

## MIOCENE PALYNOMORPHS OF TAIWAN

(VII)-Additional note on gymnospermous palynomorphs<sup>1</sup>SHU-MIAW CHAW<sup>2</sup> and TSENG-CHIENG HUANG<sup>3</sup>

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**Abstract:** Three new names of gymnospermous taxa are proposed. *Vitreisporites*, *Taxodiaceapollenites*, *Araucariacites*, *Dacrydiumites*, *Ephedripteris* and *Classopollis* whose modern generic counterparts are not represented in the modern flora of Taiwan so that their geographical and ecological significance are discussed.

Three new names are proposed: They are one new species, *Psophosphaera chuhuangkeniana*; one new combination species, *Araucariacites taiwanianensis* and one new recorded species, *Zonalapollenites azonalis*. The detailed descriptions are as follow:

Genus *Araucariacites* Cookson 1947 ex 1953 南洋杉粉屬

Type species: *A. australis* Cookson 1947 ex Couper 1953.

Diagnosis: Grains large, 45-95  $\mu$  (average ca. 70  $\mu$ ) wide. Usually flattened and crumpled, when expanded circular. Exine 1  $\mu$  thick, finely granulate.

Taxonomic affinity: Palynomorphs of this genus are related to those of the extant *Araucaria* (Krutzsch, 1971).

1. *Araucariacites taiwanensis* (Huang) *comb. nov.* 臺灣南洋杉粉

*Psophosphaera taiwaniana* Huang in *Taiwania* 24: 82. 1979.

Note: Additional records for this species are found from Wuchihshan Formation, Keelung; Shihti Formation, Sanhsia; Shihti Formation, Peliao Formation, and Yutengping Sandstone Member, Miaoli County.

Genus *Psophosphaera* Naumova 1939 ex Bokhvitina 1953 皺球粉屬

Type species: *P. tenuis* Naum. ex Bokhovitina.

Diagnosis: Grains inaperturate, 80-90  $\mu$  wide. Exine thin, infrapunctate, with many large crumpling folds.

Taxonomic affinity: Palynomorphs of this genus are related to those of the extant *Larix* and *Pseudotsuga* (Krutzsch, 1971).

2. *Psophosphaera chuhuangkeniana* *sp. nov.* 出磺坑皺球粉

Pl. I, Figs. 1-3

Diagnosis: Grains inaperturate, round when expanded with many large crumpling folds, 80-90  $\mu$  wide, Exine infrapunctate, 1-1.5  $\mu$  thick.

Locality: Shihti Formation (holotype), Sanhsia; Shihti Formation (paratype), Miaoli county.

Slide no.: St 3-2L (holotype), ML 16-4R (paratype).

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Genus *Zonalapollenites* Pflug in Thomson & Pflug 環翼織杉粉屬

Type species: *Z. igniculus* (Pot.) Th. & Pflug.

Diagnosis: Grains inaperturate. Exine of ventral regions with a strongly vestigial circular bladder. Total length 45–85  $\mu$ .

Taxonomic affinity: Palynomorphs of this genus is closely related to those of the extant subgenus *Eutsuga*.

3. *Zonalapollenites azonalis* Krutzsch 缺環翼織杉粉

Pl. 1, Figs. 4–6

Diagnosis: Grains inaperturate, elliptical to spheroidal, 60–90  $\mu$  wide. Bladder strongly reduced. Exine spinulate, spines 1–3  $\mu$  long.

Note: This species was found from Mushan Formation to Yutengping Sandstone Member, Miocene.

Generalizing the published reports concerning the Miocene of Taiwan (Ling, 1965; Canright, 1972, 1974; Huang, 1976, 1978, 1979, 1981), the following gymnosperm taxa are not represented in the modern flora of Taiwan (Li, 1975): *Vitreisporites*, *Taxodiaceapollenites*, *Araucariacites*, *Dacrydiumites*, *Ephedripites*, *Classopollis*.

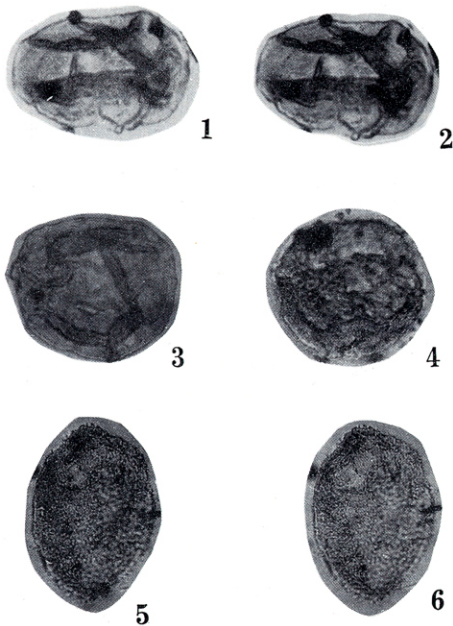
Pollen grains of *Vitreisporites* were very common in the Middle-Mesozoic, and they are similar to those obtained from macrofossils of *Caytonanthus*, a genus of Caytoniales (Hugh, 1969). Chaloner (1969) pointed out that the rise of Caytoniales seems in accord with the appearance of *Vitreisporites*, and inferred that the possible taxa *Vitreisporites* and Caytoniales and *Harrisiothecium* (a questionable Pteridosperm). Strictly speaking, *Vitreisporites* occurred from the Triassic to the Cretaceous (Chaloner, 1969; Scargel *et al.*, 1968). Nevertheless, this Mesozoic member occurs in the Shihti Formation of the Miocene in Taiwan. Accordingly, it is possible that Shihti Formation once had a redeposited event, but because this palynomorph has only one record, further study is necessary.

*Taxodiaceapollenites* is the form genera name of *Metasequoia*, Canright (1972, 1974) discussed this genus in detail.

Pollen grains of *Araucaria* has been reported from several Tertiary localities in Europe, suggesting that the family, Araucariaceae, become restricted to more southern latitudes fairly late in geological time (Scargel *et al.*, 1968). The fact that *Araucariacites* are found from almost all of the Miocene strata in Taiwan, is in accord with this view.

According to Cookson and Pike (1953), Canright (1974) thought that the *Phyllocladites* to which Ling (1965) referred, represented the *Dacrydiumites*. The *Dacrydiumites* in the present study are recorded from the Sangfuchi Sandstone and the Yutengping Sandstone Member, Miaoli county. *Dacrydiumites* whose modern generic counterpart *Dacrydium* occurs in New Zealand, New Caledonia, Indochina, Australia, New Guinea, Malaya, and the Philippines; the history of Podocarpaceae goes back at least to the Triassic, and the family was formerly widespread in Asia, Europe and North America, as well as the southern Hemisphere, and the withdrawal to present limits appears to have occurred during later Tertiary times (Scargel *et al.* 1968). However, Yamanoi (1974, 1976, 1978) obtained abundant pollen grains of *Dacrydium* from the Miocene deposit of Japan. Ling (1965), Canright (1974), Huang (1979), and the present study strongly support assertion that *Dacrydium* was a member of Miocene flora and had its distribution north to Japan during later Tertiary times.

*Ephedra*, truly xerophytic, is distributed sporadically around warm temperate latitudes, and grow best on sandy or rock sites such as deserts and mountains. The history of *Ephedra* goes back to Permian (Scargel *et al.*, 1968). Surprisingly enough, six taxa of *Ephedra* appeared in the Miocene of Taiwan (Huang, 1981). Therefore, once there might be arid habitats for *Ephedra* in Taiwan.



**Explanation of Plate 1. All figures  $\times 500$**

- 1-3. *Psophosphaera chuhuangkeniana*; 1 & 2, ML16-4R; 3, St-2L.  
4-6. *Zonalapollenites azonalis*; 4, ML12-3R; 5 & 6, Tr3-3R.

We will discuss the significance of *Classopollis* in the future due to lack of reference at hand.

However, in Taiwan, the gymnospermous species were more abundant in the Miocene than the Recent times. The evidence from fossil pollen grains of *Araucaria*, *Dacrydium*, and *Ephedra* imply that the temperature during the Miocene of Taiwan at least locally was warmer and arider than the present.

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