

THE GEOLOGICAL STRUCTURE OF THE HSUAN-HUA REGION

By C. C. SUN AND Y. L. WANG.

(With One Map and Five Text-Figures)

INTRODUCTION

The stratigraphical sequence in the Hsuan-hua region is, in general, almost identical with the usual type in northern China. The special feature is that the geological structure is, in fact, much more complicated than seen in other places. The Sinian siliceous limestone frequently lies over the Jurassic coal series, and in some cases the latter is included in the former. The geology of this region and its adjacent places has been already studied by several Chinese and foreign geologists, but as the main aim of their works was to examine the coal and iron resources or specially to study volcanic rocks, certain tectonic features have not been sufficiently worked out.

In the spring of 1929, under the instruction of Dr. Wong, director of the Geological Survey, the authors resurveyed this region. During the ten days field work it has been possible to work out in some detail the interesting geological structure of this region. The task was much facilitated of course by the earlier works especially those by Messrs. H. C. Tan¹ and H. S. Wang² already published in the earlier number of the Survey Bulletin.

SEQUENCE OF STRATIFICATION AND UNCONFORMITIES

In the region under discussion, the sedimentary strata which have been found to rest unconformably upon Archæan gneiss penetrated by the granite may be distinguished into five main formations as below :

Sinian formation: This formation belongs to the lowest portion of the sedimentary complex of Hsuan-Hua and in lower part mainly consists of quartzitic sandstone, quartzite and slate, with beds of iron ore. In its upper part this formation is composed almost entirely of siliceous limestone similar to the prevailing type in Nan-kow. The rock is mostly resis-

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1. H. C. Tan: Geology of Hsuan-hua, Cho-lu and Huai-lai districts, Bull. Geol. Surv.,¹ No. 10.
 2. H. S. Wang: The ancient volcanoes of Hsuan-hua, their rock types and geologic age. id.

tant to weathering and consequently often forming the highest hills in Hsuan-hua district and its neighbouring regions. Total thickness about 1,000 m.

Cambro-Ordovician formations: These formations in the area studied are almost entirely missing except in a valley east of Yu-tai-shan where, in a small area, the sediments have been seen to overlie the Siliceous limestone and comprise conglomerate, red shale and pure limestone similar to the Cambro-Ordovician formations of Pa-pao-shan (八寶山), probably of the same age.

Coal series: Unconformably overlying the Sinian formation is the coal series which is composed of alternating argillaceous or sandy dark-gray shale and coarse or fine gray sandstone intercalated with five or six coal seams (mainly anthracitic) and a few beds of gabbro. Toward the lower part the green-gray argillaceous shale becomes predominant. Thickness about 500 m.

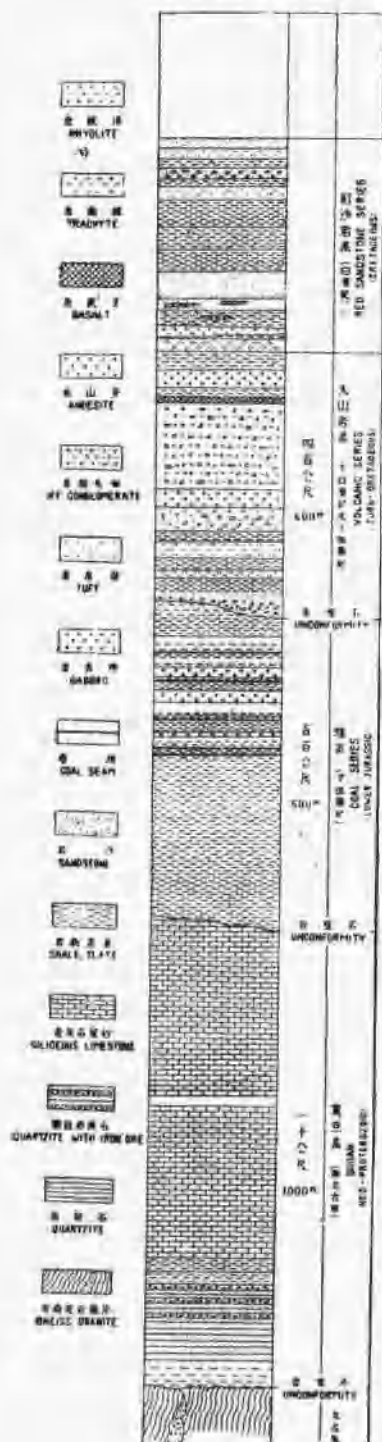
Volcanic series. Over the coal series unconformably lies a complex of volcanic rocks and subordinate sediments. The lower part of the complex comprise conglomerate and tuff, with plant-bearing thin-bedded shale and stratifical lava flows, mainly andesite. The upper part largely includes gray, red and green tuff-conglomerate with the layers of shale, basalt and andesite. Total thickness about 400 m.

Red sandstone series: The volcanic rock series is, in turn, directly succeeded by weakly consolidated red sandstones with the banks of conglomerate and shale, sometimes with the layers of whitish green colored tuff (?). The upper part of the formation was eroded away, the real thickness is not estimable, but to the remaining parts a thickness of about 300 meters is given by estimates.

The last three formations have been regarded by Mr. H. S. Wang, basing on the evidence of the fossils they contain, as belonging to Lower Jurassic, Jura-Cretaceous and Cretaceous respectively.

The sequence of stratification having been roughly traced, now we may take up the tectonic feature between the formations.

From what has been said above, we have found that there are two unconformities (see Fig. 1, P. 3) (a) between coal series and Sinian formation and (b) between volcanic rock series and coal series.



(a) Both at the southern slope of Huang-yang-shan (黃陽山) and the eastern foot of Yu-tai-shan (玉帶山), on the eroded surface of the Siliceous limestone we found the coal series with thick argillaceous shale at the basal part. But in the valley near Hsi-yao-kou (西窯溝), shale beds are entirely missing, only its successions, namely a complex of pletic and psammitic rocks of upper coal series have been seen to rest directly disconformably on the siliceous limestone. Thus the coal series evidently represents sediments which were deposited within a broad and shallow basin of Sinian limestone. Probably the deposition of the former was preceded by a period of far reaching denudation when almost the whole system of Palaeozoic and Lower Mesozoic was removed and followed by a tectonic movement, under which a gently sloping depression occurred in the region between Hsi-yao-kou and Yu-tai-shan.

The deposition of the shale of lower coal series is limited within the bottom of this depression, but higher horizons, viz, alternations of shales and sandstone begin to reach its flank near Hsi-yao-kou. Though within a small area the coal series seems to be disconformable above the limestone mass, yet the unconformity between them is, in fact, of great profundity.

(b) Another important unconformity separates the coal series from the overlying formations i. e. from volcanic series to red sandstone series. As to this hiatus Mr. H. S. Wang has given an interesting description

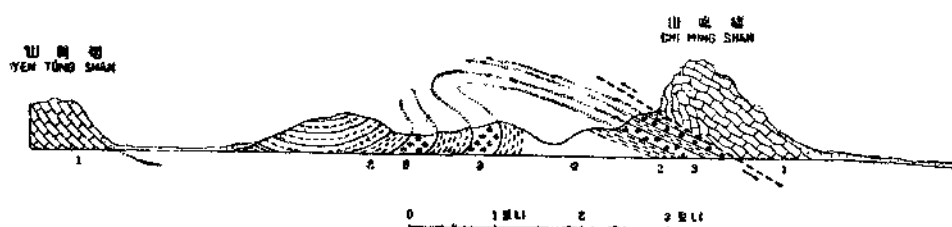
as below: "Prior to the ejection of the lava, there had been an orogenic movement by which the coal series was folded. After or accompanying the folding, erosion was effective, disclosing the older strata, such as the Sinian and Archæan by removing their respective superformation. Upon this eroded surface, the volcanic tuff and agglomerate were deposited accompanied occasionally by lava streams. Our observation has shown that the uppermost red sandstone series had not been subjected to any mechanical disturbance until the beginning of Tertiary which fact suggests that the cessation of the Upper Jurassic movement can not be later than the Middle Cretaceous."

As the coal series is of Jurassic age and the volcanic series of Jura-Cretaceous, the movement to which the unconformity (b) was due is more probably to be dated at the end of Jurassic. This was however not the last movement. There was another tectonic movement posterior to the volcanic and red sandstone series of Cretaceous age which is the last but not the least orogenic activity and to which the major structural features of this region owe their existence. These features are the main object of the present study and will be described in the following.

PA-PAO-SHAN AND CHI-MING-SHAN OVERTHRUSTS.

Pa-pao-shan has not been visited by the authors, according to the report of Mr. H. C. Tan an overthrust occurs at the southern slope of the said hill, running roughly in E-W direction for about 10 km. It often brings the Sinian and Cambro-Ordovician strata in a direct contact with the coal series and the tuff formation.

Chi-ming-shan (鷄鳴山) is situated not far E. of Hsia-hua-yuan (下花園) village. It is an isolated hill of Sinian limestone with an altitude of about 400 meters above the plain, which easily attracts the eye of any one travelling on the Peiping-Kalgan railway. The field study on this hill shows to the authors that the limestone is so profoundly folded that it is represented by a recurrent, overturned anticline overlying younger sediments by a gently inclined thrust plane beneath the anticlinal strata. It is clear that there is an overthrust from the south northward thrusting the Siliceous limestone over the coal series. (see Fig. 2.)

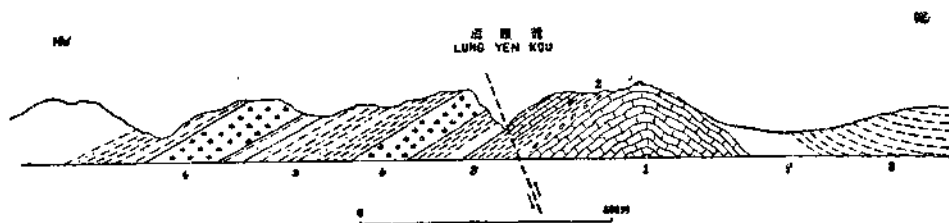


1. Siliceous Limestone. 2. Coal Series, Shale. 3. Gabbro.

Fig. 2. Section Showing Chi-ming-shan Overthrust.

On the summit of a hummock about 3 li N. of Chimingshan occurs an isolated calcareous mass lying over the coal series and having been completely cut into blocks. It seems highly probable that these limestone blocks represent the northern extension of the Chimingshan limestone. The rock had probably once a wider distribution toward north, but is now reduced to a great extent by erosion and erosion remains have been detached from each other. If so, the Chimingshan overthrust must have a great lateral throw.

In the Lung-yen valley (龍眼) W. of Yu-tai-shan near the Western bank of Yang-ho (洋河) river the Siliceous limestone is abruptly arched up from the coal series which here forms hummocks. This arched rock on the north is limited by an overthrust. (see Fig. 3) which is easily distinguished by its throwing the limestone from south northward over the rocks of coal series.



1 Siliceous Limestone. 2 Cambro-Ordovician.
3 Coal Series Shale & Sandstone. 4 Gabbro.

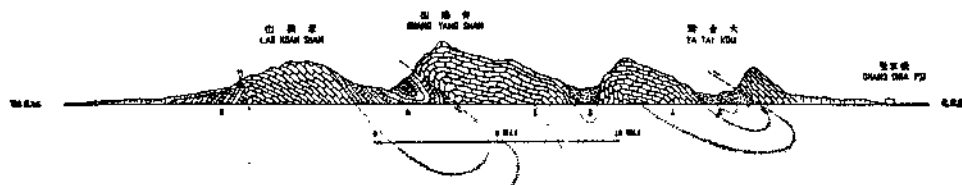
Fig. 3. Section near the Eastern Foot of Yu Tai Shan

It is highly probable that the Lungyenkow thrusting is the western extension of the overthrust running from Pa-pao-shan westward across Chiming-shan, where it, as has been stated, characteristically develops. However the Lungyenkow thrusting plane is, due to the low degree of compression under which it occurred, so steep that it almost becomes a normal fault.

TA-TAI-KOU OVERTHRUST AND FOLDING IN ITS NEIGHBORING REGIONS

As shown in the tectonic map, the western end of the Lungyenshan overthrust may go further west through the coal series to Ta-tai-kou (大台溝) valley N. of Ch'en Chuang (沈莊), therefrom westward it probably dies out.

In the said valley disconformably over the Sinian limestone lies the beds of coal series, all dipping to the southeast. The strata of the coal series seem to converge downward, which facts suggest that there is a closed syncline. Thus on the southern limb of the syncline Jurassic strata are in turn overlain by the Sinian limestone with a layer of dynamic breccia or mylonite at the base. There is thus an overthrust, thrusting the Sinian limestone from southern to north over the coal series (see Fig. 4).



1. Siliceous Limestone. 2. Coal Series Shale. 3. Taif-Conglomerate.

Fig. 4 Section Showing Ta Tai Kou & Hwang Yang Shan Overthrusts.

The thrust limestone is well exposed N. E. of Ch'en Chuang and constitutes a high hill. In several places north of this overthrust the strata from the Sinian limestone up to the coal series had been strongly affected by the tectonic movement under which the Ta-tai-kou overthrust occurred, so that they developed in anticlinal and synclinal folds. At a place N. of Hou-chia-po (侯家坡), for instance, the lower beds of the coal series lie in a narrow closed syncline, the axis of which extending towards NE. Toward the east as can be seen in the tectonic map, it broadens and becomes an open syncline, the Yuan-pao-shan limestone forming its northern limb and its axis running from the upper end of Ta-tai-kou eastward through the Yu-tai-shan hill.

As has been appointed out above, it is highly probable that the overthrusts recognized at Pa-pao-shan by Mr. Tan and at Chimingshan and Ch'en-chuang by the authors are but successive segments of one important thrust extending over fifty Chinese li or approximately 35 kilometers.

HUANG-YANG-SHAN AND LAO-KUAN-SHAN OVERTHRUSTS

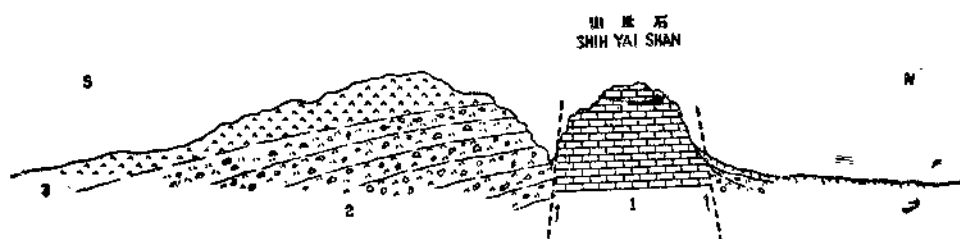
Huang-yang-shan is the highest hill in the country. Here the Siliceous limestone has, on the northwest, a precipitous cliff, which was considered by previous workers as due to a normal fault with a great vertical throw bringing the limestone in exposure and running from Hau-chia-po village northeastward through the northern foot of the said hill to Yuan-pao-shan, along a distance of about 30 li. By our recent observation the Huang-yang-shan limestone appears much disturbed with frequent minor foldings; and in its neighbouring regions the strata from Sinian limestone to the tuff formation, as observed at Wa-yao-kou (瓦窑溝) village and Lao-kuan-shan (see tectonic map), have been subjected to so strong movement of folding that at Lao-kuan-shan (老鸛山) the Sinian limestone is thrust from southeast northwestward over the tuff formation (Lao-Kuan Shan overthrust). In such a region of lateral compression normal fault is not likely to be predominant. These facts oblige us to think that as in the Chi-ming-shan area, the siliceous limestone forming Huang Yang Shan was strongly compressed from the south, so that it was first folded in an overturned anticline. The latter is subsequently broken on the north into an important overthrust from southeast toward northwest throwing the limestone over the younger formation (tuff conglomerate) as shown in Fig. 4. It is probable however that the lateral throw of the overthrust can not be more than one thousand meters, that is, it is smaller in comparison with the magnitude of that of Chimingshan overthrust.

WEI-TS'UNG-SHAN, SHIH-YAI-SHAN AND HUANG-TU-KOU
NORMAL FAULTS.

Besides the overthrusts above mentioned there are also a number of normal faults in the Hsuanhua region.

West of Wei-tsung-shan (威叢山) occurs a normal fault which has a NE and SW course. Its upthrow is on the east side. The existence of the fault is suggested by the fact that the Sinian limestone is brought in the same level with the tuff formation.

About 30 li southwest of the Hsuanhua city, occurs a most striking feature in the isolated hill (named Shih-yai-shan or rocky-cliff-hill) of Siliceous limestone, rising abruptly from the tuff formation (Fig. 5). This was described by Mr. H. C. T'an as a horst block on all sides limited by



1 Siliceous Limestone 2. Agglomerate 3. Trachyte

Fig. 5 Section Showing Shih-Yai-Shan Horst

normal fault. The correctness of this interpretation has been since doubted by several geologists, and the question was asked whether this limestone may not be of exotic origin brought here by an overthrust. Our careful investigation of the contact zone between the limestone block and the tuff formation has shown that Mr. T'an's consideration is quite correct. The limestone lies nearly horizontal. The surrounding formation tends to dip from the limestone mass outward, suggesting that it is dragged by the rising of the limestone block. In the valleys around the limestone block the faulting contact with the tuff agglomerate can be clearly seen. The contact surface of the limestone has the vertical polished grooves nearly perpendicular to the bedding plane, indicating that the movement of the limestone mass was from below upward. As to the origin of the fault of such circular shape, we may imagine that under the limestone block lies a body of magma, the former has been heaved up by the same ascending force acting on the magma.

The Huang-tu-kon (黄土溝) normal fault is developed near the Huang-tu-kou village N. of Hsuan-hua city. The fault runs from E to W with its upthrow on the southern side, where the siliceous limestone is bent up so as to form the northern limb of the broad and shallow syncline (Hsuan-hua basin).

THE TECTONIC HISTORY AND THE DATE OF OVERTHRUSTING AND FAULTING

From what has been stated above we may deduce the complete history of overthrusting and faulting. After their deposition, the different formations up to the red sandstone, as described above, were affected by the orogenic pressure coming from the southeast. Consequently successive elevation (as in the present Huang-yang-shan range, this elevation may be

called Huang-yang-shan anticline) and depression (Sung-kan-ho 桑乾河 syncline shown in the tectonic map) were formed in the region in question. As the orogenic force continued northward from south the strata within the Huang-yang-shan anticline were additionally folded into minor folds. And the compression went so far as to make the folds overturned northward and the overturned limb of the folds was broken up into overthrusts such as observable in Chi-ming-shan and Huang-yang-shan.

The date of the overthrusting in the Hsuan-hua region was assigned by Mr. H. S. Wang to Pre-Oligocene time. From this direct field evidence it can be stated only to be posterior to the red sandstone series and prior to the red Hipparion clay.

The age of the normal faults is less certain. The authors are inclined to think that they are probably produced at the same period as the thrusts. The lateral compression coming from the south seems to be gradually but quickly weakened northward so that on the south the thrust prevails while on north the faults are mostly vertical.

GEOLOGY OF HSIUWU COAL FIELD, HONAN.

By T. F. Hou

(With 2 Plates and 3 Figures)

INTRODUCTION

The well known coal field of Hsiuwu hsien (修武) and a part of Chin-yang-hsien (沁陽) (Hwaichingfu), on which the Peking Syndicate and Chungyuan Mining Co. are working, is situated on the northwestern corner of Honan province, about 80 li north of Hwangho, 120 li west of Sinhsiang (新鄉) hsien, the intersecting point of Hankow Peiping Railway and Taoching (道清) Railway (Taokou to Ching-hwa), and about 220 li west of Taokou, the east Terminus of Taoching railway, where joins the Weiho (衛河) along which the coal may be transported by ships northeastward to Tientsin. The mining centre of this coal field, Peking Syndicate and Chung yuan Co., is 50 li south west to Chingyang and 30 li south east to Hsiuwu respectively.

The districts mentioned above have been visited by several geologists, von Richthofen¹ in 1870, E. T. Nystrom² in 1917 and T. Liang³ in 1918 etc. Most of their observations are interesting to the special lines of mineral deposits and mining industry while a general description of physiographic feature of this part has been given by Richthofen.

The coal field extends for a known distance of 23 kilometers along the base of the foothills accompanying the main Taihang mountain range, which is really the rim of the great Shansi plateau. On the southern foot of Taihang Shan, the coal field extends on both sides of the frontier between Hsiuwu and Chinyang districts. So that the coal field lies in the intermediary belt between Taihangshan on the north and the great Hwangho plain on the south. The general shape of the coal field is a strip running almost due E-W but in its eastern part turning more to NE.

On the north border of the coal field, there rise a series of hillocks running almost in east-west direction with their elevations about

1. Von Richthofen. China P. 537

2. E. T. Nystrom. The Hsiuwu and Chinyang Coal Field.

3. T. Liang, Report of Hsiuwu & Chinyang Coal Field and Iron ores.

150 m above the loess plain. The surface of the main coal bearing area is on the whole almost flat, only gently sloping towards the south. There is a moderate covering of loess and alluvial sands and gravels up to 20 metres thick. This covering is here and there deeply cut by dry river beds, running mostly in a SSE direction, coming from the north and cutting through the hillocks on the northern border.

The field is limited to the north by the said hillocks which are mostly built up by Ordovician limestone. The rivers in this district are all small dry beds, the comparatively bigger ones are the Tashiho on the west, Yenho on the middle and Shanmenho on the east. The whole field is in reality part of the western indentation of the great Honan plain.

The railway, joining Chinghua on the west and Taokou on the east, just runs through this coal field and intersects Ping-Han (Peiping-Hankow) railway at Sinhsianghsien. The coal mines are concentrated on the north of Taoching railway near Chiaotso (焦作) and Liho (李河) station.

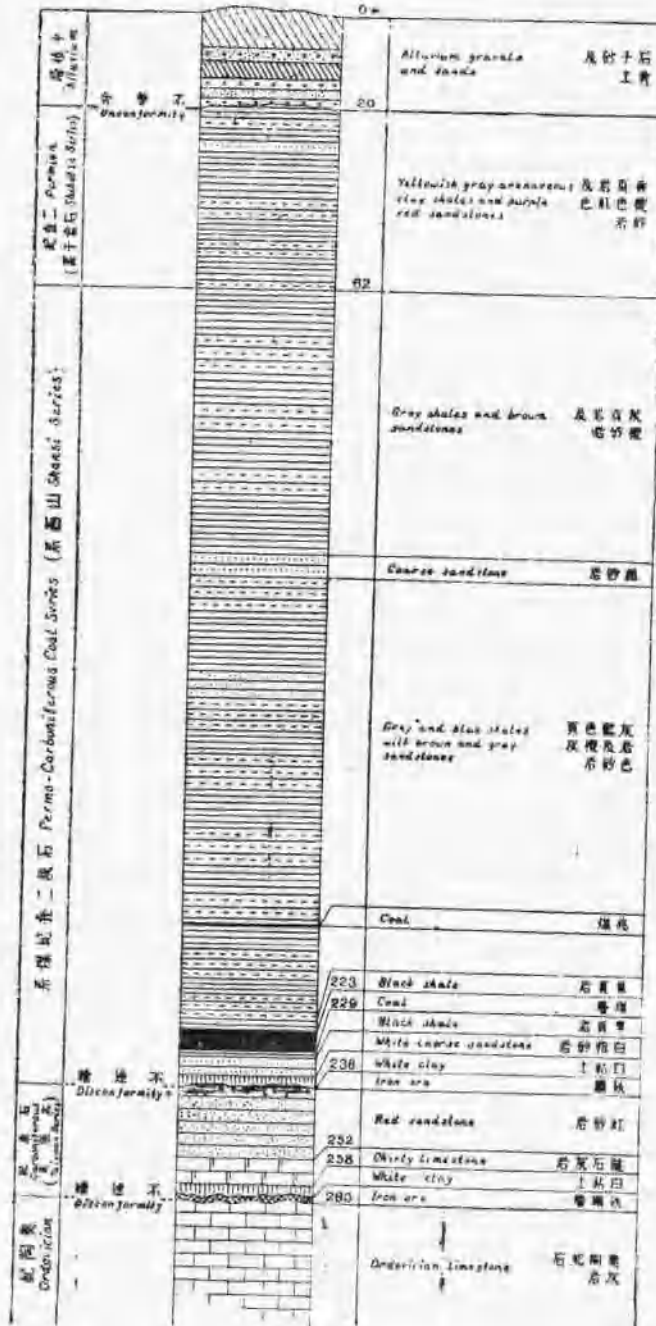
I wish to express my indebtedness to the officers of Chungyuan Mining Co. and the professors of Fuchung University who have given many informations during my visit to this coal field in 1929.

STRATIGRAPHY.

On the north border of the coal field, only the Ordovician limestone covered with debris of a small part of Carboniferous strata forms the foot hills. Apart from that, very few outcrops are to be seen in the whole field on account of the alluvial and loess covering. However we can find the general section here by the observations on some outcrops on the north part and refer to the bore hole sections on the south. The whole section in ascending order is as follows. (Fig 1 Columnar section).

一圖地 圖面剖狀耗田煤武修南河

Fig 1, The Columnar Section of Hsiuwu Coal Field, Honan



- I. Ordovician limestone.
- II. Carboniferous and Permo-Carboniferous.
 - A. Taiyuan Series thickness 26.5 m.
 - 1. Iron ore—Hematite and Limonite 0.5-2.5 m.
 - 2. White clay 2 m.
 - 3. Dark blue limestone with black flint nodules 6 m.
 - 4. Red sandstone with bands of iron ore on the top 16 m.
 - B. Shansi Series 174 m.
 - 1. White clay
 - 2. White coarse sandstone 7 m.
 - 3. Carbonaceous shale
 - 4. Coal 4.5-7.5 m.
(6m in average)
 - 5. Black and gray shales and sandstone 22 m.
 - 6. Coal (Chao mei)
 - 7. Brown and green sandstones interbedded with gray
and blue shales 138.7 m.
(5-7. According to boring sections.)
- III. Strata above the coal series
 - A. Permian
 - Red sandstones and shales in the upper part and more
yellowish arenaceous clay shales with gray sands-
tones in the lower 42 m.
 - B. Alluvium
 - Yellow and red clays with conglomerate beds up to
20 m. thick.

Ordovician:—The hills on the north rim of the coal field are mostly built up by Ordovician limestone. The strike of these limestone beds are almost due E-W but turning more northeast on the eastern part. And the dips of the Ordovician limestone beds are in southeast and southwest direction with dipping angle from 10° to 25° , being affected by local tectonic movements of folding and faulting. Far north beyond the coal field, Ordovician limestone is predominantly developed to build up a great part of Taihang mountain range which constitutes the border of Shansi plateau and Honan plain.

Carboniferous (Taiyuan Series): In this district only a part of

Taiyuan series; upper Carboniferous, is present. The basal clay of this series lies disconformably upon the eroded surface of Ordovician limestone, with iron ore bands at the base. The iron ores consist of a kind of low grade hematite and limonite always in lens shape. This sedimentary iron ore is exactly equivalent of the iron ore beds of Pingting and Chincheng in Shansi province according to its stratigraphic position and mode of occurrence. The iron ore is in dark red color and sponge structure with the thickness of the ore bed varying from 0.5 to 2.5 meters. Upon the iron ore bed lies a bed of white clay with undistinct bedding plane on the base, about two meters thick. Going upward there comes immediately a marine bed, dark blue or gray limestone containing nodules of black flint. In this marine bed, though unfortunately no well preserved fossils have been found, yet the traces of *Fusulina*, *Productus*, stems of crinoids and pieces of *Spirifer Tayuensis* have been recognized. These characteristic carboniferous fossils represent most probably the Taiyuan series¹, upper Carboniferous. This limestone bed is about 6 m thick.

Lying upon the flinty limestone there is a bed of red sandstone about sixteen metres in thickness. This sandstone is characterized by its richness of ferruginous materials and the iron ore bed which always presents on the top of it having a thickness up to two meters. This bed of hematite iron ore contains coarse quartz grains and limestone pebbles, sometimes so abundantly that it may be said to be a conglomerate bed with the ferriferous matrix. According the mode of occurrence and the type of formation of this conglomerate and iron ore, the red sandstone probably had been once exposed on the surface and eroded for a period of time, and then the iron ore and conglomerate was deposited upon it. It is probable therefore that there is a break or disconformity between the Taiyuan Series and the overlying Shansi Series in this district.

The total thickness of the Taiyuan series here is about 26.6 meters while in the neighbour province as Taiyuan in Shansi, Tsuhsien in Hopai and Liuhokou in Honan, this series is about 100 meters or more.² Therefore only a part of Taiyuan series is present in this district. It is difficult to know to which of the five marine horizons of the Taiyuan series

1 Y. T. Chao: On the age of the Taiyuan series of North China. Bull Geol. Soc. China P. 228.

2 A. W. Grabau Stratigraphy of China. Part II, P. 253.

of the more northern districts corresponds the limestone bed here without a precise study of more fossils. But by its lithological characteristics and some fossils contained it much resembles to the Taching limestone in Tsuhsien¹ coal field, Hopei, and Liuhokow coal field, Honan; if so, it may be correlated to the Pankou limestone in Taiyuan district, central Shansi.

Permo-Carboniferous coal bearing Series (Shansi Series):— Lying probably disconformably upon the topmost red sandstone of Taiyuan Series is a bed of white clay about two meters thick which is followed by a bed of white coarse quartz sandstone and a layer of carbonaceous black shale with a total thickness of about 7 meters. Upon the black shale there is the only one productive coal seam of six meters thick in average in this coal field. In the black shale, the plant fossils of *Annularia* and *Sigillaria* are always in occurrence. Above the coal seam follows a series of black and gray shales and sandstones in the lower part and brown, green sandstones alternating with gray and blue shales in the upper part with the whole thickness 138.7 meters. According to the borehole section of Chungyuan Mining Co. Twenty two metres above the main coal seam there is another coal seam 0.3 metres thick which is called Chao-coal. The thin seam is not worked. On the whole, this series is entirely continental in origin no marine horizon has yet been observed in this field. According to its lithological character and the plant fossils contained, it most probably belongs to the Shansi Series-Permo-carboniferous.

Permian (Shihotze Series): Above the coal bearing series, comes a division of alternating beds of yellowish arenaceous clay shales and gray sandstones with red quartz sandstones more predominant towards the upper part. This division of sediments is distinguished from the Shansi series below by the frequency of the yellowish arenaceous clay shales. The thickness is about 42 meters. In stratigraphic position and to a certain extent also in lithological characters, this series probably corresponds to the Shihotze series of early Permian age in the Yuemenkou² section of Taiyuan with which it is here correlated. The upper limit of this series is eroded and covered by alluvium.

1 Y. T. Chao & C. T. Tien, *Stratigraphy of Tsuhsien, Chihli and Liuhokou, Honan*, Bull Geol. Surv. China, No. 6.

2 The name of Shihotze Series is originally introduced by Dr. E. Norin for the shales and sandstones above his Yuemenkou series in Taiyuan. The fossil flora it contains has been lately determined by Dr. Halle as of Lower Permian age.

Alluvium: The whole area of this field is covered by a thick series of yellow and red clay interbedded with layers of sands and gravels. The total thickness is about 20 meters but still thicker in certain part.

GEOLOGICAL STRUCTURES

The whole area of this coal field lies on the southern foot of Taihang mountain range which runs in almost due E-W direction. The structure of this area is mainly determined by an anticline in the middle of the field, dividing the whole area into two synclines on each side of it, and by a big fault along the northern border. These different structures are described below.

1. *The Fenghuangling Anticline:* The folding structure can be seen at Fenghuangling, about 5 li north of Chiaotso where the ordovician limestone dips southeastward on the east slope and southwestward on the west slope. The axis of the anticline runs southward to the east of Chiaotso and west of Wungchien along Yenho, and extends north-west-ward from Fenghuangling along the Yenho valley where the anticlinal structure is fully developed (Plate II). The axis of the anticline (Fig 2) is pitching to the south, so that the Ordovician limestone forms the peaks of the bill along the Yenho valley on the north while the same strata are slightly plunging to the south. The direction of the axis of Fenghuangling anticline is almost perpendicular to the direction of Taihang mountain range, along which this coal field extends. By this fold of north-south direction, the coal field is clearly divided into two parts. On the east limb is the Libo-Szuho basin where the Chungyuan Mining Co. is working at, and on the west limb is the Liteng-Wangfeng (王封) basin where Peking Syndicate has been active. In the middle belt of this field, the coal bearing series was eroded away by the reason of lifting up of the fold.

2. *Liho-Szuho Basin:*— On the east limb of Fenghuangling anticline, or the east part of the coal field is the Liho-Szuho basin, which is bordered by the Ordovician foot hills on the north and Fenghuangling anticline on the west. The coal series dips south-eastward in the western border of this basin and gradually turning more southward in eastern part. Therefore the basin structure is developed on the west and north border but it is entirely concealed by alluvium on the south-east part, most probably an open basin towards southeast, but on the east end it is cut off by a fracture.