臨城後溝左近地層剖面圖

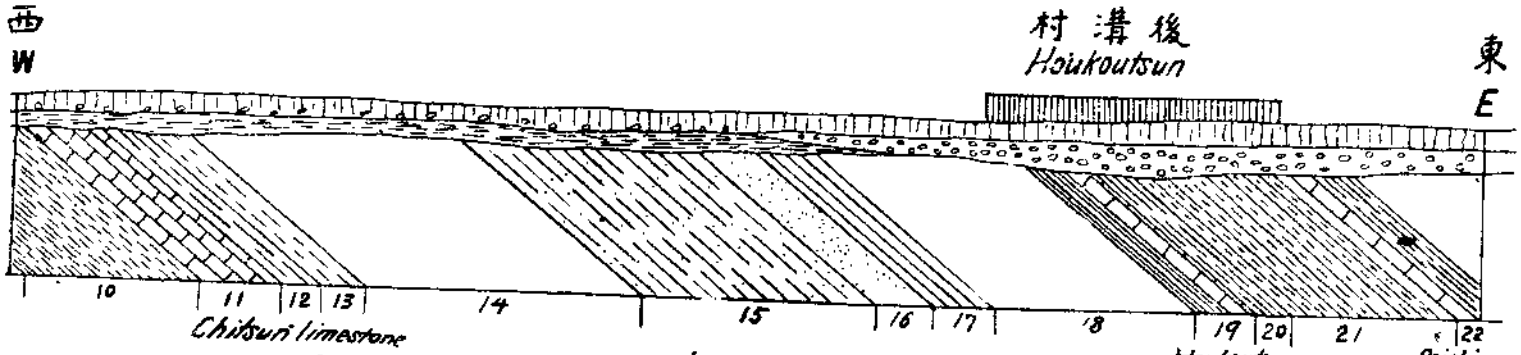


Fig. 1. Section just beside Houkoutsun, a tittle south of the Linchëng coal Mine

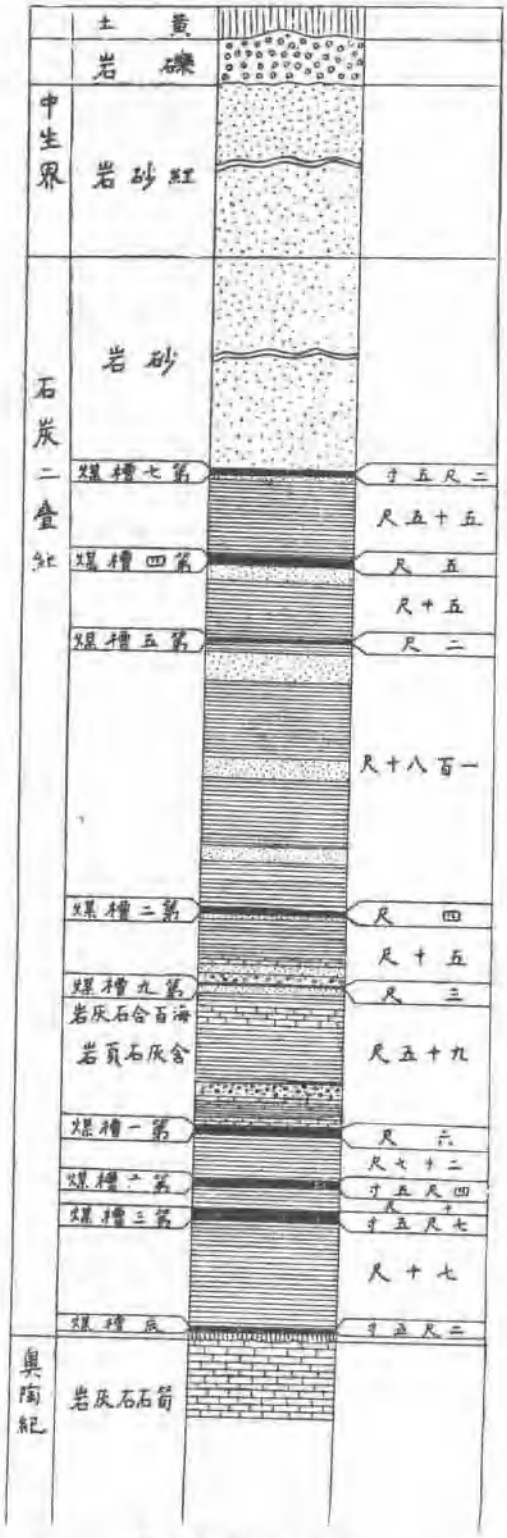
10 Bluish shale 9·4 11 Chitsun limestone 4·6 12 black greyish shale 2·0

13 greenish shale 2·2 14 covered 14·3 15 yellowish sandy Shale 12·0

16 grey sandstone 3·1 17 yellow shale 3·2 18 covered 10·6

19 Houkoutsun limestone 2·9 20 yellow calcareous shale 1·6 21 yellow shale & blue clay 8·1

22 Peiching limestone 1·2



臨城煤田地層剖面

Fig. 2. Stratigraphic Section of the Ling Cheng Coal Field.

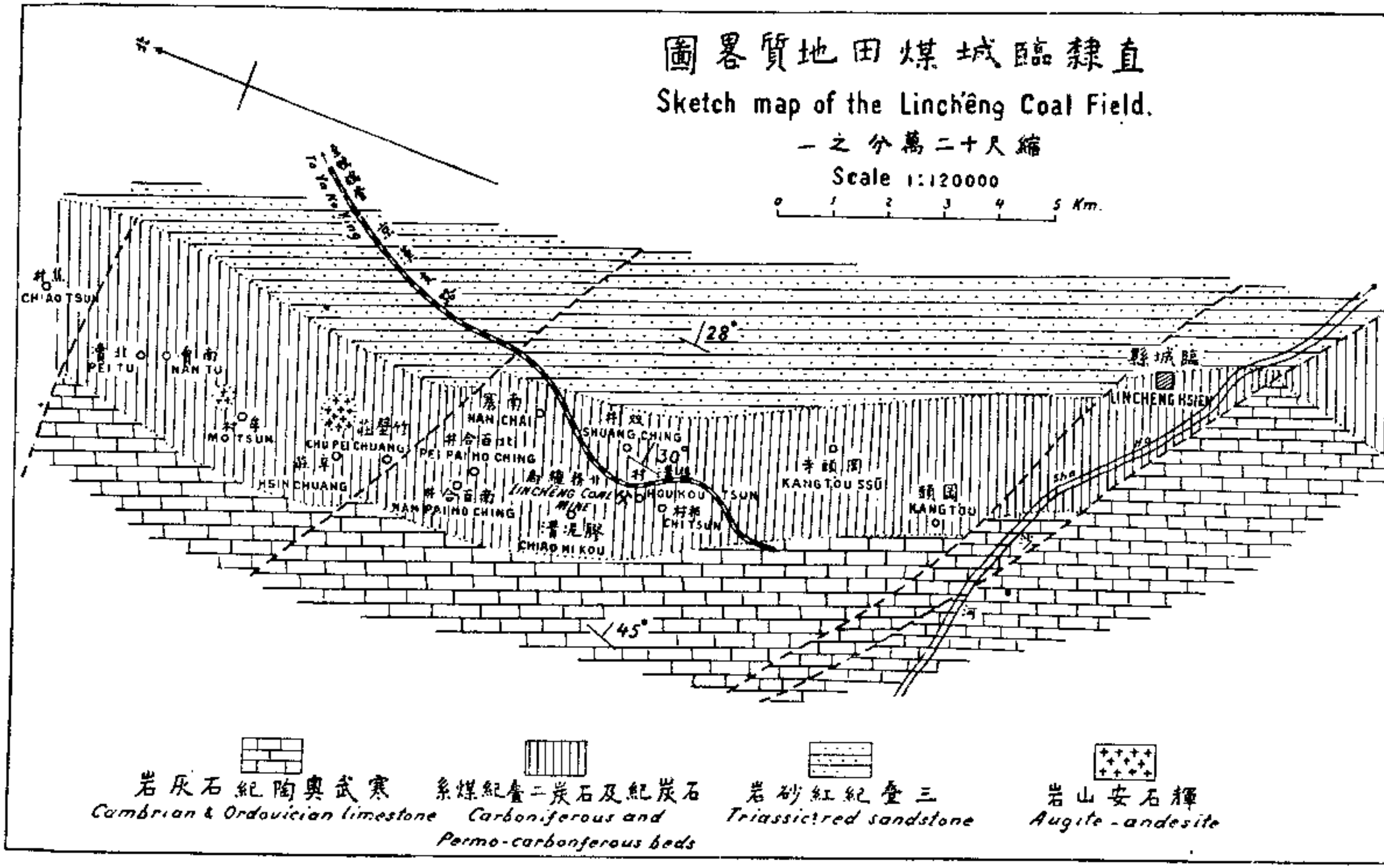

直隸臨城煤田地質畧圖
Sketch map of the Linch'êng Coal Field.
縮尺十二萬分之一
Scale 1:120000
0 1 2 3 4 5 Km.
To Ya Ko Ying
CH'IAO TSUN
PEI TU
NAN TU
MO TSUN
CHU PEI CHUANG
HSIN CHUANG
NAN CHAI
PEI PAI HO CHING
NAN PAI HO CHING
SHUANG CHING
LINCHÊNG COAL MINE
HOU KOU TSUN
CHI TSUN
CHIAO NI KOU
KANG TOU SSŬ
KANG TOU
LINCHENG HSIEN
28°
30°
45°
寒武奧陶紀石灰岩
Cambrian & Ordovician limestone
石炭紀及石炭二疊紀煤系
Carboniferous and Permo-carboniferous beds
三疊紀紅砂岩
Triassictred sandstone
輝石安山岩
Augite-andesite

Fig 1. Section through the lowest part of the coal series SSW. from Ming Shui (明水).

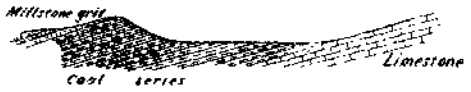


Fig. 2. Section through the coal series S. of Wang-Tsun 王村

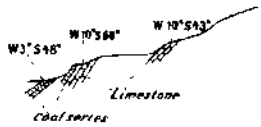


Fig 3. Section through the flexure 7 li N from Wên-Tsu-Chên (文祖鎮)

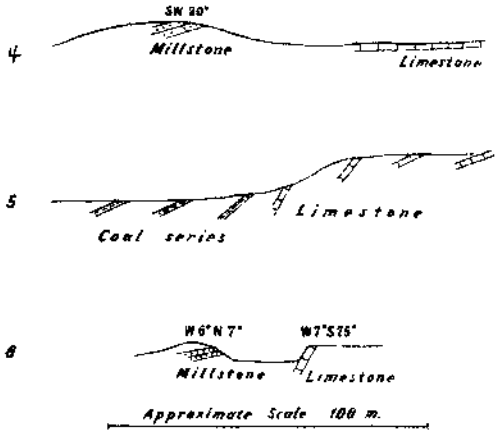
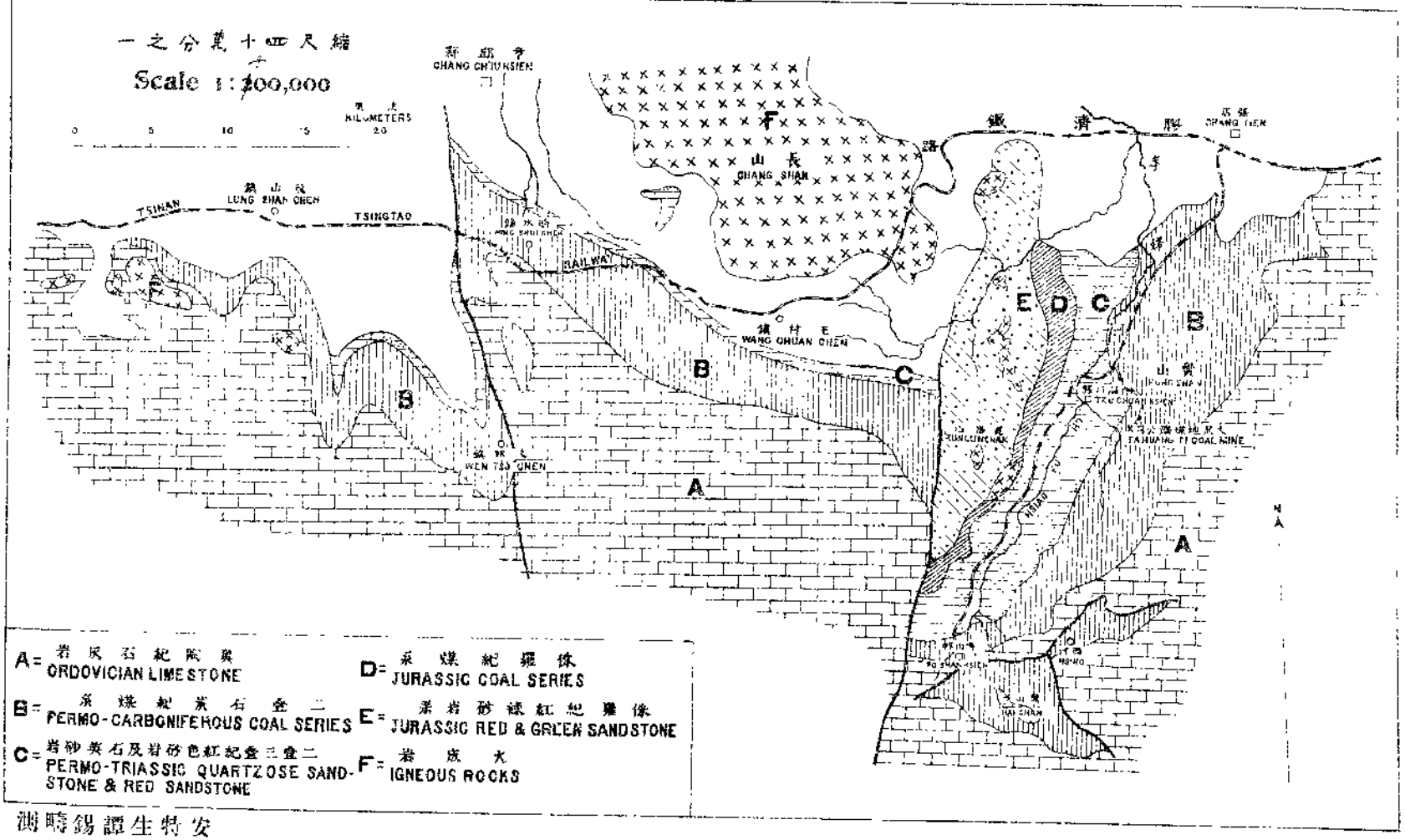


Fig. 4-6 Sections through the flexure, S. of Li-Chia-Fu 李家埠

Fig. 7 Section through the syncline of Pei-Tsi-Fan. 北寺范

山東淄博坡章煤田地質圖
THE GEOLOGICAL MAP OF THE TZUCHUAN-POSHAN-CHANGCHIN COAL FIELDS. SHANTUNG PROVINCE.



淵時錫譚生特安
By J. G. Andersson and H. C. Tan

BULLETIN

OF

THE GEOLOGICAL SURVEY OF CHINA

NUMBER 6. DECEMBER, 1924.

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PEKING
THE GEOLOGICAL SURVEY OF CHINA
MINISTRY OF AGRICULTURE AND COMMERCE

THE COMMERCIAL PRESS, PEKING BRANCH WORKS
1924.

GEOLOGY OF THE HO KANG COAL FIELD, HEILUNGKIANG

(summary)

By H. C. Tan

I. INTRODUCTION

The coal field is situated at about 70 li north of Ho Kang Chên belonging to T'ang Yuan Hsien near the lower course of the river Sungari. It is about 180 li from T'ang Yuan City and more than 1000 li from Harbin (see Plate 4) Its geographic position is approximately on latitude 47° 20′ N. and longitude 183° 18′ E.

Between the coal field and the river Sungari is a land inconvenient for transportation, which is partly mountainous, partly marshy and muddy during snow-melting time and rainy season in Spring, Summer and Antumn. In winter only the sleighs can be used for conveyance, each one can carry more than one ton and drive more than 10 li per hour. The river Sungari is navigable. Starting from Chia Mu Ssŭ, a wharf about 130 li from the coal field upwards, steamers can reach Harbin in two daya, and downwards can attain various ports along the river Amur. The difficulty for navigation is that the rivers, Sungari and Amur, are frozen in a long time during the year and navigable only in less than six months of each year.

II. TOPOGRAPHY

The southeastern branch of the Khingan Mountain Range is called Ta Ch'ing Shan which gradually decreases in height from north to sonth and conceals beneath the plain until reacbing the river Sungari. The mountains and hills in the environs of the coal field constitute the remnant part of Ta Ch'ing Shan. Topographically the coal field forms a basin surrounded by many hills, of which the highest one is about 180 meters above the lowest part of tha field (see Plate 1). The basin extends northeast and southwestwards with a narrow opening on the southeastern side, from which Shih T'ou

Ho, the main river of the coal field, with its tributaries, runs out. The river Shih T'ou Ho has its source on the north of the field and passes through its middle part with a narrow and meandering channel. Usually the water is several feet deep, sometimes overflows to form swamps along the banks of the river.

On the west of the basin there is a group of hills, of which Pi Chia Shan is the highest one, 181 meters above the bank of Shih T'ou Ho. Southwestward the hills vary in height, and near the northern bank of the river, Ho Li Ho stands Lu Chung Shan estimated at about 70 meters above the low land. Along the eastern edge of the basin there is another group of hills, among which Tung Shan is the main peak amounting to 152 meters, southward they gradually diminish in height and form a flat low range terminating on the north of Shih T'ou Ho. The hills which stand on the south of the basin are called Nan Ling. Among them the highest point is about 110 meters. Southward they decrease in elevation and vanish until reaching the river Ho Li Ho, between which and the river Sungari there lies a big plain comprising areas of fertile land.

III. STRATIGRAPHY

Most of the strata which usually occur in Northern China are missing in the region here in question, though the relations of the formations are mostly clear; upon the Archæan gneiss directly rests the Mesozoic coal series, all the Proterozoic and Palæozoic formations are wanting. Besides the alluvium there are four formations, viz., Pi Chia Shan formation, Shih T'ou Ho formation, Nan Ling formation, and Tung Shan formation (see Plates 1 and 3). The first one belongs to the Archæan; the second, to the Jurassic being determined by its plant fossils, the latter two are questionable of their age on account of that no fossils were found in them But according to the petrological characters and stratigraphic position they seem to be of Jurassic age, for in Northern China in and above the Jurassic coal series frequently occur the conglomerate and tuff which all belong to the Jurassic. The only difference is that in this field the conglomerate is comparatively more developed and the tuff shows a different colour from those in other places.

The Shih T'ou Ho formation directly overlies the Pi Chia Shan formation and the contact between them is covered by the alluvium. It is questionable whether they are in fault contact or between them exists a big unconformity. But according to the fact that the strata of the Shih T'ou Ho formation are regular and flat without dislocated appearance even along the contact zone with the Pi Chia Shan formation, the former seems to rest unconformably upon the latter. The Nan Ling formation continuously follows the underlying Shih T'ou Ho formation, but has a disconformity with the overlying Tung Shan formation. The conformity between the Shih T'ou Ho and Nan Ling formations may be proved by their similar dipping directions, and the disconformity between the Nan Ling and Tung Shan formations may be asserted by the fact that the thickness of the Nan Ling formation is so variable that its considerable difference can show the effect of erosion of the strata before the Tung Shan formation was deposited.

(1) Pi Chia Shan Formation or Archæan Gneiss: This formation consists chiefly of gneiss, including granite intrusions and quartz veins. The schistosity of the gneiss is either coarse or fine; somewhere the coarse gneiss is comparatively loose and decomposed into coarse sands by weathering, whereas the fine one is a little more compact and still preserves its rock form because of its greater resistance to the erosion. It is widely developed on the north and west of the coal field and extends far north and westwards.

(2) Shih T'ou Ho Formation or Jurassic Coal Series: This formation overlies the Archæan gneiss in unconformable contact. It is composed largely of coarse sandstone; according to the petrological characters the lower part contains white-gray and yellowish, coarse and partly conglomeratic sandstone with valuable coal seams, near which the black, gray clayey and sandy shales frequently occur. The upper part comprises grayish white, coarse sandstone also with important coal seams, above and below which is the gray-white sandstone.

On account of the thick cover of alluvium on the coal series the thickness of this formation has not been practically measured, but by calculation from the mapped area it amounts to about 600 meters.

This formation is well developed along Shih T'ou Ho, in unconformable and sometimes fault contact with the Archæan gneiss. On the west

of Nan Ling the space which the coal series ought to occupy is much narrower and the overlying conglomerate comes very near to the Archæan gneiss. Southward the space between the Archæan and the conglomerate is gradually broader and seems to be occupied by the coal series, though no outcrop was found. Moreover we can not know whether the coal series contains workable coal seams, unless boring will be taken into operation.

The geological age of the coal series was not known before. Fossils are difficult to find on account of the extraordinary scarceness of outcrop. Only in the rock dumps near an old inclined shaft, south of the mining office of Ho Kang Coal mine, were found several specimens which can be used to determine the age of the coal series. They are from the gray sandy shale above the second coal seam. The following species are represented:

Baiera gracilis
Coniopteris arguta
Cladophlebis denticulata
Williamsonia pecten
Zamites megaphyllus

The age is Jurassic, and probably lower Jurassic.

(3) Nan Ling Formation or Conglomerate: This formation rests upon the Shih T'ou Ho formation and is well developed in the environs of Nan Ling. It is conformable in dip with the coal series but probably separated by erosion interval. It consists of conglomerate which is made up of pebbles of quartzite and sandstone, and sandy cement. The conglomerate is white-yellow in colour and loose in character; the pebles are scattered almost everywhere the conglomerate occurs.

The thickness of this formation is variable, about 700 meters in the vicinity of Nan Ling according to the estimate from the mapped area, the thinest part being not much more than 100 meters.

It constitutes small hills on the north of Tung Shan. Therefrom the exposure becomes broader and broader southwards. The width of its exposure is not less than 3000 meters in the vicinity of Nan Ling, though becoming gradually narrower again southwards to the river Ho Li Ho.

(4) Tung Shan Formation or Tuff: This formation lies disconformable over the Nan Ling formation, comprising green and gray tuff with green volcanic lava and greenish sandstone. The tuff is not fine, but compact and has stratification like sandstone. (The tuff will be described in details under the section on Igneous Rocks).

It is spread on the east of the field, constitutes the conspicuous hills including Tung Shan and the flat hills, south of Tung Shan, and continues southwestward. On account of its incomplete exposure the thickness of this formation cannot be determined, but according to the part observed it is very thick, amounting to nearly 1000 meters.

(5) Alluvium: It covers all the formations described above and consists mostly of yellowish loam in the lower part and of darkish soil in the upper. Probably the latter was derived from the former by adding the decayed material from the plants.

IV. IGNEOUS ROCKS

This section includes all the igneous rocks observed in this coal field, and owing to their apparently igneous origin the metamorphic rock, gneiss, and volcanic tuff are also described under this head.

(a) Gneiss: The gneiss varies from coarse granitic to fine schistose variety; the coarse gneiss, under microscope, is composed chiefly of quartz, and orthoclase; a little amount of plagioclase, biotite, and hornblende are occasionally present. The fine gneiss embraces also quartz as chief component, plenty of orthoclase and plagioclase, the black minerals are represented by biotite and hornblende, the latter being more abundant than the former, mostly aggregated and weakly polyenromatic.

(b) Granite: The granite is included in the gneiss, forming batholiths, without apparent demarkation with the including gneiss. It consists of quartz, orthoclase, plagioclase, biotite and hornblende as essential minerals; the quartz is allotriomorphic, large in crystal but not abundant in amount, and filling up the interstices between the feldspars; the orthoclase is very abundant and mostly idiomorphic; the plagioclase is present in lesser quantity than orthoclase, mostly idiomorphic and occasionally exhibiting zonal texture; the biotite is the most abundant among black minerals, generally idiomorphic;

the hornblende is frequently present, hypidiomorphic, occasionally mingled with biotite and distinct from the latter by its deeper colour, and its cleavages. In regard to the age of the granite it can only be said that the granite is posterior to the gneiss, perhaps still of the Archæan age and seemingly not later than the early Algonkian.

(c) Andesite: The andesite constitutes the small hills in the northeastern part of the coal field. According to the structural condition and petrological texture it seems to be intrusive into the country rock not far below from the surface. It may be, however, partly extrusive or of volcanic origin. It is porphyritic in texture, the phenocrysts are plagioclase, hornblende, augite and quartz; the plagioclase is very abundant, mostly idiomorphic, occasionally possessing zonal texture; the hornblende is also plentful, yellowish in colour, and hypidiomorphic; the augite is rare, greenish and hypidiomorphic; the quartz is occasionally present with corroded form. The andesite is undoubtedly later than the lower Jurassic as it either overlies or intrudes into the coal series, but it is yet unknown whether it is contemporaneous with the tuff.

(d) Basalt: The basalt forms lava flow contained in the tuff, being dark-green in colour and fine in character. Under microscope it exhibits a porphyritic texture; the phenocrysts being constituted mostly by idiomorphic crystals of plagioclase and by olivine; the groundmass comprising the plagioclase which from mostly elongated tabular and even microlitic crystals sometimes showing a certain parallel arrangement, hornblende and augite of allotriomorphic form, and a little amount of glassy material.

(e) Tuff: The material of the tuff was mostly derived from the ashes of volcanoes, so that its texture is partly igneous and partly sedimentary. The recognisable minerals consist chiefly of quartz, plagioclase and hornblende, the former two exhibit, in certain cases, semi-rounded form due to transportation. The crystalline part is porphyritic, with quartz, plagioclase and hornblende as phenocrysts and a groundmass containing microlitic plagioclase. The tuff may be of the upper Jurassic or lower Cretaceous age.*

* Comparison may be usefully made with formations of better known localities, for instances with Tiao Chi Shan formation of the western Hills of Peking and Mêng Yin series of Shantung. See L. F. Yih: Geology of Western Hills of Peking, Mem. Ser. A No. 1 and my paper on the Mesozoic and early Tertiary in Shantung, Bull. No. 5 pt. II.

V. STRUCTURAL GEOLOGY

All the sedimentary strata dip to the one and same direction, i e to the southeast and have not any folded appearance, though the field forms topographically a basin. In general, the strike of the strata is northeast and southwest sometimes a little more north-south. The dip is to southeast or a little more south. The dipping angle of the coal series is from 12° to 2° in the northern part of the coal field; from 14° to 21° in the vicinity of the mining office of Ho Kang Coal Mine, although locally it may vary from 10° to 30°. Along the eastern bank of Shih T'ou Ho the dipping angle of the conglomerate is larger, at least 26°; the tuff is more tilted, about 30° on the southern slope of Tung Shan and 40° along the eastern bank of Shih T'ou Ho. Generally speaking the inclination of the strata of the coal field increases from west to east (see Plate 3).

The traces of faults are obscure, for the outcrop of the strata is very rare. But, from observing the distribution of the formations, there seems to be two places where fault occurs (see Plate 1). (1) In the northeastern part of the field, north of Tung Shan, the exposure of the coal series is much narrower than in other adjacent part and the conglomerate comes very near to and somewhere in direct contact with the Archæan gneiss. Hence between the coal series, conglomerate and Archæan gneiss, there likely exists an east-west fault which is a normal one, the upthrow side of which is composed of the Archæan gneiss and the downthrow side is made of the coal series and the conglomerate. (2) In the southwestern part of the field, west of Nan Ling, the conglomerata is very close to the Archæan gneiss, only a very limited space is occupied by the coal series. This shows that one part of the coal series was faulted down and another part is in fault contact with the Archæan gneiss.

VI. ECONOMIC GEOLOGY

Ho Kang coal field is one of the best coal fields so far known in Manchuria. The quality of Ho Kang coal is as excellent as that of Kailan coal. The reserves of the whole field are quite important. But the field is rather remote in situation and its communication with other places is difficult. This seems to be the present obstacle of mining industry. On account of the

extensive covering of alluvium, it was very difficult to study the exact conditions of the coal seams. Only imperfect idea can be formed from the scanty knowledge available today.

(1) Coal Seams: The coal seams are mostly included in the lower part of the coal series but not yet accurately known in number. By observing the result of boring and trenching we can get six seams, only two of which have been really taken into mining operation. The boring was made by some Russians who had very little success. But they also excavated many trenches cross the outcrops of the coal seams, by which the number and position of the coal seams can still be determined. They report that there are five seams which all crop out on the western side of Shih T'ou Ho, and that seam on the eastern side of that river is the uplifted part of the first seam. But according to the depth of one boring hole and the dipping direction of the strata the seam on the eastern side of Shih T'ou Ho is another one and does not belong to the first seam, so the known coal seams are six in number. The first seam is situated on the eastern side of Shih T'ou Ho, between no. 8 and no. 13 boring holes (see Plate 2), extending northeast and southwestward along Shih T'ou Ho. The second seam is situated on the western side of Shih T'ou Ho, and is worked at present, its position can be defined by the old and active inclined shafts, no. 11, no. 7 and no. 9 boring holes. The third seam is not distant from the 2nd. one. It has been worked, and its position can be determined by the old inclined shafts, trenches, no. 1, no. 10 and no. 5 boring holes. The fourth seam has not been worked and its position is fixed only by no. 6 boring hole and some trenches. The fifth and sixth seams have not been worked and bored, their positions are generally defined only by two parallel sets of trenches.

Attempt has been also made to have some idea on the thickness of the coal seams. The seam which has been actually observed and measured is only that one which is being worked now, the thickness of others is derived from the information of miners and the result of prospecting. The first seam is about 23 feet (Chinese *Chih*) according to the result of no. 8 boring hole, but this is the inclined thickness and the seam is only about 21 feet when corrected into true thickness. That part of the 2nd. seam, which is being mined, is about 28 feet in total thickness but it contains one foot of clayey

shale, the thickness of net coal amounts to 27 feet. But it is only 24 feet according to the result of no. 4 boring hole and about 12 feet by that of no- 7 and no. 9 boring holes. If the seam bored by the three holes is certainly the same as that being worked now, the 2nd. seam varies in thickness and the average thickness is about 20 feet. The third seam has not been measured by the author; according to the miners' information it is thicker than the 2nd. seam and amounts at least to 30 feet. And, it is about 38 feet thick at no. 3 boring hole, about 40 feet at no. 1 hole and about 32 feet at no. 10 hole. This confirms that the 3rd seam is really thick or than the 2nd. one. But that part which was reached by no. 5 boring hole and supposed to be the 3rd. seam is only 7 feet, if so, the 3rd. seam greatly decreases in thickness until rsaching the southern part of the field, but the average total thickness is still not less than 27 feet The thickness of the fourth seam is determined only by the result of no. 6 boring hole. It is about 19 feet according to the boring record of Ho Kang Coal Mine, at most 21 feet, and about 14 feet in average from the report of Russian borers. The thickness of the fifth and sixth seams is known form Russians' report, the 5th. seam is not less than 25 feet and the 6th. seam is about 28 feet in average.

The intervals between the coal seams have also been etudied. According to the inclination and the position of the coal seams the interval between the first seam and the second seam is greater than others. The coal seams and their intervals and thickness are given in the following table:

Seams	1st. seam	2nd. seam	3rd. seam	4th. seam	5th. seam	6th. seam
Thickness	21 ft.	20 ft. in average	27 ft. in average	18 ft. in average	25 ft. in average	28 ft. in average
Intervals	——	about 500 ft. from 1st. seam	about 125 ft. from 2nd. seam	about 80 ft. from 3rd. seam	about 80 ft. from 4th. seam	about 110 ft. from 5th. seam

(2) Quality of the Coal: Among the six coal seams, only two have been worked, the others were bored and trenched, Hence the samples were taken only from the second and the third seams. But the coal was worked

out entirely from those parts near the surface, and that taken from the third seam was exposed on the surface in a long time and the quality was somewhat altered. Thus the result of the analyses can only give the general quality of the parts which have been worked. The coal of the second seam is bituminous and well coking, that of the third seam also bituminous but semi-coking. The following table shows the analyses of the coal of the second and the third seams:

Seams	Water	Volatile matter	Ash	Carbon	Sulphur	Colour of Ash	Nature of Coal	Carloric Power
2nd. seam best part	0.40	31.64	3.19	61.85	0.12	pink	coking	8182
2nd. seam in average	1.77	30 93	9.50	57.80	0.31	,,	,,	7803
,,	1.74	32.86	8.04	57.36	0.33	,,	,,	7860
,,	1.81	34.60	8.30	55.20	0.36	,,	,,	7877
,,	1.81	31.03	8.06	58.50	0.34	,,	,,	8660
3rd. seam	0.34	28.41	8.01	55.24	——	gray	semi-coking	7343

(3) Quantity of the Coal: The estimate of the coal reserves depends absolutely upon the thickness of the seams and the structure of the coal field. In this field the coal seams are comparatively considerable in thickness, though most of them are yet doubtful in their real amount. The structure can be ascertained only by surface observation on the very scanty outcrop of the strata, so that the distribution and inclination of the coal series are inferred only from the outcrops of other formations and the few places which have been worked and trenched.

There are two areas where the coal series is distributed: One includes the places which Shih T'ou Ho passes through; the other is situated on the west of Nan Ling. In the former the existence of the coal series can be confirmed by real outcrops, trenches and boring holes, but in the latter on outcrop was found and the existence of coal series is inferred only by the distribution of other formations. Thus the former is taken into estimate while the latter is left. By measurement, the length of the workable seams is not less than 6000 meters, the reliable thickness is at least 20 meters, the breadth