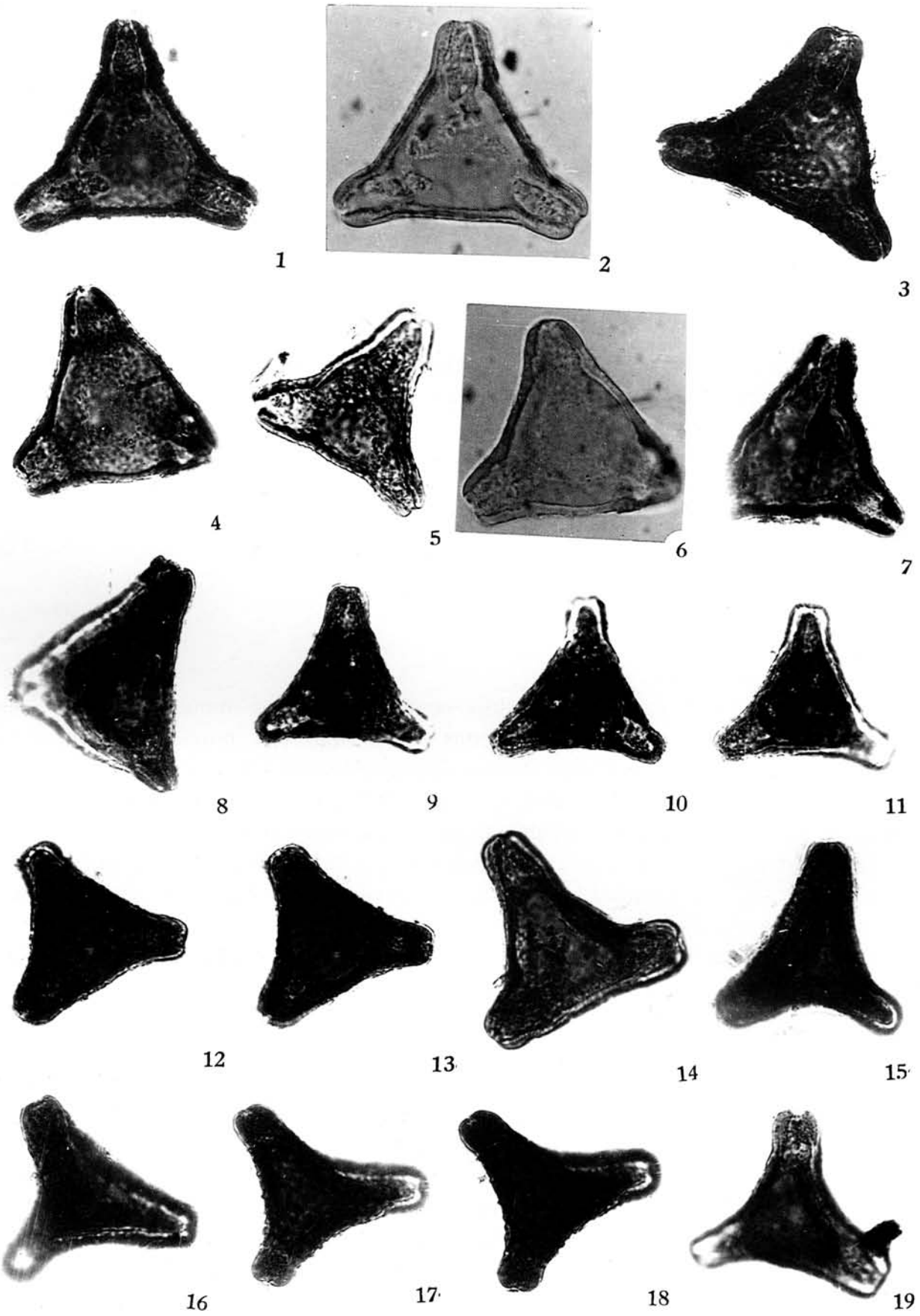
Otogipollis elegans *gen. et sp. nov.* Pl. 8, figs. 9-13

Amb triangular with slightly concave sides and longated angles, 25-35 μm (holotype 30 μm) in diameter; triporate, pore with atrium formed by elongated sexine, nexine extending to base of atrium, pore canal index *ca.* 0.5, exopore oval and small, 2-3 μm wide, endopore to 5 μm wide; exine 2-3 μm thick, sexine thicker than nexine with inner side uneven, denticulate; surface smooth, showing granulate structures in pore area and on body.

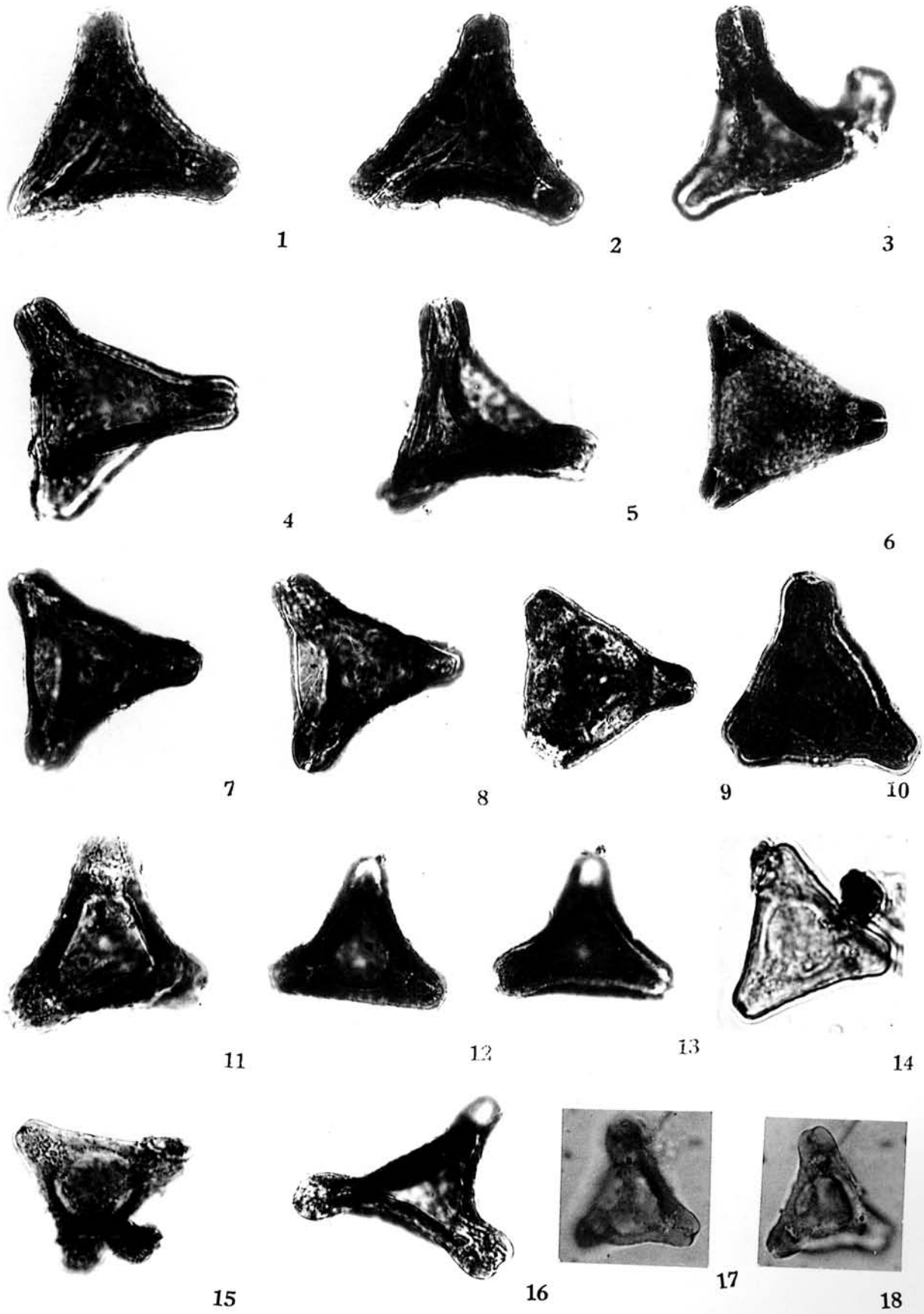
This species resembles *Conclavipollis anulopyramis* Pflug (1953, S. 105, Taf. 20, Fig. 29-32) in the amb, atrium and ornamentation, but differs from the latter in the thick exine, the absence of annulus and the larger pore canal index which is only 0.3 in the latter.

Occurrence: Otog Banner, Inner Mongolia, Lower Tertiary.

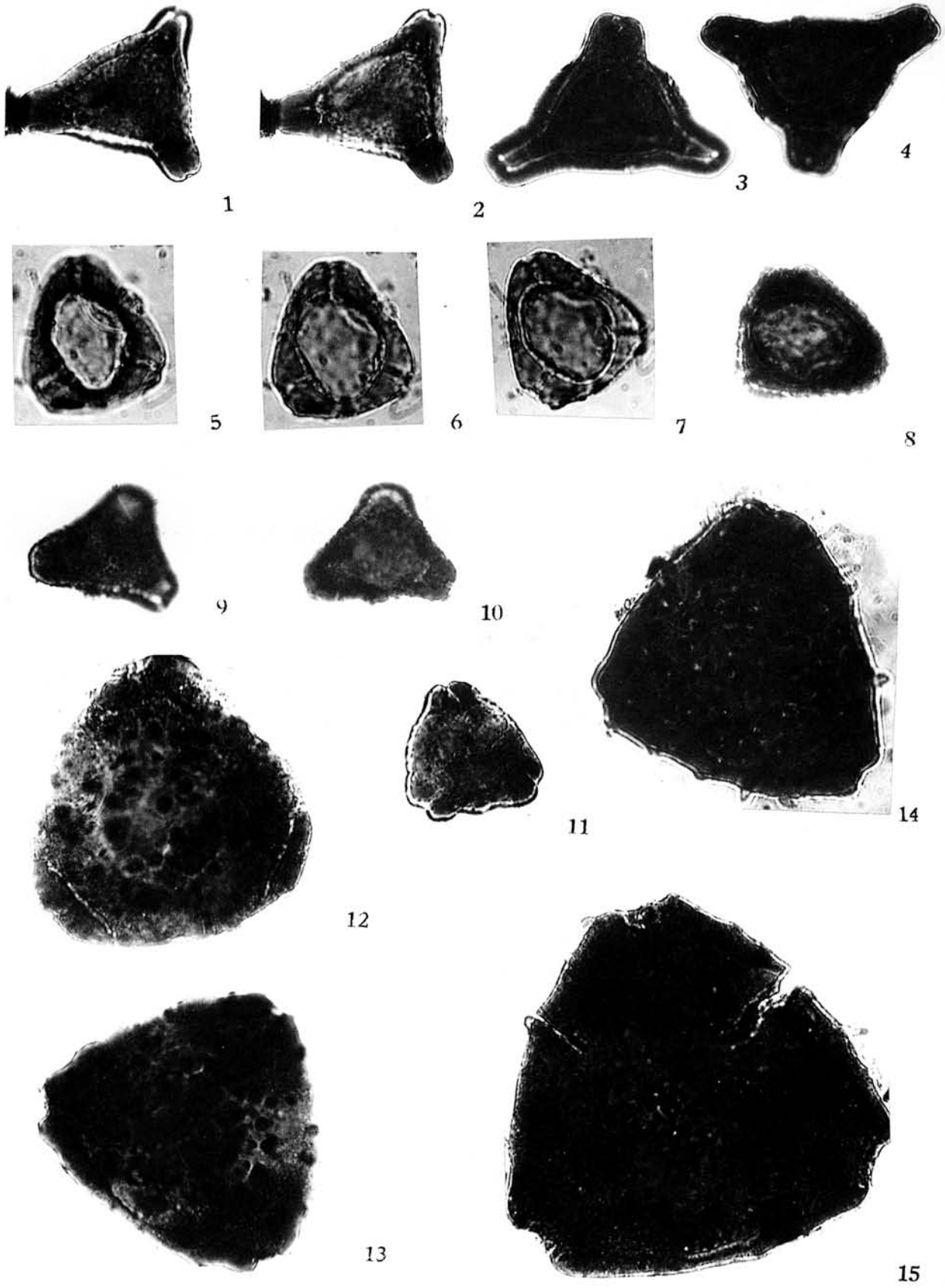
Type: Pl. 8, fig. 9; slide no.: *683(1-2).*



Pl. 8. Normapolles sporomorphs, figs.1-3. *Otogipollis tuberculatus*, 687(7-4), 687(5-3), 683(19-3); figs. 4-8. *Otogipollis curvatus*, 683(6-2), 687(10-4), 683(6-3), 479(16-4); figs. 9-13. *Otogipollis elegans*, 683(1-2), 683(A-2); figs. 14-19. *Otogipollis longus*, 523(B-4), San1(15-1), San1(2-3).



Pl. 9. Normapolles sporomorphs, figs. 1-5. *Otogipollis solidus*, 683(1-1), 523(6-3), 479(7-4), 479(D-3); figs. 6-10. *Otogipollis triangulus*, 687(5-3), 687(11-3), 683(15-3), 683(6-4); fig. 11. *Basopollis orthobasalis*, 683(6-4); figs. 12-15. *Basopollis basalis*, 479(6-3), 479(C-6), 479(C-4), fig. 16. *Basopollis obscurocostatus*, 479(4-3); figs. 17-18. *Basopollis periodus*, 687(16-3-1).



Pl. 10. Normapolles sporomorphs, figs. 1-4. *Nudopollis endangulatus*, 479(7-2), San2(8-4); figs. 5-8. *Nudopollis thiergarti*, 687(19-2), 683(7-9); figs. 9-11. *Nudopollis terminalis*, 687(4-3), 683(15-4); figs. 12-13. *Diervillapollenites magniatriμm*, 523(12-2), 683(3-3); fig. 14. *Diervillapollenites echinatus*, 683(13-3); fig. 15. *Echitriporites magnus*, 683(11-1).

Otogipollis longus (Wang, Sun *et* Zhao) *comb. nov.* Pl. 8, figs. 14-19

Proteacidites longus Wang, Sun *et* Zhao, P. 123, Pl. 17, figs. 16, 17. 1990

Amb triangular with concave sides, angles elongated and terminal ends rounded, 30-40 μm in diameter; triporate, pore with atrium, pore canal index 0.5; exine 2-3 μm thick, nexine thin, sexine thicker than nexine, containing baculate structure, with inner side uneven in atrium area, exopre oval, 3-4 μm wide, endopore over 6 μm wide; granulate, outline uneven.

This species differs from *O. elegans* in having larger size and relatively thinner exine.

Occurrence: Otog Banner, Inner Mongolia, Lower Tertiary; Sanmenxia Area, Henen, Menli Formation.

Otogipollis solidus *gen. et sp. nov.* Pl. 9, figs. 1-5

Amb triangular with slightly concave sides, angles elongated and terminal ends rounded, diameter 32-45 μm (holotype 40 μm); triporate, pore with atrium, pore canal index over 0.4; exopore oval, 3-4 μm wide, endopore over 6 μm wide; exine 3 μm thick, nexine very thin, sexine several times thicker than nexine, with its inner side denticulate in atrium; granulate.

This species differs from *O. longus* in the thicker and homogeneous exine, without baculate structure.

Occurrence: Otog Banner, Inner Mongolia, Lower Tertiary; Sanmenxia Area, Henen, Menli Formation.

Type: Pl. 9, fig. 4; slide no.: *479(7-4)*.

Otogipollis triangulus *gen. et sp. nov.* Pl. 9, figs. 6-10

Amb triangular with straight or slightly concave sides, angles elongated and terminal ends rounded, 30-40 μm (holotype 35 μm) in diameter; triporate, pore with atrium, sexine slightly separated in atrium and sometimes showing small praevestibula; exine 2 μm thick, sexine thicker than nexine and slightly thickened along pore margin; scabrate to granulate; a triangular thickening area shown indistinctively on each polar area.

This species resembles *O. elegans* in the outline, but differs from the latter in having larger size and triangular thickened area in polar area.

Occurrence: Otog Banner, Inner Mongolia, Lower Tertiary.

Type: Pl. 9, fig. 7; side no.: *687(11-3)*.

LITERATURE CITED

Goczan, F., J. J. Groot, W. Krutzsch, and B. Pacltova. 1967. Die Gattungen des " Stemma Normapolles Pflus 1953 " (Angiospermac). Palaeont. Abh. B, **2**(3): 427-633.

Pflug, H. D. 1953. Zur Entatshung und Entwicklung des Angiospermiden pollens in der Endgeschichte. *Palaeontographica* B, **95**: 60-171.

Hao, Y. and M. Chen. 1983: Study on age of a spora-pollen assemblage with Normapolles and Proteaceous.Experimental Petroleum Geology, **5**(4): 289-297 (with English abstract).

Song, Z. 1996 Early Tertiary Normapolles and related palynomorphs of China (I). Taiwania **41**(1): 53-66.

Song, Z., Y. Zheng, J. Liu, P. Ye, C. Wang and S. Zhou. 1981. Cretaceous-Tertiary palynological assemblages from Jiangsu. Geological Publishing House (with English abstract).

Song, Z., M. Li and L. Zhong. 1986: Cretaceous and Early Tertiary sporo-pollen assemblages from the Sanghui Basin,Guangdong Province. Palaeoat. Sin. Whole 171, New Series A, 10, Science Press (with English abstract).

Sun, X., D. Zhang and J. Hou. 1979: Late Cretaceous (Maastrichtian) Sporo-Pollen assemblages from northern Nei Monggol. Acta Bot. Sin., **21**(3): 285-294 (with English abstract).

Thomson, P. W. and Pflug, H. 1953. Pollen und Sporen des mitteleuropalschen Tertiars. *Palaeontographica* B. 94: 1-138.

Tschudy, R. H., 1975: Normapolles pollen from the Mississippi embayment. U.S. Geol. Survey Prof. paper **865**: 1-40.

中國早第三紀正型粉類及相關孢型(II)

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摘　　要

本文研究了中國一些地區古新統及下始新統的正型粉類及其相關的一些孢型。全文分三部份在 Taiwania 上發表。這是此文的第二部份，主要是孢型的分類學研究，共描述20屬和60種，其中包括7新屬44新種。新屬為 *Concavitriporites, Ditriangulipollis, Ditriporites, Echibasopollis, Erlianipollis, Neimongolipollis*, 和 *Otogipollis*。除註明產地者外，其它均產于內蒙古鄂托克旗草木浩石膏礦地層，時代為晚古新世至早始新世。

關鍵詞：早第三紀，正型粉類，中國。

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