

# Occurrence of *Jiangsupollis* from the Upper Cretaceous of North Eastern India and its Significance

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## ABSTRACT

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*Jiangsupollis striatus* was widely distributed in the Upper Cretaceous of southern China. Some species assignable to this genus were also reported from eastern part of India, which indicate that unknown parent plants of the pollen grains were also growing in India and geographically there was certain connection between southern China and eastern India in the Late Cretaceous for migration. This also reveals the fact that the taxa *Aquilapollenites* and *Integricarpus* which is morphologically identical to *Jiangsupollis* species in eastern India might have migrated from Asian Plate rather than northern African Plate at that time.

**Key-words**—*Jiangsupollis*, Late Cretaceous, Migration, China, India.

सारांश

पूर्वोत्तर भारत के अंतिम क्रिटेशस युग से *जियांगसूपोलिस* की प्राप्ति तथा इसका महत्व

सांग जेड, वांग डब्ल्यू. एवं हुआंग एफ.

दक्षिणी चीन के अंतिम क्रिटेशस युग में *जियांगसूपोलिस स्ट्रायाटस* विस्तृत रूप से वितरित था। इस वंश की निर्धारित कुछ प्रजातियाँ भी पूर्वी भारत से अंकित की गई थीं जिससे यह संकेत मिलता है कि परागकणों के अनामी मूल पादप भी भारत में उग रहे थे। अंतिम क्रिटेशस युग में स्थानांतरण हेतु दक्षिणी चीन तथा पूर्वी भारत के मध्य भौगोलिक रूप से निश्चित संबंध था। यह तथ्य भी प्रकट होता है कि *एक्वीलेपोलेनाइटीज* एवं *इंटीग्रीकोर्पस* वर्गकों, जो कि पूर्वी भारत में आकारिकीय रूप से *जियांगसूपोलिस* प्रजाति के समान हैं, को उस समय उत्तरी अफ्रीकी प्लेट की अपेक्षा में एशियन प्लेट से अवश्य स्थानांतरित किया गया है।

संकेत शब्द—*जियांगसूपोलिस*, अंतिम क्रिटेशस, स्थानांतरण, चीन, भारत।

## INTRODUCTION

Since the discovery of *Aquilapollenites* from eastern India (Baksi & Deb, 1976, 1980-1981) and Normapolles (Nandi, 1983, 1984, 1990) from northeastern India, the Late Cretaceous

phytogeography and migration routes of taxa to India have been much discussed. The probable routes were suggested to be from the central areas of the Normapolles and *Aquilapollenites* Provinces. Some authors (Kedves, 1971; Schrank, 1987) suggested that Normapolles and

*Aquilapollenites* originally occurred in the Senonian of Egypt, and they reached India through the Northern African Plate and reached the eastern edge of the Indian Plate. Srivastava (1983) was of the opinion that Normapollis occurring localities in northeast India were in the northern edge of the Tethys, south of the Asian Plate and southeast of the Brahmaputra River. He remarked that this area did not belong to the Indian Paleontological Plate, but was part of the Asian Plate. Our data support Srivastava's view, but the age of the palynological assemblage is Paleocene (Sun *et al.*, 1979) rather than Maastrichtian.

Herngreen *et al.* (1996, p. 1174) mentioned both Srivastava's (1983) and Kar and Singh's (1986) views, and concluded that Normapollis in India migrated from northern Africa. Srivastava (1983) believed that the Normapollis and *Aquilapollenites* assemblages from Assam and Meghalaya areas in northeastern India represent a mixed flora in the Asian Plate, while Kar and Singh (1986) suggested that it was indeed a part of the Indian Plate, near the Asian land mass. The recent pollen records in southern China will possibly gain the similar view as Kar and Singh (1986) that both floral provinces were in close proximity.

The occurrence of *Integricorpus* spp which are morphologically alike to *Jiangsupollis striatus* Song from Meghalaya, northeast India (Nandi & Chattopadhyay, 2002) shows that there was some palynofloral relationship between India, particularly northeast, and southern China, because *J. striatus* was widely distributed in southern China during the Late Cretaceous.

### JIANGSUPOLLIS PROVINCE IN SOUTHERN CHINA

*Jiangsupollis* Song 1980 is characterized by spherical or rhombic shape, without any polar protuberance; three equatorial projections slender and short, beak-shaped; tricolpate, colpi on the beak-projections; exine 2-5  $\mu\text{m}$  thick, striate. It differs from *Orbiculapollis* Chlonova 1961 having striate ornamentation, and from all other genera of *Aquilapollenites* group in lacking the polar protuberance. All specimens of this genus are preserved in lateral view, whereas the striate *Cranwellia* and *Scollardia* Srivastava 1966 are always preserved in polar view.

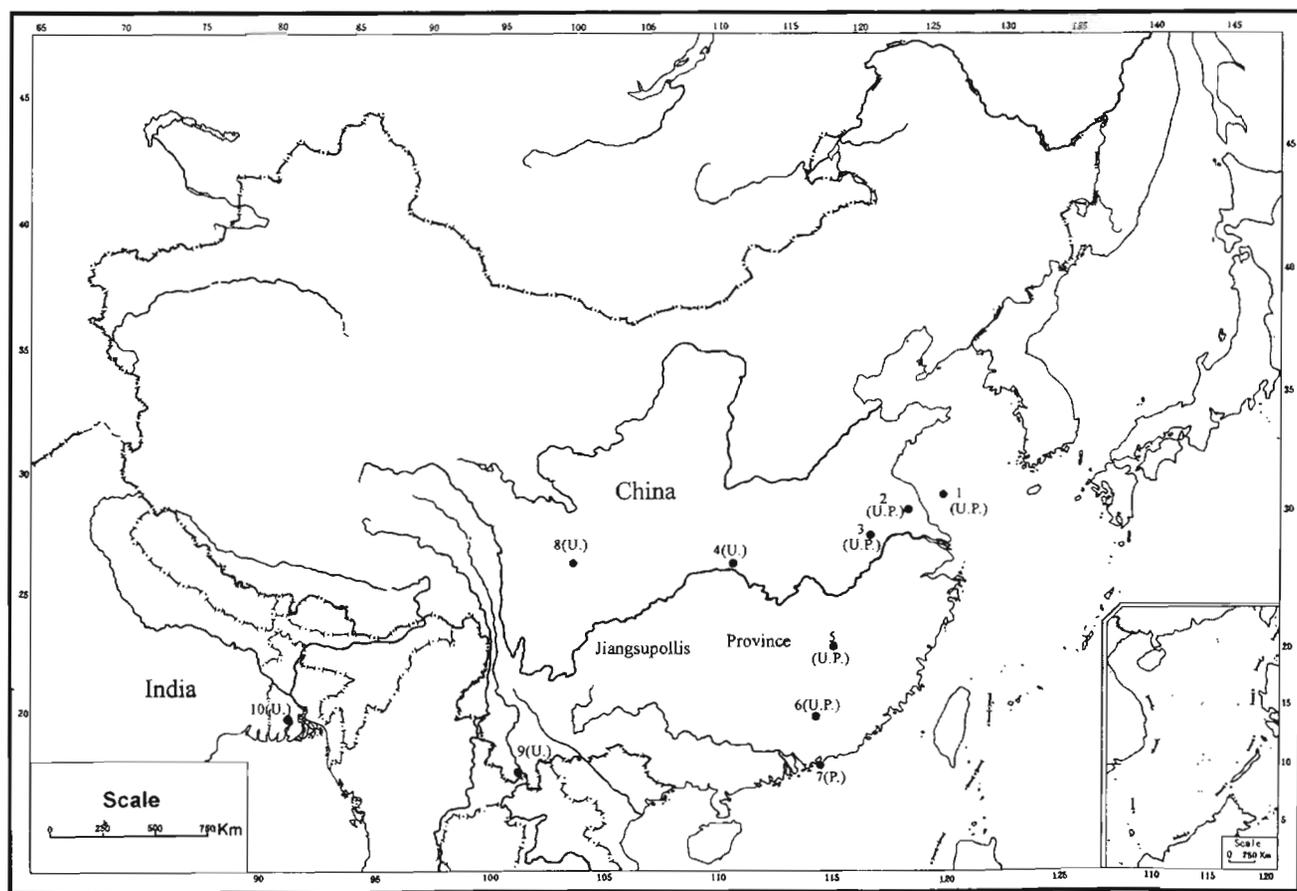
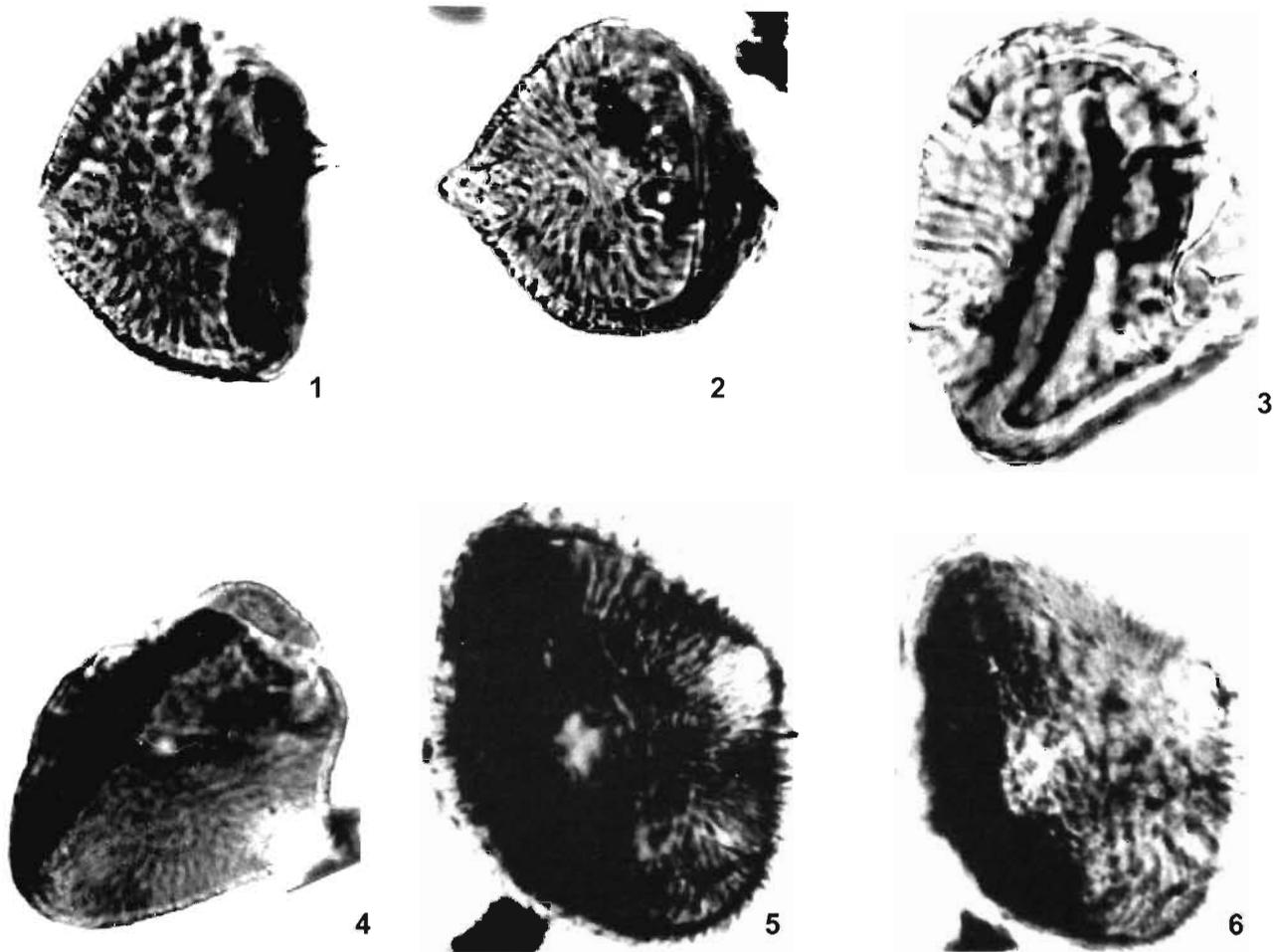


Fig. 1—Map of China and eastern part of India showing the distribution of *Jiangsupollis striatus*. 1. Yellow Sea Basin, 2. northern Jiangsu, 3. eastern Anhui, 4. Jiang-Han Basin, 5. Central Jiangxi, 6. Sanshui Basin of Guangdong, 7. Hong Kong, 8. Qionglai Basin of Sichuan, 9. Mengla Basin of Yunnan, 10. West Bengal, India. U=Late Cretaceous. P=Paleocene.



## PLATE 1

(Palynomorphs from the Upper Cretaceous of India, all figures  $\times 1000$ )

- 1, 2. *Jiangsupollis striatus* Song  
 3. *Jiangsupollis* cf. *major* Song  
 4. ? *Jiangsupollis* sp. (cf. *Aquilapollenites bengalensis* Baksi & Deb); all the above figures were determined as *Integricorpus*  
 5, 6. *Aquilapollenites bengalensis* Baksi & Deb, 1976.

The type species of the genus, *Jiangsupollis striatus* Song 1980, based on the size of pollen and the development of striate ornamentation, may be separated into three subspecies, 1) *Jiangsupollis striatus* subsp. *striatus* (Pl. 2.8-11) distinguished by 36-45  $\mu\text{m}$  size range, strongly developed baculate-striate ornamentation, and 1.5-2  $\mu\text{m}$  wide striae; 2) *Jiangsupollis striatus* subsp. *medius* (Pl. 2.6, 7) have same size as the former subspecies, thinner exine (1.5-2  $\mu\text{m}$ ) and finer striae (1-1.5  $\mu\text{m}$  wide); 3) *Jiangsupollis striatus* subsp. *minor* (Pl. 2.1-5) with 25-35  $\mu\text{m}$  in size, microstriate ornamentation (1-1.2  $\mu\text{m}$  wide) and thin exine (commonly 1-2  $\mu\text{m}$ ). Another species, *Jiangsupollis major* Song (Pl. 2.12) has large size (diameter over 60  $\mu\text{m}$ ), 4-5  $\mu\text{m}$  thick exine, sexine 2-3 times thicker than the nexine and with thinner striae.

*Jiangsupollis striatus* Song was widely distributed in southern China. It has been recorded from the Qiannan Group of the Yellow Sea Basin (Li *et al.*, 1984), the Taizhou Formation of northern Jiangsu and eastern Anhui (Song *et al.*, 1980, 1981, 1983, 1995; Wang *et al.*, 1987), the Zhoujiadian Formation of Central Jiangxi (Yu *et al.*, 1985), the Dalangshan Formation of Guangdong Province (Song *et al.*, 1986). All these strata belong to Senonian (Coniacian-Maastrichtian; Song & Qian, 1989; Song *et al.*, 1995). The unknown parent plant producing *Jiangsupollis striatus* grew in southeastern China in the Late Cretaceous. It migrated west to the central and southwestern China including the Yuyang Formation in the Jiang-Han Basin of Hubei Province (Wang *et al.*, 1980), the Guankou Formation of Sichuan Province (CIGMR, 1983) and the Mengyejing

Country	Southern China										Eastern India		
	Yellow Sea Basin	Northern Jiangsu	Eastern Anhui	Central Jiangxi	Guangdong	Jiang-Han Basin	Sichuan	Yunnan	Hong Kong	West Bengal	Meghalaya		
Areas													
Ages													
Paleocene	Funing F.	Funing F.	Funing F.	Chijiang F.	Buxin F.				Pingzhou F.				
Late Senonian	Taizhou F.	Taizhou F.	Taizhou F.	Zhoujiadian F.	Dalangshan F.	Yuyang F.	Guankou F.	Mengyejing F.					
Early Senonian	Taizhou F.	Taizhou F.	Taizhou F.	Zhoujiadian F.	Dalangshan F.							Jalangi F.*	? Gumaghat F.

\* Also present in upper part of Bolpur F. and Ghatal F.

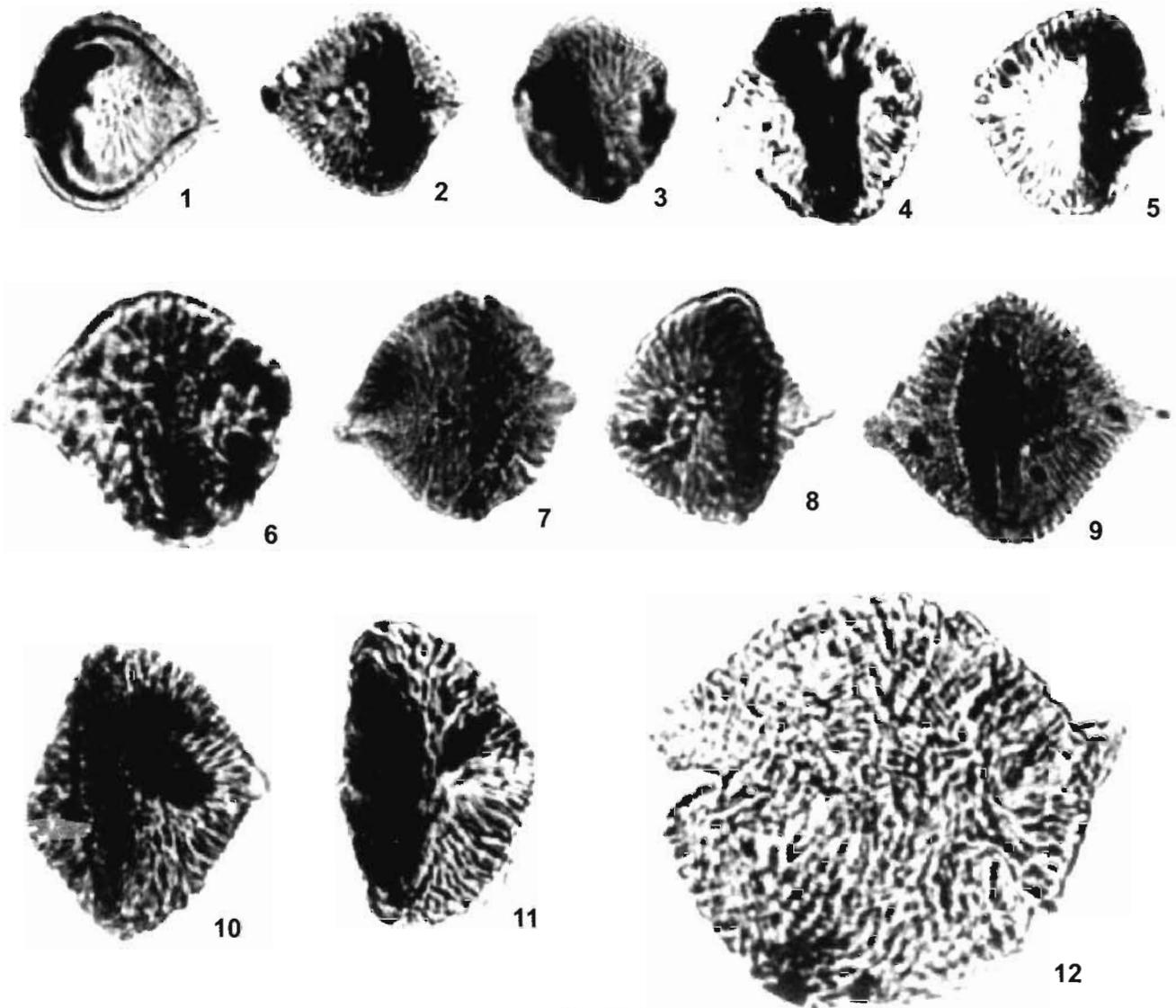
Fig. 2.—Distribution of *Jiangsupollis striatus* in southern China and eastern India.

Formation of Yunnan Province (Song *et al.*, 1976) approximately after the Campanian. Meanwhile they kept growing in southeastern China including the Funing Formation of Yellow Sea Basin, northern Jiangsu and eastern Anhui, the Chijiang Formation of Jiangxi (Sun & He, 1980), the Buxin Formation of Guangdong Province (Song *et al.*, 1986) and the Pingzhou Formation of Hong Kong (Song, 1998) in the Paleocene. This fact reveals that there was a *Jiangsupollis* Province in southern China (Figs 1, 2).

### RECOGNITION OF *JIANGSUPOLLIS STRIATUS* SONG FROM THE LATE CRETACEOUS OF INDIA

Nandi and Chattopadhyay (2002) described a number of Triprojectaperturate pollen grains from the Late Cretaceous sediments of Meghalaya and they proposed to transfer *Aquilapollenites bengalensis* Baksi and Deb, 1976 originally recorded from the Cretaceous of West Bengal to *Integricorpus* as *Integricorpus (Aquilapollenites) bengalensis* (Baksi & Deb, 1976) Nandi and Chattopadhyay (2002, p. 604).

Without going into discussion on nomenclatural ambiguity of this taxonomic treatment, it can be pointed out that the specimens combined by Nandi and Chattopadhyay (2002) is actually different from *Aquilapollenites bengalensis* Baksi and Deb 1976. This is because palynomorphs of *Aquilapollenites bengalensis* Baksi and Deb, 1976 are “with three equatorially situated lateral protrusions, isopolar, poles round, protrusions well developed, body more or less rectangular; equatorial protrusions small of conical shape, apices tapering and rounded, extending at right angles from the polar axis” (Baksi & Deb, 1976). Therefore, the latter has oblong or rectangular shape, while the former i.e., *Integricorpus* is spherical or rhombic. They are thus not the same taxon. Among four illustrated specimens by Nandi and Chattopadhyay (2002) two specimens (pl. 2, fig. 13; pl. 3, fig. 1) are with same characters as *Jiangsupollis striatus*, such as spherical or rhombic bodies, beak-shaped equatorial projections, same size and striate ornamentation. Their other specimen (pl. 2, fig. 12) with microstriate ornamentation and larger size than that of *J. striatus* subsp. *minor*, could be a new type, and we cannot determine it without examining the specimen. The fourth specimen (pl. 2, fig. 14) is comparable to *Jiangsupollis major* Song having large size, thick exine (4-5 µm), and 3 times thicker sexine than the nexine. Therefore, three species of *Jiangsupollis*, namely *Jiangsupollis* cf. *major* (Pl. 1.3), *J. striatus* (Pl. 1.1, 2) and ? *Jiangsupollis* sp. (Pl. 1.4) occurred in the Late Cretaceous of Meghalaya, India. The last species (Pl. 1.5, 6) is perhaps *Aquilapollenites bengalensis* as it has oblong body and microstriate ornamentation.



## PLATE 2

(*Jiangsupollis* from southern China, all figures  $\times 800$ )

- 1-5. *Jiangsupollis striatus* subsp. *minor* Song; 1-3. From the Taizhou Formation (Senonian) of northern Jiangsu; 4, 5. From the Mengyejing Formation (Maastrichtian) of Yunnan Province.  
 6, 7. *Jiangsupollis striatus* subsp. *medius* Song from the Taizhou Formation.  
 8-11. *Jiangsupollis striatus* subsp. *striatus* Song; 8, 11. from the Taizhou Formation; 9. from the Dalangshan Formation (Senonian) of Guangdong Province; 10. from the Mengyejing Formation.  
 12. *Jiangsupollis major* Song from the Taizhou Formation.

## DISCUSSION

Two palynozones were recognized from the Upper Cretaceous in the Bengal Basin (Baksi & Deb, 1980). The lower one is *Aquilapollenites indicus* zone representing upper part of the Bolpur Formation and the Ghatal Formation, while the upper one, *Mulleripollis bolpurensis* zone represents the Jalangi Formation. Maheshwari and Jain (1982) stated that Bengal palynological zone 1 containing *Aquilapollenites* species could not be older than the Maastrichtian.

It is interesting to mention a Maastrichtian palynological assemblage from the Mengyejing Formation in Yunnan Province, situated close to Myanmar. This assemblage is characterized by lots of spores, such as *Schizaeoisporites*, *Pterisisporites*, *Corrugatisporites* etc., a moderate amount of gymnosperms including *Inaperturopollenites*, *Araucariacites*, *Cycadopites* and *Ephedripites* and high percentage of angiosperms (60-70% of total number) represented by Normapollens, such as *Extratropipollenites* ? sp., *Trudopollis* cf. *pompeckii*, *Paratriangulipollis*

*triangulus* and few *Aquilapollenites* species including *A. rhombicus*, *Jiangsupollis striatus* (Song *et al.*, 1976, pl. 9, figs 23-25, 28, formerly determined as *Parviprojectus cf. striatus* and *Parviprojectus* sp.). The Mengyejing Formation of Yunnan, is located far west of *Jiangsupollis* Province in southern China which lie nearby to Meghalaya, northeastern India. It is suggested that there might be a migration path for plant to migrate from southern China to eastern India, which made the occurrence of *Jiangsupollis striatus* [recorded as *Integricorpus (Aquilapollenites) bengalensis* (Baksi & Deb, 1976) Nandi and Chattopadhyay 2002]. Thus it can be concluded that Meghalaya might belongs to the *Jiangsupollis* Province, and the occurrence of Normapolles and *Aquilapollenites* in eastern India might indicate that they had their migration route to India via southern China, rather than northern Africa.

Srivastava (1983, p.152) suggested that the Meghalaya area, where Nandi (1983) studied palynology, lies in the southern part of the Asian Plate and the palynoflora "represents the mixed flora of the Asian Plate rather than that of the Indian Plate". This is because "the Brahmaputra River confluence has been considered as a suture line between the Indian and Asian Plates. Thus, sediments north and east of the Brahmaputra River are deposits received from the Asian Plate at the northern edge of Tethys". However, Meghalaya where palynomorphs *Aquilapollenites bengalensis* and *Jiangsupollis striatus* (= *Integricorpus (Aquilapollenites) bengalensis*) were found is in the west of this river, and it might be a part of the Indian Paleontological Plate, which was in the far south of the Asian Plate in the Late Cretaceous. Zhang (2000, p.32) proposed that marine sedimentation in the central Lhasa block in southern Tibet did not cease till the end of the Eocene, and ocean water was there upto end of the Eocene. How did the parent plants producing *Jiangsupollis striatus* migrate to Meghalaya covering long distance of ocean water? It seems that there was a land-bridge or a chain of islands between the Indian Paleontological Plate and the Asian Plate developed during the Late Cretaceous regression. The plants could thus able to migrate from southern China to the areas of eastern India. Consequently it can be concluded that the parent plants for Normapolles and *Aquilapollenites* group in the Late Cretaceous of India most probably migrated through this passageway rather than from the northern African Plate.

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