

ON THE OCCURRENCE OF GIGANTOPTERIS FLORA IN
CHEKIANG PROVINCE.

(With 3 Plates)

BY YOH SEN-SHING. (樂森壽)

(Geological Survey of Kwangtung and Kwangsi)

Since Richthofen's first discovery of *Gigantopteris* flora in southern Hunan, it has been found to occur very extensively in China. This remarkable flora not only presents certain palaeobotanical interests but appears very important in determining the geological age of many coal-bearing series. Sixteen localities of its occurrence had already been definitely known, of which only two were found in north China, while all the others were distributed in central and south China. But in Chekiang Province, the easternmost territory of China bordering S. W. Pacific, no indication of this fossil flora had ever been detected, though some undeterminable plant remains were reported in the Permian coal series. It was so until the spring of 1930, when the writer and Mr. Y. Chiang of this Survey, made a tour to southwestern Chekiang and happened to discover a number of beautiful plant fossils with the leading genus *Gigantopteris* from two separate localities not far from each other. In spite of that they were obtained from the dump of some native coal pits, these fossils undoubtedly occur in the carbonaceous shales of the so-called Lihsien coal series. It is because plant remains are not rare and have been actually found *in situ* in the same coal-bearing formation of other localities in SW. Chekiang, but they are too fragmentary and poorly-preserved for positive identification. The fossils from these two new localities comprise the following species:—

Gigantopteris nicotianæfolia Schenk.

Pecopteris cf. *polymorpha* Brongn.

Neuropteris sp.

Tæniopteris sp.

Cordailes sp.

Walchia (?) sp.

When the writer returned to Canton, he chanced to find among Dr. A. Heim's collection in Sun Yatsen University one single specimen of fossil plant from Changhsin coal mine of north Cheking. This obviously belongs to the species *Gigantopteris nicotianæfolia*, though its stratigraphical occurrence is not yet exactly known. Dr. Heim's collection was made during his geological trip to that coal mine in the winter of 1929.

Most recently the writer and W. K. Yao had made their geological reconnaissance along the Hanchiang region of Eastern Kwangtung, and happened to find a rich flora with *Gigantopteris nicotianæfolia*, *G. dentata* and many other species from the Permian coal series near Hsinpu of Chiaoping Hsien. This flora presents no difference with T. O. Chu's collection from Peichiang region of N. Kwangtung.

With the addition of these new localities as mentioned above, we have now 20 places from which *Gigantopteris* flora is reported to occur. These different localities so far as the writer can find have been plotted on a map (Pl. III) annexed to this paper while the details of its geographical and geological distribution may be here tabulated (see p. 83).

As to the Chronological problem of this flora, palæontologists are widely divergent in their opinions. In short, Schenk believed this flora to be Carboniferous, while later Zeiller referred to Lower Triassic but David White assigned to Lower Permian. Yabe and his followers agreed with White. Still later I. Hayasaka after finding 3 specimens of *Gigantopteris dentata* at Taochung of Anhui maintained the bed carrying this species to be Lower Triassic but separated those formations with *G. nicotianæfolia* pertaining to Permian. Question arises whether this fossil flora can represent a definite geological horizon or it is really distributed with a considerable duration of time even from Carboniferous to early Triassic? In order to settle the chronological problem of this flora, both palæontological association and stratigraphical sequence should be carefully considered. Though the occurrence of this flora is so widespread in China, yet unfortunately majority of its stratigraphical position is not well established. So far as our present knowledge of this fossil flora permits us to judge, its Carboniferous age is improbable, as Schenk's view had already be negatived by Halle, when the latter personally inspected the same locality of S. Hunan where Richthofen found his

Locality	District	Province	Collector	Date of Collection	Geol. Horizon	Authority
1. Yen Tai	Pen Chi	Liaoning (Fengtien)			L. Permian	Yabe
2. Hsi Shan	Tai Yuan	Shansi	E. Norin	1921	Up. Shihhotze Ser. (L. Permian)	Halle
3. Fen Tien	An Fu	Kiangai	C. C. Wang	1918	Fengtien Ser. (Permian)	Grabau
4. Erh Tao Ching	Tung Chuan	Yunnan	V. K. Ting	1913-1914	Coal-bearing Ser. (U. Permian)	Halle
5. Lu Tsai Ping	Hsuan Wei	Yunnan	V. K. Ting	1913-1914	Coal-bearing Ser. (U. Permian)	Halle
6. Nien Fei	Hsian Wei	Yunnan	V. K. Ting	1913-1914	Coal-bearing Ser. (U. Permian)	Halle
7. Chien Chia Kou	Hsuan Wei	Yunnan	V. K. Ting	1913-1914	Coal-bearing Ser. (U. Permian)	Halle
8.	Mi Ieu	Yunnan	J. Deprat	1909-1910	L. Triassic	Zeller
9. Tou Tsa		Yunnan	J. Deprat	1909-1910	L. Triassic	Zeller
10. Luf Pa Kou	Lei Yang	Hunan	V. Richtofen	1871?	Carboniferous	Schenk
11. Liu Shan Tou		Fukien	Y. Ishii		L. Triassic	Yabe
12. Tao Chung	Fan Chang	Anhui	I. Hayasaka	1922	L. Triassic	Hayasaka
13. Ta Wang Tsun	Hsuan Cheng	Anhui	L. F. Yih & C. Li	1924	Huanchin Coal Ser. (M. Permian)	Grabau
14. Tan Chia Chung	Chin Hsien	Anhui	L. F. Yih & C. Li	1924	Huanchin Coal Ser. (M. Permian)	Grabau
15. Na Shih Pa	Chu Chiang	Kwangtung	T. O. Chu & J. L. Hsu	1928	M. or early Up. Permian	H. C. Chang
16. Tien Lo Chung	Chu Chiang	Kwangtung	T. O. Chu & J. L. Hsu	1928	M. or early Up. Permian	H. C. Chang
17. Chang Hsin Coal Mine	Chang Hsin	Chekiang	A. Helm	1929	M. Permian	S. S. Yoh
18. Chien Wu	Chiang Shan	Chekiang	S. S. Yoh & Y. Chiang	1930	Lhsien Coal Ser. (M. Permian)	S. S. Yoh
19. Mao Tsun Shan	Chiang Shan	Chekiang	S. S. Yoh & Y. Chiang	1930	Lhsien Coal Ser. (M. Permian)	S. S. Yoh
20. Hsin Pu	Chiao Ling	Kwangtung	S. S. Yoh & W. K. Yao	1931	Mid. to up. Permian	S. S. Yoh

first *Gigantopteris*. Halle confirmed the bed carrying this flora in Leipakou of S. Hunan to be exactly identical in age with the Upper Shihhotze series of Central Shansi which is unquestionably Permian. On the other hand the Triassic age of the present flora appears also doubtful as both palæontological and stratigraphical evidences are not strong. In eastern Yunnan V. K. Ting had obtained the present flora in 3 localities. In regard to its stratigraphical occurrence Dr. Ting suggests "the coal-bearing series which has yielded the plant fossils occupies a remarkably constant horizon, namely between the Permian basaltic lava and the Triassic red sandstone." This leads Prof. Halle to conclude the coal-bearing series overlain by the Triassic red sandstone to be Upper Permian in age. During 1918 C. C. Wang of the National Geological Survey, Peiping, found this flora in his Fengtien series in Kiangsi underlying the marine limestone containing Permian fossils. This again tends to prove Prof. Halle's view more authentic. For more than 4 years of working in south China, the writer was however strongly impressed by the fact the Palæozoic productive coal-bearing formations are generally Middle Permian in age. But now in many of the Middle Permian coal-bearing formations of south China such as Hsüanchin coal series of south Anhui, Lihsien coal series of west Chekiang, and coal series of north Kwangtung etc, typical *Gigantopteris* flora is reported to occur. This fossil flora is expected to be found in other coal-bearing formations of the same age in south China, if their beds are carefully and patiently searched. At the present stage of investigation, the writer comes to the conclusion that the geological antiquity of *Gigantopteris* flora in south China may range from Middle to Upper Permian but more usually Middle Permian, although sometimes a few forerunners of Triassic type are present in this flora.

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**Explanation of
Plate I**

PLATE I.

(All figures in natural size)

- Fig. 1. *Pecopteris cf polymorpha* Brongon.
Chienwu, Chiangshan.
- Fig. 2. *Gigantopteris nicotisanæfolia* Schenk.
Changhsin Coal Mine, Changhsin.



Fig. 1



Fig. 2

**Explanation of
Plate II**

PLATE II

(All figures in natural size)

- Fig. 1. *Gigantopteris nicotianæfolia* Schenk
Chienwu, Chiangshan.
- Fig. 2. *Neuropteris* sp.
Chienwu, Chiangshan.
- Fig. 3. *Gigantopteris nicotianæfolia* Schenk
Chienwu, Chiangshan.



Fig. 1

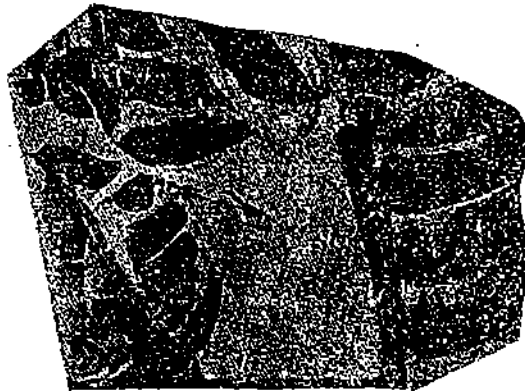


Fig. 2

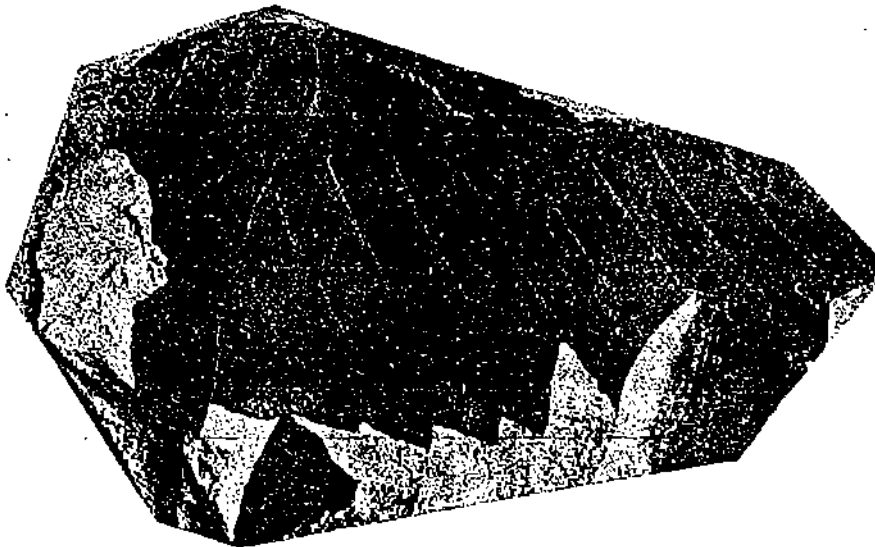


Fig. 3

**Explanation of
Plate III**

PLATE III

Localities: 1. Yen Tai, Liaoning (Fengtien). 2. Hsishan, Taiyuan, Shansi. 3. Erh Tao Kou, Tung Chuan, Yunnan. 4. Mei, Len, Yunnan. 5. Lu Tzai Ping, Hsüan Wei, Yunuan. 6. Lui Pa Kou, Lei Yang, Hunan. 7. Feng Tien, An Fu, Kiangsi. 8. Tao Chung, Fang Chang, Anhui. 9. Ta Wang Tsun, Hsüan Chêng, Anhui. 10. Fan Chia Chung, Chin Hsien, Anhui. 11. La Shih Pa, Chü Chiang, Kwangtung. 12. Tien Lo Chung, Chü Chiang, Kwangtung. 13. Chang Hsin Coal Mine, Chan Hsin, Chekiang. 14. Chien Wu, Chiang Shan, Chekiang. 15. Mao Tsun Shan, Chiang Shan, Chekiang. 16. Hsin Pu, Chiao Ling, Kwangtung.

