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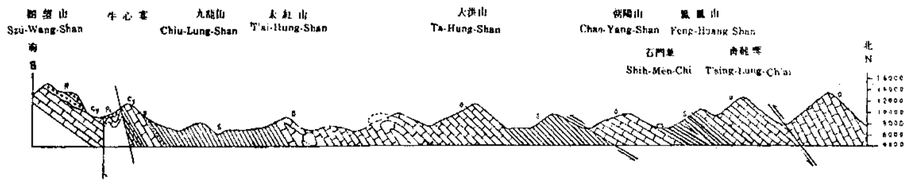
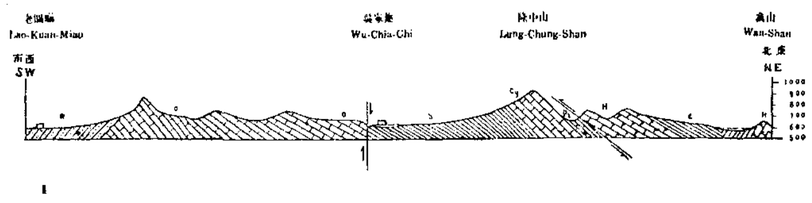
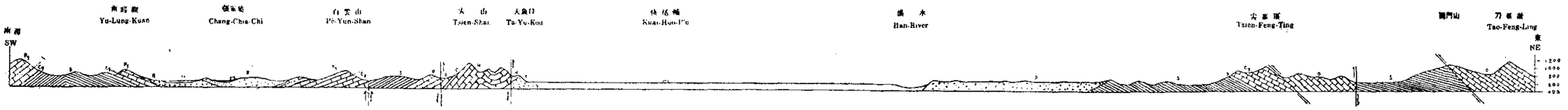
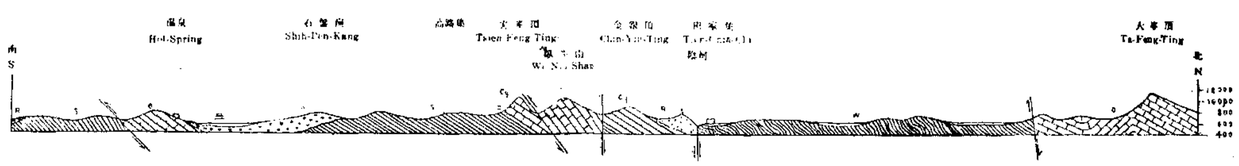
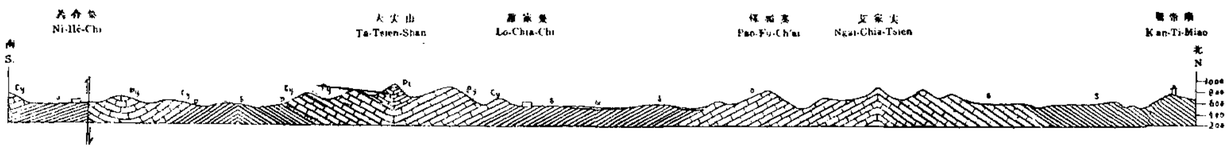










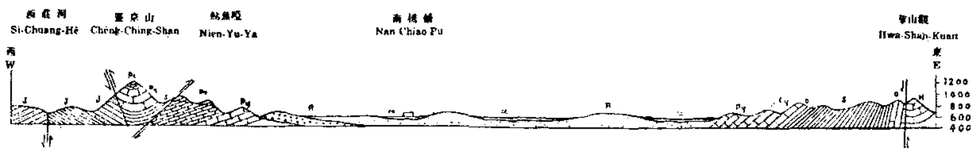


圖　例

Legend

I = 冲積層 Alluvium / 最新期 Recent

R = 紅色砂岩及礫岩 Red Sandstone and Conglomerate / 第三紀 Tertiary

J = 粗砂及含煤系 Coarse Sandstone and Coal Series / 侏羅紀 Jurassic

T = 紫色頁岩 Purple Shale / 三疊紀 Triassic

Pt = 大冶石灰岩 Tayeh Limestone / 上二疊紀 Upper Permian

Py = 上部陽新石灰岩 Upper Yanghsin Limestone / 二疊紀 Permian

Cy = 下及中部陽新石灰岩 Lower and Middle Yanghsin Limestone / 上石炭紀 Upper Carboniferous

D = 雲台觀石英岩 Yungtaikuan Quartzite / 泥盆紀 Devonian

S = 新灘頁岩 Sintan Shale / 志留紀 Silurian

O = 宜昌石灰岩及艾家山層 Ichang Limestone and Neichiashan Formation / 奧陶紀 Ordovician

C = 劉家坡砂岩 Luchiapo Sandstone / 寒武紀 Cambrian

H = 燈影石灰岩 Tüngying Limestone / 震旦紀 Sinnian

W = 片岩 Schist / 五台紀 Wutai

Y = 花崗及片麻岩 Granite and Gneiss / 前震旦紀 Pre-Sinnian

橫縮尺　Horizontal Scale　1: 200,000

GEOLOGY OF NANCHANG, TANGYANG, AND YUAN-AN COALFIELDS, NORTHWESTERN HUPEH.

by

H. M. MENG

(with 3 plates and 19 figures)

I. ITINERARY.

During the fall of 1928, Messrs. W. P. Shu, C. C. Yu and the writer were called to make a survey of the mineral resources of northwestern Hupeh on behalf of the Bureau of Reconstruction of that province. We reached Hsiangyang on the 28th October, and started our field work on the 29th. Our proposed trip was to start from Hsiangyang going westward to Lungchun, thence we were to turn southward to Nanchang, then again westward to Po-Kang and Chin-Feng-Chen. From Chin-Feng-Chen we would then go to Ku-Chen, Kwan-Hua, and Lau-Ho-Ko, and finally return to Hsiangyang where we started. After we had made a brief survey from Hsiangyang to Nanchang passing Wu-Chia-Chi, Lau-Kwan-Miao, we found however that our assigned area was too large for us to cover within the limited time of two months. It was then decided to split our party into two. Messrs. Shu and Yu formed the first party, and took up the area of I-Chen, Chin-Men, Chun-Chiang; while the writer was to survey the area stretching over the districts of Nanchang, Tangyang, Yuan-An and further to the west. After a survey of the coalfields of Yuan-An and Tangyang, the writer was prepared to go into the mountainous region to the west. Unfortunately a severe winter set in around that area. As it was impossible to carry on the field work with heavy snow storms reigning throughout the district the attempt to visit Po-Kang and Chin-Feng-Chen was abandoned. Thus only the Tungkung coalfield of Nanchang, the Kwan-In-Tse, the Miao-Chien, the Chieu-Tse-Shan, and the Shih-Ma-Chao coalfields of Tangyang were surveyed.

The actual time spent in the field was a little over two months, and the total distance traveled including all the side trips was about 3,000 *li*.

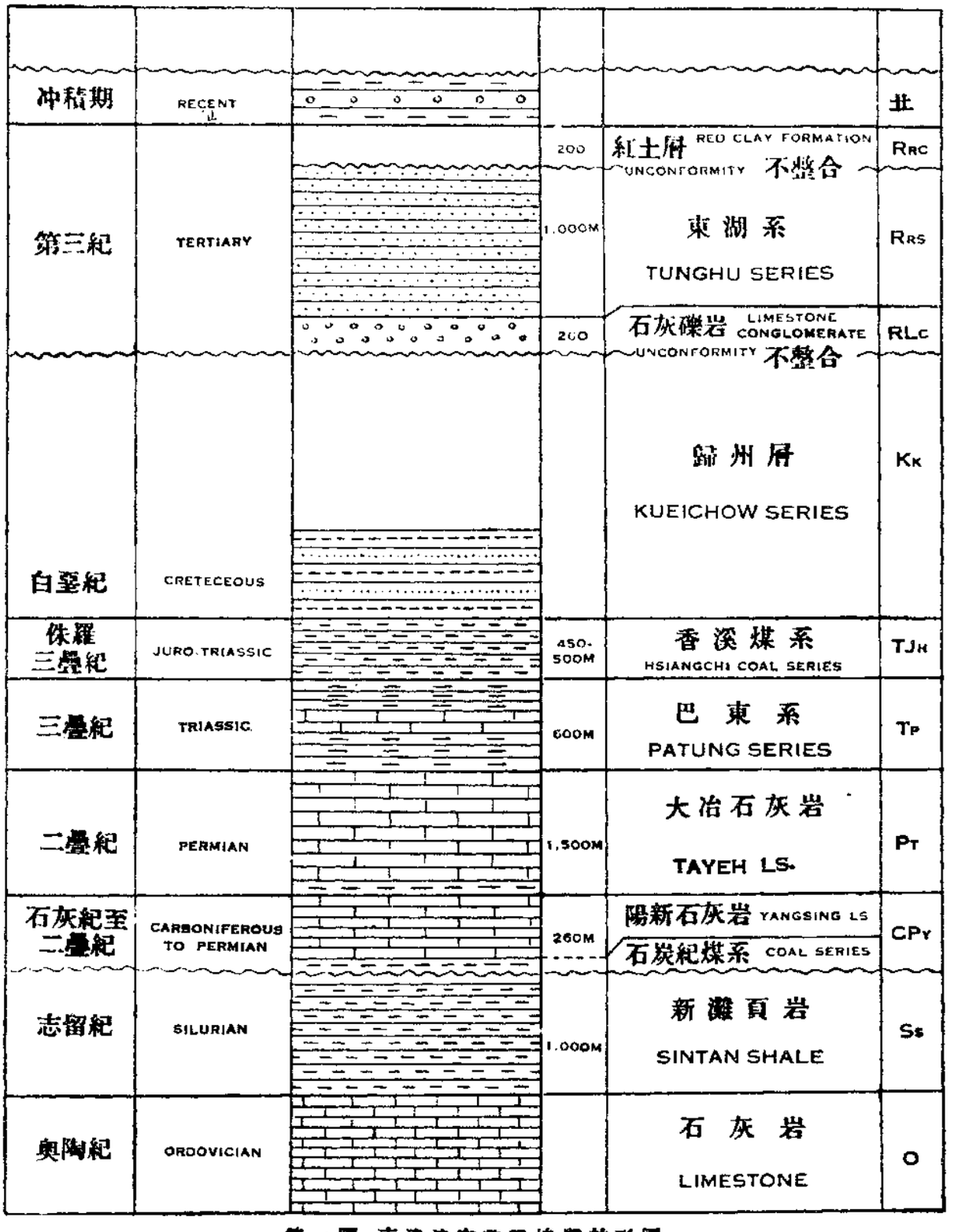
From the data recorded during the survey, one geological map and several sections are made, using the topographical sheets issued by the Hupeh Military Survey as a base. The areas to the north of Nanchang and within the district of Hsiangyang are only partly mapped.

II. STRATIGRAPHY.

Age.	*Formation.*	*Thickness.*
9. Recent	Alluvium	
8. Tertiary	*b.* Red Clay Formation.....	200 m.
	—Unconformity—	
	a. Thin-Bedded Red Sandstone...	1000 m.
	Limestone Conglomerate.....	260 m.
	—Unconformity—	
7. Cretaceous	Kweichow Series .....?	
6. Juro-Triassic	Hsiangchi Coal Series.....	400-500 m.
5. Triassic	Patung Series	600 m.
4. Permian	Tayeh Limestone.....	1500 m.
3. Upper Carboniferous to Permian	Yangsing Limestone.....	260 m.
2. Lower Silurian	Sintan Shale	1000 m.
1. Ordovician	Limestones .....?	

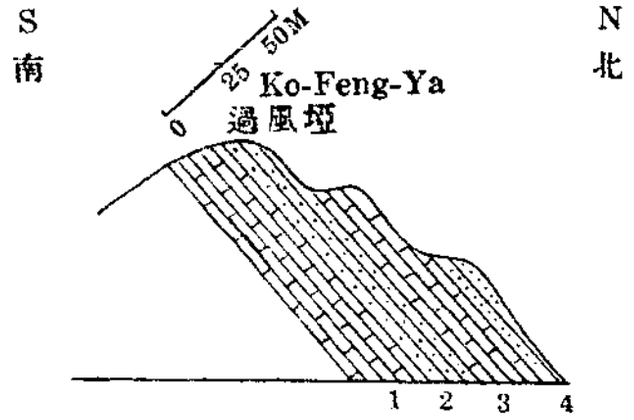
1. Ordovician Limestones.

Distribution. The distribution of the Ordovician formation in the area surveyed is not very extensive. Near Nanchang, in Chien-Tse-Ko, several fossils were found. They were mostly *Orthoceras* of Ordovician age. Here and there in the same locality some carbonaceous strata are found and the natives often worked them for coal. From Lungchun going southwestward, first we found the Permian and the Carboniferous limestones, then the coal series, then the Silurian shales which latter yielded the index fossil, *Encrinurus rex*. Below this formation, we met, at Wu-Chia-Chi, the Ordovician limestone sometimes cherty and sometimes interbedded with red clay layers or grey shales almost devoid of fossil. This limestone exhibits the same dip as the Silurian shales, *i.e.* northeast. From Wu-Chia-Chi to Nanchang, a part of this limestone has been eroded away being covered by a limestone conglomerate of Tertiary age. At Ko-Fen-Ya (Fig. 2), and Lau-Kwan-Miao, the Ordovician limestone contains some quartzitic layers. The same formation which crops out to the north of Hsiao-Chi-Tse are all very much weathered and fractured. Most of the strata give a brecciated appearance. Below this brecciated limestone there is a thin carbonaceous stratum about 1½ meters thick. This material has been now and then worked by the natives for coal. The Ordovician limestone below the carbonaceous stratum is highly siliceous and dips northeast. It is well stratified; each stratum is about one meter in thickness. Locally it contains some cherts.



第一圖 南漳遠安當陽地質柱形圖

Fig. 1. Columnar Section of Nanchang, Yuan-an, Tang-yang Districts.



第二圖 吳家集東—過風埡奧陶紀岩石剖面圖
Fig. 2. Section of Ordovician Limestone at Ko-Feng-Ya.
4. 石英岩 Quartzite.
3. 石灰岩 Limestone.
2. 石英岩 Quartzite.
1. 石灰岩 Limestone.

Going westward to the district of Yuan-An, as one approaches the divide between Yuan-An and Ichang, a layer of argillaceous limestone of Ordovician age is found below the Sintan shale. Twenty-five meters lower from the contact between the Sintan shale above and the Ordovician limestone below, there is a very thin (about 3 inches thick) argillaceous layer which is nearly filled up with *Orthoceras sinensis* Foord. The largest attains a length of 4 to 5 feet. The area to the west of Hsiang-Yo-Pin and Ko-Chia-Ya was surveyed in 1924 by C. Y. Hsieh and Y. T. Chao of the Geological Survey.[1] The Ordovician limestones extend further west and south along the eastern limb of the Huangling Anticline.

Correlation. Basing on the fossil evidence of some Ordovician *Orthoceras* found in Chien-Tse-Ko, near Nanchang, and the position in the stratigraphical column that they underly the Sintan shale, the limestones that occur in discontinuous patches along Wu-Chia-Chi to Nanchang are denominated as Ordovician limestones. West of Yuan-An Hsien at Hsiang-Yo-Pin, an argillaceous limestone is found. *Orthoceras sinensis* Foord occurs abundantly in that horizon. This argillaceous limestone

[1] C. Y. Hsieh and Y. T. Chao: Geology of Ichang, Hsinshan, etc. Districts, W. Hupeh, Bull. Geol. Sur. of China, No. 7, Dec. 1925, pp. 13-76.

lies directly below the *Graptolite* shale of the Sintan series. The rock-character, the stratigraphical position, and the fossils found therein may well prove that this argillaceous limestone corresponds, in many respects, to the Neichiashan formation of the Gorge District[2] which is of the middle Ordovician age.

2. The Sintan Shale.

Distribution. Near Lungchun, Hsiangyang Hsien, the Sintan shale consists, in its upper part, of more than ten meters of rather compact greenish shale with *Encrinurus rex*, and in its lower part of some layers of fissile shale of various colors chiefly greenish yellow. Within this fissile shale there is another bed rich in *Encrinurus rex*. To the south of Nanchang near Hsiang-Hsuei-Tung, the same shale again occurs. This band of shale comes into direct contact with the Permian and the Carboniferous limestones at Kwan-In-Tang on the south and with the Ordovician limestones at Chien-Tse-Ko and Hsiao-Chi-Tse on the north.

Along Hsiang-Yo-Pin, the Sintan shale forms a continuous high ridge following its strike with a nearly vertical escarpment. Thus looking from a distance at the escarpment, it appears as a mighty city-wall. Here the upper part consists of compact greenish or yellow shale; the middle part consists of fissile shale of various colors; and the lower part is a dark grey to black shale containing abundant *Graptolites* which become even more abundant toward the bottom of the formation. The whole sequence is exposed from Hsiang-Yo-Pin to Huai-Hsu-Tien for about 8 *li*, locally folded into small and broad anticlines and synclines. Because of these gentle folds, it is difficult to estimate the real thickness of the whole formation, which probably amounts to 1,000 meters.

The lower part of the Sintan shale along Wu-Chia-Chi is covered by alluvium, and its contact with the Ordovician limestone below cannot be examined. About 4 *li* west of Hsiang-Yo-Pin, near a small bridge, there appears some argillaceous limestone (Ordovician) below the dark grey Sintan shale. The argillaceous content in the limestone decreases as one goes down from the top of the Ordovician limestone; some thirty meters lower pure limestone appears. This fact indicates that the transition from the Ordovician to the Sintan period is a gradual one. In the lower part of the Yangsing limestone near its contact with the Sintan shale, there is a

[2] J. S. Lee: Geology of the Gorge District of the Yangtze, etc., Bull. of the Geol. Soc. of China, vol. III, No. 3-4, 1924, pp. 304-306. C. Y. Hsieh and Y. T. Chao: op. cit., pp. 31-33.

coal series. This stratigraphical relation holds true in Lungchun and in Shih-Chiao-Pin. The coal series are often interbedded with layers of quartzite. This shows two periods of marine deposition intervened by a period of continental coal formation. Although there is no evident break between the Sintan Shale below and the Yangsing limestone above, the phenomenon of two marine phases interrupted by a continental one gives good ground for inferring a stratigraphical disconformity.

Correlation. Owing to the limited distribution of the Sintan shale in the area surveyed, no attempt is made to sub-divide the formation as is done by other writers.[3] At Lungchun, two separate beds containing *Encrinurus rex* were found: one occurring in the compact greenish shale just below the Carboniferous coal series, while the other present in the yellow fissile shale about 40 to 50 meters from the top of the Sintan shale. *Encrinurus rex* may be considered as the index fossil of the Sintan shale. To the west of Hsiang-Yo-Pin, just above the Ordovician argillaceous limestone beds, abundant *Graptolites* were found in the dark grey to black shales. Following upward from this basal *Graptolite* shale there lies the greenish compact to fissile shale. Thus on the fossil evidence of *Encrinurus rex*, the upper limit of the Sintan shale is determined; and the basal part of the same formation is ascertained by the *Graptolite* bearing beds.

3. The Yangsing Limestone.

Distribution. Near Lungchun above the Carboniferous coal series, the Yangsing limestone is represented by a layer of massive coral limestone with abundant cherty inclusions. Its upper part consists of quartzite and limestone intercalations. The limestone at the top of the formation becomes highly siliceous causing the rock to show alternating white and grey bands. The white bands are usually calcareous and the grey ones siliceous. The middle part is composed of thin-bedded limestone interbedded with thin beds of quartzite and greenish shale. The quartz layers become thicker and thicker toward the upper part of the formation; some of them may reach a thickness of several feet. The lower part consists of limestone with abundant cherty inclusions and corals, and with a coal series at the base. The lower cherty limestone is about fifty meters thick, while the total thickness of the formation amounts to 260 meters.

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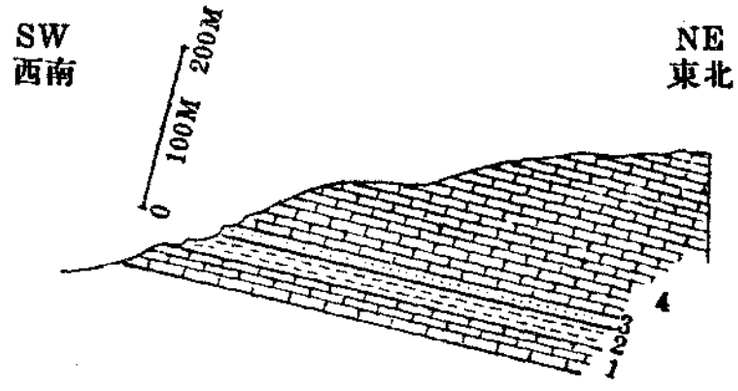
[3] J. S. Lee: op. cit., pp. 306-309.
Hsieh and Chao: op. cit., pp. 33-46.

The same formation which crops out at Peng-Chia-Po (about 12 *li* west of Shih-Chiao-Pin, Fig. 3) is entirely made up of cherty limestone. The cherty inclusions are very abundant and uniformly distributed throughout the formation. At the base there is a layer of white quartzite about 10 or more meters in thickness. Below this quartzitic layer is the coal series about 30 meters thick, and consists chiefly of shaly strata. The average thickness of the coal seam is 18 inches. Beneath the coal series is a thin layer of crinoidal limestone. The boundary between the Yangsing and the Tayeh limestones is also marked by a coal series which is exposed at Liang-Ho-Ko, west of Yuan-An. But the coal from these measures is of very inferior quality. Along with the coal seam in the coal series, one often finds a layer of deep red material, chiefly consisting of hematite which commands a better price as pigment at Liang-Ho-Ko than the coal it contains.



第三圖 彭家坡附近剖面圖
Fig. 3. Section at Peng-Chia-Po.

4. 燧石石灰岩 —Cherty Limestone.
3. 石英岩 —Quartzite.
2. 煤系—Coal Series.
1. 含海百合茎灰岩 —Crinoidal Limestone.

General Character. This formation lies disconformably above the Sintan shale with its upper part containing some quartzitic layers and its middle and lower parts consisting of chiefly cherty limestone. Near its bottom there is a coal series which is often lenticular. The coal seam attains, in rare occasions, a thickness of two to three feet, as for instance that mined in Shih-Chiao-Pin, west of Yuan-An Hsien.

Correlation. The name, Yangsing limestone, was first applied by

Hsieh and Liu[4] to a massive cherty limestone containing abundant brachiopods, corals, foraminifera, etc. in Yangsing, E. Hupeh. In a later publication, Hsieh and Chao[5] correlated it with the lower part of the Wushan limestone in the Yangtze Gorge District. Since the Yangtze Gorge lies geographically farther west from the type locality, Yangsing, than the districts of Nanchang, Yuan-An and Tangyang, it is even more plausible to apply the name, Yangsing, to the limestone of the same character in the latter districts. This limestone, distributed in Nanchang and Yuan-An occurs directly above a coal series and below the thin-bedded Permian limestone. It is also cherty and contains abundant corals as described before. Therefore, from correlations done by previous writers and from the rock character and the stratigraphical position, the limestone at Lungchun, Shih-Chiao-Pin, etc. can justifiably be denominated by the name, Yangsing. Its stratigraphical position ought, then, to range from Upper Carboniferous to Lower Permian.

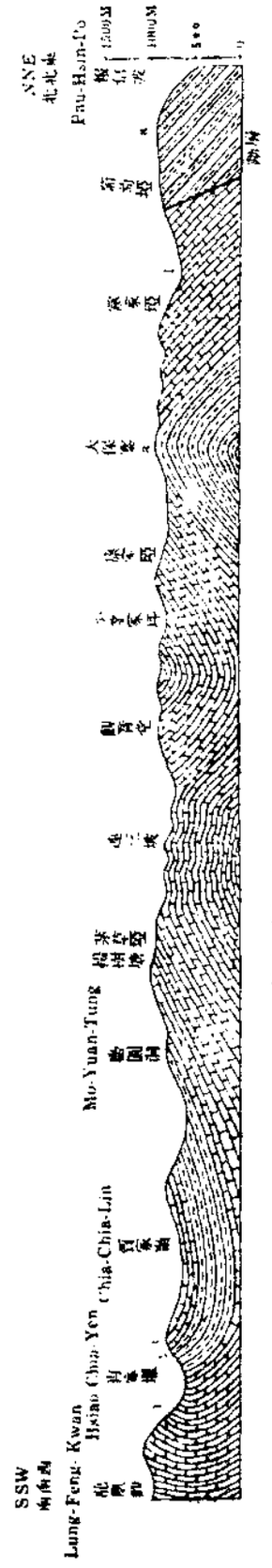
4. The Tayeh Limestone.

Distribution. The lithological character of this formation varies at different places. The total thickness is somewhere over 1,500 meters. The section from Kwan-In-Tang to Hsiao-Chia-Yen, mostly showing the upper part of the Tayeh limestone, is as follows:

G.	Cellular and weathered limestone with veins of large calcite crystale	300 m.
F.	Massive limestone with lenses of cherts	100 m.
E.	Thin-bedded and slaty limestone	100 m.
D.	Argillaceous limestone	30 m.
C.	White massive limestone	50 m.
B.	Red slaty limestone	80 m.
A.	Massive limestone	?

From A lower down the limestone assumes a thin-bedded character still belonging to the Tayeh limestone (Fig. 4). This thin-bedded limestone is exposed from Kwan-In-Tang eastward to Lung-Fen-Kwan. To the west of Yang-Pin, not far from Men-Shan-Tung, and along Lo-Han-Yu, the same thin-bedded limestone is developed. Near Liang-Ho-Ko, there

[4] C. Y. Hsieh and C. C. Liu: Outline of Geology and Ore Deposits of Hupeh, published by Hupeh Industrial Bureau, 1924.
[5] Hsieh and Chao: op. cit., pp. 46-47.



第四圖 龍鳳關至磐信坡剖面圖

Fig. 4. Section from Lung-Feng-Kwan to Pan-Hsin-Po.

2. & 3. 巴東系 Patung Series.

1. 二疊紀與石炭紀界 Permian and Carboniferous Limestones.

a. 志留紀頁岩 Sintan Shale.

lies, in the middle part of the Tayeh limestone, a few fossiliferous beds containing crinoid joints, imperfect brachiopod shells, etc. Lower down approaching a shale series, some ostracods (?) were found on the northern bank of a small stream where a paper mill is located.

Towards the top of this formation which directly underlies the Patung series, the rock becomes very cellular in structure as if it had been exposed for a long period of weathering before the deposition of the Patung series. Most of the lime content was dissolved, and some redeposited in situ. The rocks are spongy in appearance, and full of solution holes which are lined with small calcite crystals. Part of the lime in solution was carried further down and deposited in cracks and fault-fissures as calcite veins with its crystal as long as one foot. These two properties of the upper part of the Tayeh limestone—(1) cellular structure with calcite crystals lining the cavities, (2) calcite veins with crystals of fairly large size—are the spectacular points of the formation at its contact with the Patung series.

Correlation. The Tayeh limestone is correlated in the same way as the Yangsing limestone,[6] and needs no further discussion except that it is separated from the Yangsing limestone below sometimes by a coal series, and the main feature of the entire formation is its thin-beddedness.

5. The Patung Series.

Distribution. This is the most widely distributed formation in the area surveyed. It first appears at Hsiao-Chia-Yen, forming the Hsiao-Chia-Yen basin. It then occurs at Lo-Pin, Tungkung, around the

[6] Hsieh and Liu: op. cit.; Hsieh and Chao: op. cit., pp. 46-53.

Hsiangchi coal series, Hsin Chien-Si and Hsia-Ko. In the southwestern part of the area surveyed, it is distributed along the synclinal basin from Yang-Pin to Yuan-An whence flows the present Chu River. The section at Tungkung showing the entire Patung series as follows:

E. Purple shale ..... 134 m.
D. Yellow shale and thin beds of limestone intercalations.. 41 m.

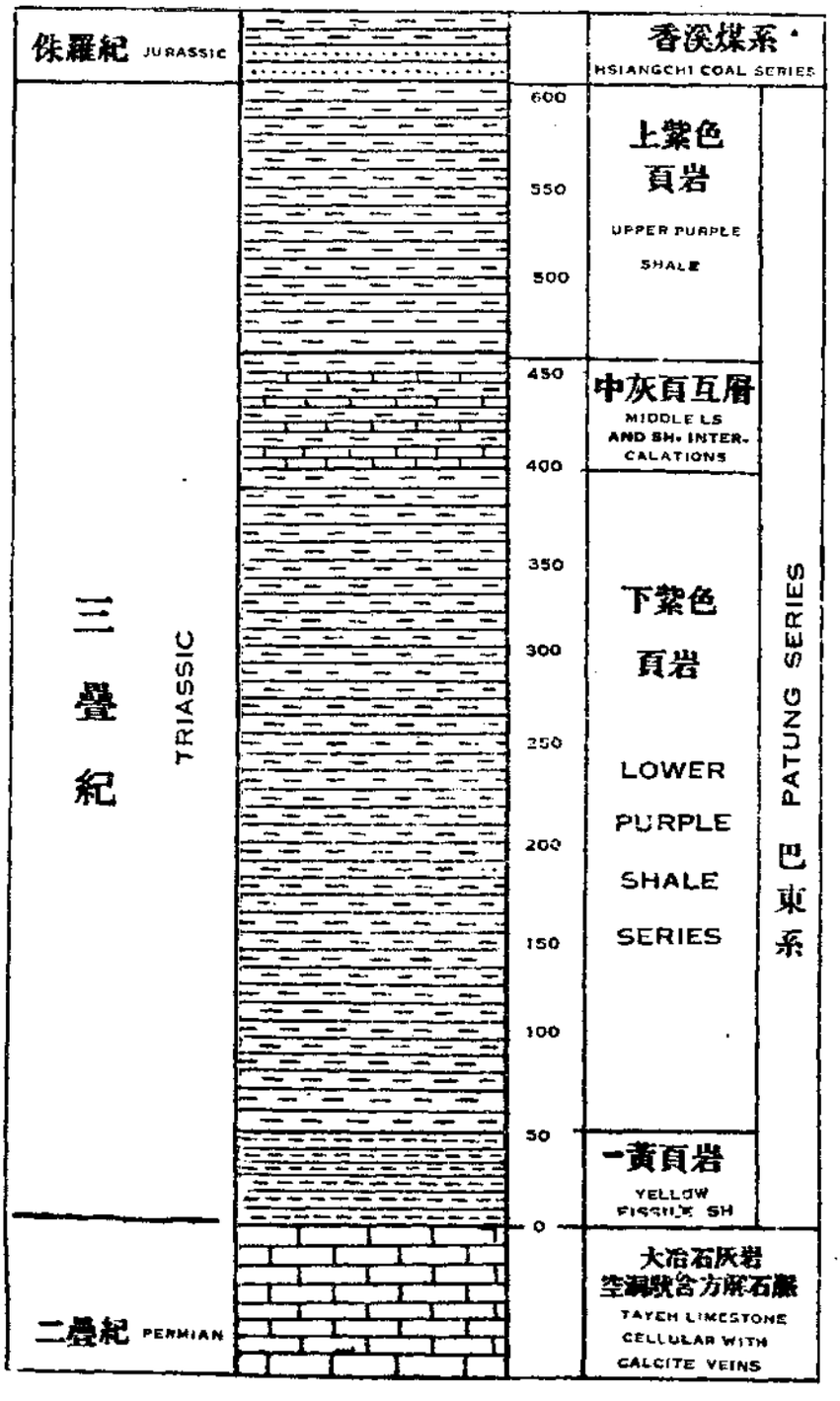
NOTE:—From the top of these intercalations down about two meters, there is a thin bed of limestone which is capped by a thin sheet of yellow shale and consists of three layers: all rich in crinoidal joints, especially the upper and the lower layers. The thickness of this thin bed of limestone is about 60 centimeters.

C. Limestone ..... 24 m.
B. Purple shale..... 350 m.
A. Yellow shale..... 50 m.

(See also Fig. 5, 6 and 7).

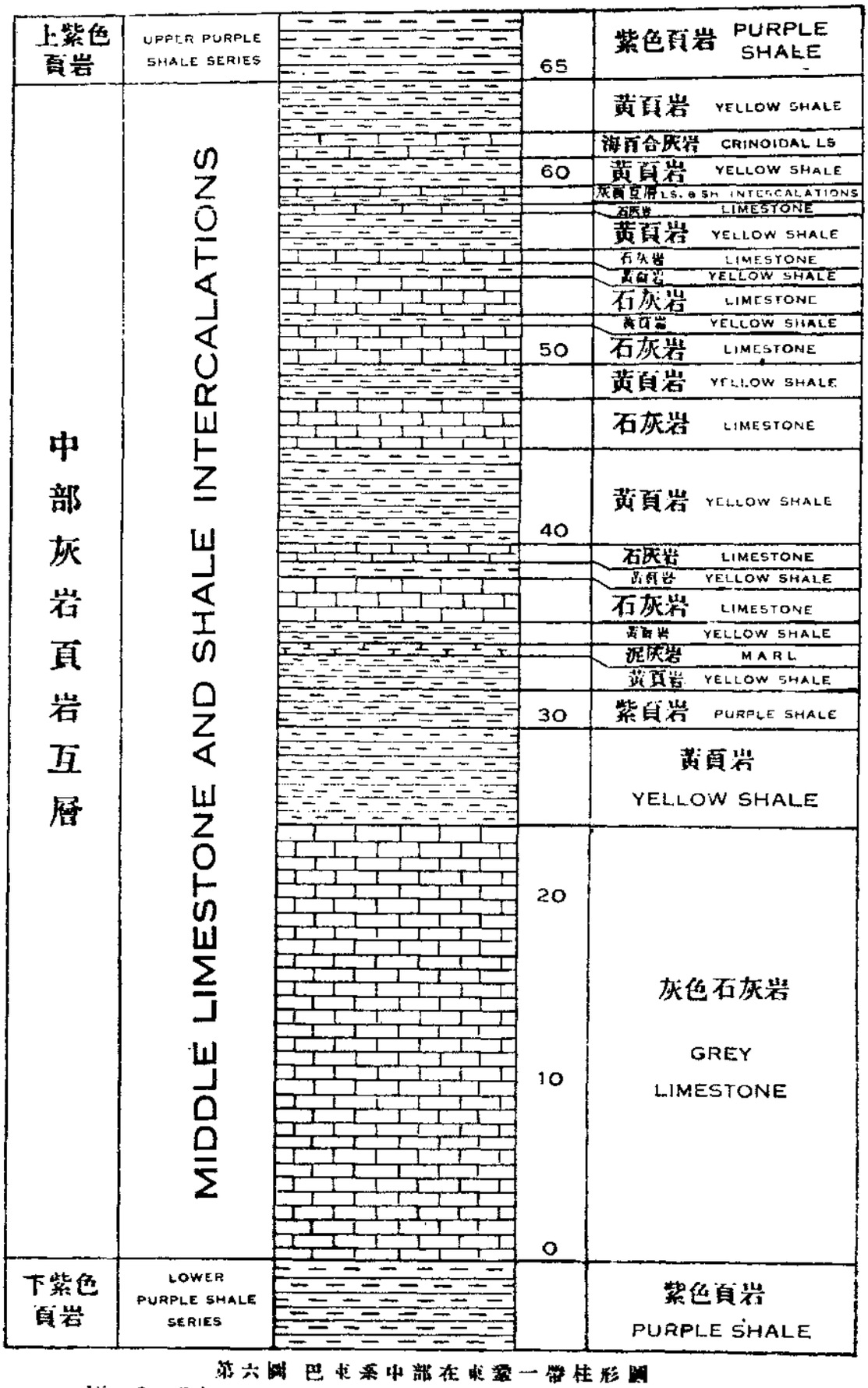
As developed near Yuan-An, this formation shows a different lithological character from that of Tungkung. In the former place, the middle calcareous layers (C and D) are thickened, and become more purely calcareous; while the shaly layers diminish with the tendency to form a continuous limestone series totaling about 150 meters thick. Often the limestone alone crops out as a continuous ridge with its foothills on both sides covered with purple shales. This is eminently the case in the In-Tse Shan, Yuan-An, and in the hills near Fu-Chia-Ho, Lo-Han-Yu, etc. According to Hsieh and Chao,[7] the Patung series attains a thickness of 800 meters in the vicinity of Patung. The limestone in the series is about 300 meters thick. "In the Hsiang-chi valley 25 *li* east of Tze-Kuei Hsien, the Patung series is mostly absent. Only at one place on the left bank of the Hsiangchi river below Pei-Ma-Tan, did we see a little outcrop of purple shales lying beneath the coal series.....This irregularity in the distribution of the Patung series may be interpreted in two ways. (1) the Patung series was only sparingly deposited along the Hsiangchi valley.....(2) The Patung series was deposited in the Hsiangchi valley same as in Patung Hsien but was again mostly eroded away before the deposition of the Hsiangchi coal series.....At any rate, the break at the base of the Patung series seems to be widespread, while that on the top is only local though the latter may be very profound along the Hsiangchi valley."[8] The break at the base of the Patung series as mentioned by Hsieh and Chao agrees

[7] Hsieh and Chao: op. cit., pp. 53-56.
[8] Hsieh and Chao: op. cit. pp. 53-54.



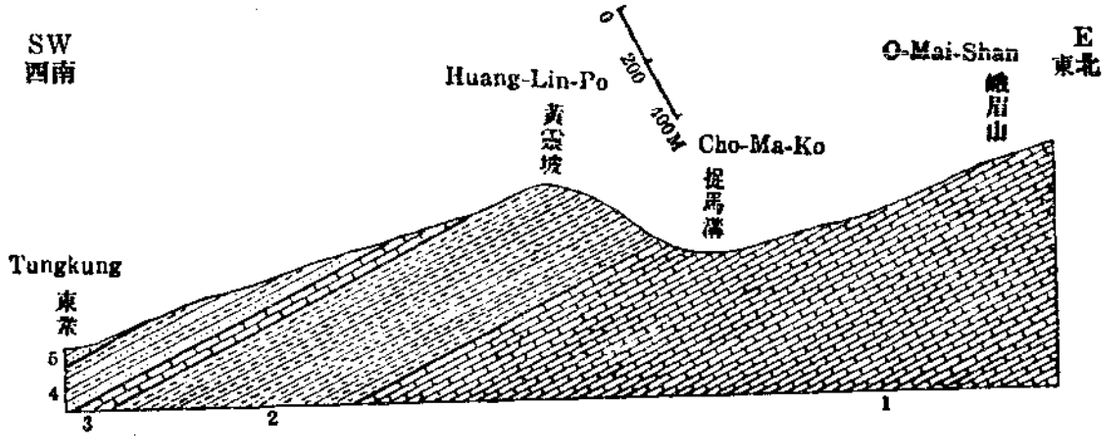
第五圖 東瀧一帶巴東系柱形圖

Fig. 5. Columnar Section of the Patung Series around Tungkung.



第六圖 巴東系中部在東鄉一帶柱形圖

Fig. 6. Columnar Section of Middle Patung Series around Tungkung.



第七圖 東鞏迄峨眉山剖面圖

Fig. 7. Section from Tungkung to O-Mai-Shan.

5. 香溪煤系 —Hsiangchi Coal Series.
2, 3 & 4. 巴東系 —Patung Series.
1. 二疊石灰岩—Permian Limestone

with the observation of the writer that the top of the Tayeh limestone often appears very much weathered and earthy. But the discontinuity at the top of the Patung series has not been observed in the area surveyed. Its total thickness and that of the limestone member are slightly different at various places. In Patung,[9] the total thickness amounts to 800 meters, and the middle limestone member has a thickness of 300 meters. In the western part of the area surveyed, as in the vicinity of Yuan-An (Fig. 13), the thickness of the middle limestone member thins down to 150 meters. Going westward to Tunkung and Hsiao-Chia-Yen, the middle limestone becomes even thinner, to about 60 meters thick, and the total thickness of the series thins down to 600 meters.

This series is capped on the top conformably by the green sandstone of the Hsiangchi coal series and followed at the base disconformably by the weathered limestone of the Tayeh formation.

Correlation. The correlation of this formation in the area surveyed with that at its type locality, Patung, is entirely based on its lithological character and stratigraphical relation. In Patung,[10] this formation likewise disconformably overlies the Tayeh limestone, and is characterized by a tripartite division, namely, two thick series of purple shale forming its upper and lower parts with a thin-bedded limestone in between.

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[9] Hsieh and Chao: op. cit. p. 56.
[10] Idem.

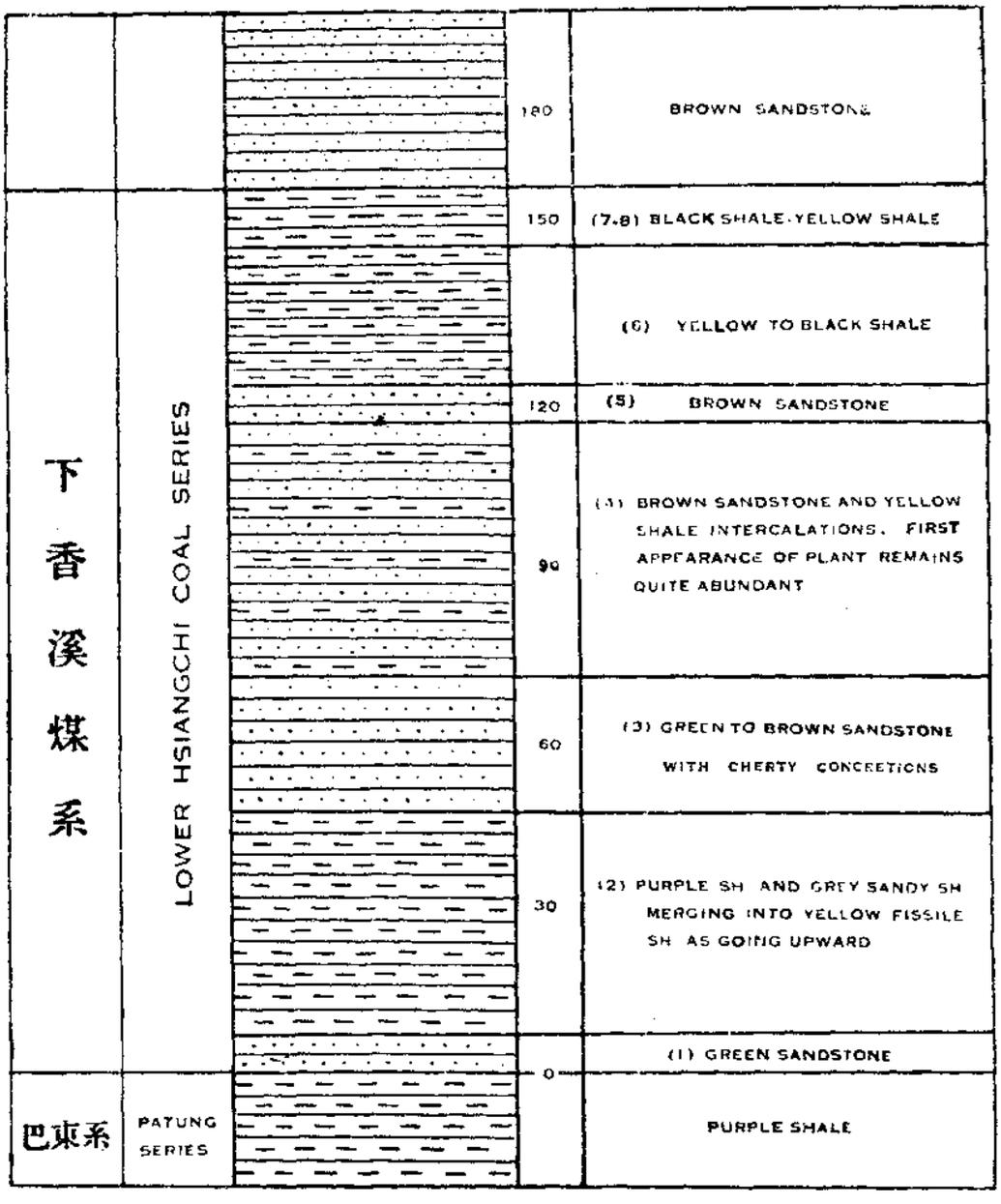
6. The Hsiangchi Coal Series.

Distribution. The Hsiangchi coal series is distributed along the margin of a synclinal basin in the central part of the area surveyed. This basin corresponds nearly to the central part of the Tanyang Syncline. The areal distribution of this series extends up to Tungkung and Lo-Chia-Wen on the north, Kwan-In-Tse and Kwan-Miao-Pin on the east, Shih-Ma-Chao and Miao-Chien on the west, and the Chieu-Tse-Shan on the south, being approximately from east to west about 30-40 *li* in width, and from north to south about 80 *li* in length.

General Character. This formation consists chiefly of shale and sandstone intercalations. Sandstones are of green, white, brown and yellow colors; and the shales are of yellow, brown, grey, to black colors. The thin-bedded sandstones and shales contain abundant plant remains. The whole series is predominantly a sandstone series. Most of the coal seams occur near the upper two hundred meters, and the coal produced is mostly anthracite. The total thickness of the coal series is about 450 to 500 meters.

The lower part of this series consists of the following sequence of strata:—

8. Yellow shale ..... 7 m.
7. Black shale ..... 3 m.
6. Yellow to black shale .....27 m.
5. Brownish yellow sandstone ..... 6 m.
4. Brown sandstone and Yellow shale intercalations, sandstone predominant .....46 m.
   Its upper part is of thin-bedded sandstone and yellow, grey to black fissile shale. Plant remains first appear in this horizon, when examining in an ascending order.
3. Green to brown sandstone with a thin layer of black shale in between .....25 m.
   The yellow shale usually contains elliptical concretions, the shells of which are composed of chert and the nuclei of loose yellow to red sand-grains. This feature is typical in the lower part of the Hsiangchi coal series and can be used as a criterion in the field for identification.
2. Purple shale and very sandy shale merging into a yellow fissile shale.....41 m.
1. The lowest, a layer of greenish compact sandstone..... 8 m.



第八圖 下香溪煤系與巴東系接觸處岩層柱形圖

Fig. 8. Columnar Section of the Lower Hsiangchi Coal Series near its Contact with the Patung Series.

The rocks succeeding 8 upward are mostly brown sandstone with intercalated yellow or black shales, while those below 1 are purple shales of the Patung series. (Fig. 8).

The entire Hsiangchi coal series can be divided according to its lithological character into three parts as follows:

3. Interbedded sandstones and shales.....150 m.
Sandstones predominate. The shales vary in color from green, brown, yellow to black. The color of the sandstone varies from grey to yellow. There are three coal seams seen in this division, and are mined at Wei-Chia-Wen, Mei-Tse-Ya, etc. The entire division is scattered with plant remains especially the top part.

2. The sandstone division .....100 m.
In this division, thick-bedded sandstone predominates. Thin-bedded sandstones and shales occur occasionally. A coal seam belonging to this division is mined at Chow-Chia-Wen, about 4 *li* south of Tungkung. The sandstones are very easily weathered to loose sand grains such as those exposed near Hsin-Chia-Ya.

1. The shale division .....150-200 m.
Variegated shales dominate this division, but they are now and then intercalated with greyish white or brown sandstones. In the middle part of this division (Fig. 9) there occurs a coal seam being mined in Pi-Chia-Wen near Tungkung.

Correlation. Pending the precise determination of the numerous plant remains, this formation is tentatively correlated with the Hsiangchi coal series of the Gorge District.

7. The Kweichow Series.

Directly above the Hsiangchi coal series, there appears a series of green sandstone and purple shale intercalations. The series is very well developed at the type locality, Kweichow, whence the name was derived.[11] In the area surveyed this series is sparingly distributed. It is only exposed in the Kwan-Miao-Pin Syncline, which is situated from north to south between Liang-Ho-Ko and Yu-Chi-Ho, and from east to west between Kwan-Miao-Pin and Kwan-In-Tse. Thus only a part of the series is seen. From the limited observations, it appears to consist chiefly of green sandstones and purple shales. Thickness is not determined, and the contact between the Hsiangchi coal series and the Kweichow series does not appear unconformable.

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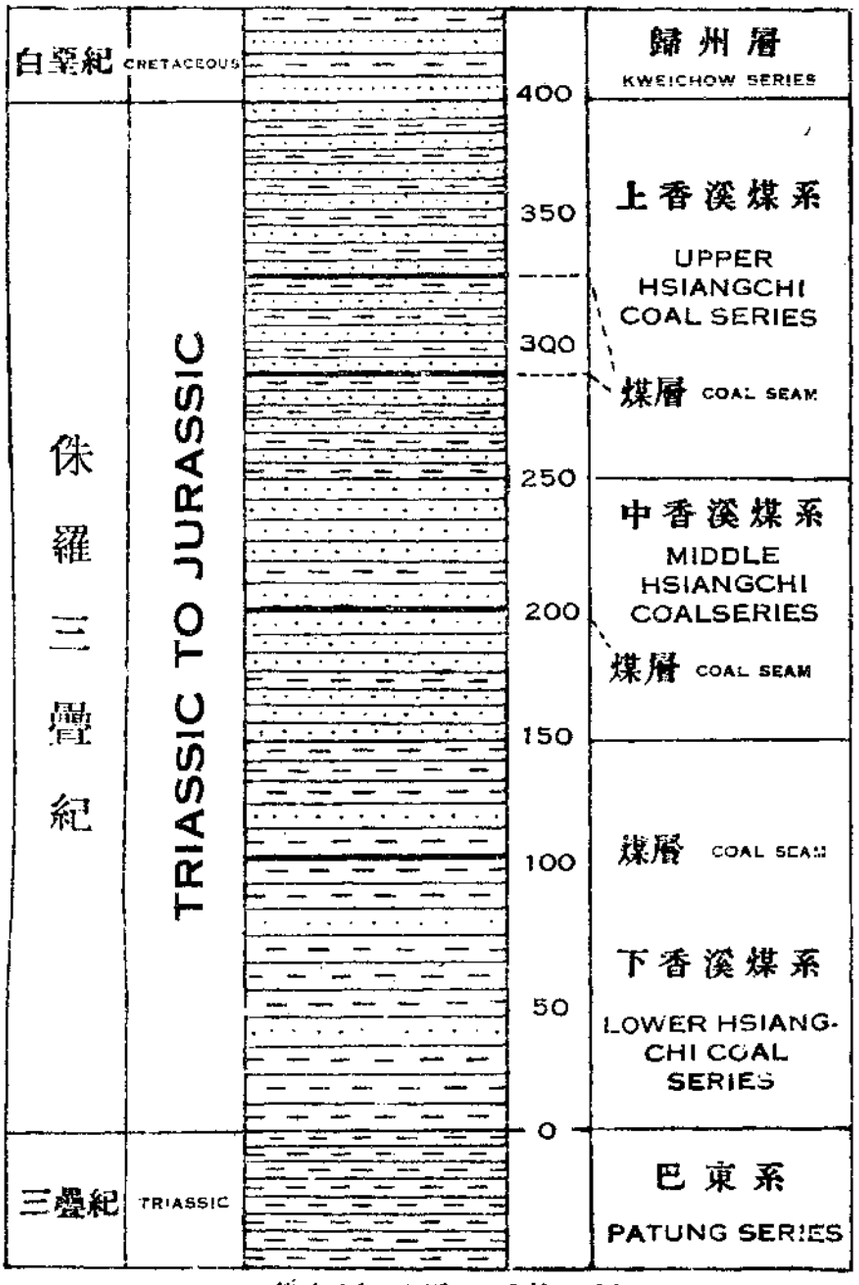
[11] J. S. Lee: op. cit. pp. 313-315.
Hsieh and Chao: op. cit. pp. 63-66.



第九圖 香溪煤系柱形圖

Fig. 9. Columnar Section of Hsiangchi Coal Series.

8. The Tertiary Formations.

a. The Limestone Conglomerate and the thin-bedded Red Sandstone.

Lying unconformably above the Palæozoic limestones, the Patung series, or the Hsiangchi coal series (Fig. 19) or even the Kweichow series is a limestone conglomerate. Its main constituents are of limestone

pebbles whence the name Limestone Conglomerate is derived. Besides the limestone, quartz pebbles are next in abundance. The average diameter of the pebbles is about 3 to 4 inches. The matrix or the cementing material is of fine sand in the upper layers, and of fine calcareous mud in the lower layers. The total thickness is estimated at 260 meters. This Limestone Conglomerate is developed at Wen-Pi-Fen south of the Nanchang city; Kwan-In-Ai, west of the same city; the Hsu-Yo-Shan, the Chieu-Tse-Shan, the Yu-Chien-Shan, near Tangyang city; and Lung-Wang-Chun, north of Hsia-Ko. Its unconformable relation with the Patung series is plainly visible to the west of Yuan-An. Above this conglomerate is a series of brownish red thin-bedded sandstone. There is no evident unconformity between the two. From Yuan-An to Yang-Pin, along the Chu river, both of the banks as well as the river beds are composed of this thin-bedded sandstone, the total thickness of which is estimated at 1,000 meters.

b. The Red Clay Formation.

This formation is distributed along the Chu river extending from Tangyang to Yuan-An. It discordantly overlies the Limestone Conglomerate. In its lower part one often finds a thin layer—about 3 or 4 inches thick—of gypsum. Its total thickness exceeds 200 meters.

9. Alluvium.

Owing to the fact that the Hsiang river is located on the eastern and the Yangtze river on the southern margins of the area surveyed, the terrace formations and the recent alluvium are all distributed in its south-eastern part. From Nanchang to Wu-An-Yen and Liu-Chia-Chi, such terrace formations occur with their plane of stratification well shown, which is nearly horizontal, each stratum being composed chiefly of loose sands.

III. STRUCTURE.

General Description. Within the area surveyed, faulting is not a predominant feature. The general structure concerns chiefly with folding. Only to the east of the area, the structure along the Hsiang river is, according to W. P. Shu, [12] characterized by numerous strike faults. The Sinian and the Paleozoic formations along the Hsiang form an anticline, and the Hsiang flows nearly on its axis with its course corresponding, in general, to the strike of the beds. From Hsiangyang to Tangyang, the structure, though seemingly complex, can be broadly assigned to one

[12] Personal communication.

anticline and one syncline. The anticlinal axis bears a northwest-southeast direction, with its wings mostly consisting of the Sintan shale, the Yangsing and the Tayeh limestones, stretching from Lungchun on the north to Kwan-In-Tang and Chu-Yang-Pin on the south. Along this anticlinal axis, near Nanchang thick beds of Limestone Conglomreate are developed. Futher south the structure is typified by a syncline, covering the area of Tungkung, Kwan-In-Tse, the whole of Yuan-An Hsien, part of Tangyang Hsien, etc. The axis of this syncline describes an arc. On the west of Lo-Chia-Wen, the axis bears an east-west direction. At Tungkung, Kwan-In-Tse, and Kwan-Miao-Pin it trends northwest-southeast. But at the Chieu-Tse-Shan, near the Tangyang city, the axis assumes a north-south direction. From Tangyang to Yuan-An, the Patung series form a syncline. Along its axis are developed the red clay formation and the thin-bedded red sandstone. From Yuan-An westward, gradually appears the Paleozoic formations; until one reaches the Ichang district, where the Sinian and the pre-Sinian rocks are exposed.

Main Structural Features. 1. The Nanchang Anticline: This is the most extensive anticline in the area surveyed. It stretches between Lungshun on the northeast and Chu-Yang-Pin and the Hsiao-Chia-Yen Basin on the southwest, with a distance over 200 *li* transversally, while the longitudinal extension runs beyond the area visited. The anticlinal axis which follows approximately the Man-Ho valley bears a northwest-southeast direction. Its northeastern limb, beginning from the Nanchang city going northeastward, consists, first, of the Ordovician limestones, and the unconformably overlying conglomerates and sandstones of the Tertiary age, then the Sintan shale, the Carboniferous coal series at Lungchun, and the Yangsing limestone. Similarly, the southwestern limb is composed, (mentioning in the order from the axial line toward the southwest direction) first, of the Ordovician limestones and the unconformably overlying younger rocks, then the Sintan shale, the Yangsing and the Tayeh limestones. The various formations composing of the northeastern limb dip generally northeast, while those forming the southwestern limb are again folded into minor anticlines and synclines. The Tertiary rocks deposited along the axis near the Nanchang city are not so intensively folded. Along the anticlinal axis, the rocks are locally shattered and brecciated such as the brecciated limestone near Hsiao-Chi-Tse. This feature is even more pronounced to the east of Ichen, Chin-Men, and Chung-Chiang where the effect of fracturing is manifested by numerous strike faults.

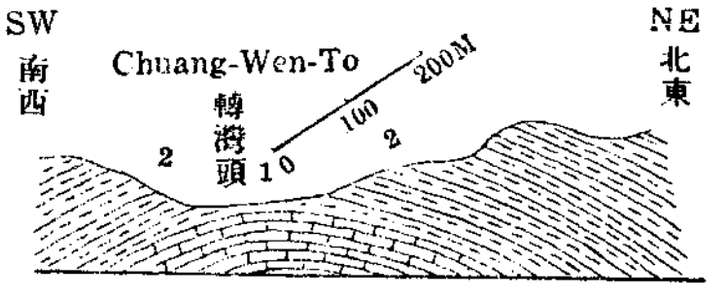
It is probably due to this folding that the rocks along the axial region were more or less brecciated, and afforded the line of weakness against erosion. The earlier Man-Ho made its way through this weak zone,

eroding away the limestones and depositing the conglomerate and the sandstone along the districts of Lau-Kwan-Miao, Kwan-In-Ai, Yu-Chih-Shan, etc.

The southwestern limb of the Nanchang Anticline is not so simple as the northeastern one. It is displaced sometimes by minor faults which have given rise to the large caves in the quartzitic sandstones near Pau-Hsin-Po. From Hsiang-Hsuei-Tung passing Kwan-In-Tang to Chu-Yang-Pin, the Yangsing and the Tayeh limestones are folded into minor anticlines and synclines as shown in Fig. 4.

2. The Hsiao-Chia-Yen Basin: This basin lies on the southwest of Chu-Yang-Pin and on the north of Tangyang syncline (Fig. 4). The ridges around the basin are formed by the thin-bedded Permian limestone which is often so intensely folded that the strata show reversed dip, as indicated in Lung-Feng-Kwan (Fig. 4). On foothills of the ridges, facing the inside of the basin, the lower purple shale layers of the Patung series crop out. At the center of the basin is exposed the middle limestone of the Patung series. The upper purple shale of the same series has been eroded away. Sometimes the entire Patung series is eroded, leaving the topmost part of the Tayeh limestone plainly exposed.

3. The Tangyang Syncline: Although the Tangyang Syncline does not show its prominence near the Tangyang city, it covers most of the area of Tangyang. Broadly speaking, this syncline extends in between the Hsiao-Chia-Yen Basin on the northeast and the Huangling Anticline on the west. The Hsiangchi coal series is exposed along its axis which runs along the Chang-Ho valley. Going northeastward from the axis of the syncline, first we see the Hsiangchi coal series, then the minor folds between the Patung series and the Tayeh limestone along Lo-Pin, Chuan-Wen-To (Fig. 10) to Hsiao-Chia-Yen; while going southwest from the axis, we meet first the Hsiangchi coal series, then the Patung series, the Tayeh limestone, the Yangsing limestone, the Sintan shale, the Ordovician limestones and the older rocks. In general, the dips of the various formations from Hsiao-Chia-Yen to Tungkung all assume a southwest direction, neglecting the minor folds. From Kwan-In-Tse westward to Yuan-An and Ichang the strata all have a general easterly dip with the exception of local variations. The synclinal axis runs northwest-southeast near Tungkung, but is turned to north-south direction in the districts of Tangyang and Yuan-An. Along the two flanks of the syncline we have



第十圖 轉灣頭附近剖面圖
Fig. 10. Section at Chuang-Wen-To.
2. 巴東系 Patung Series.
1. 大冶石灰岩 Tayeh Limestone.

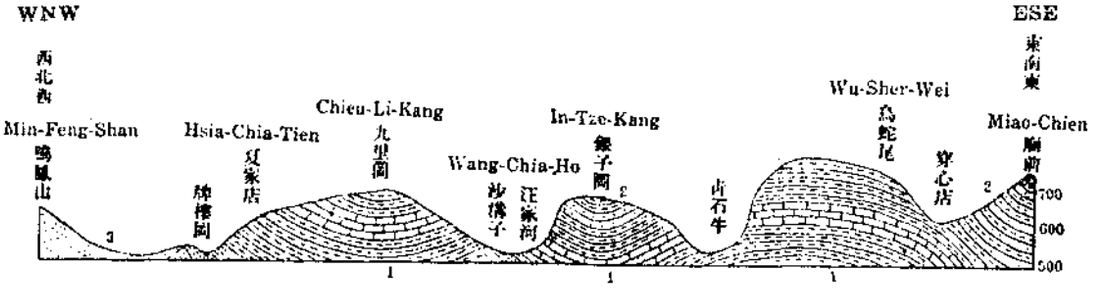
the different coalfields, namely, the Tungkung and the Kwan-In-Tse coalfields on the east, and the Chieu-Tse-Shan, the Miao-Chien, the Shih-Ma-Chao coalfields, etc. on the west.

The Tayeh limestone and the Patung series are folded into minor anticlines and synclines from Hsiao-Chia-Yen to Chuan-Wen-To and Lo-Pin, thus showing the alternating outcrops of the respective formations along the road from the former to the latter. At Tungkung the Hsiangchi coal series is generally folded (Fig. 15) and occasionally faulted with the folding axis corresponding to the synclinal axis.

The other minor features of the Tangyang Syncline are as follows:—

a. The Kwan-In-Tse Dome (Fig. 18): In the vicinity of Kwan-In-Tse, the dip angle of the Hsiangchi coal series is very low, about 0-5 degrees. The directions of the dip are all inclining away from Kwan-In-Tse. At Ta-Po-Kang, not far from Kwan-In-Tse, the coal series dips north-west. At Tsui-Chia-Ko south of Kwan-In-Tse, it dips southwest. At Liu-Chia-Wen west of Kwan-In-Tse, the dip is due west, while on the east we have the Kweichow series overlying the Hsiangchi coal series. Thus the beds at Kwan-In-Tse form a dome.

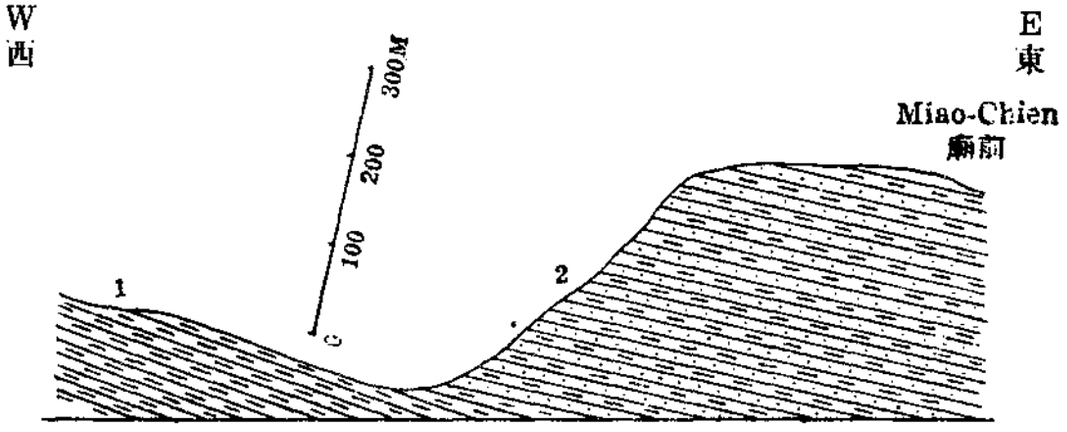
b. The Kwan-Miao-Pin Syncline (Fig. 18): Bounded on the east and west by the Hsiangchi coal series, there lies the long strip of table land, the Chang-Tse-Lin, composed mainly of the Kweichow series. Kwan-Miao-Pin, 12 *li* east from Kwan-In-Tse, is just situated a little west of this structural feature. Its axis runs nearly north and south.



第十一圖 廟前至鳴鳳山剖面圖

Fig. 11. Section from Miao-Chien to Min-Feng-Shan.

3. 紅土層 Red Clay Formation.
2. 香溪煤系 Hsiangchi Coal Series.
1. 巴東系 Patung Series.



第十二圖 廟前四之香溪煤系剖面圖

Fig. 12. Section of the Hsiangchi Coal Series at Miao-Chien.

2. 香溪煤系 Hsiangchi Coal Series.
1. 巴東系 Patung Series.

c. Minor undulations between Miao-Chien and Hsia-Chia-Tien (Fig. 11): The Hsiangchi coal series and the Patung series which are exposed in between Miao-Chien to Hsia-Chia-Tien, are gently folded and dissected by stream erosion into ridges approximately following the strike of the beds. At Miao-Chien, the Hsiangchi coal series forms a continuous low ridge as shown in Fig. 12. Thence a little to the west, the Patung series forms an anticline at Wu-Sher-Wei. A part of the western wing of this anticline is eroded away forming a stream valley. The In-Tse-Kang

constitutes a syncline with the lower part of the Hsiangchi coal series cropping out at the top of the ridge and the Patung series shown at its foothills. Following this to the west is an anticline, the crest of which is eroded away thus giving rise to the Wang-Chia River. Up to the Chieu-Li-Kang, another syncline reveals, with the purple shales and the limestone in the Patung series forming alternative valleys and ridges respectively.

d. The Yuan-An Syncline: The district of Yuan-An is situated along the Chu River and forms a long narrow valley bounded on the east and west by the north-south ridges of the Patung series. The Patung series forms small undulations from the eastern to the western border of Yuan-An Hsien with their axis running N.-S. The various undulations of the beds constitutes a syncline at large. Along the axis of the syncline, which is named as the Yuan-An Syncline, flows the Chu River. A part of the Patung series is eroded away, and in its place are found the thin-bedded red sandstone and the red clay formations. These younger deposits have suffered a second or third stage of erosion forming the isolated hills and discontinuous ridges.

e. The Huangling Anticline[13]: Further west from Yuan-An is the eastern limb of the so-called Huangling Anticline. Thus going westward from Yuan-An to Liang-Ho-Ko (Fig. 13) and Shih-Chiao-Pin, or from Yang-Pin to Hsiang-Yo-Pin, one first sees the Patung series, then the Tayeh and the Yangsing limestones, the Sintan shale and the Ordovician limestones.

Age of Folding. The whole sequence of rocks ranging from the Ordovician to the Kweichow are all apparently conformable in the area surveyed. There are two distinct unconformities above the Kweichow Series: one occurring at the base of the Limestone Conglomerate and the other in between the Limestone Conglomerate and the overlying Red Clay. In both cases the plane of unconformity is marked by striking discordance between the unconformable beds. Thus it would seem that orogenic movement in the area under consideration did not begin until the post-Kweichow period.

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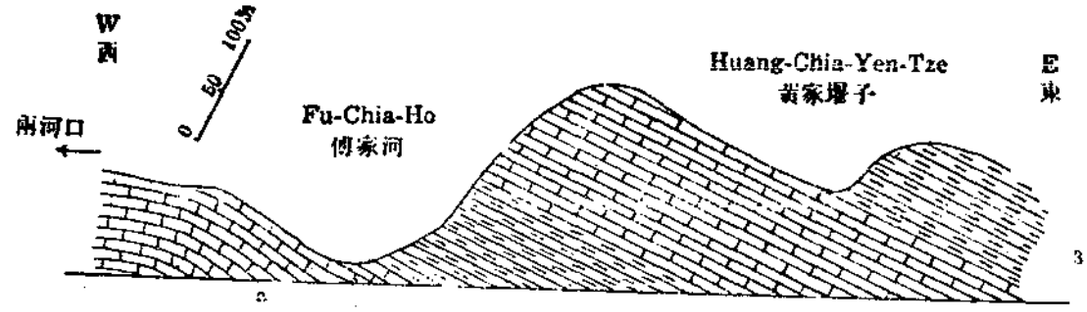
[13] Hsieh and Chao: op. cit. pp. 67-68.



第十三 黃家壢子至兩河口剖面圖
(注意巴東系中灰岩在此已加厚)

Fig. 13. Section of Huang-Chia-Yen-Tze to Liang-Ho-Ko (showing the thickening of the Middle Limestone in the Patung Series).

Patung Series. 巴東系	3. 上紫頁岩	Upper Purple Shale.
	2. 中石灰岩	Middle Limestone.
	1. 下紫頁岩	Lower Purple Shale.
	a. 大冶石灰岩	Tayeh Limestone.

IV. GENERAL TOPOGRAPHY AND HYDROGRAPHICAL SYSTEMS.

General Topography. The entire region presents an appearance of a dissected plateau of the altitude of 1,100 to 1,200 meters, formed by folded and faulted Paleozoic and Mesozoic formations. The process of dissection is chiefly due to the three different river systems, namely, the Mang-Ho, the Chang-Ho and the Chu River. The Mang-Ho drains the northern part of the area along the main roads between Po-Kang and Nanchang; while the Chang-Ho flows through the central and the southeastern part; and the Chu River irrigates the central and the southwestern part. The region as a whole is mountainous in the western and the northwestern parts and more or less featureless in the eastern and the southeastern parts. Thus around Nanchang, Yen-Chia-Pin and Hsiao-Chia-Yen in the northern part of the area, many lofty ranges are found. Along Hsiang-Yo-Pin and Shih-Chiao-Pin in the western part of the area, hills and highlands likewise prevail. At Wu-An-Yen and Liu-Chia-Chi in the eastern part, and at Yu-Chi-Ho and the Tangyang City in the southern part of the area, the topography is characterized chiefly by flood-plains and remnants of denuded heights. In the northern and the extreme western parts, the prevailing rocks are mostly Paleozoic limestones. The region along the Chu River is formed by the Tertiary red beds, while the central part, as for instance, around Tungkung, is composed of the Triassic and the Jurassic sandstones and shales which offer a less resistance against erosion than the limestones. In the south are deposited the recent terrace formations,

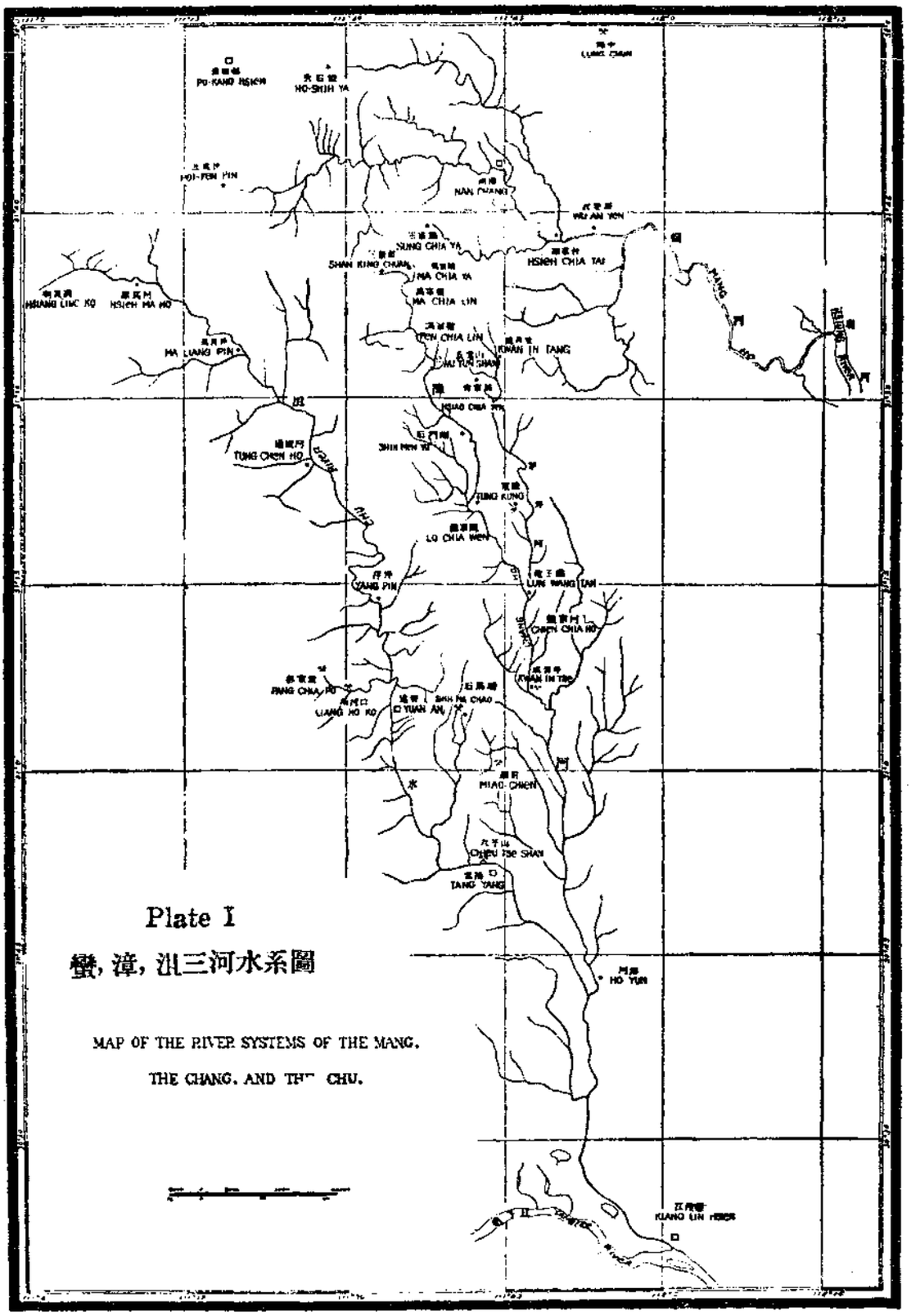


Plate I

蠻, 漳, 汨三河水系圖

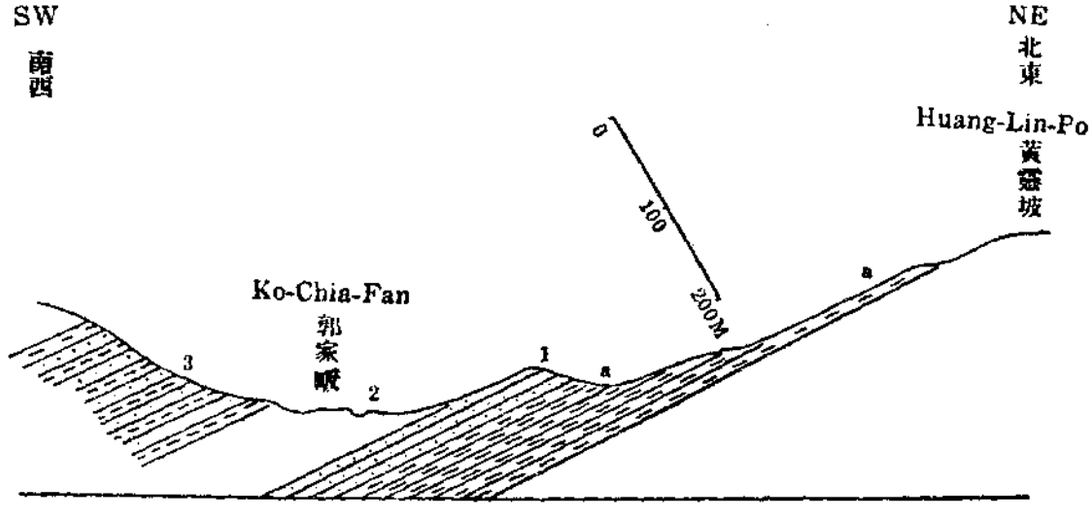
MAP OF THE RIVER SYSTEMS OF THE MANG, THE CHANG, AND THE CHU.

Hyarographical Systems. 1. The Mang-Ho begins its course in the northwestern mountainous region, far beyond the surveyed area, and is is fed by two tributaries. The first starts at Ho-Shih-Ya and flows in a west to east direction, its valley forming one of the main roads between Nanchang and Po-Kang. On the north and south sides of the valley, Paleozoic limestones constitute high ranges and steep hills. The stream meanders here and there, flowing sometimes in a west to east direction, and at other times in a northwest to southeast direction. The second tributary originates at Pei-Fen-Pin located some distance southwest from Ho-Shih-Ya. The valley of this eastward flowing stream constitutes another comparatively more frequented road between Nanchang and Po-Kang. The drainage area of the upper part of the stream also manifests a rugged relief. These two tributaries unite into one at Hsieh-Chia-Tai to form the Mang-Ho. Passing Wu-An-Yen eastward, the Mang-Ho flow to the southeast direction as far as Liu-Chia-Chow where it enters the Hsiang River. Most part of the stream is not navigable even for small boats. Between the Mang-Ho Basin and the Chang-Ho Basin, there lies the Kwan-In-Tang Divide and the Hsiao-Chia-Yen Basin. The general direction of flow of the Mang-Ho follows approximately the underlying rock structure, *i.e.* the axial direction of the Nanchang Anticline.

2. The Chang-Ho originates at Ma-Chia-Ya, Shan-King-Chuan, winding around the foothills and meandering along the deep and steep valleys of the mountainous region to the northwest. Going along the foothill of the Feng-Chia-Lin and the Wu-Yun-Shan, here and there it is reinforced by some small streams. Then it flows southeastward to Shih-Men-Yu and Lo-Chia-Wen. At Lung-Wang-Tan it is joined in by the Mo-Pin-Ho, which orginates at the Hsiao-Chia-Yen Basin and flows southward to Tai-Chia-Peng with its valley nearly parallel to the Chang-Ho. The Chien-Chia-Ho is annexed into the Chang-Ho at Kwan-In-Tse where the stream is able to maintain a traffic of small boats. At Ho-Yun, the Chang-Ho and the Chu River converge into one flow, and drains into the Yangtze River near Kiang-Lin. The stream valley corresponds nearly to the axial direction of the Tangyang Syncline.

The northern part of the drainage basin of the stream consists mostly of limestones, thus the general topography along the valley is rather rugged. On reaching the central part of the area where the Patung series is distributed, the purple shales mostly form the river beds and the middle limestone forms low hills and ridges. At Tungkung, there are three parallel streams all flowing south-southeastward while the folding axis of the various formations trends northwest-southeast to north-south

directions. The southern part of the Chang-Ho basin covers the area where the Hsiangchi coal series is distributed, and the effect of erosion is more intensive there. Owing to the limited drainage basin, the river is shallow in the winter season, and in the summer only during a week or ten days, the heavily loaded small boats can sail from Kwan-In-Tse to Sha-Shih. The increase of the water volume in the stream is sudden and enormous, but dies down in a few days.



第十四圖 郭家崛剖面圖
Fig. 14. Section at Ko-Chia-Fan.

3.	下香溪煤系	Lower Hsiangchi Coal Series.
2.	河牀	River bed.
1.	綠色砂岩	Green Sandstone.
a.	紫色頁岩—巴東系	Purple Shale of the Patung Series.

3. The Chu River begins at Hsiang-Lin-Ko, and flows eastward along Hsieh-Ma-Ho, then southeastward to Ma-Liang-Pin, and Tung-Chen-Ho. This part of the country is mostly mountainous with many a precipice and steep valley. At Hsia-Ko, where the stream is passing into the Tertiary formations, the relief is lessened and the valley widened out, thus a traffic of small boats is maintained from Hsia-Ko to Sha-Shih. Along the Tertiary red beds, the stream meanders here and there without any regularity. It flows south to Yang-Pin, Yuan-An and Tangyang then to Ho-Yun to join the Chang-Ho. The drainage basin of the Chu coincides with the so called Yuan-An Syncline.

Among the three streams, the Chu River is the most efficient for communication and irrigation. During this last survey, the region around Nanchang, Tangyang and Yuan-An had a long period of drought. Only

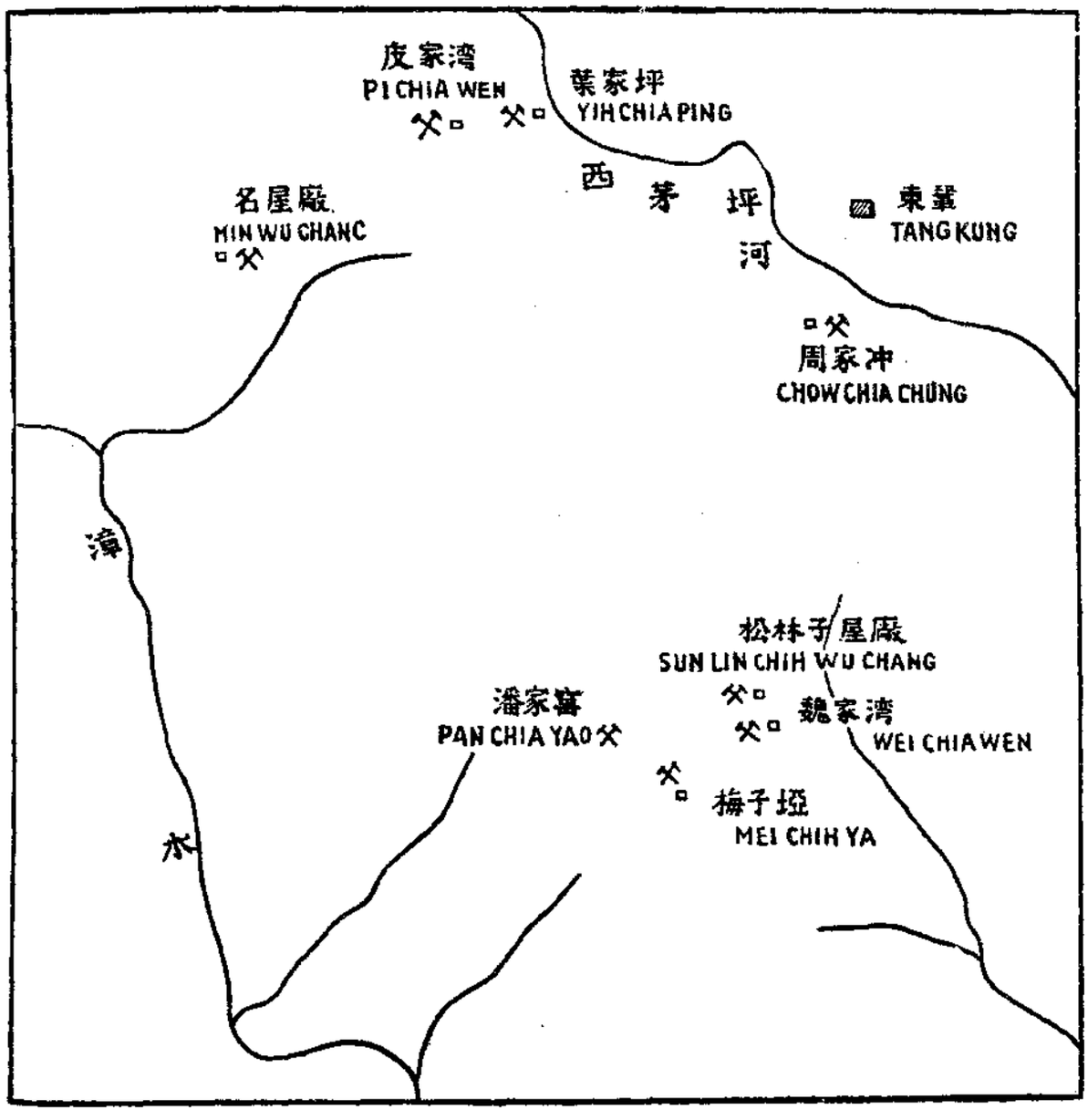
the farmers around Yuan-An received a good harvest. This shows how the Chu River irrigates the rice fields on its two banks of Tertiary red beds by forming a network of drainage system in the narrow and long Tertiary terrace which covers the Yuan-An Syncline. From Hsia-Ko to Sha-Shih, the boats require three weeks to make a journey back and forth. During the flood period in the summer season, the heavily loaded small boats can sail on the lower part of the river from Hsia-Ko to Sha-Shih.

V. COALFIELDS.

General Discussion. The coal seams though often appearing in the Permian and the Carboniferous strata, they usually are limited in reserve, inferior in quality, and more or less local in distribution. Sometimes the seams are lenticular and at other times discontinous as those found in Lunchung which are intercalated in the lower part of the Yangsing limestone. From a similar horizon we have found a coal seam at Shih-Chiao-Pin, where the present output is fairly respectful in amount, but its distribution seems to be limited. Next to this is the Permian coal series as found at Liang-Ho-Ko, Men-Shan-Tung, etc. They are mined by the natives as fuel for paper manufacturing, but its quality is poor and the reserve insignificant. Thus only the Hsiangchi coal series (Triassic to Jurassic) can be considered as the one which produces coal of fair quality and has sufficient reserve for mining within the area considered.

The Hsiangchi coal series is distributed over quite a large area. It extends from Tungkung, Lo-Chia-Wen on the north; Kwan-In-Tang, Hsuan-Ho-Ko, and Kwan-Miao-Pin on the south; and the Chieu-Tse-Shan, Miao-Chien, Pei-Ko-Yuan, Shih-Ma-Chao, etc. on the south-west. Thus its areal distribution covers from north to south about 90 *li* and east to west about 30 to 40 *li*. The number of coal seams found in the fields amounts to five; and the thickest seams all occur around Kwan-In-Tse, each about one to two feet in thickness. According to the native miners, there are three coal seams mined at Kwan-In-Tse, separating from each other by about 20 to 30 feet. At Tungkung, the number of seams mined are more numerous but they are more widely separated from each other. The coal produced at the Chieu-Tse-Shan is only from a seam about 3 to 4 inches thick. It is bituminous, and probably the only bituminous coal seen in the district, coals from all the other seams being anthracite.

Plate II



1. The Tungkung Coalfield.

Location. Tungkung is a small marketing place in Nanchang Hsien situated about 160 *li* to the south of the Nanchang city, and 145 *li* south of Wu-An-Yen which is a buying and selling center of the coals produced.

The Tungkung Coalfield comprises the area to the southwest of Tungkung where the numerous coal-pits are located. The Chang-Ho and the Mo-Pin-Ho drain the western and the eastern parts of the Coalfield respectively. The streams are shallow and cannot be utilized as means of transportation. Some 90 *li* south of Tungkung, there is another productive area, namely Kwan-In-Tse, where mining operation has been carried on.

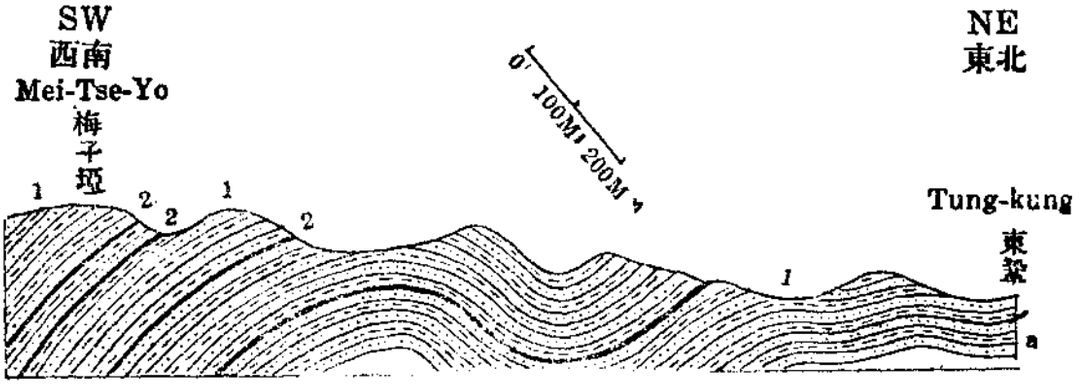
Geology. The town of Tungkung is not far from the contact between the Patung series and the Hsiangchi coal series which latter strikes north 60 to 70 degrees west, and dips southwest at 10 to 20 degrees. Folding plays a greater part than faulting in the coalfield. The folding axis forms an arc: thus from Lo-Chia-Wen the axis bears east-west; at Tungkung it trends northwest-southeast; and further south it assumes a north-south direction. The lower part of the coal series is characterized by shales with very few coal seams, while in the middle and upper parts, sandstones predominate, and the coal seams are comparatively more abundant. The structural relations between the coal seams are shown in figures 15-17. The character of the basal part of the Hsiangchi coal series is indicated in figure 14. Regarding the lithological character of the entire coal series, reference may be made in section II in the present paper.

Condition of Mining and Transportation. In the Tungkung mining district, the rocks above and below the coal seams are mostly sandstones, usually firm and compact. This fact indicates that the roof and the floor of the coal pit will stand very well and need little timbering. The inhabitants of the district mine their coal from the place it crops out and follow down along its bedding plane. The coal is very compact, thus large lumps of coal weighing 50-60 catties are mined at a time. The seams are usually thin, and consequently the openings of the pit are low. The miners have to lie flat on the ground and crawl in on their elbows and knees. With those pits especially low, the operators of the mines have to hire some thinly-built miners or sometimes some undergrown people to do the work. The beds usually dip 15-20 degrees southwest. Thus using the mining method just mentioned, it is easy to go in to work by just sliding down on a piece of board by gravity. But, hauling up is rather difficult; for during the climb the miners have to pull 50 or 60 catties of coal behind them. The total output per miner each day is only about 200-300 catties of coal. In pits where the coal is mined at quite a distance from the portal of the pit, the output will be considerably less; its decrease will vary as the distance transported underground. In each coal pit, only two to six miners are working with the average of each pit producing 500-600 catties each day. The price of the coal f.o.b. colliery is only about 6-7 tenths of a copper per catty. When it is carried into the town

by the dealers of coal, the price rises to 12-13 tenths of a copper per catty. The coal is mostly transported to Wu-An-Yen for sale with the freight about 600-700 coppers per picul. Excluding the board, the net gain of each miner is about 40-60 coppers a day. Thus the operating interest is not high and very few miners work all the year round. When the water in the spring floods the mines, they mostly go back to farming.

In the district there is no company officially registered or recognized. Mostly the land is owned by the miners. The busy mining is done in the winter when the farming is through and mining can afford some profit.

The different coal pits mined are 1. Pang-Chia-Ko; 2. Mei-Tse-Ya; 3. Wei-Chia-Wen; 4. Sun-Lin-Tse-Wu-Chang; 5. Min-Wu-Chang; 6. Pi-Chia-Wen; 7. Chow-Chia-Chung; 8. Sun-Ya; etc. All the mining done in the various coal pits are very much similar as described above. The output of the pits are very small; Wei-Chia-Wen, Sun-Lin-Wu-Chang and Mei-Tse-Ya produce the greater portion of the output.



第十五圖 東攻迄梅子垇剖面圖

Fig. 15. Section from Tungkung to Mei-Tse-Yo.

2. 煤層 Coal Seams.

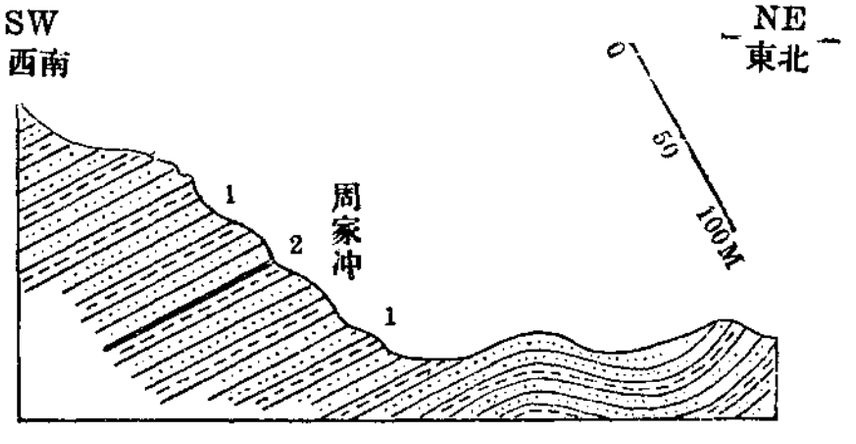
1. 香溪煤系 Hsiangchi Coal Series.

a. 巴東系 Patung Series.

2. The Kwan-In-Tse Coalfield.

Location. This district comprises not only the area around the town of Kwan-In-Tse but also those about Hsuan-Ho-Ko and Kwan-Miao-Pin. It is situated about 90 *li* south of Tungkung and 80 *li* north of the Tangyang city. The town of Kwan-In-Tse used to be a very prosperous marketing place in Tangyang Hsien, located just at the entrance of the hilly region on the northwest. Besides, the Chang-Ho, which passes by the town, facilitates the transportation a great deal especially in the summer season, when the heavily loaded small boats can travel along the stream with ease.

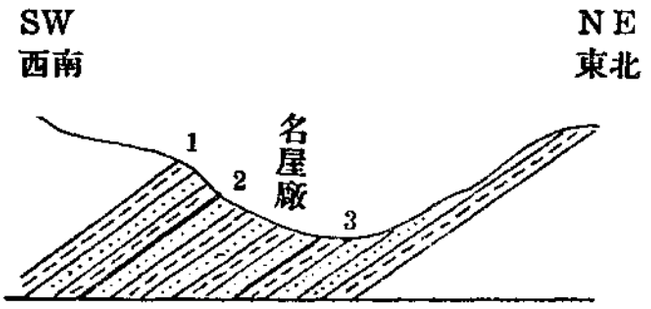
The general topography is gentle and does not possess much relief, thus the land transportation even by these crude methods is made much easier than around Tungkung.



第十六圖 東鑒周家冲煤層剖面圖

Fig. 16. Section of Coal Seam at Chow-Chia-Chung near Tungkung.

2. 煤層 Coal Seam.
1. 中香溪煤系 Middle Hsiangchi Coal Series.



第十七圖 名屋廠煤層剖面圖

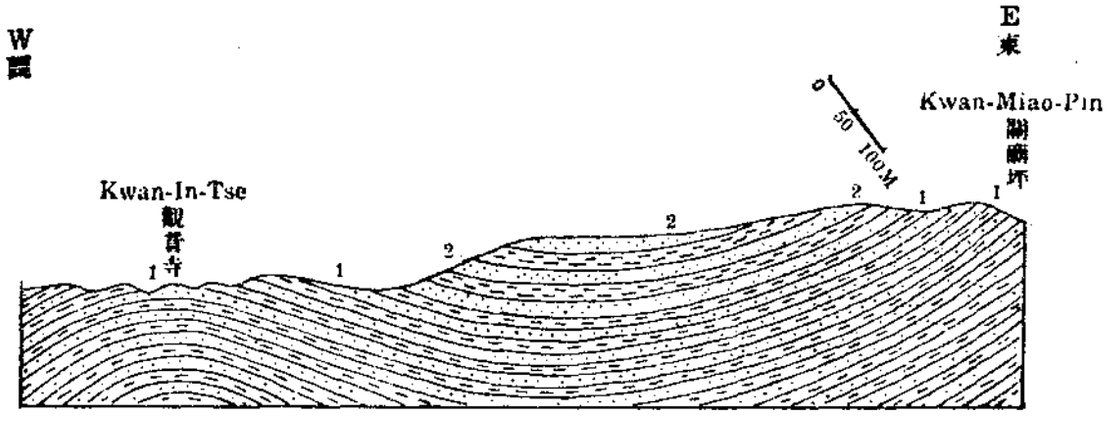
Fig. 17. Section of Coal Seam at Ming-Wo-Chang.

3. 中香溪煤系 Middle Hsiangchi Coal Series.
2. 煤層 Coal Seam.
1. 上香溪煤系 Upper Hsiangchi Coal Series.

Geology. The coal seams, mined in the Kwan-In-Tse coalfield, are derived also from the upper part of the Hsiangchi coal series. Dipping angles of the series are very low, sometimes approaching horizontality. The sandstones are not so compact as those in Tungkung. On the west of Kwan-In-Tse, one begins to see the Kweichow series. Northeastward to Kwan-Miao-Pin and Hsuan-Ho-Ko, the Hsiangchi coal series again appears (Fig. 18). The coal producing pits mostly lie around the Kwan-In-Tse Dome and along the Kwan-Miao-Pin Sycline. At the top of the

Dome, most of the beds are eroded away leaving the coal seams very close to the surface. At Kwan-Miao-Pin, the coal seams occur at the foothill of the low ridges. The seams mined in the district are about three in number with the distance apart from each other about 20-30 feet. Further southward from Kwan-In-Tse, the Hsiangchi coal series is mostly eroded away.

Condition of Mining and Transportation. The scale of mining at Kwan-In-Tse when compared with Tungkung is much more extensive. On account of the structural advantages — 1, the dome structure with its top eroded away leaving coal seams close to the earth-surface; 2, the thicker coal seams, 2-3 feet thick; 3, the short distance between the coal seams along the stratigraphical column; 4, the gentle topography— the mining operation is made much easier and the transportation more convenient. Most of the mining methods of the different coal pits are similar. They sink two vertical shafts at the most promising places, one used as the main gangway and the other used for ventilation. The two shafts are connected underground. At lower levels a tunnel or shaft is excavated for drainage or for pumping out the mine water. In this district, the mining does not stop during the busy farming season, and is a comparatively more stationary project. A few years ago the mining company at Chuei-Chia-Ko did buy a hand pump run by human labor. But the capacity of this pump is too small. Besides, it requires 6 or 8 people working on the pump to keep one miner down on the working level to mine the coal. Thus it costs more to drain off the mine water than what the actual amount of coal taken out can sell for. This method of pumping has been naturally abandoned. At present, only the coal seam along the shallow places are worked. Kwan-Miao-Pin and Hsuan-Ho-Ko also produce large quantities of coal, and the coals are transported to Kwan-In-Tse for shipment to Sha-shih. Formerly there were several mining companies registered under the Peking Regime and some of them did make profit. Owing to recent disturbances, all the companies stopped their operation. Only a few miners are still working in the collieries for barely maintaining their living with no wages paid nor any lease in effect except that the coal mined are sold to the respective owners of the mines. The price of coal at Kwan-In-Tse is about 160 coppers per picul (about 40 cents Mex.). The freight for transporting coal to Sha-shih in the winter is a dollar per picul, while in the summer the same reduces to 20 or 30 cents. A few years ago, during the prosperous period, the Kwan-In-Tse district produced 2,000 tons per month; at present only about one tenth of that amount is mined each month.



第十八圖 觀音寺至關廟坪剖面圖

Fig. 18. Section from Kwan-In-Tse to Kwan-Miao-Pin (showing the structure of Coal bearing strata).

2. 白堊紀岩層 Cretacous Formations.
1. 香溪煤系 Hsiangchi Coal Series.

The individuals or companies in the district which applied under the Peking Regime for mining, registered or non-registered, are as follows:—

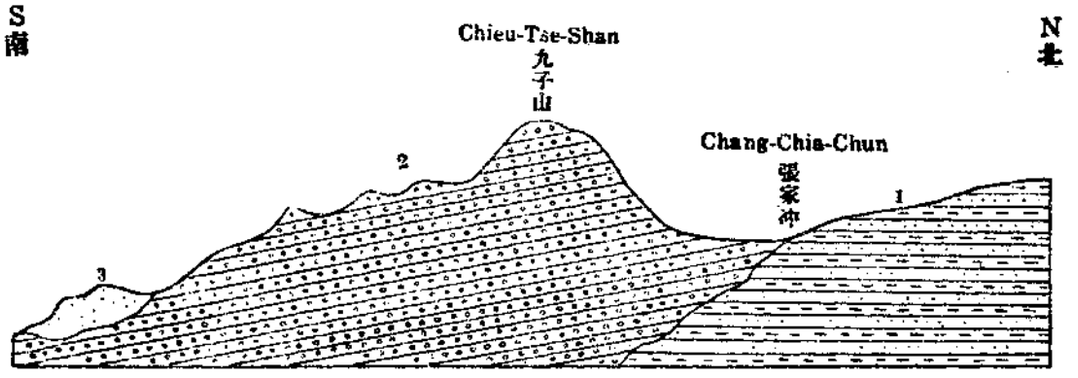
	Mine Owner.	*Location.*	*Remarks.*
1. Tung Huei Co.	Liu Chao-Chin	West of Hsiao-Ho, Kwan-In-Tse.	Under operation.
2. Ho-Chun Co.	Wang Po-Sho	Chia-Chia-Yen, Kwan-In-Tse.	Not yet operated.
3.	Hsiang Tse-Chen	Chuei-Chia-Ko, Kwan-In-Tse.	Under operation.
4.	„	Kwan-Miao-Pin	„
5.	Cheng Chin-Kwan	Tun-Ko-Shan, Hsuan-Ho-Ko.	„

3. Coalfields of the Chieu-Tse-Shan, Miao-Chien, Shih-Ma-Chao, etc.

Location: These few coalfields all are located on the northwest of the Tangyang city and east of the Yuan-An city. The Chieu-Tse-Shan is situated 12 *li* north of the Tangyang city; while Miao-Chien lies about 30 *li* north, and Shih-Ma-Chao 40 *li* north of the same.

All the small streams are either intermittent or very shallow around these districts, thus transportation has to be done on land entirely.

Geology: The Hsiangchi coal series at the Chieu-Tse Shan is just lying below the Limestone-Conglomerate (Fig. 19). The Hsiangchi coal series dips east and the conglomerate dips south. The seam mined here is very thin. Figure 19 shows also the unconformity between the coal producing formation and the Tertiary conglomerate.



第十九圖 九子山至張家冲剖面圖
Fig. 19. Section at Chieu-Tse-Shan to Chang-Chia-Chung.
(showing unconformity contact between 1 & 2, 2 & 3).

3. 紅土層 Red Clay Formation.
2. 石灰礫岩 Limestone conglomerate.
1. 香溪煤系 Hsiangchi Coal Series.

Along Miao-Chien to Shih-Ma-Chao, the strata dip southeast 15 degrees. A little further east about a few *li* from Miao-Chien and Shih-Ma-Chao the Patung series appears. The coal series at Miao-Chien and Shih-Ma-Chao forms a continuous ridge. In the coal series shale predominates, and the productive coal seam is a little more than one foot in thickness.

Conditions of Mining and Transportation. The mining methods are mostly similar to those employed at Kwan-In-Tse. Only the means of transportation is entirely done by horses, mules, donkeys or coolies. The coal is sold at different markets with no fixed price, varying according to demand. No company is organized; the mining operation is done by the native individual miners. The mining profit is slight and the output small.

4. The Shih-Chiao-Pin Coalfield.

Among the Carboniferous coalfields only the coal mined near Shih-Chiao-Pin is worth mentioning The mines are situated at Peng-Chiao-Po which is about 12 *li* west of Shih-Chiao-Pin, a village about 40 *li* west of the Yuan-An city. The coal series occurs at the base of the Carboniferous cherty limestone. Above the coal series it is often capped by a thin layer of quartzite striking north 40 degrees west, dipping northeast 15°. The coal seam is about 1-2 feet thick. The relation between the quartzite, the coal series and the cherty limestone is shown in Fig. 3. The quality of the coal is fair, it is chiefly semi-bituminous and cokes fairly well. The local miners often coke the coal by crude methods.

Is is said that the colliery has been in operation for a long time. The output is steady and fair in amount. Most of the coal mined is sold at the nearby markets for paper manufacturing, wine distillation and steel tempering. A company named Yuan-Pin was organized by Kun-Ta Yen.

Other coalfields like those at King-Cho-Yuan, Liang-Ho-Ko, in Yuan-An Hsien; and that of Lungchun in Hsiangyang Hsien are rather limited in reserve, and only produce coals of inferior quality.

5. Estimation of the Coal Reserve in the Hsiangchi Coal Series.

Within the districts surveyed, the Hsiangchi coal series contains at least five coal seams, each with a thickness of one to two feet, thus giving the average total thickness of the coal seams in the series about two meters. The coal series crops out from Tungkung to Kwan-In-Tse, a distance about 48,000 meters; from Kwan-Miao-Pin to Hsuan-Ho-Ko, a distance of 4,800 meters; and from the Chieu-Tse-Shan to Shih-Ma-Chao a distance of 19,300 meters; thus making a total distance of 72,100 meters. Along the direction of the dip downward the slope depth is taken as 300 meters. These dimensions give the volume of the total coal reserve as 43,260,000 cubic meters. Taking the specific gravity of coal as 13 and 1,000 Kg. as one ton, the total reserve will amount to 56,238,000 metric tons.

In the Patung, Tsekwei, Hsin-Shan and Ichang Districts, the total coal reserve as estimated by Hsieh and Chao[14] is 55,575,000 tons. So the coal reserve of these two places are about equal. Only the former is handicapped by the inland transportation on a small stream for 180 *li*, while the coal produced at Patung, etc. can be shipped to the nearest town on the Yangtze River in a short distance. Therefore if the means of transportation is improved the value of the coalfields in this district can be compared with that in Patung, Hsin-Shan, Tsekwei, and Ichang.

VI. METALLIC DEPOSITS.

Deposits of Copper around Tungkung and Hsia-Ko: The limestone in the district often contains various metallic deposits. The middle limestone of the Patung series now and then has some columnar chalcocite and malachite deposits at the base. It is probable that the limestone has been percolated by the meteoric water which dissolves its copper content however small, and carries the copper in solution downward until it meets an impervious layer of the shale. The water with the solute can not go any further when meeting the shale and in such a way the copper solution is gradually concentrated right above the shale and it spreads laterally

[14] op. cit. p. 75.

along the bedding plane. In the course of time the copper is precipitated as copper sulphides, when the solution is reacting with another incoming solution rich in hydrogen sulphide. Some of the sulphides are later again oxidized into carbonates. The scanty deposits at Cho-Ma-Ko near Tung-Kung, and at the Tung-Lo-Shan near Hsia-Ko were formed in a similar way. These deposits are not continuous and not always present at the base of the middle limestone, thus it presents quite a difficult problem to prospect for them. Formerly there was one mining company organized as the King-Hua Mining Company. But it failed to develop any considerable amount of ore and was closed down consequently.

Near the Yuan-An city at In-Tse-Shan there occurs some small veins of Pb-Zn-Cu ores in the middle limestone of the Patung series. But the distribution is so limited that it can hardly be of any economic importance.

At Huang-Kai-Shan, north of Yen-Chia-Pin in Nanchang Hsien, some barite veins are found in the limestone. Formerly the inhabitants there did prospect for tin in the same locality but failed.

GEOLOGY OF SIANGYANG, NANCHANG, ICHENG, CHINGMEN, CHUNGHSIANG AND CHINGSHAN DISTRICTS, NORTH HUPEH.

By C. C. Yü and W. P. Shu.

The region to the north of the cities of Chingmen, Chunghsiang and Chingshan forms a maturely dissected plateau with an average elevation of about three hundred meters above the bed of the Han River which drains the country from the north to the south. Here, the course of the Han follows the axis of the Icheng Anticline which extends from north-west to south-east. The south-west limb of this anticline comprises Pre-Sinian Granite and a sequence of sediments ranging from Sinian to Permian; the successive formations forming the north-east limb are, however, disturbed by subsequent faults.

The topographic features of the region surveyed bear an intimate relation with the structure as well as the lithological character of the bed-rocks. The hill ranges near the Han River are essentially parallel to it, but those at a greater distance from the left and the right banks run towards the east and the south respectively. All the tributaries of the Han pass either along some fault or through the low land where softer beds crop out as a rule, such as the Sintan Shale and the Tertiary Sandstone.

The stratigraphical succession of the country under consideration is somewhat similar to that of West Hupeh, where Prof. J. S. Lee[1] and Prof. C. Y. Hsieh[2] have made their observations. The major classification of the formations proposed by the said authors is found to be tenable in this region. Sub-formations are, however, proposed to record local differences. They are tabulated below in descending order:—

XI.	Tertiary	17. Tunghu Series	
		——Unconformity——	
X.	Jurassic	16. Coarse Sandstone and Coal Series	
IX.	Triassic	15. Purple Shale and Sandstones	
VIII.	Carboniferous to Permian (Wushan Limestone)	14. Tayeh Limestone	Upper Permian
		——Disconformity——	
		13. Yanghsing Limestone — Upper	Permian
		13. Yanghsing Limestone — Middle	Upper
		13. Yanghsing Limestone — Lower	Carboniferous
		——Disconformity——	

[1] J. S. Lee: *Geology of the Yangtze Gorge*, Bull. Geol. Soc. China; Vol. III, pp. 353–382.

[2] C. Y. Hsieh: *Geology of Ichang and Neighbouring Districts*, Bull. Geol. Sur. China; No. 7, pp. 20–69.

VII	Devonian	12. Yangtaikuan Quartzite
VI.	Lower Silurian ..... (Sintan Shale)	11. Chiulungshan Formation 10. Sienchü Formation 9. Lungma Shale
		——Disconformity——
V.	Middle Ordovician	8. Neichiashan Formation
IV.	Lower Ordovician ..... (Ichang Limestone)	7. Siaochisze Limestone 6. Wuchiachi Limestone 5. Loomensze Limestone
		—— Disconformity——
III.	Cambrian	4. Luchiapo Sandstone
II.	Sinian	3. Tongying Limestone 2. Tayükou Sandstone 1. Futzeya Limestone
		——Unconformity——
I.	Pre-Sinian	*c*. Schist *b*. Gneiss *a*. Granite

I. PRE-SINIAN.

Near the right bank of the Han River, that is, from Futzeya to Fongmashan, there are three different types of rocks of Pre-Sinian age: (a) granite, (b) gneiss and (c) schist. These occur in close association. In the granite, there are now and then small and irregular patches of gneiss; and the eastern border of the granite is fringed by a schist which is covered by alluvium towards the valley of the Han River. Some sixty *li* north-east of Futzeya, the same schist again crops out. There, it occupies a large area in the vicinity of Sinchai. The lithological character and probable relation of these rocks are described below.

(*a*) Granite. The surface of this granite has been so profoundly weathered that it simulates a kind of porous sandstone. On closer examination, the rock is found to be allotomorphic and holocrystalline and shows a coarse granular texture. Quartz and orthoclase form about ninety per cent of the whole rock-mass, the remaining being plagioclase and biotite with scattered magnetite. Because of high percentage of orthoclase, the rock exhibits a flesh colour on the whole.

(*b*) Gneiss. The structure of this rock is fine and holocrystalline. Ill-defined crystals of dark-green hornblende, feldspar and quartz are alternately arranged in narrow bands. The colour of the rock is dark-green; it may be called a hornblende gneiss. The red granite in contact with the gneiss is not so coarse as its main mass, and possesses a gneissic structure. It seems as if a process of assimilation had taken place before the crystallization or partial crystallization of the granite magma was effected.

(*c*) Schist. According to the principal mineral, this schist can be subdivided into two kinds: hornblende schist and mica schist. The former is dark-green in colour and the latter silver-white with a slight greenish tint. They are weathered to such an extent that it is not possible to trace any distinct line of demarcation between the two even if such line of demarcation does exist. The schistosity is megascopically developed. Although the direction of schistosity is sometimes changed, the structure of the schist is not chaotic.

An unmetamorphosed Sinian Limestone with a basal conglomerate composed entirely of pebbles of the granite, gneiss and schist lies unconformably upon the granite. This enables us to assign a Pre-Sinian age to the granite, etc. The granite is probably the youngest among these three rock-types and the schist may belong to the Wutai System, for its structure is not so chaotic as the Taishan Complex.

II. SINIAN.

The Sinian Formation of the area mapped is distributed at three localities: 1 in the south-western vicinity of the Siangyang city, 2 along the belt of Futzeya, Tayükou and Fongmashan and 3 at Hwashankuan near Chuchiapu. The whole sequence is discontinuously exposed at any of these localities as described later. According to its comparatively complete successions along Futzeya, etc., three parts can be recognized in this formation, namely:—

Upper ... .Tongying Limestone
Middle.....Tayükou Sandstone
Lower .....Futzeya Limestone

(1) Futzeya Limestone. At Futzeya, a limestone series, fifty meters thick, commences with a conglomerate which lies unconformably upon the Pre-Sinian Granite and contains three kinds of pebbles mentioned above. The conglomerate is only two meters in thickness and is immediately replaced by a very thin layer of red and green sandstone precursory to the deposition of the Futzeya Limestone. This limestone is characterised by the fact that both its lowest and uppermost parts are intercalated with thin siliceous layers and its main or middle part by large, irregular masses of almost pure, translucent silica mingled with the normal limestone with confused boundary. It is again observed at Fongmashan—more than thirty *li* south of Futzeya—where it is but twenty meters thick and comes into contact directly with the granite without the basal conglomerate and the red to green sandstone.

(2) Tayükou Sandstone. At Tayükou, thirty *li* south of Futzeya, a sequence of sandstone unconformably overlies the Pre-Sinian Granite. Its succession from the lower to the upper are as follows:—

1.	Chocolate shaly sandstone	1.5 m.
2.	Grey and violet shale	6 m.
3.	Greyish-red, thick-bedded and hard sandstone	6 m.
4.	Grey, thick-bedded sandstone	1.5 m.
5.	Alternation of grey shale and sandstone	9 m.
6.	Yellow shale	2 m.
7.	Grey, thick-bedded sandstone	2 m.
8.	Grey, thin-bedded sandstone	20 m.
9.	Grey, hard sandstone	15 m.

The contact between the Futzeya Limestone and the Tayükou Sandstone is covered at Futzeya, but the last-mentioned bed (9) is observed to overlap the Futzeya Limestone at Fongmashan. some *li* south of Tayükou. Therefore, a disconformity probably exists between them.

Along the belt of Futzeya and Fongmashan, there is a strike fault bringing the Tayükou Sandstone in mechanical contact with the Tongying Limestone. In spite of the fact that their relation is concealed by this fault, the Tayükou Sandstone which immediately overlies the granite or the Futzeya Limestone should be older than the Tongying Limestone. We have seen that a yellowish-white coarse sandstone exposed at Hwashankuan, thirty *li* southeast of Tayükou, underlies the Tongying Limestone. This coarse sandstone may either be a facies of the Tayükou Sandstone or more probably correspond to the upper part of it.

(3) Tongying Limestone. A thin-bedded limestone carrying many dark discoid bodies in its middle part rests conformably on the coarse sandstone at Hwashankuan. This forms the base of the Tongying Limestone as the same dark discoid bodies have been found in the basal part of the Tongying Limestone in Western Hupeh.

The Tongying Limestone is extensively exposed to the west of Futzeya, Tayükou and Fongmashan where it is thrown into contact by a fault with the Tayükou Sandstone or with the Pre-Sinian Granite. To the west of Tayükou the exposing beds in descending order are:—

1.	Grey limestone containing thin bands of brownish-black flint	50 m.
2.	Massive limestone with siliceous laminae parallel to its bedding plane	80 m.
3.	Light-grey limestone containing thin bands of whitish flint	70 m.
4.	Thin-bedded, grayish-yellow and fine sandstone	7 m

5. Dark-grey limestone containing thin bands of brownish-black flint .....50 m.
6. Massive siliceous limestone .....10 m.
7. Light-grey limestone containing thin bands of brownish-black flint .....10 m.
8. Thin-bedded siliceous limestone ..... 5 m.
9. Luchiapo Sandstone (Middle Cambrian)

These limestones are largely massive, and are distinguished from the younger limestones by numerous thin bands of flint which are sometimes so thin that they form laminae, two or three millimeters apart, and are arranged parallel to the bedding plane. In a horizon some two hundred meters below the Luchiapo Sandstone, we found *Collenia*.

There is another limestone exposed in the vicinity of the Siangyang City where it is brought to the surface by a fault. From Sichiachih to Chiukungshan, the successive beds of this limestone formation in descending order are:—

1. Dark-grey limestone with siliceous laminae parallel to its bedding plane, being intercalated with a thin layer of red to grey shale .....100 m.
2. Thick-bedded limestone containing thin bands of brownish-black flint ..... 40 m.
3. Light-grey limestone with siliceous laminae parallel to its bedding plane .....100 m.
4. Thin-bedded limestone containing thin bands of whitish and brownish-blaek flint ..... 60 m.
5. Well stratified limestone containing thin bands of brownish—black flint .....150 m.
6. Siliceous limestone .....100 m.
7. Dark-grey and well stratified limestone with a thin intercalation of shaly limestone and shale .....150 m.

Although no *Collenia* has been obtained from this sequence of limestones, they are believed to belong to the Tongying Limestone because of their siliceous nature. Their stratigraphical position is however probably slightly lower than those exposed at Tayükou, for the latter is immediately overlain by the Cambrian beds. At Lungchung, thirty *li* west of the Siangyang City, only the uppermost part of the Tongying Limestone is thrust upon the Permian bed, and at Wanshan, ten *li* west of that city, the same uppermost part is exposed by forming a syncline with that of Lungchung.

Comparing the Sinian Formation described above with that of Western Hupeh, it would seem that the basal conglomerate and its

overlying red and green sandstone probably correspond respectively to the conglomerate and the grit of the Nantou Series. The Tayükou Sandstone may be in turn contemporaneous with the shales of the Toushantou Series. Although these two divisions of the Sinian Formation show some local variation in their lithological character, the upper division, namely, the Tongying Limestone, is essentially uniform over Western Hupeh as well as the area surveyed.

According to Prof. Hsieh, the Nantou Tillite tends to become thinner towards the north, and carries some limestone boulders which, as the named author believes, are probably derived from a remote source of a former limestone. If this be true, the Futzeya Limestone must have been the source of such limestone boulders; for no such limestone older than the Futzeya limestone has ever been found in North and West Hupeh.

III. CAMBRIAN.

(4) Luchiapo Sandstone. At Luchiapo, three *li* west of Tayükou, a grey sandstone of a little more than one hundred meters thick lies conformably upon the Tongying Limestone. Its sand grains are rather fine, and it is both thin and thick-bedded. In the middle part of the sandstone, a thick bed carries glittering mica-plates. Typical Middle Cambrian trilobite, *Dorypyge yui* Sun, in association with *Obolella* cf. *wirrialpensis* Etheridge has been found in a very thin layer of soft, yellow sandstone succeeding the micaceous sandstone some fifty meters above the base of the sequence. The whole sandstone series plunges away from sight from Luchiapo northward through a fault. It crops, however, out again to the west of Futzeya. There, both its lithological character and thickness undergo no change. But the Cambrian bed to the west of the Siangyang City, *i.e.* in the central part of the syncline between Lungchung and Wanshan, is a green to greenish-grey shale intercalated with limestones. In this shale, Messrs. C. Li and S. Chu found Lower Cambrian *Redlichia chinensis* Walcott. Luchiapo is about one hundred *li* apart from Siangyang. It would seem that a transgressive overlap had taken place in the region surveyed during the Cambrian Period.

IV. LOWER ORDOVICIAN.

Ichang Limestone. A mighty limestone intervening the Shipai Shale and the Neichiashan Formation in Western Hupeh was called by Prof. Lee the Ichang Limestone. The same limestone is developed in the area under consideration. Here, however, it conformably succeeds the Luchiapo Sandstone. Basing upon its lithological character as well as a few scattered fossils, the limestone is divided into three parts: viz.,

the Loomensze Limestone in the lower, the Wuchiachi Limestone in the middle and the Siaochisze Limestone in the upper; the first of these has a thickness of more than five hundred meters and each of the latter two about four hundred meters.

(5) Loomensze Limestone. Some of the higher mountains between Siangyang and Nanchang and those forming the boundary between Siangyang and Ichang are largely made of the Loomensze Limestone. They form the most precipitous features among all the mountains in the region surveyed. The limestone occasionally contains thin siliceous layers, and becomes thoroughly silicified for about six meters thick in its uppermost part. In its base, thin-bedded limestones containing dark pisolites and *Archaeocyathinae* are intercalated with green shales. The pisolites show ellipsoid lamination in its cross-section, and recalls the structure of *Girvanella sinensis* Yabe. The *Archaeocyathinae* are usually as large as a copper coin in cross-section, and often project from the weathered rock-surface in the form of small cups. Above the *Archaeocyathinae* bed, the limestone becomes more or less massive, but again becomes thin-bedded as the siliceous limestone is approached. This upper thin-bedded limestone carries also some pisolitic bodies, but *Archaeocyathinae* are absent.

(6) Wuchiachi Limestone. The Wuchiachi Limestone is a dark-grey limestone sometimes thin-bedded and sometimes thick-bedded with occasional thin intercalations of reddish and somewhat shaly limestones.

(7) Siaochisze Limestone. This limestone is composed of two parts. The lower is a thin-bedded limestone with cherts sometimes arranged in bands. The upper consists of an alternation of sandstones and limestones in which chert is occasionally observed. The uppermost part of these alternating beds, namely, that closely subjacent to the Neichiashan formation, is formed by a thick-bedded limestone crowded with *Eccyliomphalus* sp., *Proterocameroceras matheui* Grabau and other small fossils.

Prof. Hsieh has discussed at some length the age of the Ichang Limestone. He states that the presence of some fragments of trilobite in the basement *Archaeocyathinae* beds, the absence of trace of disconformity between the Shipai Shale and the Ichang Limestone and the lithological similarity of the Shipai Shale and the greenish shales intercalating the *Archaeocyathinae* limestones altogether suggest that at least the lowest part of the Ichang Limestone might belong to Cambrian. It is, however, evident that the presence of some fragments of undeterminable trilobite is far from being sufficient to warrant a Cambrian age, though there are two additional corroborations to support that suggestion. On the other hand, the *Archaeocyathinae* is, according to Dr. Grabau, a widely distributed form of the Lower Ordovician. For this reason, the whole of the Ichang Limestone is tentatively relegated to the Lower Ordovician.

V. MIDDLE ORDOVICIAN.

(8) Neichiashan Formation. The Neichiashan Formation lies conformably upon the Siaochisze Limestone. It is distinctly composed of two parts. In the lower, a yellowish-green shale, twenty-five meters thick, brachiopods abound. Intercalated in this shale, there is a grey and comparatively hard band which yields numerous brachiopods, graptolites and trilobites. The upper, a yellowish-green limestone, or the Pagoda Limestone, carries gigantic *Orthoceras chinensis* Foord and other cephalopods in abundance. Trilobite is also found in association with the *Orthoceras*, but scanty. The Pagoda Limestone can be recognized at a distance by its special appearance, similar to the bark of old pine, due to its concretionary nature. This Limestone is about sixty meters thick.

These generalized statements are based on the observations made at Nanchang. From Nanchang eastward, some stratigraphical change is noticed. First, the lower shale becomes grayish-black, calcareous and muddy on the eastern side of the Han River. Second, a red Pagoda Limestone of twenty to thirty meters in thickness overlies the yellowish-green limestone, observed at some ten *li* south-east of Wu-An-Yen and to the east of Wenchuang, or the Hot Spring.

The name of this formation was derived from its type locality, Neichiashan, several *li* southeast of Sintan in West Hupeh, where *Triplecia* (*Yangtzeella*) *poloi* occurs in great abundance. It is a curious fact that, in spite of careful searching, no *Yangtzeella* has been procured in the country which we have traversed. The fossils we have found in the Neichiashan Formation are listed below:

(*a*) Fossils found in the lower shale

Graptozoa:	*Didymograptus murchisoni*
	Didymograptus sp. (several species)
Brachiopoda:	*Orthis* sp. (several species)
	Orthis calligramma Dalm.
	Dalmanella sp.
	Dinorthis sp.
Ostracoda:	*Leperditia* sp.
Trilobita:	*Asaphus* sp.
	Asaphus hupehensis Sun and Yu
	Taihangshania shui Sun and Yu
	Illaenus nanchangensis Sun and Yu
	Bronteus sp.
	Bathyurus minor Sun and Yu

(*b*) Fossils in the Upper limestone

Cephalopoda: *Cycloceras* sp.
Orthoceras sp. (several species)
Orthoceras chinensis Foord
Vaginoceras chientzekouensis Yu

In the lower part, *Orthis* is the most predominant, and in the upper, *Orthoceras* is prominent. The latter shows some affinity with the European fauna of Middle Ordovician age.

VI. LOWER SILURIAN.

Sintan Shale. The Sintan Shale succeeds the Neichiashan Formation without any discordance. There is, however, a distinct break between the two; for Upper Ordovician fossils are entirely wanting in any part of these formations, and the Pagoda Limestone sometimes exhibits traces of erosion. Although the Sintan Shale is not very uniform all over the region, its continuous and well-exposed profile to the west of the Nanchang City affords us a standard section. From lithological as well as palæontological points of view, we propose to distinguish it into three divisions, namely:

Upper.....Chiulungshan Formation
Middle.....Sienchü Formation
Lower.....Lungma Shale

(9) Lungma Shale. Although there are some lithological differences between the graptolite-bearing shale of West and North Hupeh, its fossiliferous nature is essentially alike. Hence the name, Lungma Shale, may be applied to both regions. The Lungma Shale of Nanchang is about four hundred and fifty meters thick. Its base is a black shale of twenty-five meters in thickness and extensively distributed in the region we have traversed. In the middle part of this black shale, graptolites abound. This is succeeded upward by a yellowish-green laminated shale, one hundred and fifty meters thick. Still higher up, a green shale, more than two hundred meters thick, appears, being characterized by sets of dip and strike joints, and consequently breaks away in long prisms. The uppermost part of the Lungma Shale is a dark-grey shale, some twenty meters thick, yielding some graptolites but not so abundant as in the base. Among the graptolites found in the Lungma Shale, the following genera are most abundant:—

Rastrites
Climacograptus
Diplograptus
Glyptograptus
Monograptus

(10) Sienchü Formation. The thickness of the Sienchü Formation is also approximately four hundred and fifty meters. A large portion —about four hundred meters—of it is an olive green shale, hard and thick-bedded. Its upper, namely, the remaining part, is intercalated with thin layers of limestones and shales. In these alternative limestone, especially the concretionary ones, *Favosites* and *Halysites* are frequently met with. To the south of Sienchü and to the west of Yenchihmiao, a collection of fossils was made from the debris of the same limestones. They are:

Anthozoa: *Favosites* sp. (several species)
Favosites tachlowitzensis Barr.
var. *lentiformis* Grabau
Favosites nucleolatus Grabau
Halysites cf. *cratus* Eth.
Halysites cf. *hupehensis* Grabau
Halysite sp. (several species)
Heliolites sp. (several species)
Heliolites megastomas
Heliolites bohemicus Wentzel
Syringopora sp.
Stauria cylindrica Yu (sp. Nov.)
Eridophyllum sp.
Pselophyllum? sp.

One species of *Palaeocyclus* and one of *Favosites* are obtained in the alternative limestones near Chiulungshan, south-west of Nanchang, where fossils seem to be scarce.

(11) Chiulungshan Formation. The Chiulungshan Formation, or the Upper Sintan Shale, differs lithologically from the other two below it. In this formation, grey to greyish-green colour of the rock largely replaces the green. Sandy material becomes richer upward giving rise to a sandy shale in the lower part of the formation, and an alternation of sandy shales and sandstones in its upper part. These sandstones are largely coarse and thick-bedded. In a fine sandstone, twenty meters below the top, *Encrinurus rex* Grabau and *Strophodenta* sp. are found. Ten meters still lower, a thin layer of sandy shale also yields *Encrinurus*.

The faunas in the three parts of the Sintan Shale within the area under consideration are respectively similar to those found by Prof. Hsieh in the Lungma Shale, the Lojoping Series and the Shamao Formation of Western Hupeh. Thus a Lower Silurian age is ascribed to the whole sequence of the Sintan Shale as defined above.

VII. DEVONIAN.

(12) Yüntaikuan Quartzite. Overlying the Sintan Shale without angular discordance, a whitish and reddish quartzite of varying thickness, from zero to sixty meters, shows its maximum development on the summit of Yüntaikuan, some sixty *li* west of the Chingshan City. Hence the name, Yüntaikuan Quartzite, is derived. This formation obviously corresponds to the Wutung Quartzite as developed along the Lower Yangtze Valley. The Wutung Quartzite was formerly included in the uppermost part of Silurian. But a fair suggestion was made by Dr. V. K. Ting who prefers to assign a Devonian to Silurian age to that quartzite. This view seems to be supported by the recent discovery of some *Lycopodials* in a similar quartzite on the northern border of the Taihu Lake, South Kiangsu. In consequence, the Yüntaikuan Quartzite is tentatively attributed to Devonian.

VIII. CARBONIFEROUS TO PERMIAN.

Wushan Limestone. The Wushan Limestone succeeds the Yüntaikuan Quartzite. Although they show no difference in dip, a disconformity however exists between them; for at least Lower Carboniferous is absent from our area of survey, and the varying thickness of the Yüntaikuan Quartzite at short intervals is a further indication of erosion. The Wushan Limestone is classified by following Prof. Hsieh into two main parts:

Upper.....Tayeh Limestone
Lower.....Yanghsin Limestone

(13) Yanghsin Limestone. Along the contact between the Yanghsin Limestone and the Yüntaikuan Quartzite or the Sintan Shale, there is a discontinuous layer of carbonaceous shale which sometimes yields a coal seam of little economic value. The limestone can be further distinguished lithologically into three parts: (*a*) the lower is a light-grey massive limestone with few flints. The maximum thickness is about eighty meters, but it is not uniformly developed everywhere in the region mapped. (*b*) The middle is a dark-grey limestone with numerous bedded flints; its thickness varies from zero to one hundred meters. (*c*) The upper is a well-stratified, dark-grey limestone with scattered flints, and about two hundred meters thick. This upper part of the Yanghsin Limestone sometimes rests directly upon the Yüntaikuan Quartzite or the Sintan Shale. Thus, a transgressive nature of the Yanghsin Limestone in Northern Hupeh is plainly demonstrated.

(*a*) Fossils in the lower limestone

Foraminifera: *Schwagerina* s
Fusulinella sp.

Anthozoa:	*Lonsdaleia* sp.
	Tetrapora sp.
	Vesotabularia tungliangensis Yu
	Michelinia sp.
	Michelinella sp.
	Montilopora sp.
Brachiopoda:	*Productus* sp.
	Spirifer sp.
	Reticularia sp.

(*b*) Fossils in the middle limestone

Anthozoa:	*Lonsdaleia chinensis* Girty
	Lonsdaleia sp.
	Tetrapora sp.
	Amplxus spinosus
	Michelinia minor Grabau
	Zaphrentis sp.
	Siphonodentron sp.
	Styloxis sp.
Foraminifera:	*Schwagerina* sp.
Bryozoa:	*Fenestella* sp.
	Fistulipora sp.

The above fossils show similarity to those of the Chihsia Limestone which, according to Mr. Y. T. Chao,[3] is of Upper Carboniferous age. Prof. J. S. Lee has recently found *Doliolina Claudiae* Deprat, *Fusulinella inflata* Colani and *Fusulinella bocki* Möller in the Chihsia Limestone in its type locality. This would seem, according the same author, that part of the Chihsia Limestone belongs to the lowest Permian, while a part of it may belong to Moscovian. Whatever may be the age of the lower and middle parts of the Yanghsin Limestone, its upper part must be a Permian representative.

(14) Tayeh Limestone. This is principally a light-grey and thin-bedded limestone with some shaly intercalation in its lower part. The total thickness of the Tayeh Limestone is unknown, because of the fact that its remnant either occupies the axial part of some small synclines or is cut off by faults. Both the sediments at the very base of the Tayeh Limestone and the formations that it immediately overlies show a considerable lithological variation from place to place. In the northern part of the region mapped, such as at Lungchung, thirty *li* west of Siangyang and at Bienshan, ten *li* north-east of Ichang, a yellowish-grey shale, some thirty meters thick, comes into contact with the lower part

[3] Y. T. Chao: *Brachiopod Fauna of the Chihsia Limestone*, Bull. Geol. Soc. China; Vol. VI, pp. 83–120.

of the Yanghsin Limestone; in the southern part, for instance, in the area to the west of Nanchiaopu, a conglomerate, some meters thick, composed of angular fragments of the Yanghsin Limestone overlies the upper part of the same limestone. These differences indicate that at least local breaks exist between the Yanghsin and the Tayeh Limestones. Above the yellowish-grey shale and the conglomerate just mentioned, a thin bedded limestone twenty meters thick, yields abundant *Gastrioceras* cf. *zitteli* Gemm. In a yellowish-brown sandy shale intercalated in the lower part of the Tayeh Limestone, *Sphenotus* sp., *Midiomorpha* sp. and *Gastrioceras* sp. are obtained. Thus the Tayeh Limestone is assigned to Upper Permian.

IX. TRIASSIC.

(15) Purple Shale and Sandstone. Only once to the north-west of Chingmen, we met with a series of purple shale with intercalated sandstones. This series underlies the Jurassic Formation, and its lower part is not exposed. It seems to be comparable, both as to its lithological character and its stratigraphical position, with the Violet Sandstone[4] of the Puchi District. Hence it is tentatively referred to Trias.

X. RHAETIC? TO JURASSIC.

(16) Coarse Sandstone and Coal Series. Succeeding the purple series upward, the strata are largely composed of a coarse and porous sandstone yellowish-white to greyish-yeliow in colour. In the base of this formation, two thin layers of limestone are found. They are separated from each other by a thickness of ten meters of sandstone. The lower part of this formation is intercalated with a conglomerate, several meters thick, with rounded cherty pebbles of moderate size. In the middle part, a coal series, thirty-five to forty meters thick (measured by the miners of Kouchiakou), yields abundant plant remains in which occur *Cladophlebis denticulata* Brongn, *Thyrsopteris* and *Podozamites*.

The difference in colour between this series and the purple shale indicates a change of the condition of deposition. Their exact stratigraphical relation is unknown. The plant fossils are similar to those of the Upper Hsiangchi Coal Series in West Hupeh, where there is, according to Prof. Hsieh's observation, also a conglomerate intervening the lower and upper coal-bearing series. Thus, the sequence of rocks above the purple shale and below the conglomerate may be correlated with the Lower Hsiangchi Coal Series. Hence it is regarded as a Rhaetic representative. Those above the conglomerate would be therefore of Jurassic age.

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[4] C. Li: *Geology of Puchi, Kiayu, Hsienning, Chungyang and Wuchang Districts, Hupeh*; Memoir Inst. Geol. No. III, pp. 2.

XI. TERTIARY.

(17) Tunghu Series. The distribution of the Tunghu Series is the most extensive among all the formations in the area under consideration. It unconformably overlies any older formation, and sometimes has a dip-angle of thirty degrees, as observed at Szewanshan, some ten *li* south of the Nanchang City. In the base of this series, a conglomerate is well-developed at Nanchang, where it has a thickness of about one hundred and fifty meters. The colour of the cementing material of the conglomerate is red. Its pebbles are composed of limestone and chert. They are of unequal size and irregular shape. In the lower part of the conglomerate, which is about one hundred meters thick, the pebbles are so tightly cemented that the rock is used by the inhabitants of the country as mill-stone. This thins down towards the eastern side of the Han River to fifty meters. The upper part is however not so compact and carries pebbles less in number and smaller in size. Thus the conglomerate merges into a red sandstone without marked boundary. This sandstone is present in all the low lands of the region mapped except where there is some outcrop of the Sintan Shale. It is generally coarse and porous and contains a light-green marl in its middle and a yellowish-white sandstone in its upper part at two localities to the east of the Nanchang City.

All the formations ranging from Sinian to Jurassic are conformably folded and repeatedly faulted. The axes of the folds usually strike W.N.W. in the northern and the north-eastern parts of the area surveyed. They gradually change into a N.W. trend in the Middle part, and to a N.N.W. trend in the south-western part of the area. The Han River traverses the region essentially along the strike of the strata. Some of the folds are overturned to the south-west and others are broken into thrusts. The majority, if not all, of the overthrusts are directed to the south-west. Faults generally run parallel to the folds.

湖北南漳當陽遠安等縣之煤田地質

孟憲民

1 引言

民國十七年秋,中央研究院地質研究所派舒君文博俞君建章及憲民赴鄂西鄂北爲該省建設廳調查地質礦產。余等於十月二十八日抵襄陽,二十九日卽起首調查地質。沿途經隆中,吳家集,老關廟,南漳等處。惟以余等所調查之區域甚廣,故至南漳時,卽議定分爲二組。一組爲舒俞二君。調查宜城荆門鍾祥等縣之地質。憲民則獨爲一組,專事調查南漳遠安當陽等縣之礦產地質。舒俞二君之路線當在彼等報告中敍明,不復重述,憲民之路線,原擬由南漳南行至當陽,遠安,復西北行轉上保康,再東迄穀城,終回襄陽,然迨將遠安當陽一帶煤田調查完竣,轉程赴保康時,而山中已降雪數次,調查進行殊感困難,因而中止。結果祇將南漳屬之東鞏,當陽屬之觀音寺,九子山,石馬槽,暨廟前等處之煤田稍加調查。

實際在外調查時期,二月有餘,路線總計約三千里。茲就調查結果,製地質圖一幅,及剖面圖十數幅。地形概依照湖北陸軍測量局所測者。南漳以北,襄陽境內,未得精細調查,故繪地質圖時未行列入。

2 地層統系

調查區域內之地層如下:

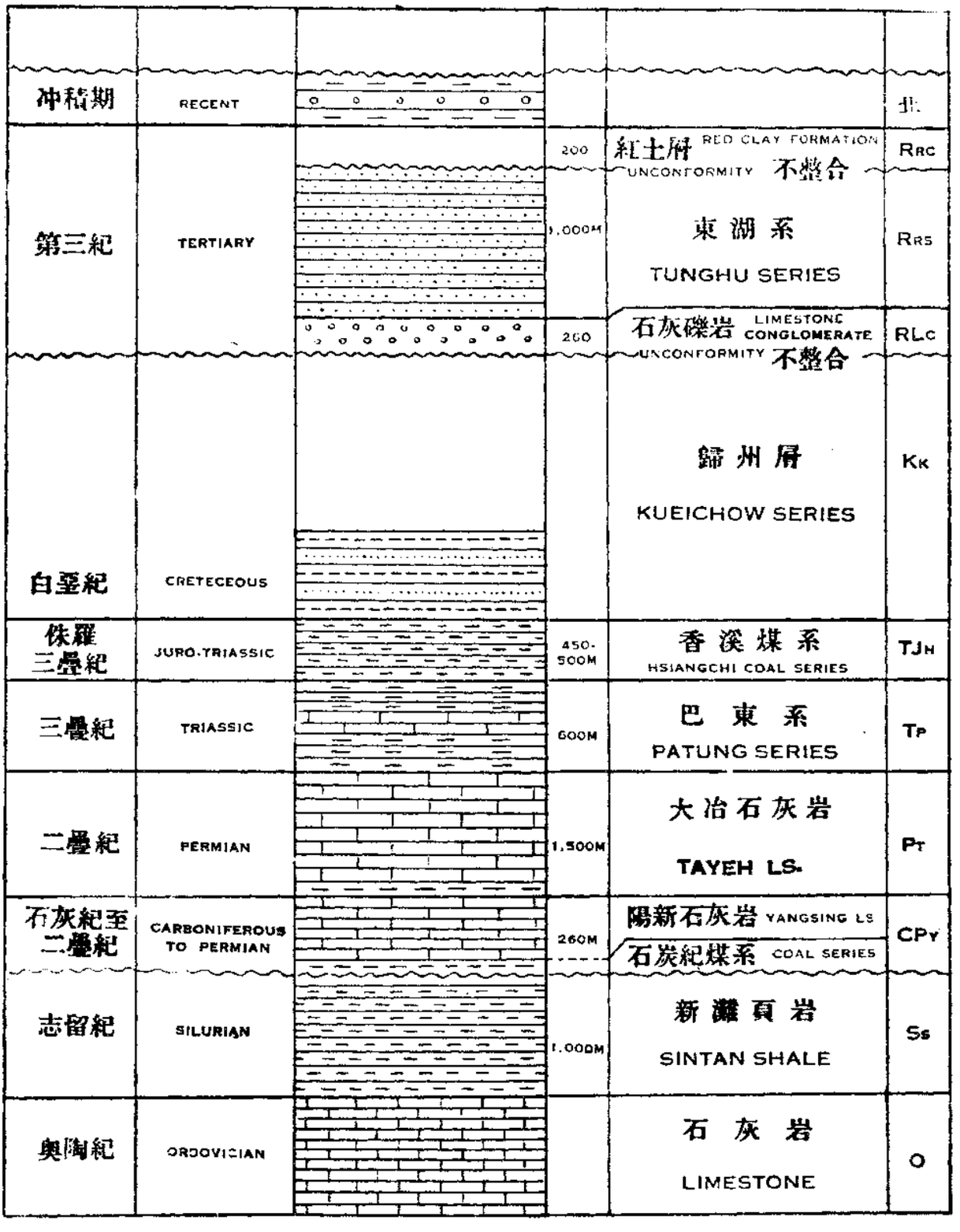
(九) 冲積層

(八) 第三紀

	(乙) 紅土層		厚二百公尺
	不整合		
	(甲) 紅色薄層狀砂岩		厚在千公尺以上
	石灰礫岩		厚二百六十公尺
	不整合		
(七)	白堊紀	歸州層	厚度未測
(六)	侏羅三疊紀	香溪煤系	厚四百至五百公尺
(五)	三疊紀	巴東系	厚六百公尺
(四)	二疊紀	大冶石灰岩	厚一千五百公尺
(三)	上石炭紀至二疊紀	陽新石灰岩	厚二百六十公尺
(二)	志留紀	新灘頁岩	厚一千公尺
(一)	奧陶紀	石灰岩	厚度未測

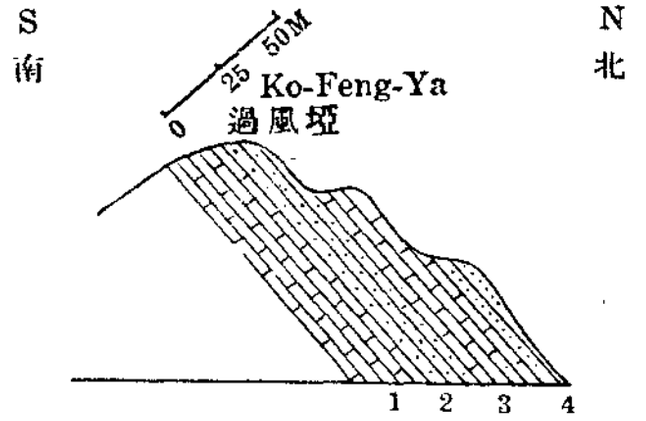
(一) 奧陶紀 石灰岩

分布：本層分布區域不廣。在南漳附近之剪子溝灰岩中，曾覓得奧陶紀之頭足類化石數種，多爲 Orthoceras sp. 此灰岩中時現含瀝青質甚重之岩層，土人多在其中探採煤層。由隆中南西行，初爲二疊紀及石炭紀之灰岩，與煤系；次爲新灘頁岩，中含該層之標準化石 Encrinurus rex. 此層之下，鄰吳家集始遇奧陶紀石灰岩，其中化石缺少，時含燧石，時夾有紅泥層，或灰色頁岩層，與新灘頁岩同作北東傾向。自吳家集至南漳，奧陶紀灰岩多受鉅烈之侵蝕，上覆以不整合之第三紀石灰礫岩。過風垭（第二圖）及老關廟一帶，此灰岩中常含石英層。至消溪寺北之奧陶紀灰岩皆多被侵蝕及斷碎，致該處灰岩多呈角礫狀。此角礫狀灰岩之下，則現一含瀝青質岩層（厚約一公尺半），土人時以其爲煤層而開掘之。瀝青質岩層下之奧陶紀灰岩含硅質甚重，層線亦顯，每層厚約一公尺，間或含不規則之燧石結凝體。



第一圖 南漳遠安當陽地質柱形圖

Fig. 1. Columnar Section of Nanchang, Yuan-An, Tangyang Districts.



第二圖 吳家集東—過風垭奧陶紀岩石剖面圖

Fig. 2. Section of Ordovician Limestone at Ko-Feng-Ya.

4. 石英岩 Quartzite.
3. 石灰岩 Limestone.
2. 石英岩 Quartzite.
1. 石灰岩 Limestone.

西至遠安屬之分水嶺,苟家垭一帶,新灘頁岩下,露奧陶紀之泥質灰岩。於新灘頁岩與該灰岩接觸處下二十五公尺,現一薄層(約厚三寸)之泥質灰岩,中幾盡爲頭足類化石 Orthoceras Sinensis Foord. 大者長至四五尺不等,荷花店,棠棣樹一帶均爲此層之分布,該地昔曾爲北京地質調查所謝君家榮趙君亞曾所調查(註一)。

概狀: 本層石灰岩性質不一;有含燧石者,有含石英層者有含紅色及雜色頁岩者,在吳家集,過風一帶,岩石多呈此狀(第二圖)。或爲薄層狀作深灰色,或含灑青質層,或呈角礫象,南漳附近,消溪寺及剪子溝等處岩層多如此。灰岩上部多受侵蝕,下部多爲浮土所掩,因之全部岩層狀況不得而知。遠安屬之香油坪西約四里,新灘系中之筆石頁岩下,現一綠色奧陶紀泥質灰岩。沿此層灰岩下二十五公尺即爲前述之頭足化石層。此頭足層上下岩層中均含有少數之頭足化石。全層以薄層(約一二英尺厚)狀灰岩爲主。

比較: 依據在南漳剪子溝所覓得之數屬奧陶紀之 Orthoceras,及該灰岩之適處新灘頁岩下,而名石灰岩露頭於吳家

集至南漳縣城一帶者爲奧陶紀石灰岩。遠安縣西,香油坪附近所現之泥質灰岩中充滿 Orthoceras sinensis Foord, 此泥質灰岩直接處於新灘系中之筆石頁岩下,其岩石概狀,其地層位次,及其中所產之化石皆足以證此泥質灰岩與揚子江山峽間之艾家山層(註二)多方相似。艾家山層係屬中奧陶紀。

(二) 志留紀　新灘頁岩

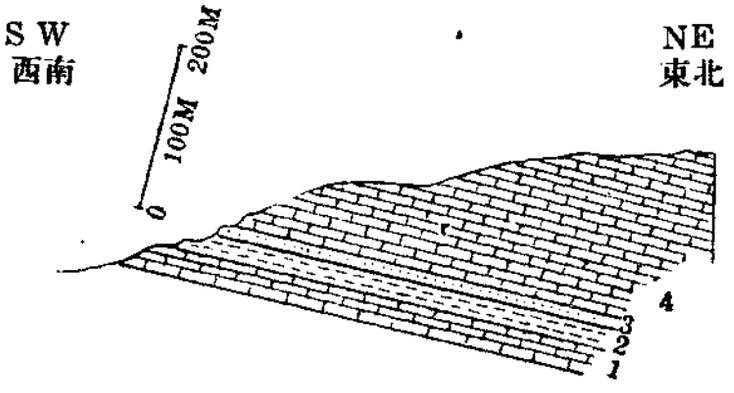
分布: 隆中所現石炭紀煤系下之新灘頁岩,上部爲十數公尺堅質綠色頁岩,中含三葉蟲化石甚多。繼此頁岩而下,則爲灰色黃色或綠色剝離性頁岩。其中亦含一層三葉蟲化石。種類多爲 Encrinurus rex. 晌水洞一帶亦現有新灘頁岩。西至遠安縣香油坪其附近一帶之山岡俱爲新灘頁岩所成。其陡坡極巉,遠望若城壘然。新灘頁岩上部爲堅質綠色,或黃色頁岩。中部爲剝離性頁岩。上中二部含有三葉蟲。下部則含筆石甚富。至底部與奧陶紀岩層接觸處,所含筆石尤豐。全層在槐樹店香油坪一帶,分布頗廣,其中褶縐甚多,厚度不易測量。總厚約計在一千公尺左右。

其下與奧陶紀層接觸處,於吳家集南漳縣等處均因爲浮土所掩,未得研究。於香油坪西四里之小橋邊,灰黑色新灘頁岩下,爲奧陶紀之綠色泥質灰岩(含泥量甚重); 該灰岩之泥量愈下愈見減少,直至由接觸處下三十公尺始見純淨之灰岩,足知當時沈澱之情形,係由海水含石灰量甚重至灰量漸行減少,而稍沈積泥質灰岩。及至新灘時期,始完全沈澱頁岩。故由奧陶紀迄新灘期開始之時,其間過度景象改遞甚漸,地形變遷亦不甚速。本層上與石炭紀灰岩接觸處,在隆中爲一煤系,在石橋坪亦爲一煤系。石英層時現於石炭紀灰岩之底部,足知當時二海象時期中間以短期之陸象。石炭紀灰岩及煤系與本層雖無不整合,然其由海象而陸地而復爲海象,其中當應有一不連續線存焉。

比較：新灘頁岩在區域內露頭不廣,故未將該層分析言之。(註三)在隆中一帶曾覓得二層含 Encrinurus rex. 之頁岩;一在石炭紀煤系下之堅質頁岩中,一在離新灘頁岩頂約四十至五十公尺之黃色剝離性頁岩中,Encrinurus 可稱爲新灘頁岩中之標準化石。西在香油坪,與陶紀泥質灰岩上直接覆以黑色筆石頁岩。筆石頁岩上則爲剝離性及堅質之綠色頁岩。因之新灘頁岩頂部可以含 Encrinurus rex. 之岩層爲限,底部以含筆石頁岩爲準。

(三) 上石炭紀至二疊紀　陽新石灰岩

分布：襄陽屬隆中煤層之上,本層下部爲一含珊瑚類之石灰岩。灰岩中多含球狀燧石。燧石灰岩多呈塊狀,厚約五十公尺,中部爲薄層狀石灰岩,間夾以薄層石英岩或綠色頁岩。愈上石英層愈厚。有厚至數尺者。頂部岩層多硅質化,致現灰白二色層岩石之互層,白色者爲石灰岩,灰色者爲硅質岩。全層厚度約二百六十公尺。



第三圖 彭家坡附近剖面圖

Fig. 3. Section at Peng-Chia-Po.

4. 燧石石灰岩　Cherty Limestone.
3. 石英岩　Quartzite.
2. 煤系　Coal Series.
1. 含海百合節灰岩　Crinoidal Limestone.

本層在遠安屬之彭家坡(離石橋坪西十二里)者,多爲燧石灰岩。其所含燧石較之隆中等處爲多,全層幾充滿球狀燧石,其下爲一層白色石英岩,約厚十餘公尺。石英岩層之下即爲煤系厚約三十公尺。煤系中多以頁岩爲主。其中含煤層一,平均厚約

十八英寸。煤系之下復爲石灰岩。其中時含海百合節。(第三圖)此層上與大冶石灰岩接觸處,亦現一煤系,例如在雨河口者,中含煤層不厚,煤質亦不佳;惟煤層上下時現一層紅土(大都爲紅鐵礦),其開採之價值,時或超過其同生之煤。

概況: 覆於新灘頁岩之上而不連續者爲陽新石灰岩。其上部時含薄石英層,中下部多含球狀燧石,底部時有晶片狀煤層。煤層有厚至二三尺者,如在遠安西之彭家坡所產之煤,卽出於一尺至三尺厚之煤層中。

比較: 湖北陽新縣境內現露一種塊狀燧石石灰岩,中含腕足,珊瑚,孔蟲等等化石甚富,謝君家榮暨劉君季辰調查至此而名之曰陽新石灰岩(註四)。其後謝君家榮與趙君亞曾在揚子山峽一帶調查而劃巫山石灰炭之下部爲陽新石灰岩(註五)。本次調查區域離陽新縣較揚子山峽一帶爲近。沿隆中一帶及石橋坪等處之灰岩性質,地層位次,暨其中所含之化石均與在陽新區域內之石灰岩相同。故亦名之曰陽新石灰岩。其地層時期當在上石炭紀至二疊紀。

(四) 二疊紀 大冶石灰岩

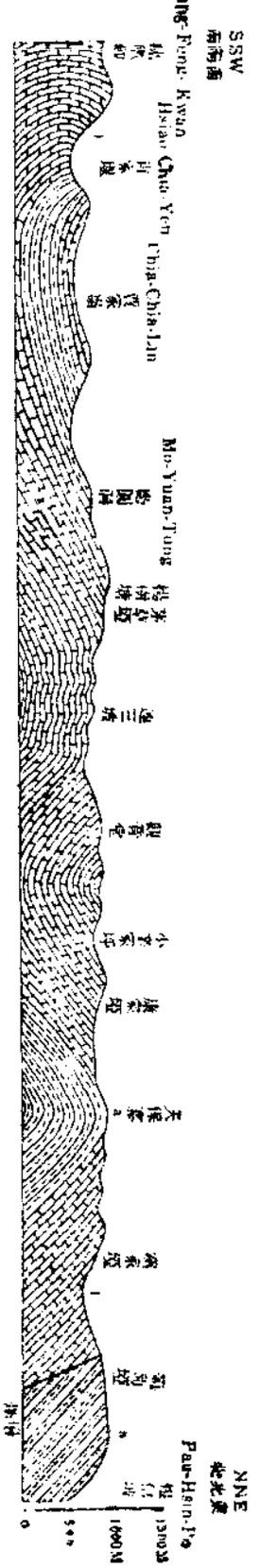
分布: 在此次調查所見之大冶石灰岩,其岩質隨地而易,厚度約在千五百公尺以上,茲就在觀音堂至肖家壋一帶之大冶石灰岩層次略述之如下:

(庚) 多溶洞及含方解石晶脈,呈腐蝕狀石灰岩。	厚三百公尺
(己) 塊狀石灰岩間含晶片狀燧石	厚一百公尺
(戊) 薄層狀似板片石灰岩	厚一百公尺
(丁) 含泥質石灰岩	厚三十公尺
(丙) 白色塊狀石灰岩	厚五十公尺
(乙) 紅色似板狀石灰岩	厚約八十公尺
(甲) 塊狀石灰岩	厚度未測

甲以下之灰岩均多呈薄層狀，猶屬大冶石灰岩。觀音堂之東，或龍鳳觀等處，均爲此種薄層灰岩。遠安屬門山洞以西及羅漢峪等處之大冶石灰岩亦多呈薄層狀。兩河口之間，大冶灰岩中部時現數層含化石岩層；化石種類多爲海百合節，及腕足類等種，間亦含似屬 Ostracoda 之化石。

本層頂部與巴東系接觸處可足注意者，即其空洞構造 (Cellular Structure)。在肖家堰附近，大冶石灰岩頂部多充滿小空洞如海絨狀。其中石灰多經溶蝕，一小部份復在原沈處澱 (Solution and Precipitation in-situ) 而成小晶體之方解石。故灰岩中多小空洞，空洞之中復沈澱多量小晶體之方解石。因之大冶灰岩之頂部岩石狀況，與巴東系接觸處，似曾露面腐蝕所致。石灰之大部份被溶蝕者，多於裂紋中或斷層間沈澱成脈，脈寬有至一二英尺者，晶體甚大，有長尺餘者。此二種現狀 (1 空洞構造；2 大晶體方解石脈)，可爲大冶石灰岩頂部與巴東系接觸處之岩石特徵。

比較：此層與他區域內之同樣岩層比較方法與陽新石灰岩之比較段中所論者相同 (註六)，故不



第四圖 龍鳳觀至報信坡剖面圖

Fig. 4. Section from Lung-Feng-Kwan to Pau-Hsin-Po.

2. & 3. 巴東系 Patung Series.

1. 二疊紀與石炭紀灰岩 Permian and Carboniferous Limestones.

a. 志留紀頁岩 Sintan Shale.

多贅。其全層多爲薄層狀,底部與陽新灰岩接觸處爲一煤系。

(五)三疊紀 巴東系

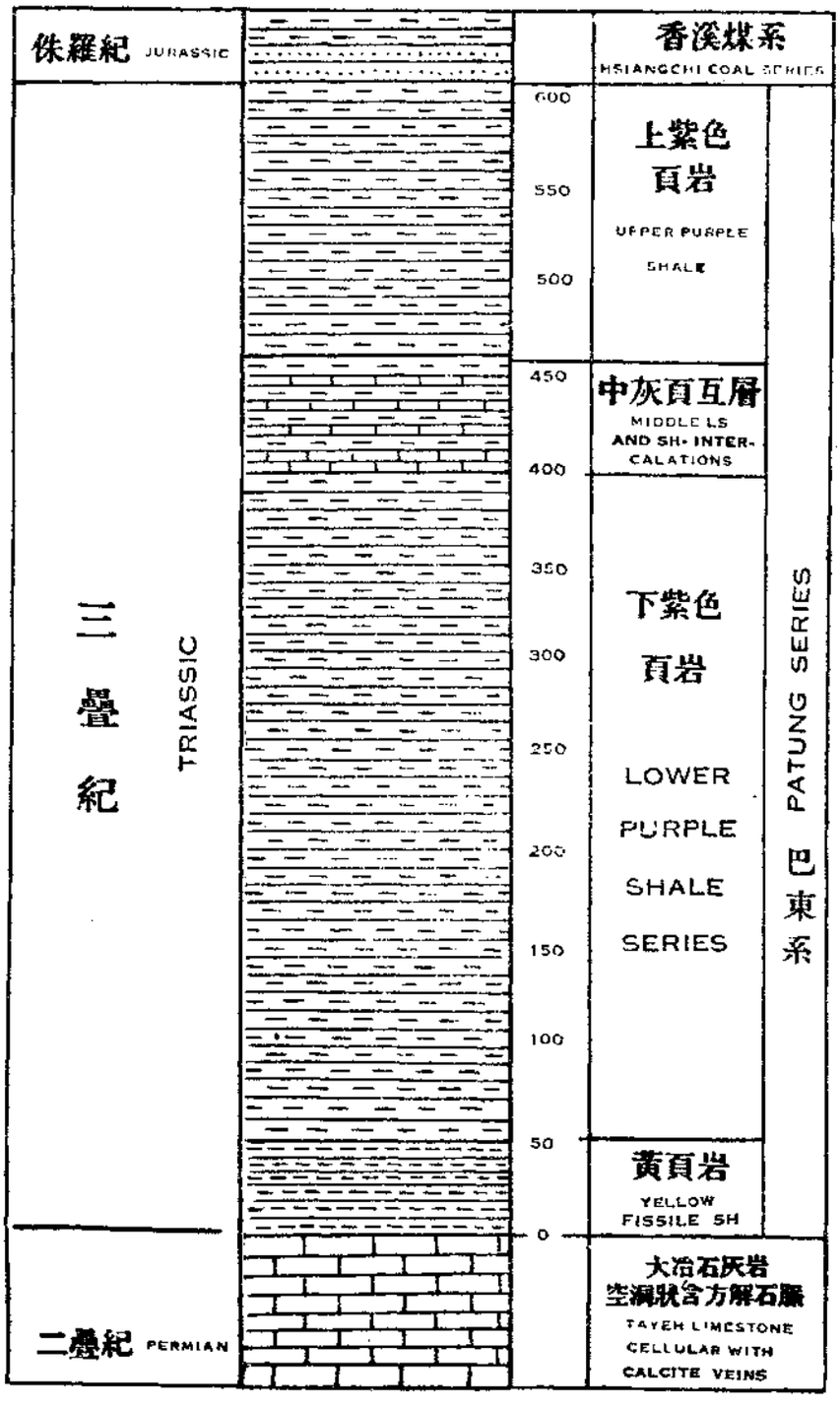
分布: 此系爲調查區域內最普遍之地層。始現於肖家壢附近;南延至東鞏;西經巡檢司迄峽口。由峽口而南,沿沮水兩岸間而至遠安,亦均露巴東系之岩層。其中縐褶不一。其全系層次,露於東鞏黃靈坡者,詳細狀況如下:

(戊)	紫色頁岩	厚一百三十四公尺
(丁)	黃頁岩與薄石灰岩互層	厚四十一公尺
	於此層層頂之下二公尺,即爲一薄層石灰岩(上爲一層黃頁岩約厚二公尺)厚六十公分,中分三層,俱富於海百合節,而尤以上下二層爲甚。	
(丙)	石灰岩	厚二十四公尺
(乙)	紫色頁岩	厚三百五十三公尺
(甲)	黃頁岩	厚五十三公尺

全系總厚爲六百公尺。下與大冶石灰岩,上與香溪煤系,皆無大不整合之象(第五,六,七圖)。

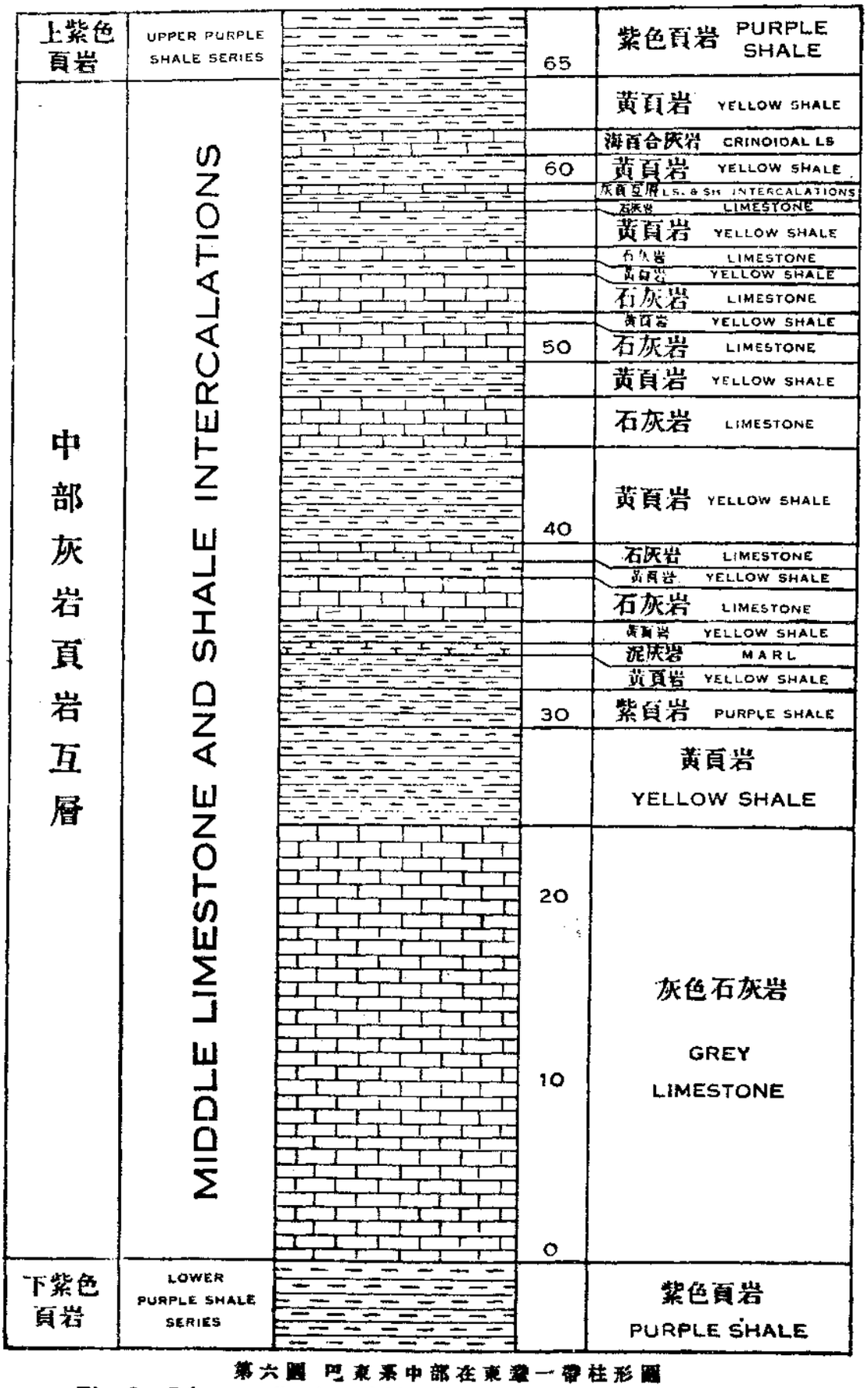
在肖家堰露頭之紫色頁岩,已全爲侵蝕所去,其底部與大冶石灰岩相接觸處,大冶灰岩多呈被溶蝕狀,二者之間走向與傾向尙同。

本層分布於當陽遠安之間者,其岩層與前所述者又略有不同。蓋其中部之石灰岩及灰頁岩互層部份,岩層加厚,頁岩份減少,灰岩份增多。灰岩及灰頁岩互層部份,總厚約一百五十公尺。往往灰岩獨沿走向成一連貫山脈,其山麓多係紫色頁岩,例如現於遠安屬之銀子岡,傅家河(第十三圖)及羅漢峪等處。據謝趙二君(註七)所調查區域內(宜城,興山,秭歸,巴東。)之巴東系,總厚約八百公尺。其中灰岩部份約三百公尺。此巴東系在其標準區域內(巴東縣境內)之厚度。『在香溪一帶,巫山石灰岩之上,有時似直接卽覆以香溪含煤系。如大峽口之對岸,有時似隔以一



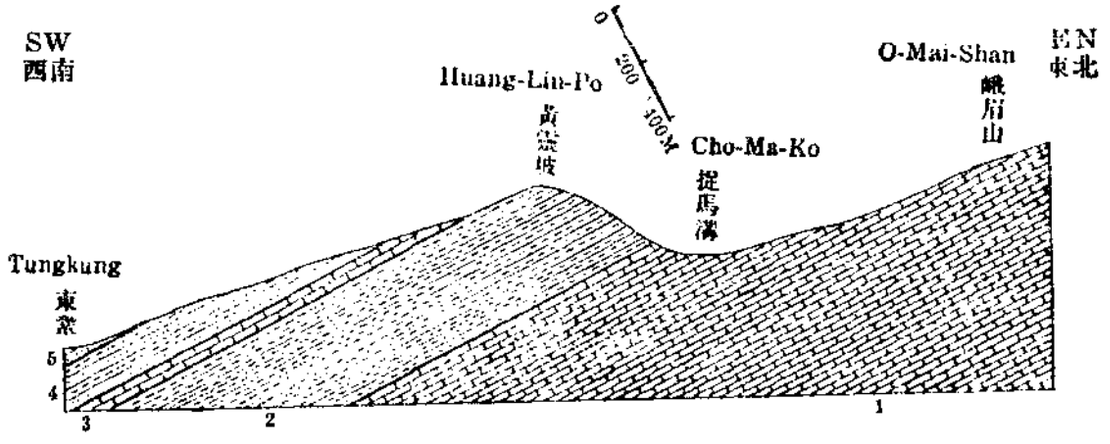
第五圖 東鞏一帶巴東系柱形圖

Fig. 5. Columnar Section of the Patung Series around Tungkung.



第六圖 巴東系中部在東鄉一帶柱形圖

Fig. 6. Columnar Section of Middle Patung Series around Tungkung.



第七圖 東鞏迄峨眉山剖面圖

Fig. 7. Section from Tungkung to O-Mai-Shan.

5. 香溪煤系 Hsiangchi Coal Series.
2, 3 & 4. 巴東系 Patung Series.
1. 二疊石灰岩 Permian Limestone

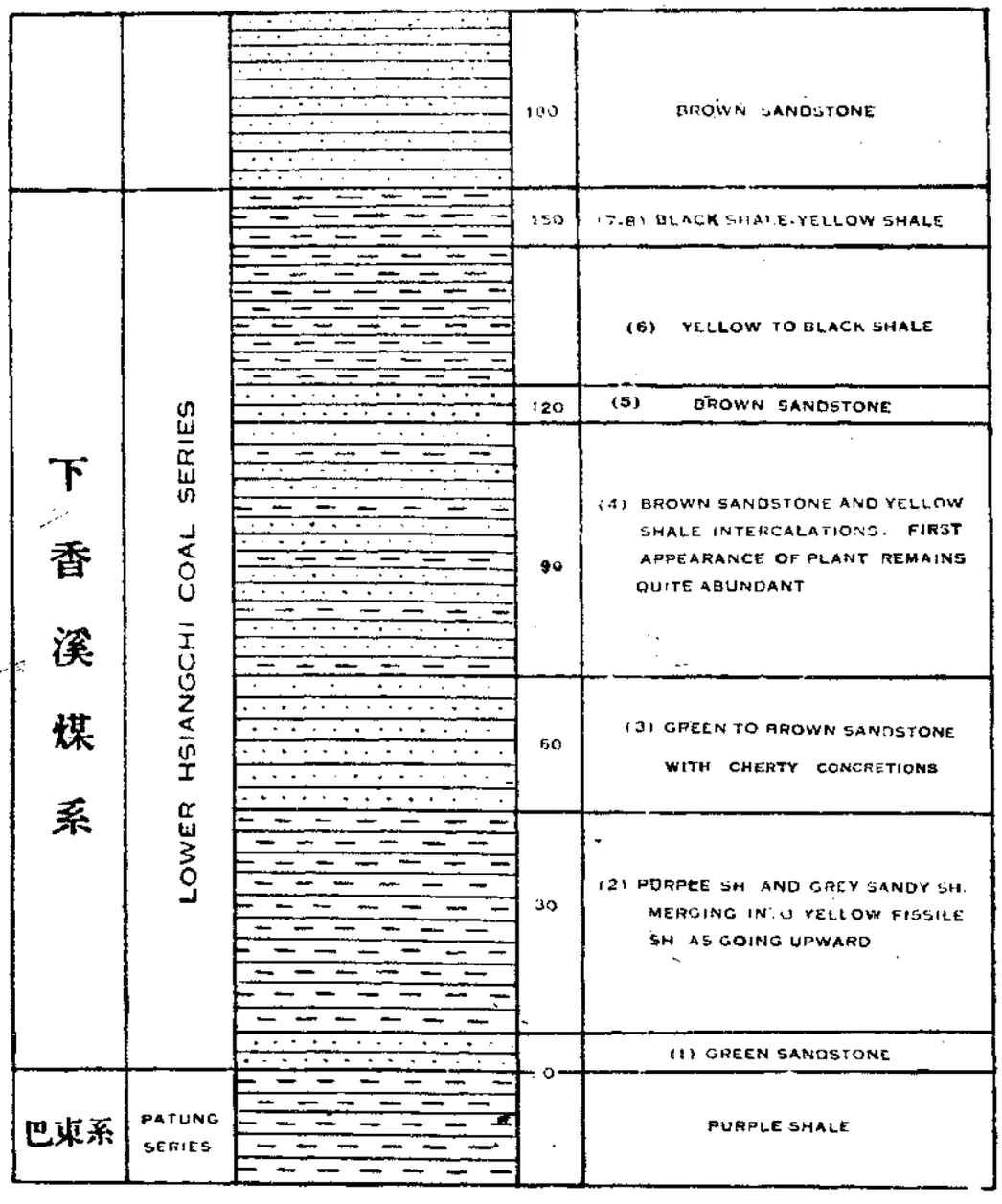
薄紫色頁岩層.....香溪西距沙鎮市只不過二十餘里,而在前者巴東系或完全欠缺,或只有數公尺,在後者巴東系厚至數百公尺。」(註八)據此而言,則巴東系在香溪附近,已幾完全被侵蝕所去。故其原有之厚度,不得而知。東至遠安西部,始露巴東系岩層。沿香溪至宜昌一帶之巴東系,皆當黃陵背斜層縐褶時侵蝕所去。巴東系在遠安附近者(第十三圖),灰岩部份厚百五十公尺,及東至東鞏黃靈坡一帶,層厚減至六百公尺,灰岩部份厚只六十五公尺。足知此系之灰岩部份,在巴東一帶甚爲發達。至東漸行減薄,及至東鞏肖家堰一帶灰岩部份只厚數十公尺矣。

在區域內,大冶灰岩之頂時露曾經侵蝕狀。故其與巴東系接觸處當有一不連續線,巴東系與香溪煤系之間未現有鉅大之不整合,然二者之間究否連續猶爲疑問。

比較: 據岩石之性質,地層之位次,在區域內之二厚層紫色頁岩與其中夾之數十至百餘公尺之石灰岩塊與在巴東縣內露頭之巴東系相比較。二者俱不連續覆於大冶灰岩上。性質既近,層位又同,二者當爲同一時期之岩石。

(六) 侏羅三疊紀 香溪煤系

分布：香溪煤系露頭區域;北始於南漳屬之東巢,羅家灣一帶;南延九十里至當陽屬之觀音寺,荊門屬之關廟坪,雙河口,南西及當陽屬之九子山,廟前,白果園等處.煤田區域適處一對斜層之中。



第八圖 下香溪煤系與巴東系接觸處岩層柱形圖

Fig. 8. Columnar Section of the Lower Hsiangchi Coal Series near its Contact with the Patung Series.

概狀：本層多爲砂頁之互層。砂岩作綠色，白色，棕色，黃色者不等。頁岩多作黃色，棕色，灰色，黑色種種。薄層砂岩及頁岩中含植物化石極多。全系以砂岩爲主。煤層多現於上部之二百公尺中，多爲無烟煤。煤系總厚約四百五十公尺至五百公尺。

其底部詳情如下：

(辛) 黃頁岩　七公尺

(庚) 黑頁岩　三公尺

(己) 黃色至黑色頁岩　二十七公尺

(戊) 棕黃色砂岩　六公尺

(丁) 棕色砂岩與黃色頁岩互層，砂岩爲主　四十六公尺

上部由下而上，爲薄層狀砂岩，及黃色，灰色，黑色剝離性頁岩等。植物化石始現於此層。

(丙) 綠色與棕黃色砂岩，中含一極薄層黑色頁岩　厚約二十五公尺

棕黃色砂岩中多含扁圓形之結凝體(外週爲燧石中心鬆粒黃砂)此象爲香溪煤系底特點。

(乙) 紫色頁岩與灰色砂質頁岩，漸沒入黃色剝離性頁岩　厚約四十一公尺

(甲) 最下層爲綠色堅質砂岩　厚約八公尺

香溪煤系之全系岩層可分爲三：

(丙) 砂頁岩互層　厚約一百五十公尺

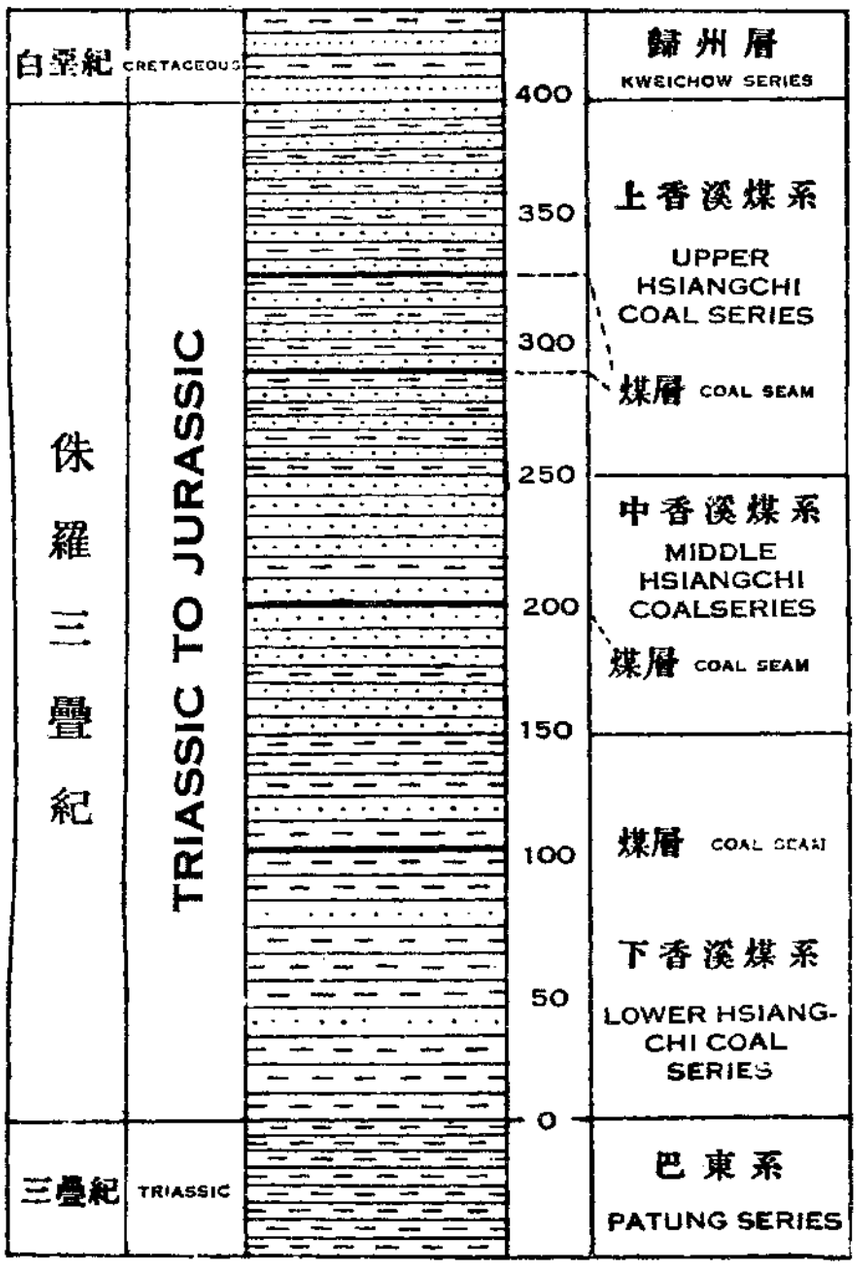
砂岩爲主，頁岩作綠色，黃色，棕色，黑色；砂岩灰色與黃色，煤層於此層中發現者有三；如在魏家灣，梅子垭等處者。全層充滿植物化石。

(乙) 砂岩層　厚約一百公尺

此層以厚層狀砂岩爲主，間含薄層狀砂岩或頁岩。中含煤層。例如在東輦南四里之周家冲者。砂岩極易腐化，辛家垭一帶所見之砂岩，皆已腐化成鬆散砂粒。

(甲) 頁岩層　厚約一百五十至二百公尺

頁岩爲主,多作黃色及淡棕色或黑色,中夾以灰白色及棕色砂岩,中部含一煤層,東鞏附近之皮家灣所產之煤,卽出於此層。



第九圖 香溪煤系柱形圖

Fig. 9. Columnar Section of Hsiangchi Coal Series.

比較: 所採之多種植物化石亟待詳細鑑定,姑以區域內所現之中生紀煤系與揚子山峽間之香溪煤系(註九)相並列。

(七) 白堊紀 歸州層

此層因在調查區域內之分布不廣,故未得稍加詳細考察。所見分布者爲由當陽屬觀音寺,至荊門屬之關廟坪,及由觀音寺至清溪河一帶,與當陽縣城以北等處。然皆祇露其一部份。以所見者而言,似以綠色砂岩及紫色頁岩之互層爲主。層厚未測,與侏羅紀煤系接觸處未現不整合象。本層在稱歸一帶極爲發育,昔威烈士(註十)調查至該處,統名巫山灰岩以上之岩層爲歸州層,復經李仲揆先生改正而限香溪煤系之上之白堊紀岩層爲歸州層(註十一)

(八) 第三紀

(甲) 石灰礫岩及紅色薄層狀砂岩

覆於古生紀之石灰岩,巴東系,或香溪煤系,或歸州層之上作一不整合象者,爲石灰礫岩。其礫石多爲石灰岩,而石英次之。平均直徑約在三四英寸之間。卵石間之黏泥多爲砂質。間亦有爲石灰質者。總厚爲二百六十公尺。南漳城南之文筆峯,城西之觀音崖等處,當陽附近之許由山,九子山,玉泉山,峽口北之龍王冲,皆爲此種礫岩所成。遠安西部於巴東系之上,亦現此種礫岩。礫岩之上,復露棕紅色薄層狀砂岩,二者無鉅大之不整合。遠安至洋坪峽口一帶。所露於沮水河底,及兩岸之砂岩,卽屬於此層。此薄層砂岩之厚度約在千公尺以上。

(乙) 紅土層

與礫岩作不整合象。而層位較高者,爲紅土層,於當陽附近沿沮水而達於遠安,多爲此層分布處,其底部常現一薄層(約三四英寸許)之石膏層,全層厚度至少在二百公尺以上。

(九) 冲積層

調查區域因東鄰襄河,南近揚子江。故各梯級層及冲積層,均露於區域之東南。由南漳至武安壩劉家集一帶,多露此種岩

層,其層線極顯,均爲緜質細黃砂粒所成之砂岩,傾斜度甚小,大都近水平線,當陽以南,亦露此種岩層。

3 地質構造

概論

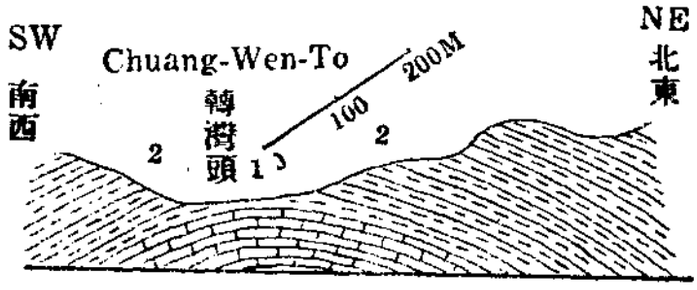
調查區域內斷層甚不多見,其地質構造純以縐褶爲主。據舒君文博(註十二)在區域之東,鄰襄河一帶調查結果,謂其地多現斷層,沿襄河一帶適爲一背斜層之軸線,襄河之流向,亦幾與岩層之走向相合。

由襄陽迄當陽一帶,構造雖甚複雜,然簡言之,其大致構造當爲一背斜層與一對斜層所成。由隆中至肖家堰盆地各地層此成一背斜層,其兩翼多爲石灰岩。軸向爲北西,南東。於此軸線間,沿南漳附近厚層石灰礫岩沈積焉。南至東鞏觀音寺,西迄當陽遠安一帶,其地層構造成一對斜層,軸線趨向適成一半弧形。羅家灣西軸向爲東西,東至東鞏而作北西,南東向。及南抵觀音寺與荊門屬之關廟坪,猶作北西,南東向。迨迄當陽九子山一帶則作北南向。由當陽至遠安間巴東系亦自成一對斜層,中部爲第三紀之紅土層,及薄層狀紅色砂岩。由遠安而西,則漸入較古層。直至宜昌縣界內,而現震旦紀及前震旦紀之岩石。

1. 南漳背斜層: 此背斜層北東起自隆中,南西達渠陽坪及肖家堰盆地,橫貫東西約二百萬里,沿軸線而北西,南東向遷延約數百里。背斜軸線爲北西,南東向幾與蠻河流向相合。其北東支所分布之岩石,自軸線而北東向,初爲奧陶紀石灰岩及其上所覆之不整合第三紀岩石,次爲新灘頁岩,石炭紀煤系及陽新石灰岩。南西支之岩石分布,自軸而西初亦爲奧陶紀石灰岩及其上不整合之第三紀岩層,次爲新灘頁岩,陽新石灰岩,大冶石灰岩。北東支之岩石多傾向北東;南西支之地層多行緜褶成背斜對斜等層。在南漳一帶沿軸線所沈積之第三紀岩層,多未經鉅烈之緜褶。沿軸線之間,岩層除第三紀岩石外,所受緜褶較

烈。因之而斷碎者有之,例如消溪寺之角礫岩。此象至宜城,荊門,鍾祥等縣之東益顯,而露爲多數之走向斷層。南西支之構造較北東支爲複雜,其岩石時現斷層,致報信坡間石英砂岩中常露偉大山洞。自晌水洞經觀音堂至渠陽坪,大冶陽新灰岩多番縐褶成背斜對斜等層(第四圖)。

2. 肖家壢盆地: 處渠坪之南,當陽對斜層之北者爲肖家壢盆地(第四圖)。盆地四週之山脊,多爲薄層狀之大冶石灰岩。該灰岩時經緊密之縐褶而致龍鳳關之灰岩傾向倒逆。盆地中之岩層多爲巴東系,其中灰岩多爲小丘,而巴東系下部之紫色頁岩多成山谷河床。巴東系上部之紫色頁岩已被侵削所去。於巴東系全部盡被侵蝕處,大冶灰岩頂部顯露甚明。



第十圖 轉灣頭附近剖面圖

Fig. 10. Section at Chuang-Wen-To.
2. 巴東系 Patung Series.
1. 大冶石灰岩 Tayeh Limestone.

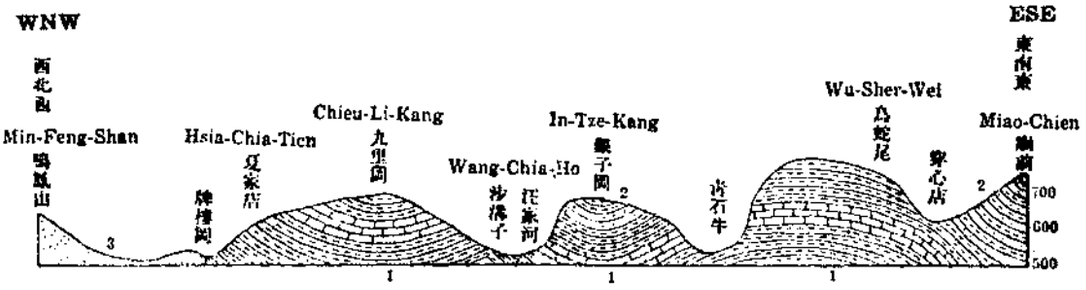
3. 當陽對斜層: 當陽對斜層雖不延及當陽縣城而大部皆位置於當陽縣屬境內,因名之曰當陽對斜層。此對斜層西界黃陵背斜層,北東鄰肖家壢盆地。軸線之間,香溪煤系分布焉。自軸線而北東行,初遇香溪煤系,繼爲巴東系與大冶灰岩之互相縐褶(沿陸坪,經轉灣頭至肖家壢多現此象,參看第十圖)。自軸線南西行,初亦爲香溪煤系,次爲巴東系,大冶,陽新灰岩,新灘頁岩,奧陶紀灰岩及較古層。約言之,各岩層之傾向自肖家壢迄東皆傾向南西。由觀音寺西至遠安,宜昌,岩層多傾東向。對斜層之軸線方向,在東緊一帶爲北西,南東;在當陽遠安等處則爲南北

向,各煤田多位置於對斜層之兩翼間,例如在東有東寨觀音寺等煤田,在西有九子山,廟前,石馬槽等煤田。

當陽對斜層間之小縐褶

(甲)觀音寺穹地(第十八圖): 觀音寺附近,香溪煤系傾斜極低,俱在零至五度之間。沿踏坡岡離觀音寺不遠,煤系傾向北西。煤系露頭於觀音寺南之崔家溝者傾向南西。於觀音寺西之劉家灣,煤系傾向西。在觀音寺之東,香溪煤系上覆以歸州層,故從構造言,觀音寺一帶適爲一盆地。

(乙)關廟坪對斜層(第十八圖): 關廟坪與觀音寺之間,歸州層獨成一帶小岡(長子嶺);香溪煤系露於其東西山麓。關廟坪處該對斜層之西部。縐褶軸線爲北南。

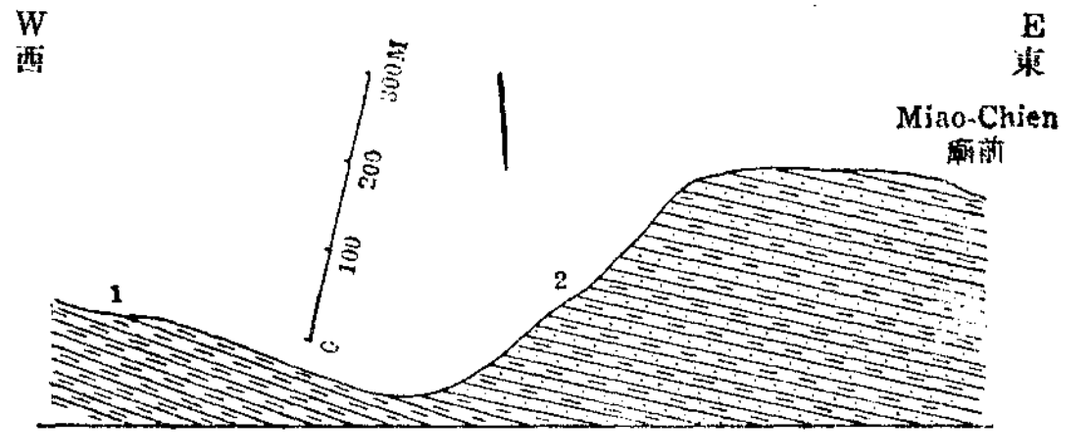


第十一圖 廟前至鳴鳳山剖面圖

Fig. 11. Section from Miao-Chien to Min-Feng-Shan.

3. 紅土層 Red Clay Formation.
2. 香溪煤系 Hsiangchi Coal Series.
1. 巴東系 Patung Series.

(丙)廟前迄夏家店間之縐褶(第十一圖): 巴東系與香溪煤系二者沿廟前至夏家店多經縐褶,復爲河流侵削而成走向山脊與河谷。廟前附近,香溪煤系自成一帶小岡(第十二圖)。稍西巴東系於烏蛇尾成一背斜層,兩翼多爲侵蝕所去。西至銀子岡復縐褶而爲一對斜層,山麓爲巴東系,至岡巔始爲香溪煤系,繼此而西,復爲一背斜層;該背斜頂部已爲侵蝕殆盡,而路汪家

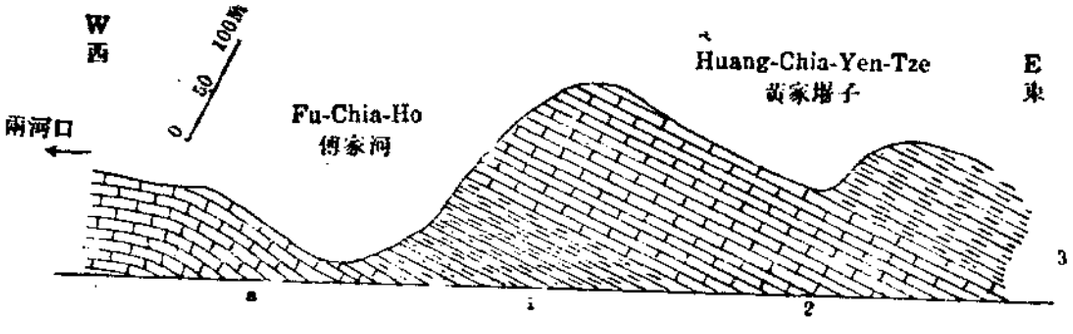


第十二圖 廟前西之香溪煤系剖面圖
Fig. 12. Section of the Hsiangchi Coal Series at Miao-Chien.

2. 香溪煤系 Hsiangchi Coal Series.
1. 巴東系 Patung Series.

河之河流。至九里岡復爲一對斜層。由此而西至夏家店一帶,均爲巴東系分布之處,其中紫色頁岩與灰岩亦經縐褶互相起落(灰岩多爲小阜,紫色頁岩則時成河谷)。

(丁) 遠安對斜層: 遠安縣境爲一沿南北之長狹河谷,東西均界以巴東系之山阜。中爲沮水流域。巴東系沿東西向面縐



第十三圖 黃家堰子至兩河口剖面圖
(注意巴東系中灰岩在此已加厚)

Fig. 13. Section of Huang-Chia-Yen-Tze to Liang-Ho-Ko
(showing the thickening of the Middle Limestone in the Patung Series)

Patung Series. 巴東系
3. 上紫頁岩 Upper Purple Shale.
2. 中石灰岩 Middle Limestone.
1. 下紫頁岩 Lower Purple Shale.
a. 大冶石灰岩 Tayeh Limestone.

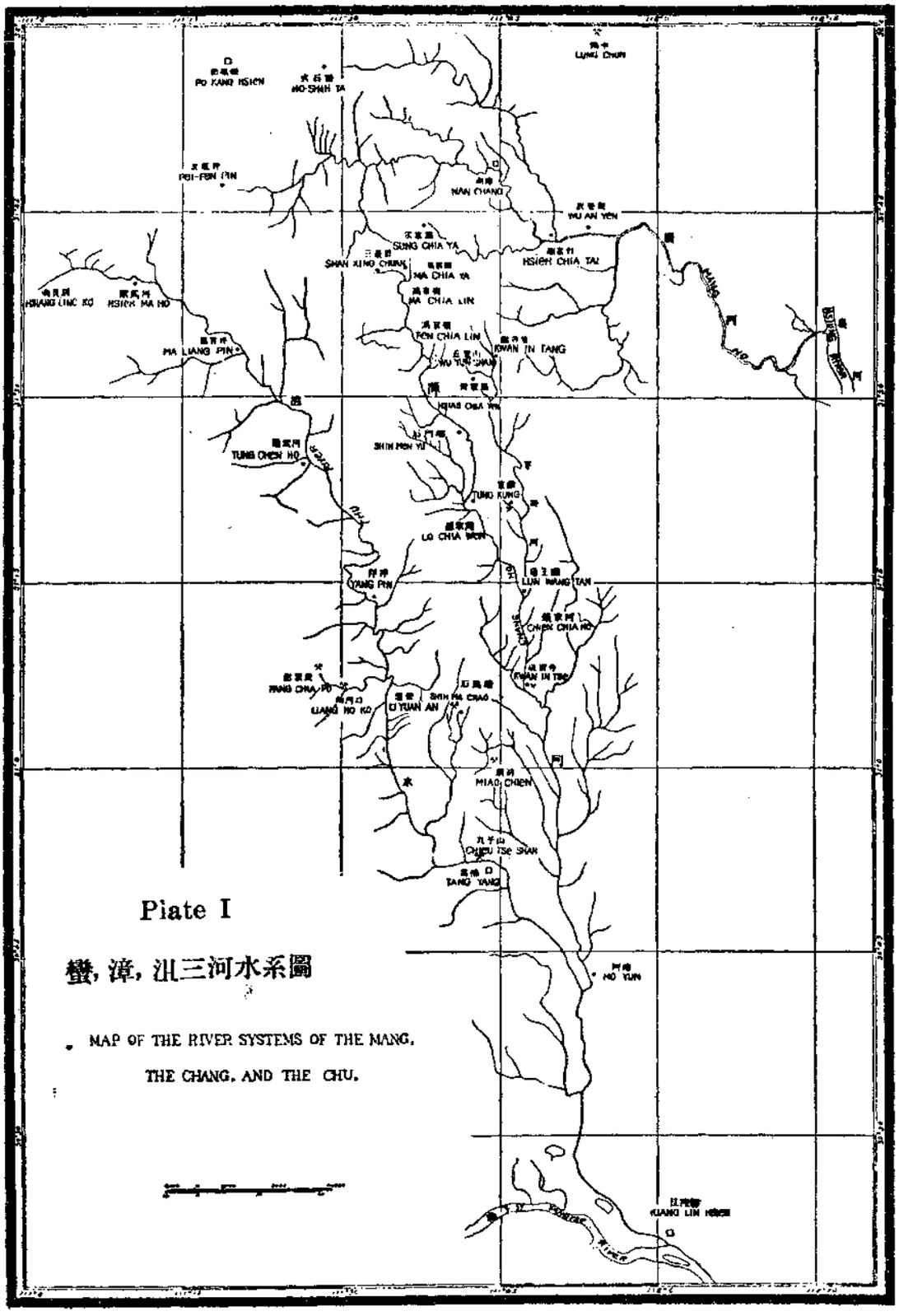
褶。各小縐褶合而組爲遠安對斜層。沮水流向多沿其軸線。巴東系時爲河流侵削所去,而沈積厚層之薄層狀紅色砂岩及紅土層。此種較新層復經侵蝕而成不連續小阜。

戊) 黃陵背斜層(註十三): 由遠安繼續西行而現黃陵背斜層之東支。故由遠安西行至南河口(第十三圖),石橋坪或由洋坪西行至香油坪初見巴東系,次爲大冶與陽新灰岩,及新灘頁岩末爲奧陶紀石灰岩。

縐褶時期: 全境岩石自奧陶紀層以迄歸州層,其中均無鉅大之不整合,故各層自奧陶紀層至歸州層之縐褶時期,當在歸州期後而在石灰礫岩沈澱之先據葉君良輔與謝君家榮之揚子江流域巫山以下之構造史(註十四),該縐褶時期似在白堊紀之末葉至第三紀開始之時。中第三紀復有一侵削時期及上第三紀開始紅土層方沈積焉。

4 地形與水系

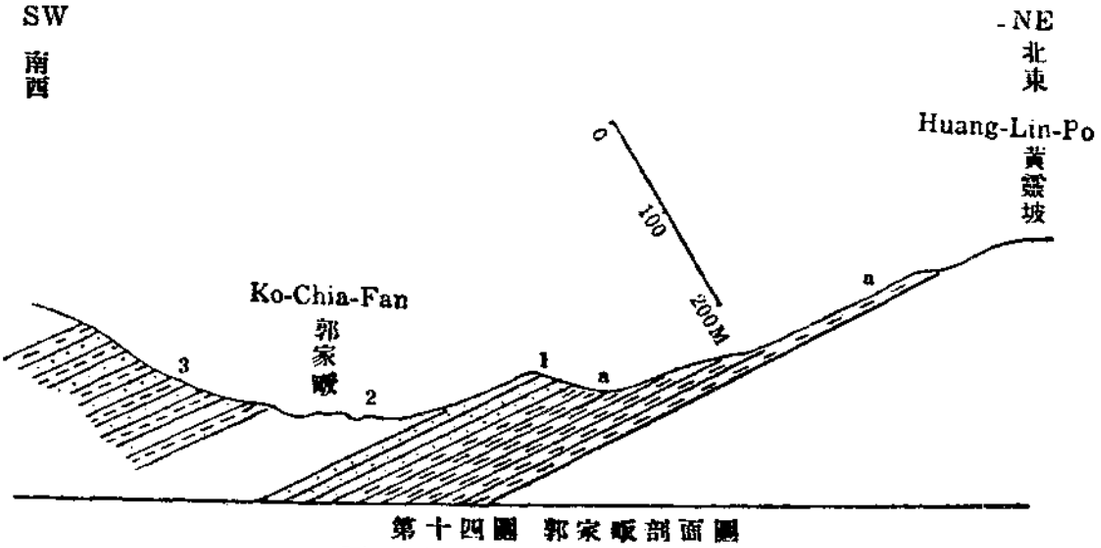
地形。 全境大致地形呈一侵削高原。高出海面1100至1200公尺。高原爲古生代與中生代之岩層所組織,復經蠻漳沮三河流之長期侵削。調查區域北部爲蠻河流域,中部及南東部爲漳水流域,中部與南西部則爲沮水流域。區域內西部與北西部多山,東部及南東部多冲積平原。故在南漳,閻家坪,及肖家壩一帶卽調查區域之北部,多露高山峻嶺;沿香油坪。石橋坪等處卽調查區域西部亦多峭壁巉崖;武安壩至劉家集(區域東部)及淸溪河至當陽縣城(區域南東部),全爲河流平原及剝削剩餘之小阜。古生代石灰岩多布於北部及極西部。沮水流域間俱爲第三紀之紅色岩層。中部如東犟等處,全爲侏羅紀二疊紀三疊紀之砂頁岩分布地,而河流之侵削速率較之北部石灰岩露面處爲烈。南部則現近代之梯級層。


Piate I
蠻，漳，汎三河水系圖
MAP OF THE RIVER SYSTEMS OF THE MANG,
THE CHANG, AND THE CHU.

第 一 版

水系。(1)蠻河源流起自二部。一部始自火石垭經閻家坪等處。河流爲東西向。河谷間爲南漳保康間之大道,谷之南北均係高山峻嶺,至石門集河流繞朝陽山成一弧形,流向多爲南東。至龍門集與北來之四都河相會,其流向復折向東,過老關廟始爲南南東流。至謝家台而會入始於北風坪之蠻河部份。此部源流起自北風坪而東向流,沿流曲折成弧,東至南漳縣城,此段河谷亦爲南漳保康間之大道。河道至南漳稍寬成弧形更甚。及謝家台而與始於火石垭之蠻河部份相會。南東流漸入襄河之梯級層。至劉家洲而入於襄。全流河身甚淺。在區域內之一部份大多不能行舟。處蠻漳二水之間爲觀音堂一帶之分水嶺及肖家堰盆地。河流多順南漳背斜層之軸向而行。

(二)漳水起自馬家垭三景莊一帶繞諸大山山麓,曲折於深谷間,南流及楊家河而與西來之溪流相會,經馮家嶺五雲山等山麓時有小流會入,南東流經石門集,至羅家灣而與乾溪河小漳河等相合,至龍王灘與茅坪河合爲一流。茅坪河起自肖家堰經陸坪,南流經水峽,載家棚等處,河流與漳水幾相平行,漳水南至觀音寺會錢家河,河流始深。及至河溶而與沮水合經江陵



第十四圖 郭家堰剖面圖

Fig. 14. Section at Ko-Chia-Fan.

3.	下香溪煤系	Lower Hsiangchi Coal Series.
2.	河牀	River bed.
1.	綠色砂岩	Green Sandstone.
a.	紫色頁岩—巴東系	Purple Shale of the Patung Series.

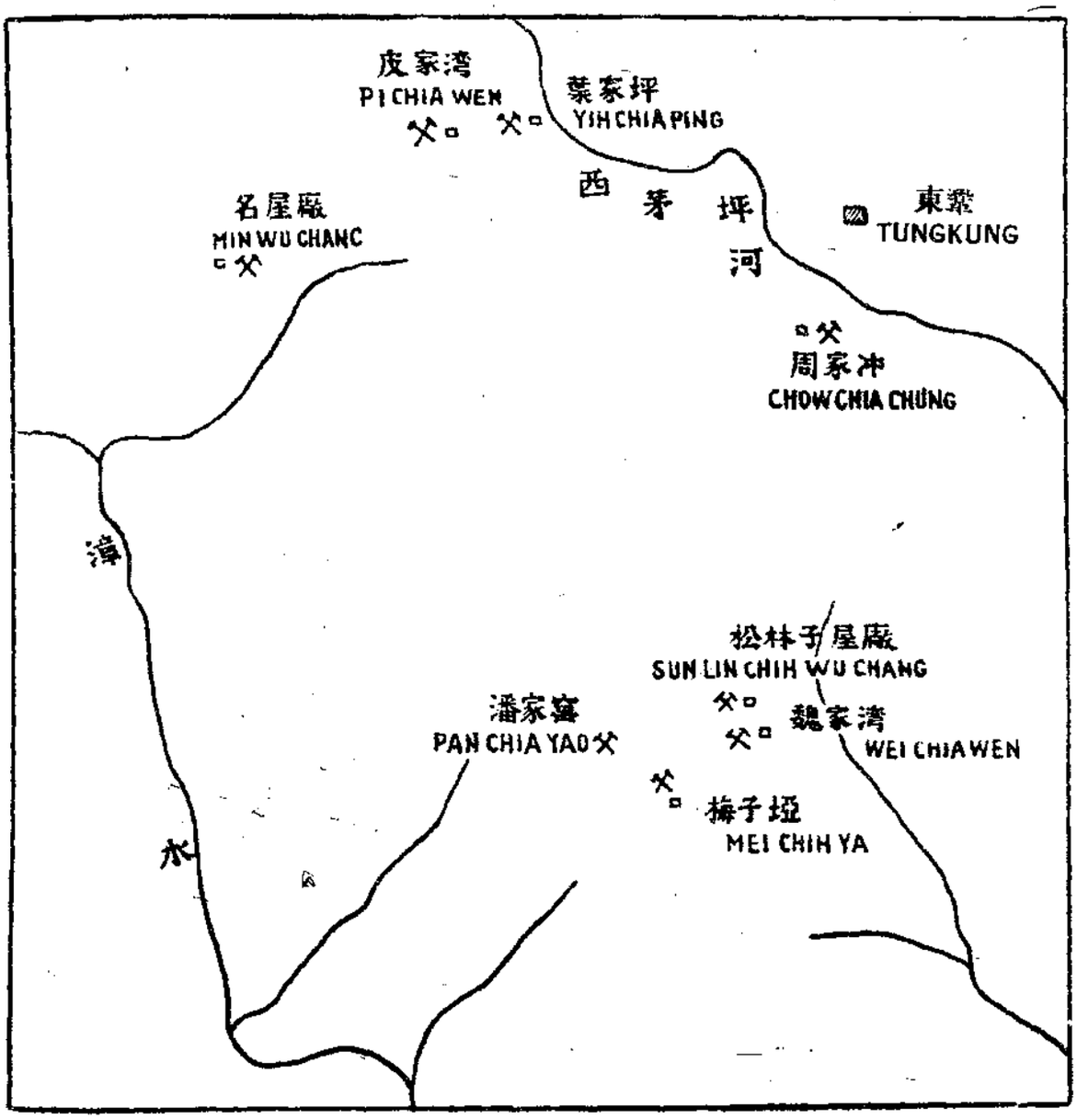
其流入江。河流趨向適與當陽對斜層之軸線相合。河流北部經石灰岩,故兩岸多峭壁。及至巴東系頁岩中,其中紫色頁岩多爲河床,中部灰岩時爲小阜。大部河流均因岩石之性質,而曲折,至東鞏一帶,同時三流並行南南東流,其中之地層縐褶軸線,適爲南東北西至北南向。河流多沿背斜或對斜軸線而行,足證漳水及其支流,均爲後成河,或順向河。漳水南部多沿香溪煤系,兩岸多小阜土山,因其流域不廣,冬日河流極淺。卽夏日,自觀音寺至沙市,亦祇有一星期時間可行重載小舟。水漲雖速,然不數日卽全行退去。

(三) 沮水始於保康屬之唐兒堀,嗚靈溝一帶。東行經歇馬河而南東流迄馬良坪通城河。此一段係多山嶺區域。山谷間多懸崖絕壁,及至峽口而入於第三紀之地層中。河道始可行舟,河流無定向,輾轉於第三紀岩層中。南流經洋坪,遠安,當陽,至河溶會漳水入江。河流區域卽爲遠安對斜層。在區域內之三河流,以沮水爲最利於交通及灌溉。當調查時,南陽一帶奇旱,而遠安收成尙可。實因沿沮水一帶,多爲第三紀之砂土層。平原多而山丘少,沮水支流遍布該平原中,農人無缺水之虞。由峽口至沙市,冬日亦可行輕便小舟,然往返須三四星期。夏日水漲可行貨船。水流亦不甚急。

5 煤田

概論: 煤層於石炭紀及二疊紀石灰岩中,雖有發現,然大都煤量不多,煤質不佳,分布不廣,或作晶片狀,而不連續。如隆中之煤,產於陽新石灰岩底部。多作晶片狀且易碎裂成末。又如遠安西石橋坪所產之煤,亦在陽新石灰岩之底部。所產雖較豐富,然亦似分布不廣,其次爲二疊紀之煤,如在遠安及兩河口等處及門山洞(或屬石炭紀)皆屬此紀。土人多掘爲製紙之燃料。然煤質不良,量亦不豐。故產量稍多者祇爲侏羅三疊紀煤系,而亦爲此次調查區域內比較中所最可採之煤系。其煤田區域始於南漳屬之東鞏,西至羅家灣,南迄當陽屬之觀音寺,及荊門之雙河

口關廟坪一帶,西南迄當陽九子山廟前白果園石馬槽等處。其區域南北約九十里,東西約三十餘里,煤層在此次調查所見者有五,最厚者多在觀音寺一帶,約一英尺至二英尺不等。據開土礦者言,在觀音寺者約有煤三層,彼此距離二三丈許,在東鞏所露之煤層較多而相距似甚遠。在九子山者據調查所見及開土礦者言,祇爲一薄層有烟煤(約厚三四英寸許)易碎,可和泥爲餅燃之。在東鞏觀音寺廟前等處所產者,俱爲無烟煤。



第二版　東鞏附近之煤礦

Plate II. Coal Mines around Tungkung.

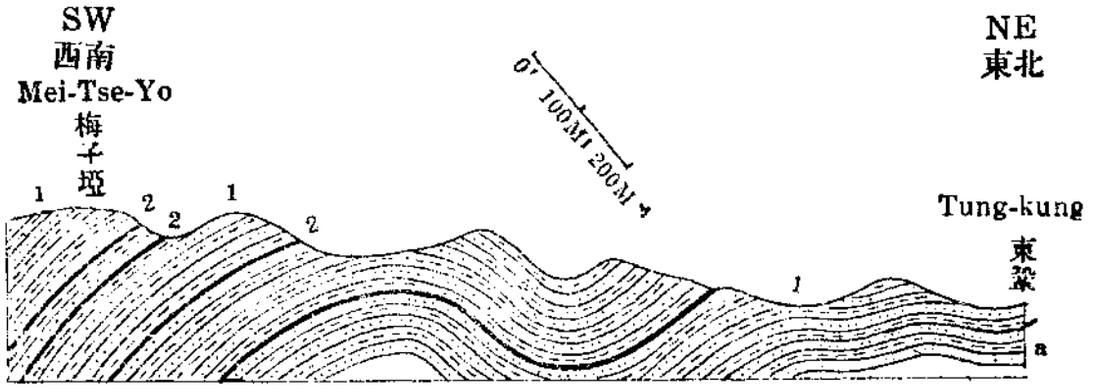
(一)東鞏煤田

位置：東鞏屬南漳縣，離縣城南約百六十華里，東至鹽池廟約五十里，北以武安壢（北去約百四十五華里），爲該地各種土產銷售之集市。南距觀音寺約九十里，西離羅家灣約三十里，漳水及茅坪河二支流貫其東西二部，然以河床不深水量不多，不足以行舳小舟，各貨物之轉運，全賴人力與牲口。

地質：東鞏離巴東系與香溪煤系之接觸處不遠。走向多爲北六十至七十度西，傾向南西十度至二十度不等。煤系中縐褶甚多而斷層甚少。軸線趨向成一半弧形：由羅家灣始，軸線爲東西，至東鞏而易爲北西南東，及稍南而爲南北向。煤系下部以頁岩爲主，而煤層所露者少。上中二部以砂岩爲主，煤層發現者較多。其露頭及縐褶狀況，參觀第十五，十六，二圖當甚明晰。第十四圖指明香溪煤系底部之綠色砂岩，及其下部頁岩被侵蝕而成河床之象。第十五，十六，十七，三圖，均表現煤層露頭之景狀。至其煤系上下岩層狀況，已在地層統系中之香溪煤系段內敍明不復多贅，

開採及運銷情形：東鞏一帶煤層上下岩石皆甚堅密，多爲砂岩，土人開採者多沿層向所趨而掘。煤塊甚大，每塊有大至數十斤者，故時見手車或牲口祇能裝載兩塊大煤。煤層薄者窿口極低，掘煤者祇能將四肢靠地匍匐而行。有洞口更隘者，則須僱幼童或身體瘦小者至內工作。東鞏地層傾向南西十五度至二十度不等，故入時甚易沿傾向而下，惟出時向上，且須拖帶數十斤之煤塊，至感困難。故每人每日祇能拖出二三百斤煤。有掘得離洞口稍遠者，尙不能達此數。每窿內約二三至五六礦工在內工作，平均每窿內每日能出五六百斤煤。在洞口出售者祇六七文一斤，經販煤者挑入集市中，則須十二三文一斤。如運至南漳屬武安壢者照加挑力。每擔加挑力後價約在六七千文左右。礦工伙食有自備者，有就食於僱主者。除伙食外，其所入工資每

日約四百至六百文因之開採利息不豐,故無常年在窿內工作者,春水發時,窿中多水,且農人至是亦忙於耕耘,無暇及此。



第十五圖 東鞏迄梅子垭剖面圖
Fig. 15. Section from Tungkung to Mei-Tse-Yo.
2. 煤層 Coal Seams.
1. 香溪煤系 Hsiangchi Coal Series.
a. 巴東系 Patung Series.

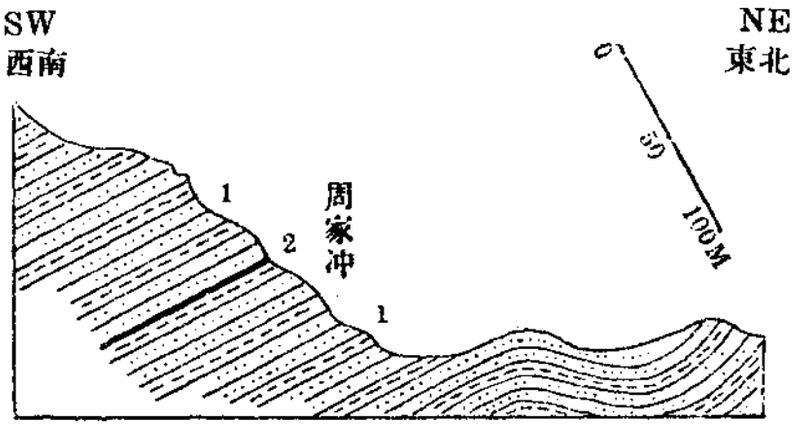
在東鞏境內未有正式公司之組織。大都或山係自有,或租賃他人山地開採。外僱數人幫同採取。開採盛時,多爲冬日。蓋是時田中工作已竣,採煤可稍得餘利。所開掘之窰,有(一)潘家窰(二)梅子垭(三)魏家灣(四)松林子屋廠(五)名屋廠(六)皮家灣(七)周家冲(八)深垭及其他小窰未及調查者。各窰中之開採情形均如上述者,產量皆不甚多,以魏家灣,松林子屋廠,及梅子垭所出之煤較多。

(二) 觀音寺煤田

位置: 觀音寺煤田,不僅指鄰近觀音寺集一帶而言。全煤田區域西南起自當陽屬之觀音寺迄崔家灣,東北至荊門屬之雙河口關廟坪,北距東鞏約九十里,南離當陽縣城約八十里,處漳河上游夏日可行重載小舟,直達江陵全境。小阜雖多,然不若東鞏以北之山嶺偉峻,故交通稍便。夏日漳水漲時,轉運土貨外出亦較便利。

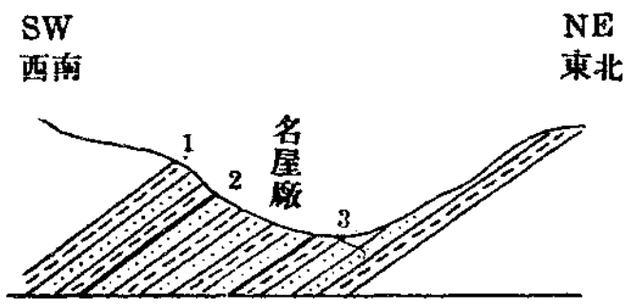
地質: 觀音寺之煤層,亦屬香溪煤系之上部。傾斜度極低,岩石不似在東鞏之堅密。由觀音寺而東,始見白堊紀之岩石,東

北至關廟坪雙河口而復現侏羅紀之香溪煤系(第十八圖)。煤田適處於觀音寺穹地及關廟坪對斜層之區域內,穹地頂部稍被侵削,故煤層離地面甚近。在關廟坪者煤層多露於山坡底部。煤層所見者有三,平均俱在一二尺左右,相離各約二丈至三丈許,由觀音寺南行,漸爲冲積平原,香溪煤系多爲侵削所去。



第十六圖 東鄉周家冲煤層剖面圖
Fig. 16. Section of Coal Seam at Chow-Chia-Chung near Tungkung.
2. 煤層 Coal Seam.
1. 中香溪煤系 Middle Hsiangchi Coal Series.

開採及運銷情形: 觀音寺煤礦開採之規模較東鄉爲大煤層傾向不高,有幾似水平線者。煤層厚有至二三尺不等。地層傾度既小,煤層亦較東鄉者厚,各煤層之距離不大,更兼地勢亦較平坦,因之開掘甚易。開採法爲挖二直井。二者相通,一供運煤及工人上下之用,一專供流通空氣。間或在地位較低處掘一井,爲運水車之用。直井達各煤層處則沿煤層開掘取煤。本區煤窰至春夏間,並不因農事而停頓。數年前崔家溝之窰,因水多曾購一人工抽水機。惜其抽水量過小,不適於用。其他各窰均沿泥中水淺處剝去煤層。漳水在觀音寺一帶可行小舟。夏日水漲時,可駛重載之舟,較東鄉運輸爲便利。關廟坪,雙河口等處,亦產煤甚富。此數處產煤地,皆以觀音寺爲集場。昔有數家公司曾在前北京農商部註册開採,獲利甚厚者有之。近年來匪患不息,致各公司皆

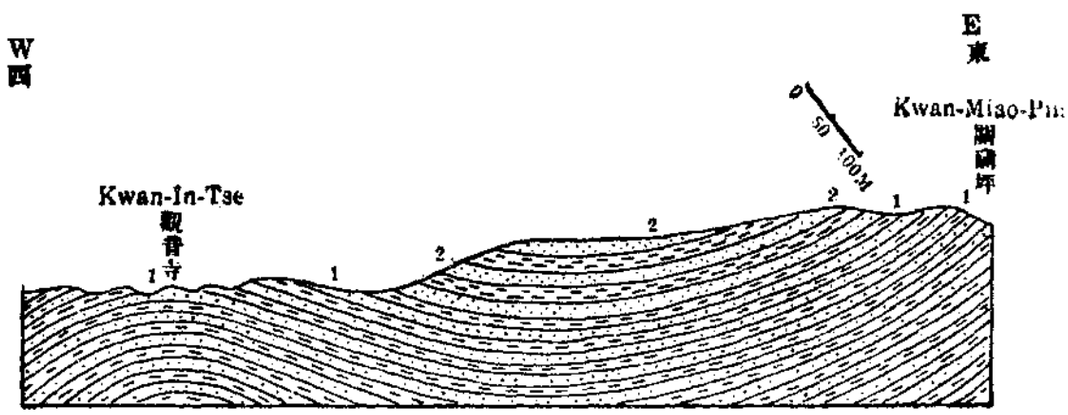


第十七圖 名屋廠煤層剖面圖

Fig. 17. Section of Coal Seam at Ming-Wo-Chang.

3. 中香溪煤系 Middle Hsiangchi Coal Series.
2. 煤層 Coal Seam.
1. 上香溪煤系 Upper Hsiangchi Coal Series.

行停採,而昔日所僱礦工爲維持生活計,尙繼續在井內工作,不取工資,礦主亦不取租費,惟所挖出之煤,概行售與各該礦主,煤之售價在觀音集亦擔約一千六百文。據運煤者言,運至沙市,冬



第十八圖 觀音寺至關廟坪剖面圖

Fig. 18. Section from Kwan-In-Tse to Kwan-Miao-Pin (showing the structure of Coal bearing strata).

2. 白堊紀岩層 Cretacous Formations.
1. 香溪煤系 Hsiangchi Coal Series.

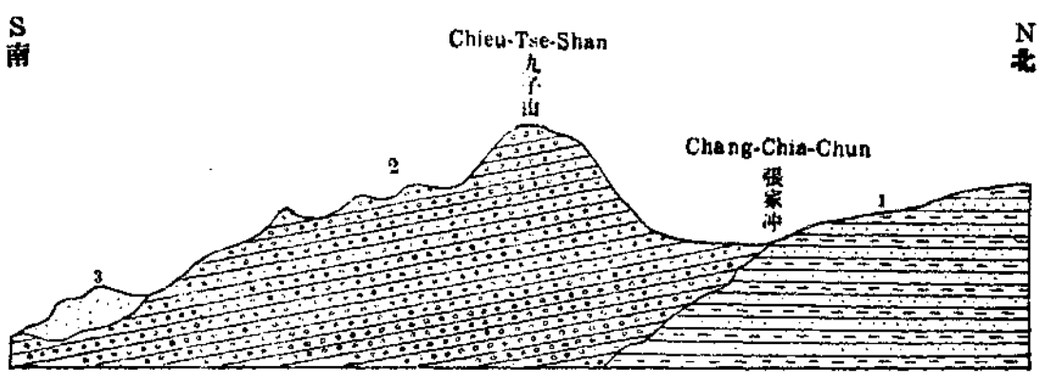
日水脚每擔須洋一元,至夏日每擔水脚則減至二角三角云云。數年前開採盛時,觀音寺全境月產煤至二千噸,近日每月祇出二三百噸而已。

前竹在北京農商部呈請開採,其註册或尚未註册者如下:

	礦權者		地點	備考
1	通惠公司	(劉朝覲)	當陽觀音寺小河西和尚坡	尚在開採
2	合羣公司	(王保授)	當陽觀音寺賈家堰	尚未開採
3		(向直臣)	當陽觀音寺崔家溝	尚在開採大部份爲水所淹
4		(同　上)	荊門關廟坪在觀音寺東十五里	尚在開採
5		(陳慶光)	荊門雙河口洞溝山	(觀音寺北東二十里) 尚在開採

(三) 九子山及廟前石馬槽等處煤田

位置: 此數煤田皆處當陽之北西,遠安之東。九子山處當陽縣城北約十餘里。廟前附近河流淺小,不足以供運輸。



第十九圖　九子山至張家冲剖面圖

Fig. 19. Section at Chieu-Tse-Shan to Chang-Chia-Chung. (showing unconformity contact between 1 & 2, 2 & 3).

3. 紅土層　Red Clay Formation.
2. 石灰礫岩　Limestone conglomerate.
1. 香溪煤系　Hsiangchi Coal Series.

地質: 九子山之香溪煤系,適處石灰礫岩之下,二者走向皆不相整合。香溪煤系傾東向而石灰礫岩傾南向。九子山之煤層甚薄,厚祇數寸許,煤系與第三紀礫岩之不整合象見第十九圖。

廟前迄石馬槽一帶岩層。多傾南東向十五度。離廟前及石馬槽東數里許卽爲巴東系。香溪煤系沿廟前石馬槽一帶而成一連貫山阜。煤系中之岩石多以頁岩爲主。煤層厚約尺餘。

開採及運銷情形：開採法多如觀音寺者，惟轉運多依人力擔運至各集市銷售。無公司之組織，純係土人自行開採或租與他人開採。利息不厚，產量亦較前者爲少。

(四) 石橋坪煤田

石橋坪約離遠安縣城西四十里。產煤之地尙在離石橋坪西約十二里之彭家坡。煤系在石炭紀燧石灰岩之下，煤系之上蓋一石英岩。走向北四十度西，傾向北東十五度。煤層約厚在一二尺之間，煤系與石英岩及燧石灰岩之關係參見第三圖。煤質尙佳，爲有烟煤，可煉作焦，該地土人時以所掘之煤用土法煉製成焦。相傳該礦已開採有年，產量據云尙屬豐富。組有遠坪公司，組織者爲嚴孔達，煤多售於附近之各集市，爲製紙作酒煉鐵等等之燃料。

其他產煤之地尙多。如遠安之兩河口，荊竹園，襄陽之隆中等處。然因其煤量不多，姑從略。

(五) 東鞏觀音寺九子山廟前石馬槽一帶煤量之估計。

據經調查所確有之煤層，其露頭由東鞏至觀音寺長約四八〇〇〇公尺。由雙河口至關廟坪，約四八〇〇公尺。由九子山至石馬槽，約一九三〇〇公尺。故其露頭線共長約七二一〇〇公尺。煤層總厚以二公尺計算(煤層在侏羅三疊紀煤系中已經發現者有五，俱在一英尺左右)。沿傾向而下，以三百公尺計算。煤之容量共爲四千三百二十六萬立方公尺 (43,260,000) 以煤之比重爲一點三。以一千啓羅爲一噸。所共儲之煤爲五千六百二十三萬八千噸 (56,238,000 Metric tons)。

巴東與山稀歸等處之香溪煤系中所儲之煤。據謝君家榮等之報告(註十五)。爲五千五百五十七萬五千噸。二者相較，儲

量幾相等,惟觀音寺一帶之煤,離揚子江較遠(由觀音寺順漳水而下達江陵約一百八十華里)轉輸較爲困難,苟能暢利運輸,則其煤田之價值,當亦不後於巴東興山等處者矣。

6 金屬鑛產

東霍峽口之銅礦

石灰岩中時含各種礦質。在巴東系中部之石灰岩中底層間含柱形之輝銅礦及孔雀石。其爲地中水流沈澱而成。固無疑義。蓋石灰中稍含銅質,被水溶蝕,隨水而流。至石灰岩之底部,遇堅密頁岩不能前進,復沈澱爲柱形之銅礦。故遇巴東系露頭處。如東霍之捉馬溝,峽口之銅綠山等處,時現此種銅礦。惟該種柱形銅礦不逼生於巴東系之石灰岩底部中。產量不多,致開採甚形困難。昔曾有荊華公司集股開採,惜資本過小,礦量不豐,不久即行停辦。

遠安鷹子山之鉛鋅銅礦脈及南漳黃界山之重晶石脈

鉛鋅銅礦脈,時現於巴東系灰岩中,惟礦脈少無開採價值。南漳黃界山一帶昔曾有人在該處探採錫礦,此次調查至此,未見錫礦礦苗,惟在石灰岩中稍見一二重晶石脈。

附註

(一) 謝家榮,趙亞曾: 湖北宜昌興山秭歸巴東等縣地質礦產,地質調查所地質彙報第七號,第五頁至六十七頁。

(二) 李四光: 峽東地質及長江之歷史,中國地質學會誌第三卷第三期至四期,第三〇四頁至三〇六頁。

謝家榮,趙亞曾,同前著,第十八頁至廿二頁。

(三) 李四光: 同前著第三〇六至三〇九頁。

謝家榮,趙亞曾,同前著第廿二頁至三十五頁。

(四) 謝家榮,劉季辰: 湖北地質礦產概說湖北實業廳印行,第十五頁。

(五) 謝家榮,趙亞曾: 同前著第三十五頁至三十九頁。

(六) 謝家榮,劉季辰: 同前著第十六頁。

謝家榮,趙亞曾,同前著第三十五頁至四十四頁。

(七) 謝家榮,趙亞曾: 同前著第四十七頁至四十八頁。

(八) 謝家榮,趙亞曾: 同前著第五十頁。

(九) 李四光: 同前著第三一二頁至三一三頁。

謝家榮,趙亞曾: 同前著第五十一頁至五十五頁。

(十) Bailey Willis and E. Blackwelder: Research in China Vol. I. PP. 277–279.

(十一) 李四光: 同前著,第三一三頁。

(十二) 舒文博: 湖北南漳襄陽宜城荊門等縣地質 (見本刊本號)。

(十三) 謝家榮,趙亞曾: 同前著第六十一頁。

(十四) 葉良輔,謝家榮: 揚子江流域巫山以下之地質構造及地文史,地質調查所地質彙報第七號.第八十三頁至八十四頁。

(十五) 謝家榮,趙亞曾:同前著第六十六頁。

湖北襄陽南漳宜城荊門鍾祥京山等縣地質

俞建章　舒文博

一　引言

民國十七年秋,湖北前建設廳長石蘅青先生復向本所提議派員調查鄂北之地質礦產。本所派孟憲民俞建章舒文博三人同往。十月二十八日,抵襄陽城。自是開始調查,經隆中,吳家集以至南漳。此後卽行分開工作。孟君前赴南漳南部及遠安當陽一帶。余等合爲一組;於南漳縣城附近,查勘一週;乃南向經武安堰,仙居,鹽池廟,南橋鋪及郭家溝以至荊門;北轉由慌忙山,郭劉灣,朱家埠,大魚口,夫子堰與宜城等處以迄鹿門寺;復折而東南,經新街,臥牛山,仙居山,雲台觀而達京山;最後自京山西北行,過義合新河二集,於十八年元旦日,抵鍾祥城,取道漢水而返。

鄂北沿漢水一帶之地層統系,與李仲揆教授[1]及謝家榮趙亞曾[2]二君於鄂西所見者,小異大同。下自前震旦紀以迄第三諸紀之地層,凡鄂西所有者,本調查範圍內亦莫不悉備;惟白堊紀層未之見耳。至於礦產方面,南漳南部之銅礦由孟君查勘之。而侏羅紀煤田,余等未得窺其全豹。故本區域內無礦產之可言。返所後,建章派赴北平,就葛利普博士以研究本次所採化石,文博則從事於地層及構造;分工合作,以成是篇。而對於葛博士之指導,李教授之改正,皆所感激不淺者也。

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[1] 李仲揆著: 宜昌秭歸間長江峽谷之地質;載中國地質會誌第三卷,353-382 頁。

[2] 謝家榮趙亞曾著: 湖北宜昌興山秭歸巴東等縣之地質礦產;載地質彙報第七號,5-67 頁。

二　地形

荊門鍾祥京山諸城而北,爲一壯年至老年之侵蝕高原。岩層大有堅柔之分,構造鮮呈複雜之象;崗巒起伏,溪河流經,皆井然有條。茲述山派河流之情形,以示岩層構造地形三者之關係。

(甲) 山脈

(一) 漢東山脈　漢水以東山脈可分四支: 第一支爲襄陽宜城之界山。西起漢濱之李家大山與鹿門寺;東南綿延,二十里許;至排山乃趨於東,鐵古寺,大峯頂及關門山諸峯皆屬之,高三百至五百公尺。第二支西北起於宜城東北十里之鷄鳴山;東南延長,爲扁山及兩乳山;至石虎寺,轉而東向,是爲黃鶯山及金銀頂等;自金銀頂忽南向而爲臥牛山及尖峯頂,由尖峯頂復趨於東。凡本支諸峯,較之第一支,高度稍遜。第三支自溫泉南之窄山寨以至京山縣城之東北,綿亘於東南方向者,約二百里。其間之仙居山,金龍山,馬頭寨,王家大山,猴王寨,保福寨及艾家尖等,與第二支諸峯約略等高。第四支之西北端爲東橋鎭南之聊屈山,東南端爲京山城南之會亭山;山向東南,長六七十里。惟其西南部之分歧較多,山向漸變爲東西。本支高峯,如雲台觀及大尖山等,不下三百公尺。

(二) 漢西山脈　可分三支; 第一支位於襄陽之西南,與南漳之東北。其間諸峯,如屏障襄樊之虎頭山及匾山,南漳北之將軍寨,高三百至五百公尺。第二支山脈之方向,爲南東而稍偏南其西北段在蠻河之北;至南漳城西之太紅山,忽然中斷。由該城至武安堰之東,約五十里,始行隆起而爲神農山。自是旁漢綿延而金牛山而夫子埡而放馬山以至白雲山,復行中斷者二十里

許。再東南至朱家埠之南，又起而爲仙女山與華山觀，以迄郭劉灣南之慌忙山。本支諸峯高約三百公尺左右。第三支之西北段位於蠻河之西南，是爲關廟埡，牛心寨及四望山等；境內諸山，此爲最高，約七百至一千公尺。至仙居，趨向南東偏南，雨龍觀及高約五百公尺之盛京山屬之。迄至荊門城西之象山，山勢漸低，而止於此。

就岩石之性質而論，前震旦紀花崗岩，片麻岩及片岩等之硬度雖大，而其風化之程度甚深，且多出露於漢水附近，以故不成高山。如新街及板橋店附近片岩所在之處，陵谷綜錯，極阻交通。燈影石灰岩富含砂質，侵蝕困難；尖峯絕壁，時以是成。襄城西南之虎頭山及鳳山，卽其例也。寒武紀之劉家坡砂岩厚度不大，影響於地形者甚小。宜昌石灰岩之下部亦多砂質，所成之山，最爲雄壯，如襄陽南漳間之最高諸山及襄宜之界山是也。但宜昌石灰岩之中上兩部，層理清楚，且夾砂岩頁岩；造成聯絡山脈，既少尖峯，高度亦遜，例如漢東第三支山脈。新灘頁岩之性質軟脆，易受侵蝕；苟非構造上有特殊之點，概成丘陵。雲台觀石英岩之最大厚度不過六十公尺，於地形亦無大關係。巫山石灰岩少含砂質，復多薄層；所成之山，與宜昌石灰岩中上二部所成者，頗無錯異；但以構造有時特別之故，往往高達五百至七百公尺，如南漳之關廟埡與荊門之盛京山是也。中生代層全爲砂岩頁岩，其抵抗侵蝕之力，無以異於新灘頁岩。至於第三紀礫岩所成地形，至不一律，以其所蓋覆之岩層爲轉移。如於最高之四望山絕頂，此礫岩冠蓋於其上；其他各處，多成小丘。而礫岩上之紅砂岩，只充塞低窪之地而已。

關於構造方面，漢東第一支山脈之方向南東偏東；漢西第三支爲南東偏南；在此二支之間者，居於南東向之中立地位，而約略平行於漢水。此無他，地層走向漸變之故也。凡此等山脈大致以地層走向爲其趨向。與夫何者爲斷層山，何者爲褶曲山，一觀此地質圖及構造章，自知其大概矣。

乙　河流

(一) 漢水　調查範圍內,漢水流經,未曾深入山地。襄陽鍾祥間,沿其河谷低窪之地,寬達五十餘里。以構造言,其地地層走向西北東南三十至六十度。而漢水於此蜿蜒於南東偏南之方向,確與宜城大背斜軸大致平行。然漢水歷史攸遠,殆可與長江同日而語;(參看葉良輔著長江流域巫山以下之地質構造及地文史,見地質彙報第七號第七七頁。)其非後成河 (Subsequent river) 也明矣。

(二)漢水支流　(1) 蠻河—源出保康;東流至南漳城,折向東南。其支流之最大者爲清涼河,位於漢西第一二兩支山脈之間,初亦東流,至石門集,折而東南。蠻河會合小溪,下游舟楫可達武安。　(2) 利河—大部份流入紅砂岩中。上游支流雖雜,而源流甚短。自雙河口以下,利河東流經朱家埠,以入於漢;小舟可至朱家埠。　(3)陰河—來自襄陽。西流經田家集;至石虎寺,乃曲向南。　(4) 敖水—順漢東第二支山脈之東北麓,流向西北;至溫峽口,忽西南流。　(5) 寨河—發源於東橋鎮之東;初向西流,復繞聊屈山而西南流。以上諸川,蠻爲最大,利河次之。要皆蜿蜒於軟柔岩層如新灘頁岩或第三紀紅砂岩之內,或流經斷層。是皆爲後成河。

三　地層

(三) 地層　調查範圍內與鄂西之地層統系大致相同,已如上述。故此地岩層之大要分類,可仍用李謝二先生原定之名稱。惟對於局部之變更,則另立新名,以示區別,而資比較。茲自下而上,列爲一表:

XI 第三紀.....17 東湖系

—不整合—

X 侏羅紀 .....16 粗砂岩及含煤系

IX 三疊紀 .....15 紫色頁岩及砂岩

VIII石炭至二疊紀（巫山石灰岩）
- 14 大冶石灰岩……上二疊紀
- —不連續—
- 13 陽新石灰岩
  - 上部……二疊紀……0-200
  - 中部……0-100
  - ……上石炭紀
  - 下部……0-80

—不連續—

VII泥盆紀……12雲台觀石英岩……0-60

下志留紀……（新灘頁岩）
- 11 九龍山層……200
- 10 仙居層……400+
- 9 龍馬頁岩……450

—不連續—

V中奥陶紀……8 艾家山層……100

IV下奥陶紀……（宜昌石灰岩）
- 7 消溪寺石灰岩……400+
- 6 吳家集石灰岩……400±
- 5 鹿門寺石灰岩……500

—不連續—

III寒武紀……4 劉家坡砂岩……110

II震旦紀……
- 3 燈影石灰岩……1000
- 2 大魚口砂岩……60+
- —不連續—
- 1 夫子垭石灰岩……0-50

—不整合—

I前震旦紀……
- C 片岩
- B 片麻岩
- A 花岡岩

表中皆以公尺計算

I 前震旦紀

迫近漢水西濱之夫子垭,大魚口及放馬山一帶,有三種不同而同屬於前震旦紀之岩石,卽(A)花岡岩,(B)片麻岩及(C)片岩是也。其後二者皆與花岡岩相接。花岡岩中,夾雜微量而無定形之片麻岩。而花岡岩體之東,復有片岩稍許。由大魚口東北行,越漢水約六十里,則見同樣片岩,復行出露於板橋店及新街附近,面積寬廣。茲將此三岩之性質及其彼此之大約關係,分述如下:

(A)花岡岩　表面風化,類似一種粗鬆砂岩。細察之,則見岩之組織爲全晶質;晶體雖大,晶面不全。其中礦物,石英及正長石幾佔全體百之九十;餘爲斜長石及黑雲母,並有星散之磁鐵。因正長石甚多,故全岩呈肉紅色,極爲美觀。

(B)片麻岩　結構細密,爲全晶質,晶粒互相排擠,不顯晶形。岩色深綠,由角閃石甚多所致。其中白色礦物有石英及長石,與綠色之角閃石相互排列,成平行紋。故此岩可稱角閃片麻岩。又與此接近之花岡岩,不徒不若其大體者之粗,且其中石英及長石亦相互排列,以成片麻狀之構造。於是似於花崗岩汁未曾凝結,或未完全凝結之先,有一種已成岩石,陷入其中,而發生同化作用。

(C)片岩　依主要礦物之不同,可分雲母片岩及角閃片岩二種。前者色銀灰而稍綠,後者深綠色。全體之片理顯明,肉眼可視;其方向雖時有變更,尙不混亂。至於片岩與花崗岩之關係如何,雖未能斷言,但以片岩廣大之面積觀之,似非因花岡岩之變態作用而成者。

於夫子垭,曾見未受變態作用之震旦紀石灰岩,並有由上述花岡岩,片麻岩及片岩三種卵石組成之基底礫岩,不整合於花岡岩之上。則三者皆爲震旦紀以前之物,可無疑義。以片岩結

構不若泰山雜岩之混亂而言,其時代或可視爲五台紀。而花岡岩或爲此三岩中之最新者。

II 震旦紀

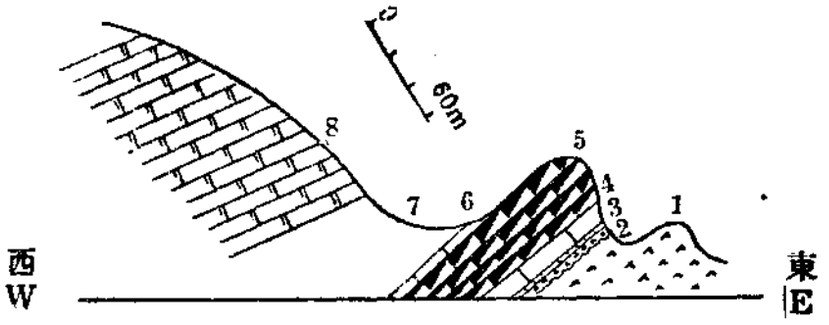
本區域內,震旦紀層之分佈,可分三區：一在襄陽縣城之西南,一在夫子垭,大魚口及放馬山一帶,一在朱家埠南之華山觀。惟各處均未見其完全露頭。茲就其露出於夫子垭等處之較爲完全者,分爲三部,卽：

上部—燈影石灰岩

中部—大魚口砂岩

下部—夫子垭石灰岩

(1) 夫子垭石灰岩　於夫子垭,曾見一石灰岩層,(如第一圖),厚約五十公尺,開始以厚僅二公尺之基底礫岩,不整合於

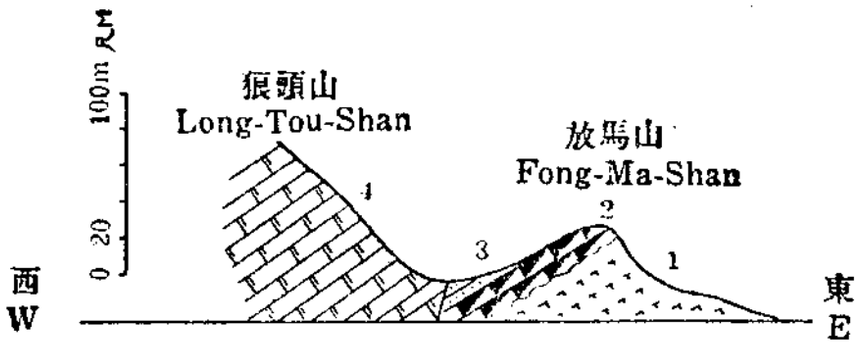


第一圖　夫子垭剖面　Fig. 1—Section at Futzeya.

1 前震旦紀花岡岩Pre-Sinian Granite. 2-6 夫子垭石灰岩Futzeya Limestone: 2基底礫岩, 3紅綠色砂岩, 4厚層石灰岩含燧石薄層, 5純粹而半透明之砂質大塊,中夾微量石灰岩,互相交錯, 6薄層石灰岩,含燧石薄層, 7掩蓋, 8燈影石灰岩Tongying Limestone.

花岡岩之上。礫岩中三種卵石之種類已如上述,大者三四十公寸,小者數公寸,皆呈菱角狀。夫子垭石灰岩中,純粹而半透明之砂質大塊與石灰岩相雜,界限混亂。然察其實,砂質塊及石灰岩似皆爲同時之停積,不顯曾經轉運而來之象,殊爲特別。又於夫子垭南三十餘里之放馬山,如第二圖,復見夫子垭石灰岩,厚約

二十公尺,直接與花岡岩相接;所有基底礫岩及紅砂岩皆付缺如。蓋斯二者原皆極薄,且爲不整合帶之岩層,其分佈之不廣,亦無足怪。

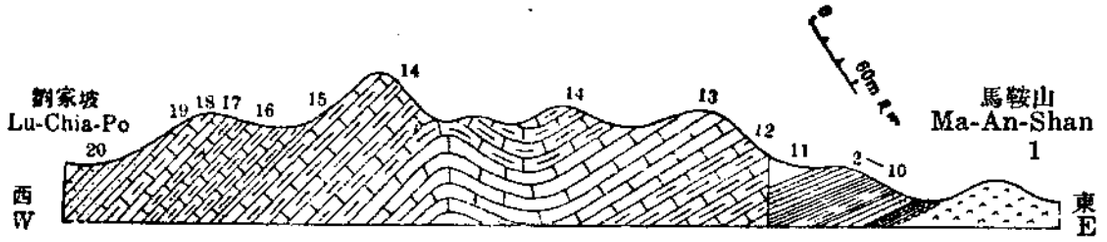


第二圖　放馬山與狼頭山間剖面

Fig. 2—Section from Fongmashan to Longtoushan

1 前震旦紀花岡岩 Pre-Sinian Granite. 2 夫子垭石灰岩 Futzeya Limestone. 3 灰色硬砂岩 Grey, hard sandstone. 4 燈影石灰岩 Tongying Limestone.

(2) 大魚口砂岩　夫子垭南三十里之大魚口,有砂岩層,以不整合之形式,覆於花岡岩之上。第二剖面中之第3項灰色硬



第三圖　大魚口南馬鞍山至劉家坡之剖面

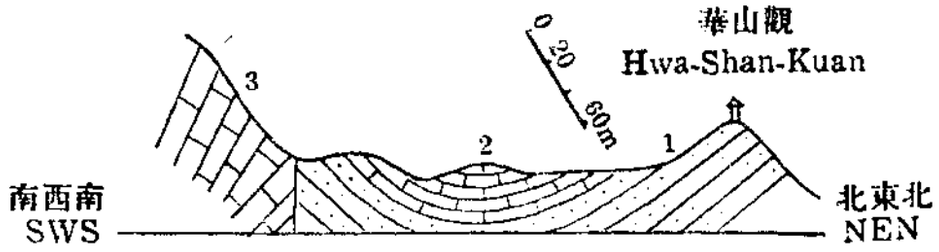
Fig. 3—Section from Ma-An-Shan to Luchiapo, S. of Tayükou.

1 前震旦紀花岡岩 Pre-Sinian Granite. 2-10 大魚口砂岩 Tayukou Sandstone: 2 紫色頁狀砂岩 (1.5m.), 3 灰色及紫色頁岩 (6m.), 4 灰紅色厚層硬砂岩 (6m.), 5 厚層灰色砂岩 (1.5m.), 6 灰色頁岩及砂岩之互層 (9m.), 7 黃色頁岩 (2m.), 8 灰色厚層砂岩 (2m.), 9 灰色薄層砂岩 (20m.), 10 灰色硬砂岩 (15m.), 11 掩蓋. 12-19 燈影石灰岩 Tongying Limestone: 12 灰色石灰岩含褐黑色之燧石薄層, 13 塊狀石灰岩有極薄而平行於層面之砂質層, 14 淺灰色石灰岩含褐黑色燧石薄層, 15 薄層灰黃色細砂岩, 16 深灰色石灰岩雜褐黑色燧石薄層, 17 塊狀砂質石灰岩, 18 淺灰色石灰岩夾褐黑燧石薄層, 19 薄層砂質石灰岩。20 劉家坡砂岩: (中寒武紀)

砂岩,與第三剖面中之第10項相當。於第一剖面夫子垭石灰岩以上被掩之部,亦曾見與大魚口砂岩相同之碎塊。於是夫子垭

石灰岩與大魚口砂岩之間,有一間斷;以致前者之厚薄不等,甚至侵蝕無遺,而後者亦因而發生前進覆蔽之象。放馬山距大魚口雖只數里,而所缺乏之岩層,即第三剖面之2至9,共厚四十餘公尺而已。

大魚口與放馬山一帶,發生斷層,使大魚口砂岩與燈影石灰岩成機械之接觸。故此砂岩是否全體露出於大魚口(露出者



第四圖　朱家埠南華山觀剖面

Fig. 4—Section at Hwa-Shan-kuan, South of Chuchiapu.

1 黃白色粗砂岩 Yellowish-white, Coarse sandstone. 2燈影石灰岩,薄層狀,有極薄而平行於層面之砂質層,中部富含黑色扁球體 Tongying Limestone. 3宜昌石灰岩 Ichang Limestone.

約六十公尺),與夫其上密接之岩層爲何,皆不得而知。但大魚口砂岩爲直接覆於夫子垭石灰岩或花岡岩之上之岩層,自應老於燈影石灰岩。余等又於大魚口東南三十里之華山觀,曾見黃白色粗砂岩,露出之部不及百公尺,砂粒大都爲石英,而居於燈影石灰岩之下(如第四圖)。則此粗砂岩或爲大魚口砂岩之一岩像(facies),或更有爲其上部之可能。

(3) 燈影石灰岩　華山觀粗砂岩之上,有薄層石灰岩;中有一層,幾全爲豆大之黑色扁球體所作成。此即燈影石灰岩之底部。因布拉克魏爾德 (Blackwelder) 及謝君於鄂西燈影石灰岩之底部,發現同樣之黑色扁球體故也。

燈影石灰岩之出露於夫子垭,大魚口與放馬山一帶者,以斷層與大魚口砂岩或花岡岩相接。露出之部,厚三百至四百公尺。第三圖中之12至19屬之。大都塊狀,富含燧石或砂質薄層。砂質層有時極薄,則有極薄之層,彼此相距約二三公釐,而平行

於層面。此砂質或燧石薄層之靡有間斷，實爲燈影石灰岩之特徵以與境內較新諸石灰岩相區別。又於距頂約二百公尺之處，曾得一種圓球體，直徑一公分有奇，經葛博士大略之氣定，爲 *Collenia*.

襄陽縣城附近，有一種石灰岩系，以斷層單獨出露。此灰岩由習家池至九宮山之層次，自下而上，爲：一

1 深灰色石灰岩，有極薄而平行於層面之砂質層，並夾紅色及灰色頁岩一薄層 ……百公尺
2 厚層石灰岩含褐黑色燧石薄層……四十公尺
3 灰色石灰岩有極薄而平行於層面之砂質層……百公尺
4 薄層石灰岩含白色及褐黑色燧石薄層 ……六十公尺
5 層狀石灰岩含褐黑色燧石薄層……百五十公尺
6 砂質石灰岩……百公尺
7 層狀深灰色石灰岩夾頁岩及頁狀灰岩—薄層……百五　公尺

此等石灰岩中雖未得化石，但以其富於砂質而觀，信可歸諸燈影石灰岩。然其層位應在出露於大魚口等處者之下；因後者之上，密切覆以寒武紀層故也。於襄陽城西三十里之隆中惟燈影石灰岩之頂部以斷層逆掩二疊紀層。城西十里萬山之本灰岩亦屬頂部，與在隆中者成一向斜層。

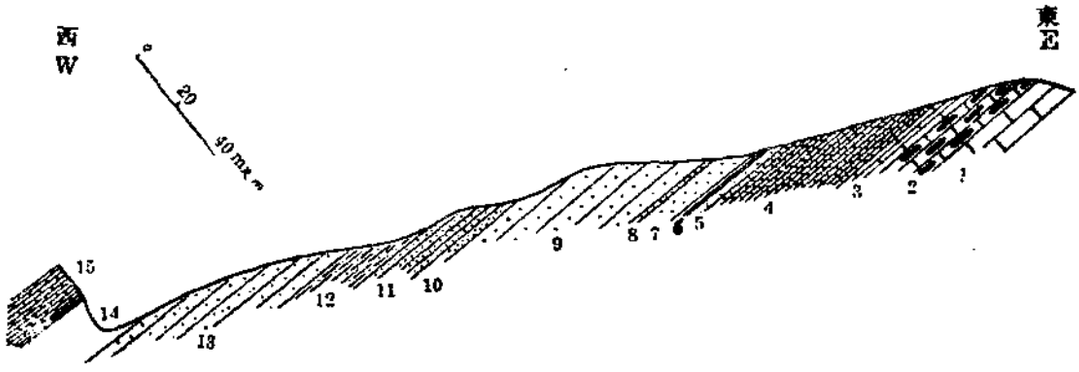
將鄂西之震旦紀層與上述者相比較，夫子垭石灰岩及其下之基底礫岩與紅綠色砂岩，大約各與南沱礫岩及粗砂岩相當。大魚口砂岩亦可相提並論，與陡山頭系之諸頁岩爲同時之停積。雖於岩石性質上，震旦紀層之中下二部稍有局部之不同，而其上部，即燈影石灰岩，在鄂西及本調查範圍內，則頗一致，惟鄂西燈影石灰岩之厚度較小耳。

據謝君之查勘，南沱冰積岩向北漸薄，且含石灰岩塊。彼以爲冰積岩未成之先，南沱附近或他處，應有一已或石灰岩系之

存在。夫如是,則夫子垭石灰岩當爲此石灰岩塊之來源;蓋石灰岩之老於夫子垭石灰岩者,鄂北鄂西均未之見也。

III 寒武紀

(4) 劉家坡砂岩　大魚口西三里之劉家坡,有砂岩層,厚百公尺而稍強,整合於燈影石灰岩之上。此砂岩多爲灰色,厚層薄層均見,砂粒頗細。其中之厚層硬砂岩含雲母片,灼灼有光。此含



第五圖　大魚口西三里劉家坡剖面

Fig. 5—Section at Luchiapo, 3 *li* west of Tayükou.

1-3 燈影石灰岩 Tongying Limestone: 1灰色塊狀矽質石灰岩. 2灰色石灰岩含褐黑色燧石薄層, 3 薄層矽質石灰岩。 4-13 劉家坡砂岩 Luchiapu Sandstone: 4薄層黃色細砂岩, 5厚層灰色硬砂岩, 6黃色頁岩, 7厚層灰色硬砂岩, 8灰色砂岩, 9厚層灰色硬砂岩含雲母片, 10黃色軟砂岩產三葉蟲, 11薄層灰色硬砂岩, 12灰黃色頁狀砂岩, 13層理清楚之灰色砂岩。14 掩蓋。15宜昌石灰岩 Ichang Limestone.

雲母片砂岩之上,或距燈影石灰岩之頂五十公尺之處,有厚二公尺之黃色軟砂岩,產中寒武紀三葉蟲類之標準化石;經孫雲鑄博士之鑑定,爲 *Dorypyge yui.* 與此相伴產生者,尚有 *Obolella* cf. *Wirrialpensis* Etheridge.　自劉家坡而北,全體砂岩爲斷層所掩。其復出露於夫子垭以西三里者,岩石性質及厚度皆未變更。惟在襄陽之西,寒武紀層爲綠色至灰綠色之頁岩,且夾石灰岩層;李捷朱森二君於其中採得下寒武紀之 *Redlichia chinensis* Walcott　於是調查範圍內之寒武紀層,發生前進覆蓋。

IV 下奧陶紀

宜昌石灰岩 介居鄂西石牌頁岩與艾家山層間之巨厚石灰岩系,李仲揆教授名之曰宜昌石灰岩。其在本區域內,位於劉家坡砂岩之上。於劉家坡及夫子堰之西,兩遇二者之接觸帶,未見傾斜不同之象。茲依宜昌石灰岩之岩石性質,及其中少數化石,分三部述之,卽下爲鹿門寺石灰岩,中爲吳家集石灰岩,上爲消溪寺石灰岩。鹿門寺石灰岩厚五百公尺以上,其他二者皆約四百公尺。

(5) 鹿門寺石灰岩 襄陽南漳間最高之山,襄陽宜城之界山,大部份由鹿門寺石灰岩作成;高峯聳峙,雄冠諸山;以本灰岩間含砂質薄層,而頂部之六十公尺則完全砂化故也。但本灰岩之砂質層既不若燈影石灰岩之所含者之聯續無間,而其底部復有特殊之點,以自別於燈影石灰岩。所謂特殊之點者,卽含黑色腎粒及古杯珊瑚 (*Archaeocyathinae*) 之薄層石灰岩,與綠色頁岩層相間是也。腎粒之長徑一公分有奇;剖面顯同心橢圓狀之薄層,與矢部 (Yabe) 所謂之 *Girvanella sinensis* 之構造,彷彿相似。古杯珊瑚普通大若銅幣;常突露於風化岩層之表面,作小杯形。自珊瑚層以上,層疊漸厚,甚至塊狀。但將近砂質石灰岩,則復爲薄層。此上部薄層灰岩之中,亦有少數腎粒,惟未見珊瑚,

(6) 吳家集石灰岩 調查時遇見本灰岩者凡三次。一於吳家集,一於交子嶺之西,一於鷄鳴山之北與排山之南。皆未見化石。岩色青灰;時爲薄層,時爲厚層。且有紅色頁狀石灰岩數層,夾於其中。紅色層之厚者十餘公尺,薄者數公尺。

(7) 消溪寺石灰岩 南漳背斜層以消溪寺石灰岩爲其軸部。自溫泉以達京山縣城之東北,本灰岩大半褶曲以成背斜層。而夫子堰大魚口以西一帶,及朱家埠南之仙女山等處,皆有其不甚完全之露頭。岩之下部爲薄層石灰岩,中有一段富含燧石,有時排列成行。上部則爲砂岩與石灰岩之互層。互層灰岩之中,

亦間含燧石。瓦層之頂部。卽與艾家山層相接者,爲厚約十二公尺之厚層石灰岩豐產 *Eccyliomphalus* sp. 及成堆之小化石, *Proterocameroceras matheui* Grabau 亦復不少。

關於宜昌石灰岩之年代,謝君之討論頗詳。彼以石牌頁岩與宜昌石灰岩之間,未見不連續之痕跡宜昌石灰岩底部所夾之綠色頁岩,與石牌頁岩之岩石性質相類,而古杯珊瑚層中,復有三葉蟲之碎片,遂疑宜昌石灰岩之下部,或僅其底部之古杯珊瑚層,可屬諸寒武紀。但不能精確鑑定三葉蟲碎片之存在,不足以證明寒武紀之時期,甚屬明顯。雖有上述之其他附屬證據,亦不足憑。且顧諸他方面,中國所發現之古杯珊瑚,依葛博士之鑑定,皆屬下奧陶紀之物。於是以全體宜昌石灰岩,暫時歸於下奧陶紀。將來再有發現,謝君之擬議方可決定也。

V. 中奧陶紀

(8) 艾家山層 凡上述消溪寺石灰岩之上,莫不有艾家山層與之形形相隨。艾家山層可分二部。其下部之岩層,在漢水東西,各不相同;而其上部之厚度亦隨地而稍異。在南漳城西,下部爲薄片狀之黃綠色頁岩,厚二十五公尺,富含腕足類化石;中有褐黑色板者一薄層,除產腕足類之外,並含三葉蟲及筆石。迄至漢水之東,此下部頁岩變爲灰黑色而多泥灰質;其化石內容如何,未之細敲。上部概爲結核狀石灰岩,卽寶塔石層,其中大小不一之頭足類化石,多且完美。此灰岩以結核之故,表面酷似老松皮,尤爲特別。故無須尋覓頭足類化石,遠望卽知其爲艾家山層之上部。寶塔石層之顏色有二種。在下者深綠至黃綠色,如出露於南漳城西者,厚約六十公尺。在上者色紅;只於武安壩東南十里許之鼓樓寺,及溫泉東之烏頭山,兩次見之,厚二十至三十公尺。其他各處,僅留其下之綠色者。

本層之得名,以鄂西新灘東北數里之艾家山極富 *Triplacia poloi* (Yangtzella). 此次於本範圍內,竭力尋覓,而未之一見,殊可異也。茲將吾等於艾家山層所得之化石列下:—

A. 南漳城西太紅山

(a) 下部頁岩中之化石

筆石類: *Didymograptus murchisoni*

Didymograptus sp. (數種.)

腕足類: *Orthis* sp. (數種.)

Orthis calligramma Dalm.

Dalmanella sp.

Dinorthis sp.

介蟲類: *Leperditia* sp.

三葉蟲類: *Asaphus* sp.

Asaphus hupehensis Sun and Yu

Taihangshania shui Sun and Yu

Illaenus nanchangensis Sun and Yu

Bronteus sp.

Bathyurus minor Sun and Yu

(b) 上部石灰岩內之化石

頭足類: *Cycloceras* sp.

Orthoceras sp. (數種.)

Orthoceras chinensis Foord

Vaginoceras chientzekouensis Yu

B 南漳城東西二十四里大洪山

(a) 下部頁岩中之化石

筆石類: *Didymograptus murchisoni*

Didymograptus sp.

腕足類:　*Orthis* sp.　(數種.)

三葉蟲類:　*Asaphus hupehensis* Sun and Yu

Illaenus nanchangensis Sun and Yu

(b) 上部石灰岩中之化石

頭足類:　*Orthoceras* sp.

Vaginoceras sp.

下部頁岩中,以 *Orthis* 爲最富,上部石灰岩中之頭足類以 *Orthoceras* 爲最多。其他各處, *Orthoceras* 及其他之頭足類常見但未能一一採集。

VI. 下志留紀

新灘頁岩　新灘頁岩位居艾家山層之上,無傾斜之不同。但二者之任何部份俱無上奧陶紀之化石,且艾家山層之上部時呈稍經侵蝕之象,則二者之間,自有一平行不整一。調查範圍內,新灘頁岩之分佈甚廣。凡較低之地,若無新生地層,則必有此。如(1)隆中之南與吳家集之北,(2)南漳城西蠻河流經之處,(3)郭劉灣附近,(4)東橋鎮與官橋舖一帶,及(5)黃鶯山與尖峯頂之南,與烏頭山之北,皆有其全體之露頭。仙居附近,鹽池廟西之毛坪及新河集等處之新灘頁岩,皆居於背斜層之中心;而在石門集,則位於向斜層之軸部。故諸背斜層或向斜層軸部之新灘頁岩,皆未得全體露出。此外以斷層而顯露或被掩覆一部者,尚有數處: 一在南漳大洪山與朝陽山之間,一在宜城東北十里之扁山附近,一在荊門仙居寺之東,一在盤京山之東坡,一在京山羅家橋與義合集之南。

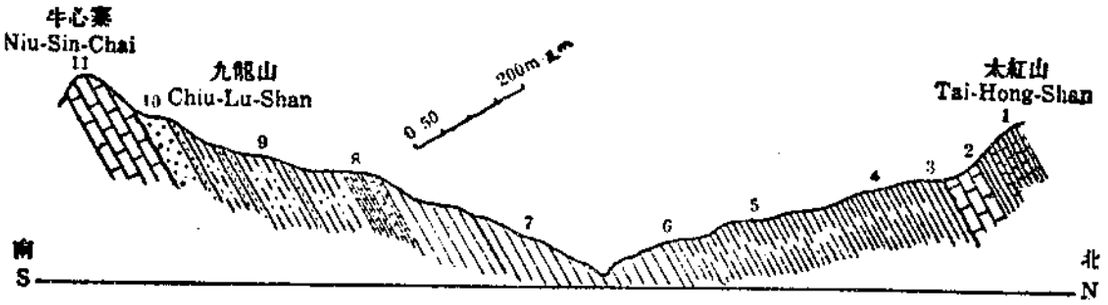
上述各處新灘頁岩之全厚似頗一致,約千公尺以上。而其岩石性質因地而差異者,亦屬甚微。茲取南漳城西本岩清晰而

聯續之剖面,以代表其他。且依岩石之性質及化石之分佈,類分之爲三,卽

上部—九龍山層

中部—仙居層

下部—龍馬頁岩



第六圖　南漳城西太紅山至牛心寨之剖面

Fig. 6—Section from Taihongshan to Niusinchai, west of Nanchang.

1 宜昌石灰岩 Ichang Limestone. 2 艾家山層 Neichiashan Formation. 3-9 新灘頁岩 Sintan Shale: 3 筆石黑頁岩, 4 黃綠色頁岩層薄而柔軟, 5 綠色頁岩有平行於走向及傾向之二節理,恒破碎成長條形, 6 筆石褐色頁岩, 7 深綠色硬頁岩, 8 石灰岩及頁岩之互層, 9 灰色及灰綠色之頁狀砂岩及砂岩。10 雲台觀石英岩 Yuntaikwan Quartzite. 11 下部陽新石灰岩 Lower Yanghsin Limestone.

(9) 龍馬頁岩　鄂西鄂北含筆石之頁岩,在岩石性質上,雖有不同,然其化石之內容一也。故龍馬頁岩之名稱,可兩地適用。第六圖中之 3 至 6 屬龍馬頁岩。其底部爲黑色頁岩,厚約二十五公尺,中部富含筆石。此黑頁岩之分佈甚廣,凡境內艾家山層之上,莫不有之。頂部之筆石頁岩層顏色灰褐,厚二十餘公尺,距底部四百餘公尺;所產筆石,不若在其底部者之多。其採自大洪山之黑色頁岩中者,經大略鑑定,有下列數類:—

Rastrites

Climacograptus

Diplograptus

Glyptograptus

Monograptus

(10)仙居層　第六圖中之7至8爲仙居層,厚約四百公尺以上。其大部份爲深綠化之硬頁岩,層疊頗厚。其餘之上部厚約五十公尺,爲石灰岩薄層及頁岩之互層。此互層石灰岩之呈結核狀者,特多化石。曾於仙居之南,鹽池廟之西,隨意拾取此互層灰岩之崩解層塊,輒得完美化石。種類頗繁,而以*Favosites* 及 *Halysites* 爲最著。境內其他各處,亦時見此二種珊瑚。惟南漳之西,本互層灰岩內之化石較少。

A. 荊門仙居附近本層內之珊瑚

Favosites tachlowitzensis Barr.

var. *lentiformis* Grabau

Favosites sp.

Halysites cf. *cratus* Eth.

Halysites cf. *hupehensis* Grabau

B. 荊門鹽池廟西毛坪東北一里本層中之珊瑚

Favosites nucleolatus Grabau

Favosites sp. (數種.)

Halysites sp. (數種.)

Heliolites megastomas

Heliolites bohemicus Wentzel

Heliolites sp. (數種.)

Syringopora sp.

Stauria sylindrica Yu (sp Nov.)

Eridophyllum sp.

Pselophyllum? sp.

C. 南漳城西九龍山本互層中之珊瑚

Palaeocyclus sp.

Favosites sp.

(11)九龍山層　九龍山層,或新灘頁岩之上部,爲第六圖中之9,厚約二百公尺。其岩石性質與其下之龍馬頁岩及仙居層

逈異。本層岩層色灰或灰綠,綠色者極爲少見;而砂質漸上漸富,故其下爲頁狀砂岩,上爲頁狀砂岩與砂岩之互層。砂岩層疊厚者較多,砂粒頗粗。在南漳之西及隆中之南,於本層頂部發見化石層二。一爲細砂岩,距頂二十公尺許,產 *Encrinurus rex* Grabau 及 *Strophodenta* sp. 一爲砂質頁岩,距頂三十至四十公尺亦產 *Encrinurus*.

總觀上列各部新灘頁岩中之化石,各與產生於鄂西龍馬頁岩,羅惹坪系與紗帽山層之中者,多屬同種。即以岩石之性質論,鄂西之龍馬頁岩以黃綠色頁岩爲主;羅惹坪系爲薄層石灰岩,灰質頁岩與黃綠色頁岩之互層;而紗帽山層,砂質較多,上部尤富,爲灰綠色頁岩及砂質頁岩所組成。其各與上述之三部,亦復大致相同。故本調查範圍內之新灘頁岩,亦可全歸下志留紀。又於鄂南咸寧志留紀層之上部,建章曾得 *Encrinurus rex*. 按其層位,應與九龍山層之三葉蟲層相當。此化石層之分佈,可謂廣矣。

VII 泥盆紀

(12)雲台觀石英岩　九龍山層之上,巫山石灰岩之下,有石英岩層;顏色灰白,及呈肉紅;而其厚度自零以至六十度。隆中之南,板橋店南黃鶯山之南坡,及仙居與鹽池廟以西之一部,未見此岩。其他如南漳之西南,郭劉灣附近,尖峯頂之南坡及官橋舖與義合集之間,常夾露於其上下岩層之內,望之若帶,圍繞山腰。惟東橋鎮南之聊屈山與雲台觀之山頂,有最大厚度之石英岩,冠蓋於新灘岩之上。於是以雲台觀名之,用示特別。

與雲台觀石英岩相當之岩層,中國南部,最爲普遍。其最著者,爲長江下游一帶之梧桐石英岩。梧桐石英岩向以屬諸志留紀之上部。然丁文江先生以爲與其屬諸志留,不若改歸泥盆之爲愈。最近太湖北岸之同樣石英岩中,發現 *Lycopodials*, 對

於丁先生之提議,頗有貢獻。於是雲台觀石英岩試以屬於泥盆紀。

VIII 石炭紀至二疊紀

巫山石灰岩　巫山石灰岩位居雲台觀石英岩之上,已如上述。二者之傾角雖無差異,然以化石論,其間至少缺乏下石炭紀之全部,有一平行不整一,自不待言。而雲台觀石英岩之厚薄不等,甚至於無,則又侵蝕之證據也。茲將本區域內之巫山石灰岩分爲二大部,即

上部—大冶石灰岩
下部—陽新石灰岩

(13)陽新石灰岩　陽新石灰岩與雲台觀石英岩,或新灘頁岩之接觸帶,時現斷續不連之炭質頁岩。炭質頁岩成分較高之處,往往成一不良之煤層;隆中現正開採,及郭劉灣附近與官橋舖西南之業已停開者,即此層也。依岩石性質,陽新石灰岩又可分爲三部。下部色灰塊狀;稍含燧石,而其底部二十公尺以內則絕無之。中部顏色深灰,層疊頗厚,燧石甚多。上部色亦深灰,層疊清晰,燧石頗少。第各處所見,此三部之分佈至不一律。襄陽之隆中,南漳之牛心寨,宜城之扁山,石虎寺,黃鶯山及尖峯頂等處,只留其下部,厚約八十公尺。於荊門之仙居附近及白雲山,鍾祥?之慌忙山,下部極不發育,中部厚約百公尺以上,上部約二百公尺。京山官橋舖與義合集之間,三部均見。於荊門盛京山所見者只其上部直接覆於新灘頁岩之上;而鹽池廟之西,或盛京山之北,下部全體及中部之一部皆形缺乏。據此諸種分佈情形而觀,鄂北陽新石灰岩前進覆蓋之象,甚屬顯明;而當時海水又似向西南前進。再就化石而言,下中二部化石甚豐;上部全未採得,或搜尋之未詳。茲將所得化石分列之:—

(a) 下部灰岩中之化石

(一) 南漳牛心寨及其附近之屯糧寨

有孔蟲類: *Schwagerina* sp.

Fusulinella sp.

珊瑚類: *Lonsdaleia* sp.

Tetrapora sp.

Vesotabularia tungliangensis Yu

Michelinia sp.

(二) 宜城扁山

珊瑚類: *Lonsdaleia* sp.

Michelinella sp.

Tetrapora sp.

腕足類: *Productus* sp.

Spirifer sp.

(三) 宜城石虎寺及鳳凰山

珊瑚類: *Tetrapora* sp.

Lonsdaleia sp.

Montilopora sp.

腕足類: *Reticularia* sp.

(b) 中部灰岩中之化石

(一) 荊門仙居西之仙居寺

珊瑚類: *Lonsdaleia chinensis* Girty

Tetrapora sp.

(二) 荊門慌忙山

珊瑚類: *Lonsdaleia chinensis* Girty

Lonsdaleia sp.

Tetrapora sp.

Amplexus spinosus

Michelinia minor Grabau

(三) 京山新河集

珊瑚類: *Tetrapora* sp.

Zaphrentis sp.

Siphonodentron sp.

Michelinia sp.

有孔蟲類: *Schwagerina* sp.

苔蟲類: *Fenestella* sp.

Fistulipora sp.

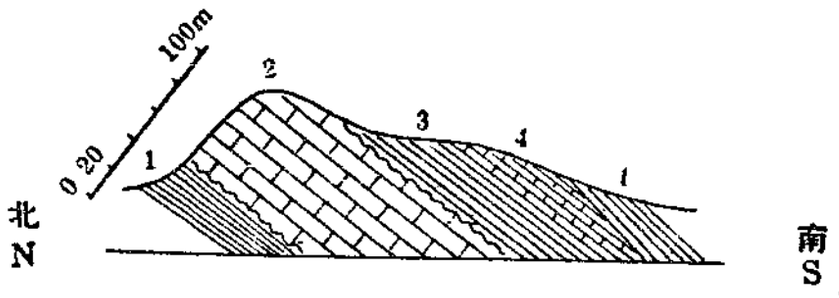
(四) 南漳關廟埡

珊瑚類: *Styloxis* sp.

上列諸化石,與採自棲霞石灰岩中者極相類似,屬上石炭紀[3]。然李仲揆教授最近於南京棲霞山,曾得*Doliolina Claudiae* Deprat, *Fusulinella inflata* Colani 及 *Fusulinella bocki* Möller. 據李先生之意見,棲霞石灰岩之一部屬二疊紀之最下部,而其他一部屬上石炭紀。然無論陽新石灰岩下中二部之時代如何,其上部必屬二疊紀。

(14)大冶石灰岩 本區域內主要之大冶石灰岩色淺灰而呈薄層,絕無燧石,下部間夾頁岩。其底部之岩層各處不同,而其所蓋覆者,亦隨地而異。隆中,牛心寨,扁山及黃鶯山等處,皆有厚約三十公尺之灰黃色頁岩,直接覆於下部陽新石灰岩之上,如第七圖;此灰黃色頁岩之上,有灰色薄層石灰岩,豐產頭足類之*Gastrioceras* cf. *zitteli* Gemm. 然在官橋鋪之西與東橋鎮南之大尖山,惟主要之大冶石灰岩與上部陽新石灰岩相接,其間未見灰黃色頁岩。而在南橋鋪西三里之鮎魚埡,則見緊承上部陽新石灰岩者,爲厚數公尺之礫岩,如第八圖;礫岩卵石爲陽新石灰岩,呈菱角狀。礫岩之上,主要之大冶石灰岩之下,復見*Gastrioceras* 層。但此化石層之顏色灰紅;其岩石性質,似與於扁山所

[3]趙亞曾著: 棲霞石灰岩之腕足類;中國地質會誌第六卷第二期。

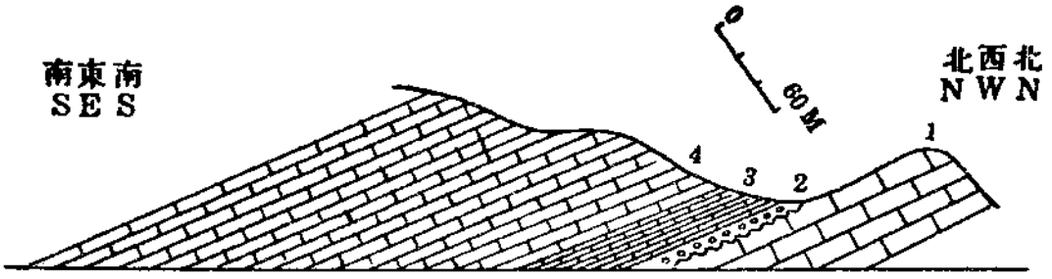


第七圖　宜城東北十里扁山剖面

Fig. 7—Section at Bienshan, 10 *li* N.E. of Icheng.

1 新灘頁岩 Sintan Shale. 1下部陽新石灰岩 Lower Yanghsin Limestone. 3-4 大冶石灰岩 Tayeh Limestone: 3灰黃色頁岩, 4灰色層薄石灰岩富含 *Gastrioceras*.

見者,略有不同。至於大冶石灰岩之全厚若干,未之能測。隧中之北,燈影石灰岩逆掩於大冶石灰岩之上。扁山,黃鶯山及牛心寨等處,發生斷層。自鮎魚垭以西,本灰岩亦以斷層與新灘頁岩相接;就其露出者而言,厚約二百公尺。其存留於盛京山及大尖山二向斜層之軸部者,厚不及百公尺。



第八圖　南橋鋪四三里鮎魚垭剖面

Fig. 8—Section at Nien-Yu-Ya, 3 *li* W. of Nanchiaopu.

1 上部陽陽新石灰岩 Upper Yanghsin Limestone. 2-4 大冶石灰岩 Tayeh Limestone: 2礫岩, 3灰紅色薄層石灰岩及綠色頁狀石灰岩,前者富含 *Gastroiceras*, 4淺灰色薄層石灰岩。

又於牛心寨南四道溝大冶石灰岩所夾之黃褐色砂質頁岩中,採得 *Sphenotus, Midiomorpha* 及 *Gastrioceras*. 就 *Gastrioceras* cf. *zitteli* 而言, 大冶石灰岩屬上二疊紀。如上所述,其底之岩層發生局部之差異,而其下之陽新石灰岩各處表示侵蝕不同之象;則至少鄂北之陽新與大冶二灰岩之間,有一間斷。又鄂西他處陽新石灰岩之上,有二疊紀煤系,而本區域內則未之見。該煤

系在鄂省東南之蒲圻,據李捷君之勘察,厚約八十公尺。謝家榮君於鄂西巴東所見者,厚只二三十公尺。於是若非二疊紀煤系停積時,本調查範圍內之情形特殊,則此煤系向西北有漸入於無之趨勢。

IX 三疊紀

(15)紫色頁岩及砂岩 於荊門東北三十里許之南漳河附近,一遇紫色頁岩及砂岩。全體無二色,頁岩較多,砂岩與之相互。下部未曾露出,露出者厚約三百公尺。其上有侏羅紀層。以此紫色層之岩石性質及其層位而言,應相當於蒲圻紫色砂岩,而同屬三疊紀。[1]

X 上三疊紀?至侏羅紀

(16)粗砂岩及含煤系 上述紫色層之上,大都爲粗砂岩。顏色黃白及灰黃,組織頗鬆,間夾頁岩。於南漳河以西及郭家溝一帶,概成高約百公尺以下之小山。底部有厚約二公尺之石灰岩層二,間以厚十公尺之砂岩。下部有礫岩層,厚數公尺;卵石多爲燧石,頗小而圓。中部爲含煤系;據郭家溝業煤者云,煤系厚約百丈,共煤五層,最厚在尺許。煤系黑色頁岩中,多植物化石;所採者爲 *Cladophlebis denticulata* Brongn. *Thyrsopteris Podozamites.*

本系與其上之紫色層之顏色截不相同,當由停積情形之各異。然二者地層上之眞確關係,未之明瞭。按上述植物化石,與謝君採自鄂西香溪上煤系中者,實屬相似。香溪上下煤系之間,亦間以礫岩層。於是本區域內紫色層以上,礫岩層以下之岩層,雖不含煤而又未得化石,然似相當於隸屬上三疊紀之香溪上煤系,其在礫岩之上者則爲侏羅紀。

[1] 李捷著:湖北蒲圻嘉魚咸寧崇陽武昌等縣地質;地質研究所集刊第三號,第17-19頁。

XI 第三紀

17 東湖系　東湖系在本調查範圍內,分佈最廣;對其就近之任何較老岩層,概成不整合之蓋覆。本系下部爲礫岩,在南漳附近,最爲發達,厚約百五十公尺;其在四望山者,傾角大至三十度,岩基紅色。卵石爲石灰岩及燧石,大小不一,形狀無定。礫岩下部百公尺以內,卵石之團結堅固;本地居民多以此岩作爲磨盤;但此堅固礫岩之厚度,於漢水之東,則形大減;如於鐘祥城東二十餘里之上中下三盤石崗所見者,厚只五十公尺。上部礫岩之卵石較少而小;漸變爲紅砂岩;而無顯明之分劃。紅砂岩大致粗鬆,層疊厚薄均有。於南漳城及武安壤之間,曾見紅砂岩之中部夾淺綠色之泥灰岩,上部有黃白色之粗砂岩。

四　構造

本區域內,斷層甚多,摺曲次之。就大體言,構造雖不複雜,惟以漢水流經一帶低窪之處,寬達五十餘里,第三紀及冲積層掩蔽其間,而其他平坦之區,亦多有新生層故諸山脈彼此之關係明瞭者,雖屬多數,而頗費研究者,亦復不少。茲先依山脈,分區述之,然後全體大要之構造,可得而觀焉。

(一) 襄陽南漳間

(1) 襄陽城西背斜與向斜層　城西十里之萬山有燈影石灰岩之頂部。其在山頂者,傾向南十五度西,斜角六十度。在山之北坡者,傾向北十五度東,斜角三十度。成一小背斜層。萬山南之千山亦爲燈影石灰石之上部。與在隆中者相聯屬;傾向北三十度東斜角二十五度,此二山之灰岩復成一向斜層;寒武紀層居其軸部,軸向約北七十度西。

(2) 諸葛祠北逆掩斷層　襄陽城西三十里隆中諸葛祠之南,大冶石灰岩之底部,陽新石灰岩及新灘頁岩等順次傾向北十五度東,斜角三十度;祠北爲燈影岩,卽上述向斜層之南翼,傾向斜角均無變更,逆掩於大冶石灰岩之上。

(3) 吳家集斷層　隆中南之新灘頁岩向南展佈,將近吳家集之北,一小段爲土所掩。集南爲宜昌石灰岩之中部,卽吳家集石灰岩,傾向仍爲北十五度東,斜角三十度。土掩之下,是否有消溪寺石灰岩及艾家山層,固不可必。但二者共厚約五百公尺,若以三十度之斜角計之,其露頭當遠寬於土掩之部。於是吳家集有一斷層,起自集西數里,其地方向南二十五至三十度東之小河流經之。

(4) 黃龍觀斷層　隆中之陽新石灰岩及新灘頁岩等順其南七十五至八十度東之走向,往東出露;迄抵襄陽附近虎頭山,忽爾終止虎頭山,鳳山,黃龍觀等爲燈影石灰岩所成。此灰岩大致傾向南三十度西,斜角三十度,西與新灘頁岩等以南北向之斷層相接。此斷層南起黃龍觀之西,北與諸葛祠北隆中逆掩斷層之東端相交。

(二) 南漳縣城附近

(1) 南漳背斜層　城西二里之太紅山及其西北十五里之大洪山,皆有艾家山層。其在太紅山者,發生局部縐曲,大致傾向北三十度東,斜角七十度以上;新灘頁岩反居其下。其在大洪山者,上有新灘頁岩,皆傾向北至北五度東,斜角四十五度。且自太紅至大洪,消溪寺石灰岩重復出露。於是成一倒轉背斜,名曰南漳背斜層,以消溪寺石灰岩爲其軸部;軸向北十五度東。

(2) 牛心寨與關廟埡之斷層　南漳背斜層南翼上之新灘頁岩向南分佈。至牛心寨之北,則爲雲台觀石英岩;寨頂爲陽新石灰岩及大冶石灰岩底部之灰黃色頁岩。諸岩層皆依倒轉次序,傾向北三十度東,斜角六十至七十度。惟寨南之大冶石灰岩

傾向相反,斜角約六十度以上,北與底部之灰黃色頁岩成走向斷層之接觸。自此以南,大冶石灰岩以薄層故,多小縐曲,至關廟埡之北,復與陽新石灰岩以斷層相接觸。此斷層約爲東西而稍偏南或北。

(3) 牛心寨與關廟埡間之向斜層　關廟埡之陽新石灰岩傾向仍爲三十度東,斜角三十餘度;但其次序不復顚倒,與在牛心寨者似有成一向斜層之趨勢。或者先縐曲而後發生上述之二斷層。

(4) 朝陽山逆掩斷層　此斷層方向爲北二十五度西,東北仰側爲宜昌石灰岩,傾向北十度東,斜角三十度;朝陽山,娘子尖及石灰山等皆爲之所成。西南俯側爲南漳背斜層北翼上之新灘頁岩,傾向斜角已如上述。故灰岩對於頁岩爲逆掩。

(5) 石門集向斜層　此爲倒轉向斜層,新灘頁岩位於軸部,軸向南八十度東。石門集南及集北鳳凰山兩處之艾家山層與宜昌石灰岩皆傾向北十度東,斜角三十度,各爲南北兩翼。

(6) 青龍寨逆掩斷層　自吳家集而西南,宜昌石灰岩以北十五度至二十度東之傾向,連續出露。至老關廟北三里許,爲其下部鹿門寺石灰岩,斜角六十度以上。該處鹿門寺石灰岩頂部之矽質石灰岩構成尖峯,北西偏北綿延聳峙,經過青龍寨之東北。而石門集北鳳凰山之宜昌石灰岩傾向北十度東,斜角三十度,順其倒轉次序,北至青龍寨,與上述之矽質石灰岩相接。故青龍寨之東,似有一斷層,方向南東;其東北仰側之下部宜昌石灰岩逆掩青龍寨宜昌石灰岩之上。不然,何以鳳凰山之岩層倒置,而在其東北者則否? 若謂此處發生背斜層,鳳凰山爲其西南翼,故東北翼岩層之次序恢復原狀,亦頗近理。但鳳凰山之宜昌石灰岩非其下部,背斜層說恐難成立。

(三) 仙居及鹽池廟之西

(1) 仙居背斜層　仙居東南之毛家寨爲陽新石灰岩,傾向北三十度東,斜角五十度。其西六七里之尖山一帶,亦爲陽新石

灰岩,傾向南西,斜角約四十度。故兩處灰岩成一背斜層;厚薄不等之雲台觀石英岩及新灘頁岩居其軸部,軸向約南三十度東。

(2) 毛坪背斜層　此背斜層在上述者之南。情形相同,本兩相銜接。惟其間分水埡之陽新石灰岩之露頭隔斷,而分爲二背斜層。

(3) 仙居寺逆掩斷層　仙居背斜層之西南翼,發生走向逆掩斷層。自尖山西至仙居寺,新灘頁岩及陽新石灰岩重復出現。仙居寺之新灘頁岩及陽新石灰岩傾向南五十度西,斜角四十五度。是爲斷層西南之仰側。

(4) 泉口斷層　毛坪背斜層西翼之南端,有方向約南二十度東之斷層,長不及十里。該處陽新石灰岩忽傾向北六十度西,斜角四十五度,與其東翼之陽新石灰岩相合於泉口,泉自斷層流出,泉口之名當原於此。且泉口附近有小斷層數,均不克於地質圖中表示之。

(四) 南橋舖與荊門縣城之西

(1) 盛京山東逆掩斷層　自泉口而南,經南橋舖之西,以迄荊門城西之象山,陽新石灰岩初傾向北西偏北,往南漸轉而南,西偏西。在南橋舖西數里之鮎魚埡,陽新及大冶二石灰岩傾向北西北,斜角約廿度。將近盛京山東麓,發生南北向之斷層。西爲仰側,即傾向西南稍南,斜角約三十度之新灘頁岩,與其東俯側大冶石灰岩相接。故此斷層不徒逆掩,且爲斜交。於盛京山之南數里,新灘頁岩及大冶石灰岩之露頭皆行絕斷;北向延長,所見二十里許。

(2) 盛京山向斜層　盛京山東麓新灘頁岩上之陽新石灰岩褶曲以成向斜層;軸部尙有厚約六十公尺之大冶石灰岩,構成偏尖冠,盛京山,白岩山等峯;軸向幾近南北而稍西,兩翼上地層斜角均約三十度,甚爲對稱。

(3) 盛京山西斷層　盛京山西坡爲侏羅紀層,傾向東而稍北,斜角三十餘度。於是與盛京山向斜層西翼之陽新石灰岩成斷層接觸。此斷層南起荊門城西,北向經羅漢山,白岩山,盛京山及偏尖冠等之西,約三十餘里,而尙未知所止。

(4) 西莊河斷層　上述侏羅紀層向西展佈。至南漳河附近,見其下之三疊紀紫色岩層,傾向斜角無大變更。再西至西莊河,侏羅紀層復現,傾向大致西而稍偏南或北,斜角二十至三十度,東與紫色岩層成斷層接觸。自北而南之西莊河,上段名香爐溝,流經斷層線。

(五) 漢西第二支山脈之中段

(1) 神農山斷層　神農山與金牛山一帶之宜昌石灰岩,與在劉家坡以西及牌亭子以東者向聯屬,傾向西稍偏南,斜角三十度左右。牌亭子以西,爲新灘頁岩;再西至白雲山,爲陽新石灰岩,傾斜仍前。但神農山西麓,只見狹而不聯之新灘頁岩露頭;白雲山之陽新石灰岩不得順其走向,往北出露於神農山之西。故神農山西麓有南北向之斷層。自該山而南,長約二十餘里。

(2) 羅鐵溝斷層　白雲山之陽新石灰岩及牌亭子以西之新灘頁岩,以南北向之羅鐵溝爲界線。因該處新灘頁岩之露頭甚狹,上部未見,故羅鐵溝爲一斷層。

(3) 石龍寺逆掩斷層　白雲山東北十餘里之石龍寺,有艾家山層,傾向南十七度西,斜角二十度;其東南及西南兩方面,皆爲傾向南西偏西之新灘頁岩。於是該處之艾家山層逆掩新灘頁岩。

(5) 交子領西斷層　夫子垭之西,燈影石灰岩之上,有劉家坡砂岩。由此南至交子領西麓,宜昌石灰岩直接與燈影石灰岩相接。再南至大魚口西三里之劉家坡,砂岩復現,但其上宜昌石灰岩之露頭甚狹,中下兩部之大部份皆未之見。凡此諸種變動,

皆由交子領西發生斷層之故。此斷層之方向大致南北而略西偏；劉家坡砂岩爲其北段所掩，而劉家坡以西宜昌石灰岩之厚度又爲其南段所減。

(5) 交子領東斷層　夫子堰，大魚口及放馬山以西一帶，燈影石灰岩傾向南六十至七十度西，斜角三十度上下。厚不過四百公尺；其下部或中部岩層，如出露於襄陽縣城附近之虎頭山及黃龍觀等處者，概未之見。且與之相接之岩層，在大魚口及放馬山，爲大魚口砂岩，而在交子領東麓，則爲前震旦紀花崗岩。故順燈影石灰岩之走向，北起夫子堰，經交子領之東麓，南達放馬山，有一斷層，長四十里許。

(6) 大魚口及劉家坡間之褶曲　大魚口西，燈影石灰岩傾向南七十度西；往西漸變爲東北東，成一小向斜層；更西至劉家坡復爲南西偏西，成一背斜層。

(六) 漢西第二支山脈之東南端

(1) 仙女山斷層　宜昌石灰岩之上部及其中部之一部份出露於朱家埠南之仙女山及郭劉灣東北諸山一帶；斜角八十度左右；傾向西南西偏，但有時傾向北東偏東，以呈倒置之象。蓋以此岩於仙女山之東，與燈影石灰岩底部岩層成斷層接觸；斷層起自仙女山，東南迄郭劉灣附近流向東西之小河。該處變動急烈，能使斜度甚大之宜昌石灰岩之傾向，忽東忽西。以致郭劉灣東北之新灘頁岩，傾向東北東，反壓於艾家山層之下。其實該灣附近之新灘頁岩大致傾向南西偏西，似無顯明之背斜層，或斷層可覩。

(2) 華山觀向斜層　仙女山東麓燈影石灰岩底部岩層傾向北東偏東，往東至華山觀，和緩縐曲，以成小向斜層，其兩翼上岩層之斜角均約二十餘度。

(3) 慌忙山與石門山等處之褶曲　郭劉灣附近新灘頁岩，雲台觀石英岩及陽新石灰岩繼續傾向南西偏西。西南至石門

山,陽新石灰岩成一向斜層。而在石門山灰岩與在其南慌忙山者復成一背斜層。褶曲軸向西北東南。

(4) 慌忙山斷層　於郭劉灣附近之東南,新灘頁岩及雲台觀石英岩之露頭,忽然斷絕,顯因慌忙山之東,有一南北向之斷層;斷層東西兩旁,皆爲陽新石灰岩,傾向不同。自荊門胡家集至郭劉灣,取道於此。

(5) 郭劉灣斷層　郭劉灣附近,有流向東西之小河。河北爲宜昌石灰岩。南爲新灘頁岩;而後者厚度甚小。故沿小河,亦有斷層;與在慌忙山之東者,似相交於郭劉灣。

(七) 豐樂河而北至襄宜之界山

(1) 仙居山斷層　自豐樂河而北,新灘頁岩傾向北東北。將近仙居山之南麓,斜角甚大約八十度,與宜昌石灰岩以斷層相接。此灰岩傾向北二度東,近斷層之斜角較大,稍遠約三十度左右。斷層起自溫泉之南里許;東向二十里至王家大山之西南,折而南東者數里。

(2) 金龍山南北斷層　仙居山之宜昌石灰岩繼續北東偏北之傾斜。往北至金龍山之南,艾家山層及新灘頁岩次第出露。但金龍山爲傾斜仍前之宜昌石灰岩所成,故該山灰岩逆掩於其南新灘頁岩之上。金龍山北麓,有傾向仍爲北東北之新灘頁岩,與宜昌石灰岩成斷層接觸。再北,復有艾家山層,傾斜同上,逆掩新灘頁岩。共計金龍山南北斷層凡三,皆平行于地層走向。因該處新灘頁岩之二露頭極狹,地質圖中均不克表示之。

(3) 馬頭寨逆掩斷層　自仙居山至王家大山之東,宜昌石灰岩之傾向轉變爲北五十度東,斜角約四十度。王家大山艾家山層之上,有寬不及一里之新灘頁岩露頭。至馬頭寨之西,則爲傾向約北六十度東,斜角三十度之艾家山層,對於西南之新灘頁岩,自以斷層逆掩之。斷層東南至青頭山,即行終止;且與金龍山北之逆掩斷層似相聯屬。

(4) 臥牛山斷層　金龍山北之新灘頁岩繼續約二十五度東之傾向,抵尖峯頂。其上之雲台觀石英岩及陽新石灰岩,順次顯露。惟尖峯頂北之臥牛山爲傾向仍爲北東北之宜昌石灰岩所成。臥牛山北之金銀頂有傾向北東北之陽新石灰岩,而山東七八里之大泉畈及其西麓,皆爲新灘頁岩。則是臥牛山四面皆爲斷層所包圍。在其南及北者,爲走向斷層;在其東及西者,則爲斜交。且臥牛山爲漢水第二支山脉高峯之一,此支山脉之方向,在由陽新及大冶石灰岩所成之黃鶯山及金銀頂一帶,西東而稍偏南;至臥牛山,忽變爲自北而南;至尖峯頂,復爲西東。凡此山脉方向之變更,與夫陽新石灰岩露頭之移動,皆與臥牛山北西南三斷層密切關係。

(5) 關門山斷層　大泉畈以東之新灘頁岩,北至關門山之南坡,與傾向北東北之宜昌石灰岩成斷層接觸。此斷層之方向東西而偏南,西端與臥牛山東之斷層相交。

(6) 陰河斷層　黃鶯山之陽新及大冶石灰岩傾向北二十度東,斜角五十度左右。山北陰河兩岸之岩層,大相懸殊。河南爲第三紀礫岩,并有宜昌石灰岩少許;河北爲片岩。故陰河自東而西,河經斷層,且約略平行於黃鶯山岩層之走向。

(7) 扁山西斷層　扁山西麓,有新灘頁岩之上部,與宜昌石灰岩之底部,以斷層相接。此斷層起自南瓜店,向南延長數里。

(8) 扁山東逆掩斷層　扁山新灘頁岩之上,有陽新石灰岩及大冶石灰岩,傾向南六十五度東,斜角三十度。扁山之東爲傾向相同,斜角較大之新灘頁岩,逆掩於該山大冶石灰岩 *Gastrioceras* 化石層之上。此斷層自此而南約數里,曲向東南,經過石虎寺與馬頭山之間,以迄陰河西畔;傾向北東偏東之新灘頁岩及陽新石灰岩,重復出露於石虎寺及馬頭山者,職是之故。

(9) 兩乳山斷層　兩乳山爲鹿門寺石灰岩頂部之矽質石灰岩,傾向北東偏東。扁山東之新灘頁岩至兩乳山之西麓,自以斷層與該矽質灰岩相接。

(10) 兩乳山與石虎寺間之斷層　兩乳山位居石虎寺之北一爲宜昌石灰岩,一爲陽新石灰岩;其間自有一斷層。

(11) 南瓜店斷層　南瓜店之北,宜昌石灰岩底部岩層傾向北而稍偏東。扁山及兩乳山之諸岩層,北向至此,皆爲之截斷。

(12) 新街斷層　新街附近,片岩之露頭寬廣。其北及西兩方面,皆與鹿門寺石灰岩成斷層接觸。此東西及南北二斷層相交於新街。一向西延長於宜昌石灰岩之內,未知所終。一起自黃鶯山之北麓,經板橋店及新街之西,似復由新街略折而西北,以達馬耳山之西南。蓋此斷層西北段爲自北而南較爲平坦之途;而馬耳山之宜昌石灰岩傾向北東北,與其西南艾家山層之間,自有一斷層。

(13) 襄宜界山之褶曲　襄宜間界山之大部份由鹿門寺石灰岩所成,前已述之。然其露頭甚闊,自有小褶曲及斷層。據所見而言,漢東李家大山(卽本支山脈之西端)與其東北小團山之間,有一背斜層;自霸王山北至獅子山,初成背斜,復成向斜;由鷄鳴山北抵排山,先見向斜,旣見背斜;而自新街東之珍珠泉往北以至大峯頂,其間褶曲似與於鷄鳴及排山間所見者相同。要之,諸褶曲之軸向大致東西,而稍偏南或北。是否彼此聯貫,則未之知。大約敍述,以示該山脈鹿門寺石灰岩分佈寬廣之原因。

(八) 漢東第三支山脈

(1) 馬家坡,猴王寨及保福寨一帶之背斜層　漢東第三支山脈之西北端,卽溫泉至王家大山等處之構造,於上第七節,已曾及之。本節所述者,自馬家坡東南以達京山縣城之東北。其構近極形簡單,爲一背斜層。大半以消溪寺石灰岩及艾家山層居其軸部,以形成本支幹部山脈。其走向與幹部山脈之方向大致相符;新灘頁岩在其兩翼。又新灘頁岩與艾家山層之接觸帶,時見斷層,然多未足輕重者。

(九) 漢東第四支山脈

(1) 大尖山向斜層　上述背斜層之西南翼,往西南方向,成一向斜層。大尖山之大冶石灰岩及陽新石灰岩居於中心,軸向約北四十五度西。

(2) 新河集背斜層　自大尖山而南,復有一背斜層。新河集之新灘頁岩出露於其軸部。兩翼皆爲陽新石灰岩。大尖山向斜層之西南翼,卽此背斜層之東北翼。背斜層軸向約北七十度西。

(3) 新河集與義合集間之向斜層　自新河集而南至義合集,陽新石灰岩復行縐曲,以成向斜;軸向幾近東西。

(4) 雲台觀斷層　雲台觀在大尖山之西。大尖山向斜兩翼之陽新大冶二石灰岩於觀東與雲台觀石英岩相接,故該處有一南北向之斷層。

(5) 羅家橋斷層　羅家橋與義合集之北,有東西向之斷層,長約二十餘里。北爲俯側,卽新河集與義合集間向斜層層之南翼。其南仰側爲新灘頁岩之上部岩層,傾向南而稍西偏。

(6) 會亭山斷層　京山縣城西南,艾家山層以斷層出露於新灘頁岩之內。地質圖之縮尺過小,無法表明。但城南之會亭山爲宜昌石灰岩所成。山之東爲浮土所掩;其西與陽新石灰岩成斷層接觸。

(十) 總論

調查範圍內,山地所佔之面積頗小。以上零星敍述,對於襄陽以下漢水流域之地質構造,難多貢獻。但合而觀之,以追求諸山脈彼此之關係,則知境內斷層雖多,而縐曲之勢力亦殊不弱,似無所軒輊於其間。縐曲之顯明者,前已一一言之。其不甚顯明,由觀察上列事實而知,尙須於此補述者,一爲張家集向層斜,一爲宜城背斜層。

(1) 張家集向斜層　參閱孟君遠安當陽地質圖,遠安之西,自奧陶紀以至白堊紀諸岩層東向傾斜;荊門之西,侏羅紀層傾

向西而稍南。是爲一複雜大向斜層。其東翼卽漢西第三支山脈之仙居寺嶺京山一帶。於此一帶發生局部褶曲及斷層，以致陽新石灰岩之傾向或爲北東，或南西偏西。大致言之，此灰岩與其東白雲山及慌忙山之傾向南西偏西者，有成向斜層之可能。雖其間之構造爲新生層所掩，然大規模之褶曲運動鮮有至此忽然終止之理勢。張家集適居此向斜層之中心，故名。其軸向南東偏南。

(2) 宜城背斜層　宜城與豐樂河間沿漢水一帶，地層走向約爲西北東南三十至六十度。漢東地層傾向北東北；在其西者，卽張家集向斜層之東北翼，傾向南西偏西。是以復成一大背斜層，流向南東偏南之漢水，大致與其軸向平行。而宜城位於漢濱，故以名之。然此大背斜層兩翼上地層極不齊整。西南翼自迫近漢水之大魚口而西，前震旦紀之花崗岩以迄二疊紀層次第顯露。而其東北翼迫近漢水一帶，全無奧陶紀以下之岩層；且自豐樂河而北，奧陶，志留及石炭二疊紀層重見疊出，若按其露頭而引長之，則斜交於漢水河谷。據此種種情形而言，背斜層似不能成立。但其所以若是之不整齊者，乃背斜告成之後，(a) 順軸向發生斷層，漢東之老岩層爲之沉蔽；(b) 如前所述，豐樂河以北有斜交而角度甚小之階級斷層，故重見疊出諸紀岩層之露頭，有斜交於漢之趨勢。

茲將調查結果歸納之：(a) 第三紀以前各時期地層同受整一褶曲。(b) 境內北及東北部地層之走向爲西北西，或南東兩；至其中部，走向漸變爲北西或南東；而在其西南部者爲北西北，或南東南。(c) 數褶曲皆向西南倒轉 (d) 走向斷層較多；卽有斜交者，角度亦小。(e) 大多數逆掩斷層面之西南部皆爲俯側。及 (f) 第三紀層之斜角自數度以至三十度。由 (a) 點而言，與葉良輔[5]君之研究"長江諸省之褶曲始於白堊紀之末葉，而

[5] 葉良輔著：　長江流域巫山以下之地質構造及地文史；地質彙報第七號第87頁

終止於第三紀之前期,"極相符合。(b) 至 (e) 諸種現象表示當時造山之側面壓力,乃自東北而西南,或西南而東北。至於第三紀層之側角頗大,當受另一時期造山運動之影響。然此是否即爲喜馬拉雅期之造山運動,尚無充足之證據。

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