

SOME OBSERVATIONS ON THE FEILAI FENG LIMESTONE
IN CHEKIANG

BY

S. F. SHENG

West Lake Museum, Hangchow

REPRINTED FROM THE
BULLETIN OF THE GEOLOGICAL SOCIETY OF CHINA
VOL. XI, NO. 4, 1932

SOME OBSERVATIONS ON THE FEILAI FENG LIMESTONE IN CHEKIANG.¹

By S. F. SHENG. (盛莘夫)

(*West Lake Museum, Hangchow*)

INTRODUCTION.

The name Feilailfeng Limestone was introduced by Mr. T. O. Chu in 1924, who first saw it at Feilailfeng (飛來峯), south of Linyingssu (靈隱寺), near Hangchow, and hence its name. Subsequent investigations have disclosed the fact that this limestone is widely distributed in Chekiang, but owing to the lack of fossils its age has not been positively determined. Being a native of that province, the writer had opportunities to study that formation in different localities and made notable palæontological collections therefrom. The fossils so far obtained were determined by Mr. T. K. Huang of the National Geological Survey at Peiping and by Mr. S. Chen of the Geological Institute, Academia Sinica, Shanghai. There are more than 40 species, over 10 of which are new. When the fauna as a whole is considered it is clear that it represents an evolutionary series: lower forms occur in lower horizons while higher forms are found at upper horizons. The lower forms are of Middle Carboniferous age but the higher forms belong to early Permian.

DISTRIBUTION OF THE FEILAI FENG LIMESTONE.

As will be shown below the Feilailfeng Limestone is equivalent to the Chihsia Limestone of Lee and Chu², which is wide-spread in the Yangtze Valley. In the province of Chekiang in particular, this formation is chiefly confined to the southwest and to the northeast. In the southwest two zones of distribution may be recognized. One begins from Hsiashihfu (下石埠), of Ch'nhsien (衢縣), passing Houch'ichieh (後溪街), and Chiangshanhsien (江山縣), and reaching Ts'inghu (清湖). The other traverses

1. Received for publication in February 1932, original in Chinese, translated by T. K. Huang.

2. Lee, J. S. & Chu, S., Note on the Chihsia Limestone and its associated formation. Bull. Geol. Soc. China, Vol. IX, 1930, p. 43.

the districts of Fuyang, T'unglu, Chienteh, Shouch'ang, Ch'uh sien, Ch'angshan, Ch'unan and K'aihua. In the northeast the limestone is extensively developed in the Ch'anghsing district, while in the environs of the West Lake beautiful exposures of it can be found in many places. Besides the Feilailfeng itself, the hills Ch'ip'an-shan (棋盤山), Wengchiashan (翁家山), Nankao-feng (南高峯), Tingchiashan (丁甲山), Chiuyaoshan (九曜山), Nanp'ingshan (南屏山), Yuhuangshan (玉皇山), Tsiangt'aishan (將台山), Fenghuangshan (鳳凰山), and Ch'enhuangshan (城隍山) are the notable ones. At Feilailfeng the upper part of the limestone had disappeared through continued erosion. It is surrounded by Devonian sandstone which immediately comes under it. Evidently the structure is a syncline, with the limestone inlier marking its centre. Such a structure is not infrequently met with in other parts of the province.

The folding of the Feilailfeng Limestone is not very intense in the West Lake region. At Feilailfeng and Tsuyunling (慈雲嶺), the average dip is 20° . But there are notable exceptions. At Chiuyaoshan, Nanp'ingshan

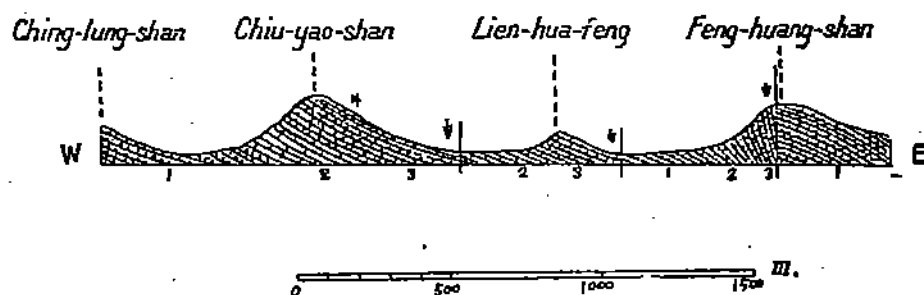


Fig. 1. Section from Chinglungshan to Fenghuangshan. 1, Devonian sandstone; 2, Lower Feilailfeng limestone; 3, Middle Feilailfeng limestone; 4, Upper Feilailfeng limestone.

The strata strike $N50^{\circ}W$ at Chiu-yao-shan and $N65^{\circ}W$ at Lien-hua-shan, the section is therefore oblique to the dip at these areas, but it is parallel to the dip at Fenghuangshan where the strata dip from W. to E.

and Tsiangt'aishan, for example, the dip may increase to 70° . The relation between the limestone and the Devonian sandstone is apparently conformable, no angular discordance having ever been noticed. Intrusive bodies are not uncommon in the limestone; at Chiuyaoshan it is traversed by igneous dikes, and also at Lichiahsiang (李家巷) of Ch'anghsinghsien and at

T'ungkuantsun (銅官村) of Chientehhsien. Occasionally the effects of intrusion has resulted in marmorization. Normal faults are also frequently met with in the limestone; the upthrow is generally on the east while the downthrow on the west. The valleys of Tsuyunling and Yunt'iling (雲梯嶺), are due to normal faulting (See fig. 1, p. 276).

STRATIGRAPHY.

The Feilailong Limestone may be subdivided into Upper, Middle and Lower Divisions according to the lithological character and fossil content. The Lower Division is further divisible into three parts, the lower part being of Middle Carboniferous age.

A. Lower Division.

This is an exceptionally pure limestone, almost devoid of flint nodules. It is extensively and at the same time almost exclusively used for burning lime. It is thick-bedded, each bed averaging 2 m. The total thickness is 80 m. It can be subdivided into the following (Fig. 2, p. 278).

(1) Lower Part: This contains numerous *Foraminifera*, some corals and occasionally crinoids. At Tsuyunling it furnishes species of *Staffella*, *Neofusulinella*, and *Girtyina*. Besides, there are *Bradyina*, *Cribrostomum* and *Tetralaxis*. Most of these have been found in the Huanglung Limestone of Kiangsu. Southeast of Yuhuangshan the writer collected *Chaetetes lungtanensis* Lee et Chu, another characteristic fossil of the Huanglung Limestone. It seems certain then that the age of this part is Middle Carboniferous. At a stone quarry near Tsuyunling, the contact line between the lower part and the middle part can be clearly observed. The top of the former is shaly and its color is dark. It furnishes a few individuals of *Staffella*. Above this stratum higher forms of *foraminifera* such as *Schellwienia* and *Schwagerina* are found. The total thickness of the lower part is 30 m.

(2) Middle Part: In color and texture this part is not different from the preceding. But the fossils evidently represent more advanced types. Specimens of *Schellwienia* can be seen on any rock fragment while *Fusulinella* is entirely wanting. The thickness is about 20 m.

(3) Upper Part: The character of this part does not differ from those of the middle and lower. It is distinguished by its fossils. In the middle part both *Schellwienia* and *Schwagerina* are very abundant but in the upper part they become very rare. Evidently a distinct change has taken place in the foraminiferan fauna. In the field however no stratigraphical break can be found. The thickness of this part is about 30 m.

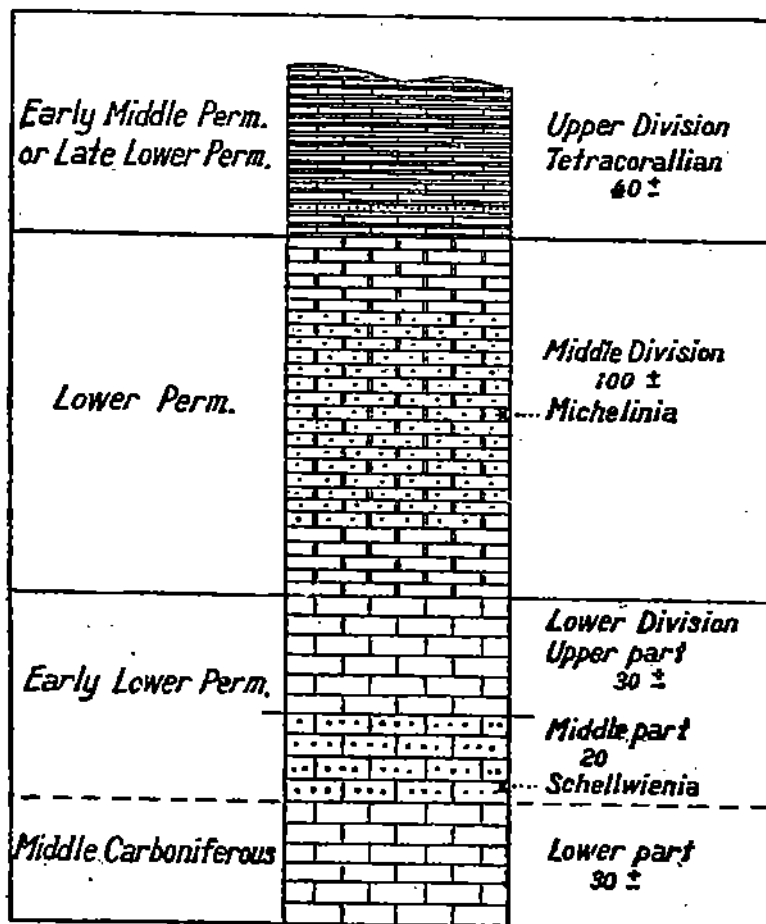


Fig. 2. Columnar section of the Feilaiteng.

B. Middle Division.

The limestone of this division are comparatively thin-bedded. They are impure and unusually flinty. The flinty concretions are of fist size while the

lenticular ones attain a length of 1 ft. Since they are resistant to weathering they generally project out from the rock surface. The total thickness of this division is over 100 m. Many of the precipitous cliffs in this part of the province are due to this limestone.

The fossils in this division are entirely different from those in the lower division. Fusulinoids are very rare, their place being taken by species of *Michelinia*. Besides, there are brachiopods, gastropods and crinoidal stems. The *Michelinia* generally abound in the middle part of this division and have been found not only near the West Lake of Hangchow but also in other localities of this province. In the field it is convenient to consider these corals as the index of the middle division. The species are *Michelinia marginocystosa* Huang and *M. aff. siyangensis* Reed. According to Mr. Huang these are typical species of the Chihsia Limestone. Typical Chihsia corals were also collected by Mr. S.S. Yoh in S.W. Chekiang. It is clear then that the Feilaiseng Limestone is the equivalent of the Chihsia Limestone and the statement by C. C. Liu and Y. T. Chao that the former is younger than the latter is incorrect.

C. Upper Division.

The limestone of this division are impure, shaly and unusually thin-bedded. *Michelinia* characteristic of the middle division are entirely absent. At Nanp'ingshan and Chiuyaoshan the lower part of this division is marked by a thin coral bed which furnished

Corvenia lipoensis Huang (sp. nov.)

C. chiuyaoshanensis Huang (sp. nov.).

A single specimen of *Productus* has been found in this limestone, and described by Prof. A. W. Grabau as *Productus inflatiformis* var. *pauciplicatus* (var. nov.). The total thickness of this division is 30-40 m.

The complete list of fossils found in the three divisions described above is given below.

UPPER DIVISION: Lower or Early Middle Permian

Bryozoa

Fenestella sp.

Anthozoa

Corwenia lipoensis Huang (sp. nov.).

C. chiuyaoshanensis Huang (sp. nov.).

Brachiopoda

Productus inflatiformis var. *pauciplicatus* Grabau (var. nov.)

MIDDLE DIVISION: Lower Permian

Anthozoa

Bradyphyllum caninoidea Huang (sp. nov.)

Bradyphyllum shengi Huang (sp. nov.)

Michelinia marginocystosa Huang (sp. nov.)

M. aff. *siyangensis* Reed

Yatsengia hangchowensis Huang (sp. nov.)

cf. *Lophophyllum multiseptum* Grabau

Lophophyllum sp. indet.

Brachiopoda

Athyris bicincta Grabau (sp. nov.)

Dielasma sp.

Gastropoda

Euphemus sp.

LOWER DIVISION, UPPER AND MIDDLE PART: Early Lower Permian.

Foraminifera

Schnagerina princeps Ehrenberg

Schellwienia japonica Gumbel

Sch. minima? (Schellwien)

Sch. longissima Moller

Sch. contracta (Schellwien)

Sch. cf. *tschernyschewi* (Schellwien)

Sch. vulgaris (Schellwien)

Sch. prisca (Ehrenberg) Moller

Sch. chengi (sp. nov.)

Sch. sp.

Tetrataxis conica var. *gibba* Moller

T. planolocula Lee et Chen

T. paleotrochus Ehrenberg

T. eximia Eichwald

Nodosaria sp.

LOWER DIVISION, LOWER PART: Middle Carboniferous

Anthozoa

Schoenophyllum (sp. nov.)

Chaetetes lungtanensis Lee et Chu.

Foraminifera

Staffella angulata (Colani)

Tetradaxis parviconica Lee et Chen

Fusulina (Girtyina) *cylindrica* Fischer

F. lanceolata Lee et Chen

F. quasicylindrica Lee

Staffella ozawai Lee et Chen

S. confusa Lee et Chen

Fusulinella (Neofusulinella) *chuanshanensis* Lee et Chen

Fusiella typica Lee et Chen

F. paradoxa Lee et Chen

Schubatella obscura Lee et Chen

S. obscura (var. nov.)

Bradyina nautiliformis Moller

B. sp.

Cribrostomum longissimoides Lee et Chen

C. laxum Lee et Chen

C. sp.

Textularia sp.

Endothyra bowmani Phillips

Lingulina szechenyi Lorentz

Boultonia willsi Lee?