國民政府農鑛部直轄

地質調查所

學術研究與國立中央研究院合作

地質彙報

第十三號

民國十八年六月

總目

熱河阜新縣煤田……王竹泉黃汲清著

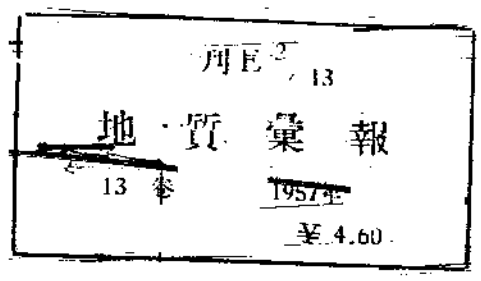
奉天本溪縣小市煤田地質簡報……黃汲清著

遼寧省本溪縣田師付煤田西安縣煤田及吉林溝額穆縣蛟河煤田地質……王竹泉著

吉林省穆稜密山二縣地質鑛產記要……王恆升著

黑龍江省嫩江兩岸之地質……譚錫疇王恒升著

北平京華印書局代印


13
地質彙報
13 卷
1957年
¥4.60

國民政府農鑛部直轄

地質調查所

與究研術學國立中央研究院合作

地質彙報

第三十號

民國十八年六月

總目

熱河阜新縣煤田……王竹泉著 葛汲清著

奉天本溪縣小市煤田地質簡報……黃汲清著

遼寧省本溪縣田師付溝煤田西安縣煤田及吉林額穆縣蛟河煤田地質……王竹泉著

吉林省穆稜密山二縣地質鑛產記要……王恒升著

黑龍江省嫩江兩岸之地質……譚錫疇 王恒升著

北平京華印書局代印

地質彙報第十三號

目次

		頁數
王竹泉著	熱河阜新縣煤田	一
黃汲清著	奉天本溪縣小市煤田地質簡報	五
王竹泉著	遼寧省本溪縣田師付溝煤田西安縣煤田及吉林省額穆縣蛟河煤田地質	一一
王恒升著	吉林省穆稜密山二縣地質鑛產記要	二五
譚錫疇王恆升著	黑龍江省嫩江兩岸之地質	六三

地質彙報　目次

熱河阜新縣煤田

王竹泉
黃汲清

緒言

阜新煤田最初曾經英人穆樂氏調查假想煤系時代屬於第三紀、次經瑞典人安特生氏研究、採得少許不完全之植物化石、推定煤系之時代應爲侏羅紀、二氏關於經濟地質方面煤層煤質煤量等項、皆記載極略。泉等於民國十七年冬應北票煤鐵公司及京奉鐵路局之招、乃蒞鐵作較詳密之勘測、於煤田內發見火成岩分布甚廣、並採得動植物化石頗夥、據植物化石推斷、則煤系時代似應屬於中侏羅紀或侏羅紀後期、但較北平西山山西大同等下侏羅紀煤系爲新、不可混爲一談也。野外調查時對於煤層之分布、煤樣之採集、尤爲注意。茲將研究所得、分爲煤田位置交通及煤田附近地層構造煤產等章、各論之於左。

煤田位置及交通

阜新煤田位於熱河之東南、平奉路打虎山車站之西北、阜新縣城遺居煤田之中部。如以縣城爲起點、陸路東南距平奉打通支路八道壕車站六十里、惟其間距縣城約十五里之處、須經一山嶺、路途極爲險峻。東距打通支路新立屯車站九十里、路沿河床、道途稍平。又西南經清河門距平奉錦朝支路義縣車站一百四十里、路途亦尚坦平。所述三路皆可通騾車、調查時因煤之轉運、悉惟陸路是賴、交通雖不免困難、然三路之中、無論何路如能修築鐵軌、則煤即可利用火車直達營口、以輸出海外。故煤田之位置比較的尚爲優良、此一點亦開鑛者所應注意者也。

地形

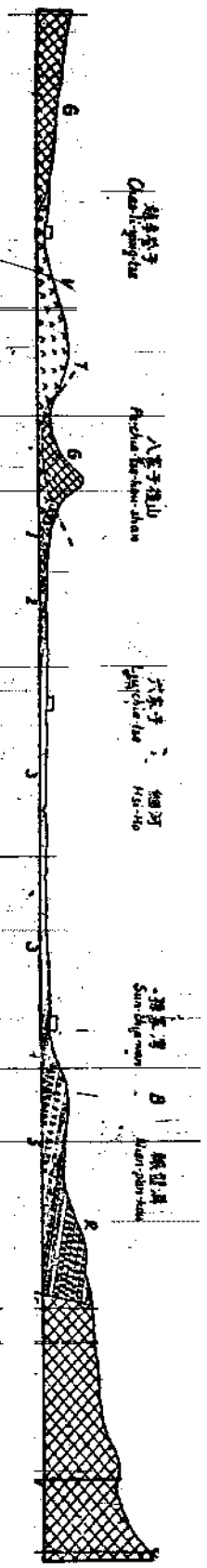
此次調查、先乘火車至八道壕、始易騾車赴阜新鑛山。八道壕附近地勢頗平、僅有一二列低山脊自西蔓延而來、緩布其間、蓋地當奉天平原之邊緣、自此而西北望則見峰巒重疊、峻嶺環列、山勢極爲雄壯。初憶若西北入山、必經崖巒絕澗、路途應極險阻、孰知乘車深入、不惟溝谷甚爲寬闊、而山脊亦頗平緩。行三十五里逾單于溝、山勢始稍急、更行七八里經一石嶺、雖具有相當之高峻、然登嶺北望、崗阜起伏、地勢低降、即阜新煤田所在之區。自西北而東南寬約三十里、長則一望無際、周圍環以崇嶺、若隱若現。下嶺入煤田則見寬平之阜谷間、又時有V字形之狹峽、寬僅數丈、深不及百尺、如在大崗崗附近及孫家灣之南阜新縣城之北等處、此種狹峽尤爲明顯。故總括地形之發育、大致可分爲二期。一爲闊谷緩坡之半老壯年期、一爲V字形狹峽之幼年期。

地層

煤田附近之地層、除冲積之土壤砂礫不計外、約可別爲三系、試自古而新分論於左。

片麻岩　此岩晶粒大部均細、片理不甚清晰、每含有花崗岩及他種基性火成岩侵入體。惟花崗岩之侵入、率爲塊狀、基性火成岩侵入、則多呈脈狀。在阜新縣城南大巴溝附近及楊溝之東南更有片岩露布、層序極清、皆一致向西北傾斜、約由四十五度至八十度、悉與片麻岩呈不整合接觸。在王胡蘆西北則有石英岩、層序紛亂、傾斜方向已不易辨。若以地質時代論、片麻岩應甚古、其成因抑原係火成岩或水成岩、頗難證明、大抵與維理士氏在山東直隸所稱之泰山系相當而屬於太古代。片岩與石英岩則確原係水成岩、其時代自應較新、大抵與維理士氏之五台系有一部相當、而屬於元古代。

片麻岩分布極廣、煤田周圍之羣嶺、悉爲此岩組成、由八道壕至煤田中間數十里、亦皆屬此岩。在阜新縣城西北八家子後山、片麻岩則構成孤獨之山脊、蓋此岩抵抗侵蝕之力較強、故其露出之處、恒現爲大山峻嶺、遠望之極易辨認也。



圖一

中侏羅紀煤系　不整合覆於片麻岩之上者爲煤系。其組織爲頁岩砂岩礫岩與煤層等、大致呈黃色或黃綠色、在阜新縣城西北兼現有少許黑色頁岩。全系之厚度、尙不易計算、約略估之、當在千公尺以上。礫岩恒露出於煤系底部或頂部、惟露出於底部者如在阜新縣城西北八家子後山及烟台營子東北所見、礫石多屬火山岩、大者直徑可至尺許。礫岩位於煤系頂部者、如在孫家灣南之所見、則礫石每爲片麻岩及少許石英岩、直徑大者可至二尺、小者僅寸許。因可證明煤系沉積之始、煤田周圍之山嶺、率覆以火山岩、故煤系底部之礫岩多火由岩礫、現時煤田西北面海州營子至四官營子一帶、均有安山岩露頭、想必爲是項火山岩之遺留無疑。及至煤系之頂部岩層沉積時、火山岩流已被侵蝕殆盡、其下之片麻岩露出、以致煤系頂部礫岩每含片麻岩礫、

而礫石直徑之大、又可證明礫岩沉積時煤田周圍山形侵蝕之速、及煤田距山嶺之近。

在孫家灣舊煤窰日騐石堆中、採得含植物化石灰砂岩數塊、茲經約略鑒定屬左列三種。

Podozamites lanceolatus Lindley & Hutton
Pityophyllum nordenskiöldi (Heer) Nath.
Ginkgo cf. sibirica Heer

右三種化石中尤以第一種爲最常見、在孫家灣之南相距約一里之處、於黃灰色頁岩內獲得植物化石亦夥、其種名爲

Dicksonia gracilis (?) Heer
Podozamites lanceolatus Lindley & Hutton
Ginkgo cf. digitata (Brongniart)
Pityophyllum nordenskiöldi (Heer) Nath.
Pterophyllum sp.
Eladocladus sp.
Pagiophyllum sp.

右化石中以第一及第二兩種爲最多、而前四種則爲中侏羅紀最發達之化石、第二種雖亦產下白堊紀、要以產生侏羅紀者爲常見。統觀上列植物化石、可知此植物羣與產於日本之Tetori系之植物羣、及俄羅斯東西

比利亞及阿穆爾省二處之中侏羅紀植物羣、十分相似、此植物羣之代表化石、亦大半押日本及俄國之代表化石、故就現刻知識判定阜新煤系之時代爲中侏羅紀似無大謬（參看英文部）。

煤系之分布略現一東北西南向之長帶狀、雖其西南端尚未測盡、然據已測知者、由朝代營子大崗崗之西南、經阜新縣城孫家灣哈拉火燒達土胡蘆一帶、共長約七十里、東南由新邱長哈達東瓦房起、西北至朱家四子四官營子四道嶺等處止、計寬約三十里。

下白堊紀紅色礫岩　此礫岩層之下部、以紅綠色粘土頁岩爲主、間夾有少許砂質紅色粘土頁岩。所有礫岩其礫石均爲片麻岩與石英岩、直徑大小相差甚巨、因礫岩層之一部、在調查區域內爲斷層所切、故全層厚度之推計頗難、大抵亦不在煤系厚度之下。此層內尚未發見化石、雖其與煤系爲整合接觸、但不整一之存在似屬可能。大概此層與中國北部有名之凝灰礫岩相當、若然則其時代當屬下白堊紀、唯此層中之火山凝灰塊集岩似頗少耳。

礫岩層在楊溝南瓦房一帶露布較廣、由此面西南尚未勘測、自此面東北則漸狹、至長哈達附近竟完全爲斷層所割裂而失蹤。

火成岩

煤田內時有火成岩露布、茲據所採之標本研究所得、約可別爲四類如左。

（一）輝綠岩　色暗黑、全結晶、晶體尚粗。自顯微鏡下觀之、其中鑛物以斜長石及輝石爲主、斜長石大部爲鈣鈉長石、常受大塊輝石晶體所包圍、成所謂輝綠岩組織。輝石頗有成斑晶之傾向但全形晶體絕不之見。附屬

鑛物以磁鐵鑛爲最多。

此項岩石來自傅家凹子、據上所云、其爲侵入火成岩似無疑問。

(二)安山岩　此項岩石結構及成分、均易地而多有變異。自外形觀之有全結晶者、如產在蛤螨營子者是有岩基成微晶狀者、又有中含氣孔或空隙內儲次生物質者。但色暗綠、風化分解甚烈、則爲共同之性質耳。因風化過度、故在顯微鏡中、頗難判別其組成鑛物之種類。大體言之、長石以含灰質者爲主體、鐵鐵鑛物以輝石及角閃石爲最多、此二者通常大都風化成綠泥石。尙有黑雲母及磁鐵鑛亦占重要位置、橄欖石未見、即有亦絕稀。有一種大概爲透輝石之鑛物、頗似橄欖石、惟在直交偏光鏡下表示斜消光、則其不爲橄欖石可知。此項岩石分布甚廣、蛤螨營子海州營子及九營子二帶、均有良好之露頭。由上所言大部份必爲古代熔岩無疑。

(三)粗面岩　色暗紅、結構密緻、斑晶爲白色正長石、黑雲母、及紅色柱狀晶體、後者大概係角閃岩變化而成。岩基夫都成微晶、甚至作玻璃狀、除少許無定形之卵白石外、石英全未之見。

產自燕台營子東北、係火山熔岩。

(四)角礫流紋凝灰岩　白色質輕、爲多數之火山岩碎塊及小粒所成、在顯微鏡中知此種碎粒乃由風化之正長石石英所組成、鎂鐵鑛物甚少、其成分與流紋岩最相近故名。

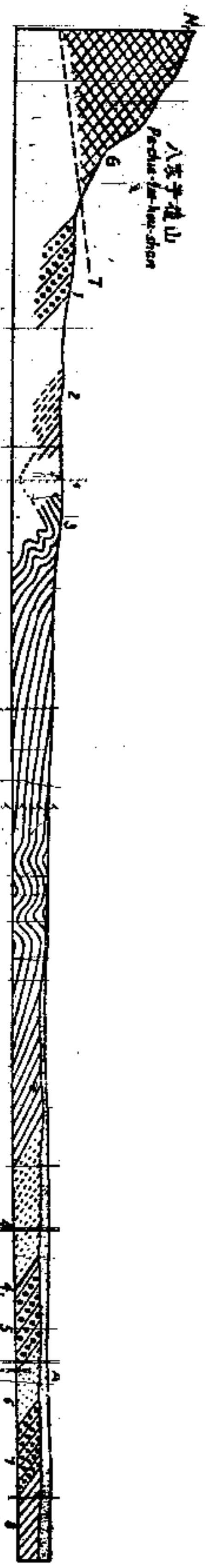
產西主胡廬、爲火成碎屑岩、其上覆以淡水介殼化石層、所採得之化石、經約略鑒定以 *Ophicula andersoni* 及二種腹足類爲最多。此種化石在北票煤田八道濠煤田及義縣煤田丙均曾經發見、其所代表

時代應屬於白堊紀。

構造

煤田附近之地層除片麻岩與片岩率傾斜急陡方向屢易外、凡煤系與紅色礫岩皆大致傾斜東南向、恆在十五度左右甚爲規則惟在阜新縣城南米家窩鋪長哈達等處傾斜有時稍急、可至二四十度。又在阜新縣城西北八家子北於二溝內見煤系摺曲頗烈、構成數向斜層及外斜層。(見第二圖)

第二圖



(八家子附近剖面(長約一里半)；表示煤系下部摺縐。1,層底礫石帶安山岩礫石；2,黑色頁岩；3,黃色頁岩；4,灰綠色砂岩；生煤層；5,煤岩層岩及石英岩礫石；6,綠灰色砂岩；7,礫岩；8,黃色頁岩；G,古代片麻岩；A,沖積層；T,逆掩斷層面。

阜新縣城西北八家子後山之片麻岩山脊南爲煤系、大致傾斜南向、山之東西北三面則爲安山岩。片麻岩與煤系及安山岩之接觸、悉爲土壤覆蔽。初視此山頗覺離奇、或疑煤系原以組成此山之片麻岩爲底床而沉積、山北安山岩流亦覆於片麻岩之上。然細察地文情形、此論又毫無實據。反覆推勘、欲得二可能之理解、頗似此片麻岩山係因逆掩摺斷推移而來、其推移之方向應自北而南、與在北票附近翁詠霓先生所見逆掩摺斷推移之方向略相同。

第三圖

土胡蘆附近剖面。1,礫岩;2,黃色頁岩;3,黃色砂岩;4,礫岩;5,砂岩及頁岩;6,角礫流紋岩(六公尺);7,化石層中含 *Corbicula andersoni*. Q_4 石英岩。

在西土胡蘆燒鎢之西、突出一圓形小山、山之周圍皆爲煤系、一致傾向東南傾斜、近山頂則爲白堊紀角礫流紋凝灰岩、亦略有傾側、與其下覆蓋之煤系、似呈不整合接觸。果如所見不謬、則煤系與紅色礫岩摺曲之時期、應在上白堊紀、同時兼有火山活動、因而構成角礫流紋凝灰岩、而流紋岩之傾側、則應更屬別一較新之時期。(見第二圖)

煤田附近除摺曲之外、斷層亦甚夥。最著者爲煤田東南之斷層、斷線爲東北西南向、現在已測知之部分、由朝代營子之東起、至楊溝之西南止、已長達六十里。構成煤田之東南界。仰側居斷線之東南、屬一正斷層、沿斷線在新邱與大崗崗之東南、俱見煤系與片麻岩爲斷裂接觸、極爲明顯。長哈達與楊溝之東南、則易爲紅色礫岩與片麻岩直接接觸、其爲斷層所致、尤易推知、且可表示斷層之斷距、自東北而西南漸次增加、在大崗崗與新邱附近斷距約不過數百公尺、至長哈達與楊溝一帶則可達一千公尺以上矣。

所述大斷層之外、尚有較小之斷層二、一在長哈達之東、如平面圖所示、將紅色礫岩切斷、且將前述之大斷層線分割爲二。此種斷層之性質、頗似近平移斷層一類、其斷裂應較後於東北西南向之大斷層、故能將其分割。斷線走向、自北而南僅長約數里。一在新地之西南、蓋在新地附近露出之煤系、皆傾斜向東南、至其西南沿

河床露出之岩層、則皆忽易爲紅色頁岩層下部之紅綠色粘土頁岩與頁岩、傾斜西向偏南、其間當爲斷層所致、此種斷層大抵屬正斷層類、降側居斷線之西、斷線呈南北向、其長度雖尚未完全探悉、大抵亦與長哈達附近之斷層相伯仲、其斷距則可在百公尺以上。

在朝代營子附近煤系底部頁岩露出、大致傾斜東向、由此再東行四五里、即爲片麻岩、頗疑煤系與片麻岩在此接觸、或亦爲斷層關係、特尚未得一往研究爲憾。

礦產

煤層　煤田內重要煤層之蘊藏、悉近於煤系上部、據前日本人打鑽之結果、含煤有三組、(見篇末第四圖)上組總厚約三・四公尺、中間可細分爲三層、上層厚約一・二公尺、中層厚約〇・五公尺、下層厚約〇・九公尺、上層與中層隔以黑色頁岩厚約〇・二公尺、中層與下層亦隔以黑色頁岩厚約〇・六公尺、中組總厚約八・六公尺、亦可細別爲三層、上層厚約〇・二公尺、中層厚約七・一公尺爲開採主要之煤層、下層厚約一・三公尺、上層與中層隔以黑色頁岩、厚僅〇・一公尺、中層與下層隔以砂質頁岩、厚約二・一公尺、下組總厚約一・七公尺、可細分爲兩層、上層厚約〇・四公尺、下層厚約〇・六公尺、中隔以黑色頁岩、厚約〇・六公尺、上組與中組相距約六十公尺、中組與下組相距約二十四公尺、各組間以頁岩與砂岩、自李家溝西南行十二里至朱家營鑛、據李天義稱、在前二十年採煤只有一層、厚約四公尺、再西南行二十里爲王家溝、所採之煤層有二、上層厚約二公尺、下層厚約二・四公尺、中間隔以砂岩與頁岩、共厚約二公尺、其二煤層間頁岩石之厚度、有時變薄、以致二煤層合併爲一、更西南行五里爲烏龍泉、所採之煤一層、厚約八公尺、甚爲可

新邱之煤據翁先生所采日本人之分析如左、

水分	揮發分	定炭	灰分	發熱量
一二・〇〇	三五・〇〇	四二・五〇	一〇・〇〇	六〇九〇

應稱中淨褐性烟煤其記號爲BC₁

據察阜新之煤與奉天撫順及西安之煤頗相近、茲爲便於比較起見、援引二處煤之分析各一例如左、

產地	水分	揮發分	定炭	灰分	發熱量	化驗處
撫順	六・七三	三九・三四	四八・一五	五・二五	六七八〇	日本
西安	四・四二	三九・二八	四七・六九	八・六一	六四六〇	奉天兵工廠

由右表可知撫順之煤、應稱高淨褐性烟煤、其記號爲BC₂與孫家灣一部分之煤完全相同、西安之煤則應稱中淨褐性烟煤、其記號爲BC₁與日本人所分析新邱之煤亦略相似。

煤量、阜新全煤田雖由東北而西南延布甚廣、然重要煤層蘊藏之區、僅限於金家四子韓家店一帶、共長約四十里。金家四子以東及韓家店以西煤層漸薄、煤質亦劣、其儲煤量可暫置而不論。而韓家店金家四子間之儲煤量、又可按煤層厚度之變易、傾斜之緩急、分爲三部推算。倘如均假定開採深至六百公尺爲止、則得儲煤量如左。

(一)金家四子老君廟之間、煤層平均傾斜爲十五度、平均厚度定爲六公尺、煤層露布長度約五千公尺儲煤

量約達九〇、四〇二、〇〇〇噸。

(二)老君廟郭家四子之間、煤層平均厚度定爲四公尺、平均傾斜約四十度、煤層露布長度約七千五百公尺、儲煤量計達三六、三八七、〇〇〇噸。

(三)郭家四子韓家店之間、煤層露布長度約一萬公尺、煤層平均厚度定爲六公尺、平均傾斜爲三十度、儲煤量達二三六、八二二、〇〇〇噸。

以上三部總儲煤量共達二六三、六〇一、〇〇〇噸簡言之共約達兩萬萬六千萬噸。因阜新全煤田重要煤層蘊藏之區、悉包在內、故此計算所得之數、亦可視爲全煤田之儲煤量。

鑛業　煤田內鑛區雖極複雜、而曾經開採者則只有四處、鑛廠之組織、以新邱大興大新煤鑛公司規模爲較大。備有升降機汽鍋爐機器修理廠等、惟公司名義上雖爲中日合辦、實權皆操於日人之手、中國方面不過虛設一總辦及經理已耳。因煤之運銷困難、調查時正在由斜井內排水、停工已及一年、聞不久水乾時、仍將開工、並已聘用日本人打鑽、以備將來別開新井。

米家窩鋪之煤窰、原係奉天鑛務局開採、停工亦逾一年、窰廠內只住有管鑛主任會計庶務各一人、及鑛警四名。以備收束、兼經理孫家灣煤窰包採事務。所有舊斜井及竪井皆被水淹閉或傾塌、井口外僅尚有未售出之煤一堆、及所餘之二二破汽鍋爐倒置耳。

孫家灣爲煤田內產煤最多之區。奉天鑛務局在此亦有一部分鑛區、係包給他人開採、憑鑛權而收其所得煤價百分之二十八、名爲包採。例如包採人售煤得資百元、須以二十八元交鑛務局、凡鑿井雇工採煤售煤排水

等項、皆歸包採人自理。惟鑛務局在窰廠住一收款員及一井內測量員、任指導採煤之責、所有二員之住址飲食、亦悉歸包採人供給。鑛務局共有包採四家、悉用土法開採、一名同益昌有竪井八口、二口專備排水之用、餘均出煤、又置有斜井一口。一名德興順有斜井一、竪井五。一名瑞增祥有斜井二、竪井二。一名同興盛有斜井二、初鑿透煤層、尚未出煤。各井之深度恒在六七丈、惟出水井可深至八丈。又各竪井口上皆置有四人絞之轆轤、以備絞煤。採煤之方法、完全爲包工制、大抵六工人爲一班、二人在井內採、二人往井口運、二人在井上絞、各班可合作以湊足四人絞轆轤之數。每工人平均日可得資約六七角、工作時所用火食燈油別由包採人供給。總計凡採出煤一百小筐（約一千斤）、包採人約付工資五角、平均每噸煤由井內至地面、約須費洋八角。絞煤筐之平常可盛煤百斤、用斜井出煤者、則以人力肩擔兩筐、每筐約盛煤五十斤、沿石梯上下。鑛務局包採四家出煤最多時、每日可達二百噸、調查時每日出煤約五六十噸、每年產額約三萬噸。末煤每噸在窰廠售五角、可值洋四元、塊煤每噸則可值洋六元、皆由馬車運銷於本地、以供家用。平常四套馬車可載煤三千斤、運煤時沿路無稅卡之煩。自孫家灣而西南至烏龍皋、尚有裕後煤鑛廣興煤鑛及慶昇煤鑛等、皆係自領之鑛區、其開採方法與鑛務局之包採悉大致相同、惟有時置有汽鍋與汽泵以便排水。欲統計孫家灣烏龍皋一帶各鑛之產煤總額、頗爲不易、因各窰時開時停、屢有變易、約略估之、每年當不下八萬噸、

層厚 Thickness	總層厚 Total Thickness	地層 Strata	
1.160 m.	1.160 m.	浮土	Surface Soil
1.525	2.690	灰色砂岩	Gray Sandstone
12.040	14.730	黑色粘土	Black Clay
0.790	15.519	暗灰色頁岩	Dark Gray Shale
1.215	16.735	煤層	Coal Seam
0.200	16.935	暗灰色頁岩	Dark Gray Shale
0.500	17.435	煤層	Coal Seam
0.600	18.035	黑色頁岩	Black Shale
0.915	18.949	煤層	Coal Seam
0.200	19.149	黑色頁岩	Black Shale
2.350	21.499	暗灰色頁岩	Dark gray Shale
7.240	28.739	黑色頁岩	Black Shale
9.415	38.145	灰色砂岩	Gray Sandstone
8.620	46.765	淺白砂岩	Whitish Sandstone
11.410	58.175	淺白礫岩	Whitish Conglomerate
7.990	66.165	灰色砂岩	Gray Sandstone
5.190	71.355	暗灰色砂岩	Dark gray sandstone
6.290	77.555	灰色砂質頁岩	Gray sandy shale
0.200	77.755	煤層	Coal seam
0.170	77.925	黑色頁岩	Black shale
7.145	85.070	煤層	Coal seam
1.745	86.815	暗灰色砂質頁岩	Dark gray sandy shale
0.350	87.165	碳質頁岩	Carbonaceous shale
0.190	87.355	暗灰色砂質頁岩	Dark gray sandy shale
0.935	88.290	碳質頁岩	Carbonaceous shale
1.285	89.575	煤層	Coal seam
1.070	90.645	碳質頁岩	Carbonaceous shale
0.715	91.360	黑色頁岩	Black shale
12.580	103.940	灰色砂質頁岩	Gray sandy shale
0.415	104.355	黑色頁岩	Black shale
0.380	104.735	砂質岩	Sandy shale
1.855	106.590	黑色頁岩	Black shale
2.305	108.895	砂質岩	Sandy shale
2.560	111.455	黑色頁岩	Black shale
1.515	112.970	灰色砂質頁岩	Gray sandy shale
0.450	113.420	黑色頁岩	Black shale
0.425	113.845	煤層	Coal seam
0.690	114.535	黑色頁岩	Black shale
0.615	115.150	煤頁	Coal seam
1.975	117.125	灰色砂質頁岩	Gray sandy shale
6.275	127.400	黑色頁岩	Black shale
12.315	135.715	暗灰色砂質頁岩	Dark gray sandy shale
0.400	136.115	灰色砂岩	Gray sandstone
0.550	136.965	灰色礫岩	Gray conglomerate
10.235	147.200	灰色砂質頁岩	Gray sandy shale
4.200	151.900	灰色砂頁	Gray sandstone

奉天本溪縣小市煤田地質簡報

黄汲清

民國十七年十月請實本所技師王竹泉君奉派赴奉天省調查地質礦產抵瀋後約定王君往吉林致查煤田、請同往本溪小市先作測量蒞小市之第四日、即因要事輟工返瀋故對於小市附近地質及煤礦情形均未克詳加研究下所紀述不過一種初步簡報、謬誤之處、在所難免。

小市煤田曾經大連地質調查所派人察看、（註一）於地質方面僅有簡略之紀載、於煤產方面興紀述較詳、且曾將煤層標樣作化學分析。故下文所言、以關於地質方面者爲多

位置及交通

小市煤田位於本溪縣之東部崇山中、地當太子河流域小市爲煤田內第一大村鎮、居煤田之中央由本溪縣達至此、陸路約八十里、水路逕之。東距田師傅溝約四十里、西北距牛心台約三十里。赴縣陸路大都崎嶇難行、且須經過二峻嶺、故交通十分不便。水路則僅太子河可行小船、惟水淺且急、冬日小船亦停、只木筏尚可行駛耳。

地形

本溪縣東南一帶地方均屬山嶺區域重巒疊嶂、勢欲摩天、峻壁懸崖、矗立百尺此境此情小市煤田自無例外惟煤系岩石大都比較鬆軟、風化易石故煤田內尚不乏平坦之地。就觀察所及、煤田四週大都爲石灰岩所成之高山峻嶺、東北一帶山勢尤爲險惡。煤田本部之山則最高者不過一百公尺。小市老母閣上山城寨一帶則

爲一小規模之冲積平原、太子河自東而西橫貫之、渾河則由南至北流入太子河。河身灣曲甚多、迴旋山嶺間、蜿蜒如帶。河曲凸處率爲石壁、凹處則多顯平坦、泥沙堆積其間、成半月形或長條形之洪水平原、詳察煤田地形、山高而峽谷鮮親、水急而湍流絕無、故其地文時期已過幼年、而未及壯年、其爲幼年晚期似無疑問。

地層

自本溪到小市先沿太子河南岸行。河南諸山太都爲紅色砂岩所成、致往南微傾。在本溪縣東約二里許、此噴岩層出露於河之南岸、岩石除紅色砂岩及頁岩外、尙有火山角礫岩多層。由此往東至臥龍村、沿途均有相似岩石露布、且更見有甚多之火山熔岩。再東行則火山岩絕跡、而寒武奧陶石灰岩突現眼簾。大概由臥龍村到三架嶺二十里地之間、路北全爲石灰岩、路南則爲震旦紀之石英岩、中間以一逆斷層相隔。石英岩覆壓於石灰岩之上、其接觸處在臥龍村東一小溪畔表現最清。斷層走向大致爲東偏南。由三架嶺東行到處惟見石灰岩峻嶺、直到謝家崴子一帶、始有煤系之露頭焉。

煤田地質早經有名地質學者李希霍芬氏紀述（註二）彼謂煤田四週之石灰岩爲奧陶紀灰岩、下志留紀」斷狀灰岩、及層狀灰岩。此次察看所見略同、惟層狀灰岩似不甚多。煤系岩石下部以頁岩爲多、內含薄層石灰岩。頁岩則多作灰黑色、但有一層紅色者、厚不過二十公尺、位置離奧陶紀石灰岩不遠。上部岩層砂岩占其大半色黃或灰黃、間有頁岩夾雜其間。礫岩則甚稀少。煤層通常位於砂岩層下面。全系露頭總厚最多不過二百呎尺。其地質時代想應與本溪溯煤系相同、下部爲本溪系、含煤層及砂岩層則應屬山西系、山西系以上之地質則均被侵蝕以去矣。

構造

大體言之小市煤田爲一東西長南北狹之盆地、經衆多之斷層割裂而改形者。盆地四週繞以寒武奧陶紀石灰岩、俱大致向盆地傾側、傾度由三十度至七十度。煤系與石灰岩爲整合、故其傾側亦如之。盆地被小市平原區爲東西二部、西部煤系地層構成一東傾向斜、向斜軸大致沿由小市至謝家崴子大道、地當出之凹處。兩翼地層向中傾斜、傾度由三十至四十度不等、因上部岩石大都爲硬砂岩、故作成南北對峙之二山嶺。東部地勢平緩、煤系地層傾側不甚規則、惟大體構成一西傾之向斜、與西部向斜遙相呼應。

煤田內斷層頗多、但斷距均不甚大、斷線亦不甚長、大致均作東西走向。茲舉其重要者述之。西部向斜之南、煤系與石灰岩山相接、石灰岩向南傾、煤系則向北傾、中以一溝相隔、溝北尚有少許石灰岩出露煤系之下與之整合接觸、故知斷層線應與山溝約略一致。在謝家崴子東北太子河左側、石灰岩構成石壁、傾斜向南偏東。構造若無變動則河套內小山岩石、應仍屬石灰岩、然實際則有一遍黃色頁岩出露。頗疑有一斷層介於其間。又上由城塞溫東、地勢平坦、紅色頁岩歷歷可見、故煤系必有一部在此出露、其與馬平溝煤系之關係、似又爲斷層斷線即沿太子河河道。又馬平溝本爲一寬闊之溝、向南突變狹窄、溝東突出二石灰山脊、將煤系隔斷、大概又有一較小斷層發生。

綜上所述、似煤田先受摺曲動作、隨後斷層發生、將煤系割成四分五裂、其性質似屬正斷層一類。惟按在臥龍村二架嶺間之觀察、似此區內逆斷層頗多、即平推動作甚盛。煤田內斷層走向、適與前述逆斷層一致、然則其爲逆斷層、似更屬可能。

經濟地質

煤層　調查時各土窰均已廢棄或停工、故煤層眞相頗難窺見。據云煤有數層、均不甚厚、大都產於煤系中部。據日本人報告謂其厚度由〇・三公尺至一公尺。

煤質　煤質大致爲無烟煤、質頗惡劣、通常含多量灰分、且大部爲碎塊本地人呼爲砟子、惟間有成大塊者、尙適於家用。

煤量　本煤田儲量因煤層厚度未確知、故頗難計算。茲姑從樂觀方面着想、假定可採煤層厚度爲一公尺、煤田平均長三公里、寬一公里半、煤層平均傾度爲三十度、煤之比重爲一・五。更因煤系全部均埋藏不深、故煤層全部均可採取。如此計算全儲量約爲七百萬噸。惟小市平原下覆蓋之煤系、大都被河流侵蝕、恐煤層存留者已無幾矣。又小市東北約十五里、有地名泉水河子、聞亦產煤、惜爲時間所限未克一往察看、統觀上述各點、足見小市煤田之煤質甚劣、煤量甚微、實無用新法開採之價值、只可用土法挖掘、以供鄉僻之急需耳。

（註一）鳳凰城圖幅地質說明書南滿洲鐵道株式會社地質調查所出版

（註二）李希霍芬著「中國」第二册第九十八頁

遼寧省本溪縣田師付溝煤田西安縣煤田及吉林省額穆縣蛟河煤田地質

王竹泉

民國十七年五月入手調查遼寧（以下因原文作於十七年仍用原名奉天）吉林境煤田六月中旬竣事、爲期共二月又二十日。惟因田師付溝西安與蛟河三煤田位置相距過遠、路途之跋涉、幾耗時間之半、幸煤田附近地形、悉有舊圖、可資參攷、尙稱便利。茲將三煤田之地質情形分陳於左、並附述奉吉二省之地形於後。

一、本溪縣田師付溝煤田

田師付溝煤田於民國六年及十二年曾前後經日本人碧海康温與齋藤亮氏等調查、十三年復經日人青地乙治今井澄等研究、著有報告、印於南滿鐵道地質調查所支那鑛業時報第六十五號內。其重要結果謂煤田時代應屬石炭二疊紀及二疊三疊紀、並推測煤田內有許多斷層存在。作者應北票煤鑛公司之招、往煤田內探求鑛區、對於地質雖僅爲四五日之簡略調查、然含煤之岩層、顯可決定分爲二系、二屬石炭二疊紀、二屬侏羅紀、而斷層之分布、亦似非如日人所想之多。茲將所見之現象、論述於左。

位置及交通

田師付溝係太子河之一支流、位於安奉鐵路本溪縣車站之東南。陸路距縣城一百三十里、僅通騾駄、路程約爲一日半、須逾五嶺、以八盤嶺爲最大。水路沿太子河距本溪約二百四十里、路程須四日、因小船夜間不能航行故也、惟當夏日雨後水大時、二日亦可達、冬日則河身完全封凍、所恃爲轉運者、只有陸路耳。

地質

地層

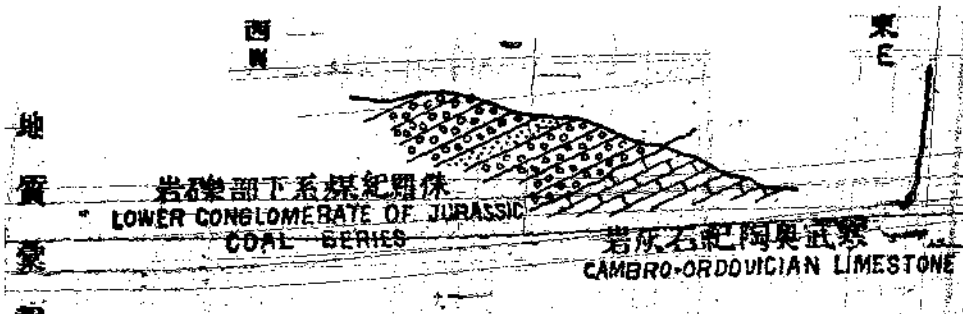
煤田附近之地層、除火成岩外、約可分爲四系如左。

一、寒武奧陶紀石灰岩　近煤田之邊緣、石灰岩分布甚廣、恒構成崇嶺、絕壁、總厚度約不下千公尺。如煤田西之八盤嶺、以及孔家堡子北與大東溝東之高山脊、悉由此灰岩組成。而其時代、在調查區域內雖未採得化石、以資鑒證、然按其岩石性質、自應相當於中國北部最普通之寒武奧陶紀石灰岩。

二、石炭二疊紀煤系　寒武奧陶紀石灰岩之上、爲石炭二疊紀煤系。二者之層序接觸、以在佟家嶺子北爲最明瞭、顯示不連續之跡甚著。煤系在調查區域內僅下部現露、上部則悉被斷層割裂。下部之岩層組織爲灰色與紅色頁岩及黃白色砂岩、近上部則多黑色與綠色頁岩及煤層。煤系之分布、以在孔家堡子、全家堡子、郭家南溝一帶爲最廣、由全家堡子經佟家堡子而西北、則煤系露頭現一狹帶狀、其北端止於何處、現在尚未探悉、惟登高嶺而北望、則見介於東西兩石灰岩山脊之間、由煤系組成之低阜、向北延布甚遠、據本地人談、稱至少須在三十里以上。在此狹帶煤田內、煤層有時被斷層割斷、只餘一部、岩層現露、亦有時煤層尚保留、則土窯開採甚盛。

孔家堡子東南山坡、舊窯口甚夥、於廢石中採得多數植物化石如 *Sphenophyllum verticillatum* Schloth, *Neuropteris* sp., *Callipteridium trigonum* Branke, 及 *Pecopteris* (*Asterotheca*) *hemitelioides* Brongn. 等、足證煤系之時代屬於石炭二疊紀。於此並見煤層之上、係爲一種白色石英砂岩、本地稱爲磨石、多用以做磨、厚度

第一剖面圖



鞍山子北寒武奧陶紀石灰岩與侏羅紀煤系下部礫岩之不連續接觸

似甚大、全家堡子之北山、大部由此岩組成。

三、侏羅紀煤系　侏羅紀煤系露布之區、從前日人數次調查、均認之爲石炭二疊紀及二疊二疊紀。作者現由岩層之組織與化石之鑒定、悉足以證明侏羅紀煤系之存在、惟其與石炭二疊紀煤系之層序關係、因所見甚係斷層接觸、尙不明瞭。在大堡北如第一剖面圖所示、侏羅紀煤系直接覆於寒武奧陶紀石灰岩之上、足爲侏羅紀煤系與較古岩層呈不連續接觸之表示。侏羅紀煤系之組織、約可分爲三部。下部爲礫岩層、礫石多石英、以類鷄卵大者爲最多、全厚約近百公尺、分布於大堡之北及大東溝一帶、其露出之部恒構成石崖、本地稱爲石磊子。（本地凡遇石崖皆稱爲磊子、如雷劈磊子等其最著者也。）中部爲綠色灰色與黑色頁岩及薄層砂岩煤層等、總厚約不下一百公尺、露布于大堡魏家堡子盤龍寺等處。在杉松河南入凌樹銀石王溝一帶、因近花崗岩、大部變爲石英岩及板岩。在魏家堡子東雷劈磊子附近曾採得 Cladophlebis nebbensis (Brongn.), Palyssya mandhurica sp. 及 Czekanoskia rigida Heer, 等植物化石、在大堡東南則採得 Coniopteris hymenophylloides (Brongn.) 現在雖尙與 Baiera sp. 等確定煤系屬於侏羅紀。煤系之上部亦係礫岩層、其礫石亦多石英岩與下部相似、惟近底層每夾薄層砂岩、往往含植物化石印跡頗夥。近上層於三個嶺之西南則見有石英岩似受變質甚深、每含有長石晶粒、局部兼顯示柱狀結構、初視之頗疑爲火山岩、細察之知仍屬

一種變質甚深之石英岩。煤系上部之總厚度約可達五十公尺恒組成山頂石崖如石冠、顯露於三個嶺雷劈磊子夾皮溝盤龍寺北部一帶。

四、冲積層　此層含有土壤及散石礫、土壤大部分布於田師付溝與杉松河之兩岸、散石礫則多積於溝底河床內。近侏羅紀礫岩石崖處、因礫岩多被風化、恒多石英礫散雜於土壤之內。

五、花崗岩　杉松河之南、如沿歪脖子溝或銀石王溝而深入、俱見花崗岩露出甚多。岩石大致現粉紅色正長石結晶頗粗、幾占成分之大半、石英粒較稀、雲母尤少。因侏羅紀煤系已深受此岩侵入之影響、故其侵入之時期、至早須在侏羅紀之後。雷劈磊子東更見有安山岩類火成岩直侵入於侏羅紀煤系之內、而現爲岩脈、其侵入時期似應較花崗岩尤新。

構造

煤田附近岩層如石炭二疊紀煤系及寒武奧陶紀石灰岩等之分布於孔家堡子佟家嶺子八盤嶺一帶者、大致傾斜向西或西南、傾角約由十度至四十度。（參攷第四版AA剖面圖）侏羅紀煤系則構成一向斜層、（第四版BB剖面圖）褶軸爲西南東北向。近軸帶岩層爲煤系上部礫岩、起自盤龍寺北向東北經雷劈磊子達三個嶺一帶。向斜層西北翼在全家堡子南及大堡大東溝等處、其岩層爲奧陶紀石灰岩侏羅煤系下部礫岩及中部頁岩等、率傾斜東南向、傾角約由十五度至三十度。組成東南翼之岩層、在銀石王溝魏家堡子八棱樹一帶、則被花崗岩穿割、僅餘侏羅紀煤系中部、傾向西北約由十度至二十五度。若以地形論、則向斜層褶軸組成

一山脊、爲田師付溝與杉松河之分水嶺、而其東南與西北兩翼則爲所述二河流谷床之低凹地域、而斜層之結構、極爲明晰。

煤田附近斷層甚夥、茲將其較重要者、分述於左。

一、八盤嶺斷層　八盤嶺東山麓之斷層、茲名爲八盤嶺斷層（第四版AA剖面圖）、蓋郭家兩溝與佐子嶺子迤北一帶之石炭二疊紀煤系、及八盤嶺之寒武奧陶紀石灰岩、皆一致西傾、其間接觸當係一斷層。沿斷層線石灰岩崖壁立、又可表現斷層面急陡之狀況、及微向東傾之趨勢、因而證明八盤嶺斷層係一正斷層。斷線走向南南西—北北東、其長度在測量區內約十餘里、恐向北延長尙有數十里、爲煤田附近斷層中之最大者。仰側居斷線之西西北、其上下移動約達六百公尺以上。蓋石炭二疊紀煤系之一部與侏羅紀煤系全部悉被缺失、其移動之巨、可推而知。

二、大堡斷層　大堡之西北、如平面圖所示石炭二疊紀煤系與侏羅紀煤系恒直接接觸、在全家堡子南爲石炭二疊紀煤系與侏羅紀煤系中部接觸、至郭家南溝東南、則爲石炭二疊紀煤系與侏羅紀煤系上部接觸。此種不規則之接觸、自當係斷層所致。斷線爲東北西南向、已測得者共長約十二里。仰側居斷線之西北、其上下移動至少約在三百公尺以上。斷線之西北端、以理推測應與八盤嶺斷線相交切、特此交切點之狀況、尙未得以研究。

三、孔家堡子斷層　孔家堡子西北寒武奧陶紀石灰岩突出甚急、大致傾斜西向、與石灰岩接觸之石炭二疊紀煤系、則多傾斜西南、二者之間當係一斷層。斷線自東北走向西南、共長約六七里、其東北與西南兩端、因俱

走入同一岩系內、如石灰岩與煤系等、不易考察。仰側居斷線之西北、其上下移動約達二百餘公尺。

四、全家堡子斷層　此斷層之辨認、由於全家堡子北石炭二疊紀煤系下部紅色頁岩與上部石英砂岩直接接觸、（第四版AA剖面圖）一致南傾。斷線爲東南西北向、長約四里、東南端界於大堡斷層、西北端限於北家堡子斷層。仰側位於斷線之西南、其上下移動約近三百公尺。

五、轉山子斷層　孔家堡子西寒武奧陶紀石灰岩與石炭二疊紀煤系、時現斷裂之接觸。（第四版AA剖面圖）沿斷線而東南、則見石炭二疊紀煤系與侏羅紀煤系下部礫岩接觸、其斷裂情形益爲明顯。斷線爲東南西北向、共長約四里。仰側位於斷線之東北、其上下移動約不過數十公尺耳。統察該斷層與全家堡子斷層略現平行、以致中間在孔家堡子附近之石炭二疊紀煤系下降、因而構成槽形斷層結構。

六、大東溝斷層　大東溝斷層自東南走向西北、斷線長達十餘里。仰側居斷線之東北、其上下移動由零至三百餘公尺。該斷層之推定、由於大東溝東南侏羅紀煤系下部礫岩及中部頁岩各與奧陶紀石灰岩直接接觸、一岩層多向西緩傾、或現平層。大堡之西北如平面圖所示、似尙有一東西向之小斷層。惟此斷層與大堡斷層與轉山子斷層之一部、或係一獨立斷層、尙未推定。

統察斷層之走向、雖無甚規則可尋、而煤田之四周、除南部界於花崗岩外、多限以斷層、此種斷層率以煤田爲下降之區、簡言之、煤田區域、直可稱之一大槽形斷層中之槽心也。至斷層之時代、因斷線曾切割侏羅紀煤系、自當後於侏羅紀。

鑛產

煤層　因煤田開採較古、故煤層賦存之狀況亦較明瞭。石炭二疊紀煤系在孔家堡子南山普通開採之煤層一有十、本地各予以專名如左。

層數	特名	厚度	備考
第一層	小槽子	一尺	此爲最上之煤層由此而下依次類推
第二層	大槽	六尺	
第三層	大烟頭	二尺	
第四層	兩路貨	二尺	
第五層	十二路	二尺	
第六層	馬札腿	五寸	
第七層	二道槽	一尺	
第八層	十三節	一、五尺	
第九層	二節	四尺	
第十層	十二節	一、五尺	

右表中以第一與第九煤層較厚、質亦較佳、開採亦此二層爲盛、特稱之爲香煤。在郭家南溝與佟家嶺子西北一帶、煤之層數似較此稍減、厚度亦頗有變異。侏羅紀煤系內所含煤之層數、據在大堡東南探知者、亦有十層、且亦各有特名如左。

層數	本地特名	厚度	備考
第一層	蓋把里（一名大頭煤）	二尺	
第二層	大興行	五尺	最上之煤層
第三層	大頭節	四尺	
第四層	馬札腿	二—二尺	
第五層	小頭節	二、五尺	二名頂爐大頭節
第六層	上二節	三尺一	
第七層	三節	三尺	
第八層	下二節	二、五尺	一名底爐大頭節
第九層	大頭節	三尺	
第十層	小馬札腿	二尺	

右表中以大興行煤層爲最佳。自第一至第六煤層、本地稱之爲爐札意謂煤多大塊而無烟宜於爐用也。第七至第十煤層則稱之爲鐵札、因燃時稍帶有烟、宜於本地打鐵之用也。

煤質　石炭二叠紀之煤、悉屬烟煤、本地稱爲粘煤、末多塊少、間有二薄煤層能煉焦作者所採煤樣做未花。孔家堡子之煤、據日本中央試驗所分析之結果如左。

地點	水分	揮發分	定炭	灰分	色	硫磺	焦性	比重	發熱量

孔家堡子　一〇六　一六・六〇　七四三　八〇三　桃黃色　一・三三　粘結　三九五　三四六

侏羅紀之煤、可別爲無烟煤與半烟煤兩種。除在大堡東南如前所述以煤層位置區分外、又可以煤層所在地點分之。大旺大東溝四海溝產大塊半烟煤、寶石溝頭道溝一道溝三道溝魏家堡子驟駝脖子三個蕎等處、皆產大塊無烟煤、而煤層中之蕎把里、無論在何地統係末煤。作者所採之煤樣尙未化驗、茲先錄日本中央試驗所分析之結果於左、以資參考。

地點	煤層	水分	揮發分	定炭	灰分	灰色	硫磺	焦性	比重	發熱量
四海溝三	節	一、〇一	一〇、四九	六六、九五	二二、五五	桃黃色	〇、四二	粘結	一、五〇七	七、四〇九
雷勞磊子	頂煤大頭節	〇、七四	七、四八	六九、九六	二二、八二	帶赭色	〇、四四	不粘結	一、五七	七、九二
魏家堡子	大興行	六、九〇	八、三〇	七八、二二	六、四八	褐色	〇、三〇	不粘結	一、五九	六、三二

煤量　石炭二疊紀煤系之儲煤量、爲計算便利計、可分爲兩部。一爲孔家堡子南山部分、二爲郭家南溝至佟家嶺子部分。孔家堡子南山部分煤層之層數厚度、已述於前、茲以煤層總厚度之半數即二公尺、爲煤層之平均厚度、以二十五度爲煤層之平均傾斜、並定煤之比重爲一、二、開採深至三百公尺爲止、則煤層之長度爲一千八百公尺、儲煤量應爲二百萬噸。郭家南溝至佟家嶺子部分煤層之平均厚度、定爲二公尺、平均傾斜定爲二十度、開採深度與前同、則煤層之長已測定者共爲三千五百公尺、煤之儲量計爲五百萬噸。侏羅紀煤系在大堡大凌樹魏家堡子盤龍寺一帶、因大致構造爲一緩傾之向斜層、傾斜恒僅二三十度、可按

平層約略計算其儲煤量。茲定煤層之平均厚度爲五公尺、則煤田由大東溝至盤龍寺計長約四千八百公尺、若以一千四百公尺爲平均寬度、面積應共爲六百七十萬平方公尺、儲煤量爲四千二百萬噸、再以供日出二千噸之煤鑛、可足六十年之用。

鑛業

煤田內經營之公司名富華公司、現在煤田內已經着手試採者只有此一處。鑛廠設於大堡領有鑛區二。第一鑛區包有大東溝四海溝二道溝等處、第二鑛區沿大盤嶺山麓占有佟家嶺子附近。二鑛區中以第一鑛區開採最盛、第二鑛區次之、實則煤田內重要產無烟煤之部分、此二鑛區已幾盡包占。窰口俱係斜洞、統用土法開採。第二鑛區僅有一二小窰從事於採取烟煤、用以煉焦。

富華公司純爲孟凌雲獨資經營、其組織總辦爲孟凌雲、經理採玉清、副經理張成文董兆容。此外賬房二人、跑山二人、外跑二名。各辦事人火食、皆由公司供給、薪工每年共爲奉票二萬五千元、約合現洋一千五百元。鑛區稅每年約合現洋四千三百元。統計鑛廠全年開支共約現洋七千元。公司之採煤、係用轉租法、憑鑛權將鑛地分包給各把頭工作、凡打洞採煤悉由把頭自爲之、特需用款項時、公司可暫先墊付、日後由把頭付還。把頭領鑛地採煤末者俟將煤賣出得資、公司與把頭各分其半。末煤在窰廠售出每千斤約值奉票十八元、合現洋六角六分六厘。採煤工人火食工資、皆由把頭供給、工人每日工資約需奉票六元、合現洋二角二分二厘。把頭領鑛地採塊煤者、每千斤煤在窰廠可值奉票七十二元、把頭得二十八元、各把頭需用洋油米麵、皆先由公司墊付、折合錢數、賣煤時扣還。

末煤率銷於本地其轉運多用騾馱、騾每匹可拖一百二十斤。騾每匹可拖一百二十斤騾每匹可拖一百二十斤騾每匹可拖一百二十斤。塊煤恒在窰廠以每千斤二十八元向把頭結算、再由公司僱大車運至太子河岸之河口裝船。鑛廠距河口路約十五里、每千斤煤運費、約合奉票十八元五套騾車、即用五騾拉一車）可裝煤二十一百斤、平均每套可拖四百斤。蓋由鑛廠沿溝谷至河口、路既稍平、又係下坡、故車運尚便。由河口用船沿太子河運至本溪、水路約二百四十里、每百斤運費約需奉票十三元、普通四隻小船連在一起、可裝煤五千斤、二四日可達本溪。塊煤在本溪售出、每百斤可值奉票四十元、富華公司在本溪設有分銷處。煤在本溪賣出後、仍多由安奉路運銷於奉天營口一帶。計田師付溝之大塊無烟煤、在奉天需用甚廣、無他煤田足與之競爭也。民國十六年富華公司、共產煤約六七千噸、全年純益現洋約一萬元。

二、西安煤田

西安煤田位於西安縣城北門外縣城距煤田僅二三里、自奉海路通車後煤田之價值大增、近奉海路更建長支線直達煤田之內部、交通益便。該煤田於民國三年及十四年曾前後經日本地質學者村上孫藏氏與青塊煤田內除富華公司外、尚有王殿甲鑛區一處、鄔文溪鑛區二處、王殿甲鑛區位于雷劈磊子、附近只有窰口一座開採、係大塊無烟煤、開鑛地已租於富華公司、故採煤把頭屬於富華公司、所產之煤、亦悉歸富華公司運銷。鄔文溪鑛區一在孔家堡子南山、一在佟家嶺子之北。鑛區內只有舊窰洞頹塌、作者調查時、已無採煤者。鑛區內既悉屬石炭二疊紀之烟煤、銷路本狹、而鄔文溪原係山東人、自領得鑛區後、從未出鑛區租、本人踏勘果在何處、已無人能道其詳矣。

乙治氏等調查二次、皆著有報告、已分載於滿鐵地質調查所支那鑛業時報第四十號及第六十七號中。其重要結果、悉謂煤田之時代屬於侏羅紀、並謂彼等所稱之斑岩、玄武岩等活動、應在煤層沉積以後。據作者之研究、煤田之時代似應較侏羅紀新、而火山岩之活動、則均在煤層未沉積之前。煤田西南界一大斷層、亦爲日人所未逮及。茲將作者調查時所見之現象、分地質與鑛產兩章、各論之於左。

地質

地層

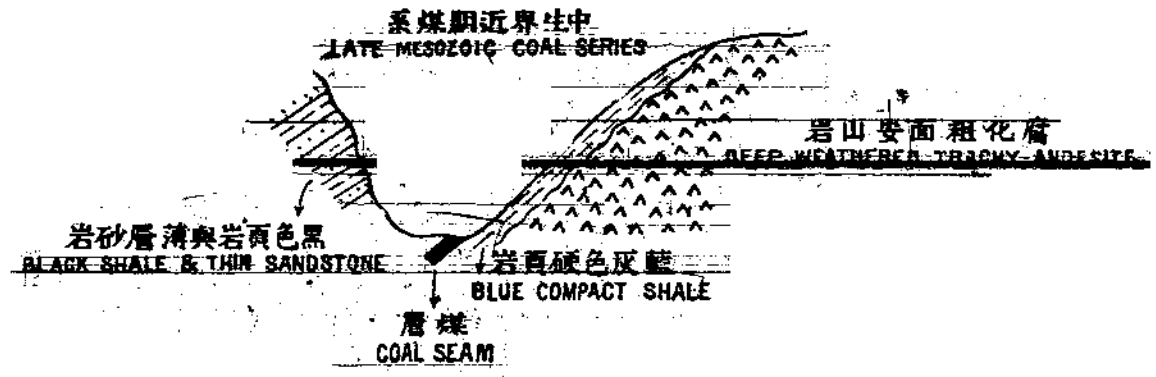
煤田附近之地層、約可分爲片麻岩粗面安山岩玄武岩及沖積層等四組如左。

片麻岩　此爲一種灰棕色細粒片麻岩、片理極爲明晰。成分以石英正長石爲多、黑雲母甚少。時代應屬古生界。已屬於太古界。露布於煤田之西南部、爲煤田之西南界、東南趨自西安北門外、西北直至猛亮河岸。西安西豐間此岩分布尤廣、惟在此一帶長石結晶甚粗、恒令全岩露頭呈粉赤色。

粗面安山岩　此岩由肉眼察之、係一種灰色緻密岩石、每含有氣孔、日本人曾稱之爲斑岩。據作者所搆之標本、層狀構造片理顯微鏡窺之、則見斑晶絕少、石基大部爲長方形之長石、及少量玻璃質與磁鐵鑛、長石中每含有斜長石、皆排有一定之方向、顯示粗面岩結構甚著、自當稱之爲粗面安山岩。該岩在西安煤鑛公司第二坑東、長石中以正長石爲多、偶含輝石斑晶。在採鑛科房址西北、石基中斜長石亦頗夥。在臘海舊址東則石基結晶較細、粗面岩結構不甚顯著、每含輝石斑晶。

該岩之分布、南起自秦信煤鑛公司之南、北達於臘海舊址之東北、完全組成煤田之東界、大抵係一種火山碧

第二剖面圖



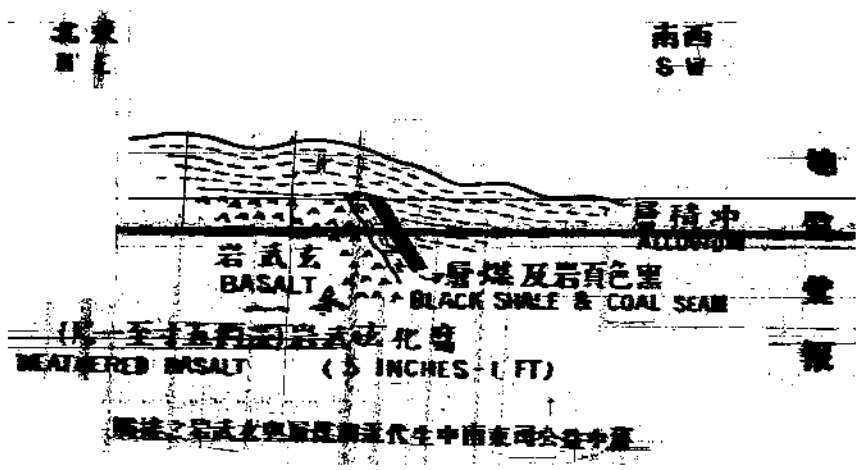
西安煤礦公司礦區北西部煤田內新生代近期煤系與粗面安山岩之構造

流。其噴出之時期、應在下述白堊紀煤系沉積之先、故如第二部面圖所示、煤系直接覆於腐化甚深之粗面安山岩。又如第五版西安煤鑛公司鑽井柱形圖所示、皆於煤層下發見粗面安山岩、凡此悉證明粗面安山岩活動之時期、須在白堊紀以前。而田師付溝煤田又可表示火成岩之活動、至早須在下侏羅紀之後、故田師付溝下侏羅紀煤系大受花崗岩及他火成岩侵入之影響。然此粗面安山岩之噴發、與田師付溝花崗岩之侵入、如屬同一時期、或在侏羅紀之末期歟。西安煤田之西、日本地質學者所稱之小梨樹煤田、（滿鐵地質研究所支那鑛業時報第四十號）據云侏羅紀煤系組成之山脊、恒覆有斑岩與玄武岩流、彼所稱之斑岩、現已證明屬粗面安山岩、則其噴發之時期、愈足表現其不能先於下侏羅紀矣。

玄武岩　此種岩石呈黑色、質極堅密、氣孔甚爲稀見。據在煤田北部中盆煤鑛舊址東所採之標本、置於顯微鏡下、略現斑狀組織。斑晶爲晶形完整之橄欖石輝石及少許斜長石。輝石之消光角、恒近四十度、偶現雙晶結構。石基爲橄欖石針狀斜長石及圓粒輝石、磁鐵石亦夥。橄欖石多裂縫、沿裂縫恒變爲綠色蛇紋石。

東猛虎亮大黑山附近石質結晶較粗、不呈斑狀斜長石率現長方形

第三剖面圖

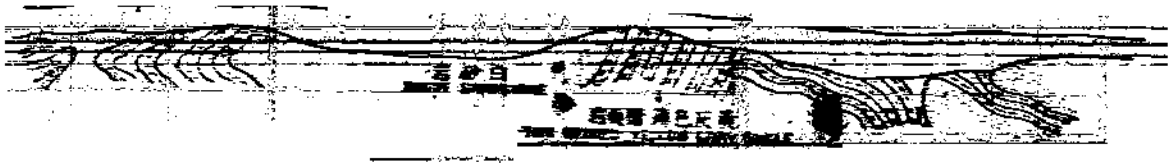


第三剖面圖中生代造煤層與玄武岩之關係

玄武岩露布於大黑山一座營一帶、構成煤田之北界。在中營煤鑛東南如第三剖面圖所示、該岩直位於白堊紀煤層之下、其接觸當非爲玄武岩侵入之關係、乃爲玄武岩之噴發、在煤層沉積以前、與粗面安山岩情形相同。故玄武岩之時代、非如在進順等處、屬於第三紀、乃應屬於侏羅紀與白堊紀之

序關係、甚爲明顯。面第二剖面更表示近接觸帶粗面安山岩大部分悉變化變爲粘土、惟大山岩之結構、大致可辨、該粘土與煤層之間、大成岩活動之劇烈矣

中生代近期煤系　此系不整合覆於片麻岩粗面安山岩及玄武岩之上、其與粗面安山岩情形相同。故第二剖面圖所示、煤層皆直位於噴出岩之上、層次第一種薄層堅硬青灰色頁岩、含有植物化石甚多、足可推想當中生代近期繁殖於粗面安山岩風化黏土上之情況矣。煤系之組織爲青色與黃灰色軟砂岩及煤層等、其大致層序如第四剖面圖及第五版第一、第二、第四第五等鑽井柱狀圖所示、惡厚甚因鑽之完全露頭、不易計算、約略估之、大概在二百公尺以上。在舊窯口採



煤田內已探知之煤層、悉位于煤系之底部、其層數厚度多隨地而變異。在西安煤鑛公司採鑛科附近打鑽之結果、如第五版第一號鑽井柱形圖所示、煤爲三層、最上一層厚約五公尺、其下隔石約十公尺、遇第二煤層、厚約三公尺半、再下隔石約十一公尺半。第二號鑽井柱形圖表示煤雖仍爲三層、但第一層厚達十二公尺、其下隔石僅一公尺、則爲第二煤層、厚約三公尺半、再下隔石約達三十二公尺、始遇厚僅半公尺之第三薄煤層。第五號鑽井柱形圖僅見煤兩層、上層厚約七公尺半、頗似第二柱形圖中之第二煤層、於此已合爲一層矣、下層厚僅半公尺、大抵相當於第二柱形圖中之第三煤層。至第四號鑽井柱形圖則共見煤一層、蓋第五號鑽井柱形圖中之下煤層、於此已完全失蹤矣。茲攷所遘之四柱形圖、相距最遠、未過三百公尺、煤之層數厚度已相差若此、煤層變異之巨、可想而知矣。在煤田之他部、因調查時各煤窰多已停閉、無從探尋煤層之狀況、惟在採鑛科西北、如平面圖上二坑三坑四坑所採之煤層西、相距約三百公尺處、亦有從前露天工作舊坑內、煤層現出、傾斜西向約二十度。此煤層是否與二四坑所採者爲同一煤層、或別爲一新煤層、位置較上、尙難確定、若以坑口之地位推之、頗似後說爲較近。

煤質　各煤層悉屬褐炭、作者在西安公司第一坑第一煤層所採煤樣、化驗之結果如左。

水分	揮發分	固定炭	灰分	灰色	發熱量
一〇・二五	三二・八一	五一・五〇	四・四四	米色	六九五六

若按翁詠霓先生所定煤質分類之符號別之爲BC_2應名爲褐性烟煤。西安公司對於煤質亦多有所分析。茲擇

要表列於左以供參攷。

地點	水分	揮發分	固定炭素	性質	灰分	灰色	硫黃	發熱量
第一坑與第四坑混合煤末	二〇·七九	三六·五四	四五·〇二	強粘結	七·六六	黃	〇·九二	六二五一
第一坑與第四坑混合煤塊	八·一五	三八·四〇	四六·一三	強粘結	六·八二	黃	〇·八三	七二五一
第一坑煤末	四·八五	三八·一〇	三八·九〇	強粘結	一八·一五	灰黃	一·一五	六一六〇
第一坑煤塊	四·四二	三九·二八	四七·六九	強粘結	八·六一	灰黃	一·一五	六四六〇
第二坑煤末	四·七八	四三·五〇	四二·〇〇	強粘結	九·七四	灰黃		六五六〇
第二坑煤塊	四·七三	四二·三〇	四六·七〇	強粘結	一二·五六	灰黃	〇·五二	七〇四〇
第三坑煤末	五·二六	三八·八〇	四四·一九	強粘結	一二·七五	微紅黃		六六〇〇
第三坑煤塊	五·八九	四七·六〇	四二·〇七	弱粘結	五·四四	微紅黃	一·四七	七五六〇
第四坑煤末	五·九二	三七·五〇	四六·二三	弱粘結	一〇·三八	微紅黃		六三八〇
第四坑煤塊	六·二六	四二·九二	四四·九四	弱粘結	五·八九	微紅黃	〇·八四	七〇二〇

以上所謂第一第二第三等坑，係指西安公司採鑛科附近之煤坑，已標記於平面圖者。由前後所述十二次化驗，知煤質與撫順煤極相似，能用於火車及作他種機器燃料之需，而與撫順煤競爭銷路，以求挽回利權也。

儲煤量　煤田內煤層厚度，如第五版西安公司鑽井柱形圖所示，最厚可達十四公尺，最薄亦有八公尺。在

田他部煤層厚薄亦大致與此相似。茲暫以六公尺定爲煤層之平均厚度、煤之比重定爲一・三、以開採深至五百公尺爲止。則煤田全部可分爲三區計算其儲煤量。第一區爲由秦信公司東至寶興公司舊址附近、共長約二千公尺、煤層之平均傾角爲二十五度、儲煤約一千八百萬噸。第二區由西安公司修理廠北達於寶華舊址、共長約四千公尺、煤層之平均傾角爲三十五度、儲煤量約爲一千七百萬噸。第三區由寶華舊址西至中益舊址、共長約一千五百公尺、煤層之平均傾角爲五十度、儲煤約七百萬噸。總計煤田全部之儲煤量、共爲五千二百萬噸、除去已採之部分及近地面不能採之部分、實在可採之煤量、亦能達五千萬噸、以之供給日產二千噸之煤鑛公司、足供六十年之用、煤田儲藏之豐富、於此益可見矣。

鑛業　西安原係前淸皇家獵場。光緒二十六年始開放、故煤田發見甚晚。淸末始有人開採、民國初元鑛業方盛。當時純屬於中國人經營者、有利華寶興富國裕興永記大成富華富海寶華中益等公司、名爲井日合辦實爲日本人出資者、有泰信健元健光等公司。各公司所開窰口、均係斜洞、間有置蒸汽鍋爐、用機器絞煤者、統計全年產煤約可達五萬噸。迨至民國十六年由楊宇霆與莫德惠省長提議、將中國人經營之十公司、收歸官辦、設立西安煤鑛公司、額定資本二百四十萬元、奉天兵工廠奉海鐵路及奉天省政府各出五十萬元、舊公司產業作爲九十萬元。實際截至作者調查之時期爲止、僅兵工廠督撥到二十萬元、內中以二萬元償抵各公司機器價、餘作爲維持費、奉海路與省政府則一文未發。總辦爲書丰彭、技師長白銘璋、採鑛科長胡源深。出煤之鑛井有三、統爲斜洞。第一坑係新開之洞、爲出煤最多之窰口、用機器絞煤、自洞口至洞底設有鐵軌、每日約可出煤二百八十木車、每車盛煤半噸強、合出煤約達一百五十噸。第一坑係舊洞、亦用機器絞煤、每日約可出

百噸。第二坑與第三坑則以人力用布袋背煤、每日共可出煤三四十噸。總計西安公司每日共產煤約近二百噸、採煤工人共約二百名、每名工資日需奉票十五元。（合現洋約五角強）煤之銷售、除煤田附近外、大部銷於奉海路奉天兵工廠紡紗廠電燈廠等。煤由鑛山運至奉天、每噸運費約需現洋四元。煤在鑛山售出、未煤每噸價爲現洋八元、塊煤十二元、在奉天售出、未煤每噸價爲現洋十元。塊煤十四元、每噸煤由窰洞採出需成本現洋四元。調查時公司窰廠堆煤甚夥、聞重要原因由於奉海路車皮短少所致。凡奉海路或兵工廠用煤、恒由公司記賬而不付現欵、公司對於運費亦欠而不付、實際上公司經濟狀況、因之甚爲拮据。

二十一　額穆縣蛟河鑛煤田

蛟河鑛煤田位於吉林之東南、距省城約二百四十里、近松花江右岸、可利用帆船以與省城往來。自吉敦路修築後、橫貫煤田之北部、居全路之中心、交通益形便利。茲將煤田附近之岩層別爲四系、分論於左。

地層

古生代近期板岩及石英岩　此系之組織、大部爲黑色板岩及白色石英岩。其變質大抵由於受附近花崗岩侵入影響所致、如在烏林屯東所見、板岩每含有石英脈、往往摺曲極烈、傾斜甚急、而石英岩更有時露頭爲塊狀、層面不易推測。全系之厚度、因所見者悉爲侵蝕殘餘、岩層露頭時廣時狹、忽斷忽續、無由計算。而在烏林屯東於黑色板岩中、含有石墨質、可推定原爲含煤之岩系、或與石炭二疊紀之煤系相當、亦頗可能、茲暫定其時

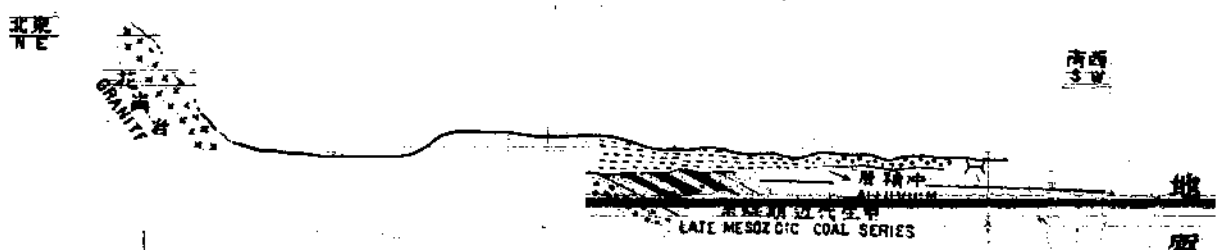
代爲古生代近期。

該系之露布、每近煤田之邊緣。在煤田之東者、分布於奶子山鳥林屯一帶、在煤田之西者、則廣布於三家溝窰家口以西等處。

中生代花崗岩　此岩近煤田部分含長石成分較多岩石表面每呈灰赤色、距煤田稍遠部分含石英似較著。據在奶子山所採之標本、係一中粒岩石、長石與石英尋常目力即能分辨。置于顯微鏡下、正長石風化頗深、石英每含微細物體（Enclosures）甚夥、岩石全體中鐵鎂鑛物極爲稀見、似已近於長英岩類。在舊站北磊門子附近所採之標本、岩石結晶較細、現赤色。置於顯微鏡下、除風化正長石與含細微物體之石英外、兼有少許長石呈 Perthitic intergrowth 結構、及風化極深之暈綠色黑雲母、附屬鑛物則有磁鐵鑛 Ilmenite 等。在老爺嶺所採之標本、石質爲灰白色、結晶較粗、長石仍風化甚深、惟大部呈 Perthitic intergrowth 結構、正長石中包有鈉長石條紋、而鈉長石之完全晶體亦偶見之、石英有時消光方向屬經變異、足爲岩石曾受大壓力之證、僅含有少許黑雲母。在杉松東北所採之標本、置顯微鏡下、則見除正長石石英之單獨結晶體外、而長石與石英每現 Graphic texture、即長石之中、恒包有石英細粒、排列於一定之方向、又鈉長石亦見之。故此岩結晶之次序、大抵除少許雲母外、最先爲長石、次爲石英、再次爲長石與石英同時結晶、有時見受蝕化之石英粒、周圍繞以現 Graphic texture 之長石、即爲此證。

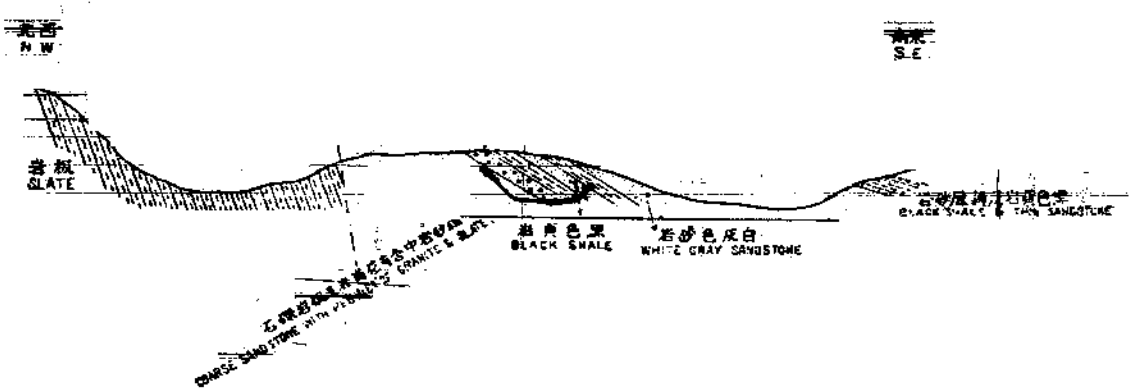
花崗岩分布於煤田之四周、露出面積極廣其最特異之現象、爲長石與石英晶體內每含有包圍物體、因構成 Graphic 或 Perthitic 組織。在煤田北部舊站大屯一帶及南部唐家城子杉松等處、花崗岩恒直接與煤系接

第五圖面剖



係關之岩崗花與系煤期近代生中北東站集

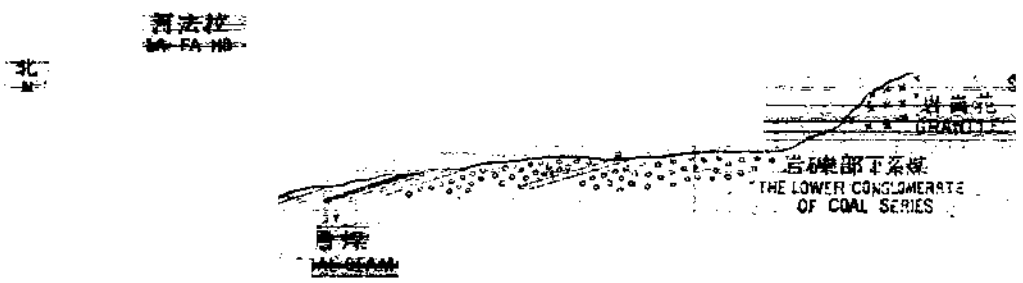
第六圖面剖



斜傾之層岩系煤期近代生中內港家

第七圖面剖

觸、如第五圖及第六圖等所示、煤系下部近接觸帶爲礫岩、礫石、牽爲花崗岩及他種火成岩。煤系內岩層則完全未受變質、足證煤系之沉積、後於花崗岩之侵入。煤系之時代、如後所述、應爲白堊紀、然則花崗岩之時期、似應在白堊紀以前。此種花崗岩自蛟河鎭西北直抵吉林省城附近、在此一帶延布已達二百四十餘里、沿吉敦路著名之老爺嶺、亦悉由此岩組成、其分布之廣、可想而知。在老爺嶺所採



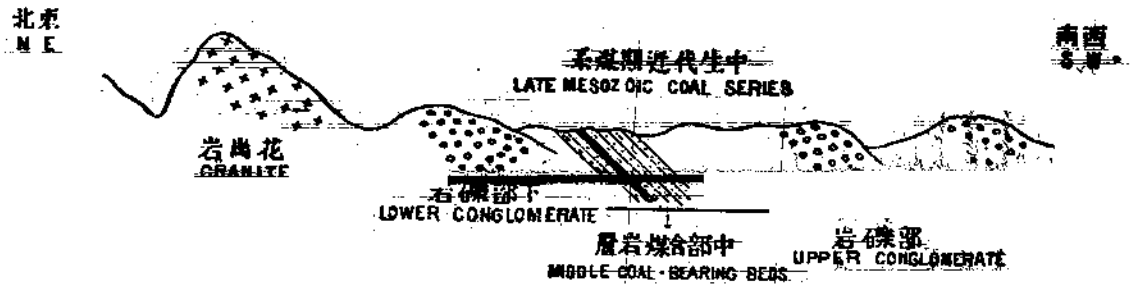
岩礫部下系煤期近代生中南子嚴家店

之標本、石英每顯消光方向變異之形態、於此益可推知花崗岩侵入時期確甚古、至晚須在煤系摺曲時期以前、故有曾受大壓力之表示。據前節所述之古生代近期板岩及石英岩、似沉積於花崗岩未侵入以前、故花崗岩不能早於古生代近期。又據在本溪縣田師付溝煤田附近所見之花崗岩、其侵入尚在下侏羅紀以後、此兩處花崗岩雖相距甚遠、然可推想其同屬古生代後、花崗岩侵入之活動、或屬於同一時期亦頗可能、果如斯說不謬、則此花崗岩之侵入、似更在下侏羅紀之後。據在西安煤田附近之觀察、白堊紀煤系沉積之前、曾有粗面安山岩玄武岩等火山岩噴發、益可推定白堊紀前確有火成岩活動之現象。其現象爲侵入與噴發兩種、其時代大抵屬於侏羅紀之末期或白堊紀之初期。

考北平西山周口店等處及綏遠大青山一帶、皆有大塊花崗岩或侵入於石炭二疊紀煤系附近、或在二疊紀與下侏羅紀岩層之內。因可推知中國北部在中生代中期即侏羅白堊紀之過渡期、花崗岩漿活動確甚盛、且甚廣、較河附近所見之花崗岩、乃其一例耳。據王恒升君等較近研究、北平西山花崗岩時似應爲白堊紀然此處花崗岩分布較廣、而白堊紀煤系並不受變質、則以上結論或仍可用。

中生代近期煤系、此系在烏林屯奶子山等處位於古生代近期板岩及石英岩之上、其接觸面雖悉爲土壤覆蔽、然板岩與石英岩皆變質甚深、摺曲頗烈、傾斜率急陡、而煤系則完全未受變質影響、傾斜亦甚平緩、可推知其層序接觸、應屬不整合。在舊站大屯等處、煤系直接位於花崗岩之上、亦未受變質影響、且如第五圖及第六第七等圖所示、煤系底部悉爲礫岩、礫石多爲花崗岩或板岩石英岩等、其與較古岩層之呈不整合接觸、益爲明顯。

第八剖面圖



杉松東中生代近期煤系之岩層

煤系之組織、大致可分爲兩部、僅下部含有煤層。其底層在舊站大屯奶子山一帶、恒爲礫岩狀長石砂岩、或爲花崗岩礫岩。在唐家崴子杉松等處、則悉爲礫岩、厚度似有增加之趨向、礫石俱有各種火成岩、直徑約由半寸至半尺、大小極不規則。此種底層礫岩之上、即爲煤層黑色頁岩灰色砂岩等。煤系上部之底層、據在口琴三家溝等處之所見、爲灰白色砂岩、或如第八圖所示、兼含有礫岩層、礫石亦多花崗岩板岩等、至唐家崴子杉松等處、則如第七圖所示、悉爲礫岩、礫石亦俱有各種火成岩。此種礫岩層之上、如第八圖所示、及在蛟河鎭與小蛟河附近所見、則爲黑色頁岩與薄層砂岩相間。煤系全部之厚度、因無完全露頭可資計算、實不易確定、約略估之、當亦不下四五百公尺。在奶子山舊煤窰口之廢石堆中、尋得植物化石頗夥、茲經約略鑒定其種名如左。

Pinus Nordenskjoldi Hr.

Podozamites lanceolatus Heer

Baiera gracilis Bunb.

Adiantites sp.

右述第一第二兩種保存於黑色砂質頁岩中、爲煤田內最普通最多之化石、其情形與西安煤田頗相似、第三第四兩種前者與第二同保存於黑色頁岩中、後

者遺留於灰色砂岩內、皆較爲稀見、在唐家箴子舊窰口亦尋得化石、大抵屬於第一與第二兩種。按所得之化石、悉屬侏羅紀與白堊紀共有之種類、其正確時代雖尙不易定、然以之與西安煤田相較、以屬於白堊紀爲近似、因暫定爲中生代近期、以明煤系在地史上之位置。

煤系在煤田內分布極廣、煤田全部悉爲此岩所組成、特附近煤系東西露布之寬度達三十里、至杉松一帶則減至二十里、南北長度則共達九十里。

冲積層　此層之組織幾悉爲土壤、僅河床谷底、偶有礫石散沙流布其間。在平面地質圖上、雖未將此層特爲繪出、實則所謂煤系分布之區、可爲此層現露之代表。其厚度有時可達數丈以至十數丈、土性甚肥、率可耕種。

構造

煤田附近顯著之構造爲摺曲可分爲兩部一爲古生代近期岩層之摺曲一爲中生代近期煤系之摺曲。前者可以古生代近期板岩與石英岩表現之、如在烏林屯奶子山一帶所見者、率爲急烈之小摺曲、紛紜倒置、極呈紊亂擠壓之象、此種摺曲似與花崗岩侵入有連帶關係。後者爲煤系之摺曲、大抵平緩寬闊、可以一大向斜層表現之、如第四版DD剖面圖所示、此大向斜層之西北翼、由舊站大屯經羅圈溝三家溝直達於窩家口一帶、傾角約由十度至二十度、惟在三家溝內發見中生代煤系與古生代板岩爲斷層接觸、以致煤層被壓下甚深、沿西北翼之所以無煤窰開採、其原因或即爲此、果爾則此斷層線應甚長、將西北翼已完全切割矣。大向斜層之東南翼則自烏林屯奶子山西南經南大屯法河溝達於唐家箴子杉松等處、傾斜約由五度至二十度、但在奶子山附近有時可達五十餘度。凡此悉由煤系下部礫岩及中部頁岩煤層等組成。摺軸爲東北西南向、近軸帶

岩層如在蛟河鎮新街附近所見、爲煤系上部之黑色頁岩與薄層砂岩等、率現平層狀或爲四五度之緩傾。褶紫向斜層之形態、東北闊而西南狹、略現一長橢圓形。

右述摺曲之時代、顯可分爲二期。一摺曲之發育、伴以花崗岩之侵入即爲板岩及石英岩摺曲之時期。大抵在古生代近期之後、中生代近期之前、被煤系與板岩石英岩花崗岩等悉呈不整合接觸。若以嚴格論之、此種發育顯似在侏羅紀白堊紀之過渡期、蓋斯時適爲花崗岩侵入之期、已論述於前、地殼被橫壓而摺曲、岩漿因活動而上升、理所當然也。二摺曲之發育、在中生代近期以後、即煤系摺曲之時期。此種摺曲之確期、僅據在煤田附近所得之材料、頗感不足、然相信其在新生代、大抵已在第三紀之後半期、或者竟與煤田西南相距約七八百里之撫順海新統煤田摺曲時期相同、亦頗可能。

鑛產

煤系內所含之煤層、已探知者在奶子山有六層如左。

煤層	上下	厚度
小煤槽		寸數。
大煤槽		九尺
砂岩		三尺
二煤槽		三尺
砂岩		二尺
三煤槽		三尺
砂岩		二尺
四煤槽		四尺半
頁岩與砂岩		一丈八尺
五煤槽		一尺

奶子山煤鑛公司所採者悉屬大槽。在唐家崴子則有煤層二十層本地稱爲小槽、厚約一尺半、上層稱爲大槽、厚約六尺。其餘各處皆尚未試採。

煤質係烟煤、塊多末少、塊約在十分之七。在奶子山所採大槽煤樣分析之結果如左。

水分	揮發分	固定炭	灰分	色	發熱量
七・六八	二八・六八	四七・七三	一五・九一	米色	六二八六

若以煤質分類符號別之爲B1應名爲低碳烟煤。據在奶子山鑛廠所見、煤層內每含有極薄之頁岩與煤質相間、選擇頗不易。奶子山西、相距約五里之後窰地方、曾因煤層內頁岩太多、幾占大半、以致煤在窰廠無法出售、堆積遺棄、隨地皆是、窰主李善鳴因賠虧而歇業。故煤層內之夾雜頁岩、實爲煤之缺點、將來欲採此煤者、本可不急講完善選煤之方法也。

煤田內儲煤量之計算、假定煤之比重爲一・三、開採深至五百公尺爲止。則煤田之東部、（即煤系大向斜層之東翼）由舊站之東起、南抵瓜奇之東止、煤系露布共長達四萬二千公尺、煤層之平均厚度、假定爲二公尺、平均傾斜定爲十五度、則儲煤量約達二萬一千八百萬噸。煤田西部（煤系大向斜層之西翼）由舊站起南達杏樹溝附近止、煤系長度約爲三萬八千公尺、此部尚無人開採、煤之層數厚度因之亦尚不明瞭、茲若假定與煤田東部相似、煤層之平均厚度亦定爲二公尺、平均傾角則定爲二十度、煤之儲量可達一萬三千八百萬噸。合計煤田全部之總儲煤量、共爲二萬五千萬噸、以之供給日產二千噸之煤鑛、可足四百八十年之用。故蛟河煤田之蘊藏、千爲不富、所宜注意者、只在煤層應如何詳加試探、及應如何運銷耳。

蛟河煤田發現甚晚、僅煤田東部近數十年來始有人開採作者調查時、正在出煤者只奶子山一處、稱奶子山煤鑛公司、原名寶興窰、係前吉林督軍孟恩遠所創辦、設立已近二十年。原鑛區面積爲五千四百畝、民國十五年已領到採鑛照、近更擴充達十方里。總經理爲高啟明、據稱孟督軍原出資十萬元、高經理五萬元、最近吉林商會會長張松齡出資四萬元、合計資本已達十九萬元。鑛廠主任高鳳林、孟督軍代表竇成起、皆常住鑛山管理事務、此外蛟河事務所主任爲何之銘、高經理則住省城籌畫一切。鑛廠共有斜洞三口、各深約三十五六丈、俱用土法採煤、每日共約出煤五萬斤、計合三十噸。共用工人約二百五十名、分晝夜兩班工作、係用包工方法、每出煤一斤給工資吉林官帖錢三百文、即出煤一噸合給現洋二元五角、火食燈油悉由工人自備、惟可由公司先墊、再由工資扣還。出煤時盛以布袋、用人背負、沿洞內石梯而上、每袋約可盛煤一百六十斤。洞內工作之指導者、稱爲把頭、共有四人、每人月給工資約合現洋二十元、別由公司供給火食。鑛警十一名、每名薪資約合現洋十二元。統計全鑛開支、每月約需現洋四五千元。聞擬改良開採方法、已在哈爾濱購妥機器、約合現洋三萬九千元、尙未運到。惟當作者調查時、工人已兩月未付工資、加以洞內通風不良、深處多不能燃燈、因之已入停工狀態。鑛廠堆積之煤雖夥、距蛟河車站尙有十五里、亦無法運銷、而公司經濟益現困難。民國十六年曾與吉敦鐵路局訂約合辦、由路局出車務段長溫國樑所領磨石磊子之鑛區十方里合併爲一、並已聘妥蕭篤先爲鑛師、但此事近因局長之易人、已完全擱置。現在吉敦全路已將通車、並有自蛟河加修支路至奶子山之說、將來此鑛不患無人投資、不過時間問題耳。

蛟河煤田在作者調查時、雖只有奶子山一處從事於開採然自橫經煤田北部之吉敦路有開工修築之議起

而投機領鑛區者已風捲雲起。在黃花甸李善鳴領鑛區五方里在唐家崴子王鍾霖領鑛區二千零九畝杉松東王惠霖領鑛區五千零五十二畝、濫泥溝王尚霖領鑛區一千五百畝、皆已領採鑛照。其未領得鑛照者、在舊站東則有陳祥五呈請鑛區一千六百餘畝、在杉松附近更有温國樑楊文魁等請領鑛區。自表面觀之鑛業不爲不發達、考其實際內容、此輩人、目的皆在獲得鑛權、以期將來有欲辦鑛者、自己恃鑛權以漁利、非眞有意自己開採也。

故所述之各鑛區、僅李善鳴曾用土法開鑿數斜洞、後因煤肉夾石太多、不久即停歇、王鍾霖鑛區內有前淸未年開採之舊洞遺跡數口、陳發祥曾開鑿深僅丈許之斜洞兩日、因遇水而停工、其他不惟完全未動工、即欲在鑛山尋求經理鑛區之一人亦不可得、開採云乎哉。

四、地形

此節所述之地形、不僅限於煤田附近、即沿南滿安奉奉海吉長吉敦等鐵路所見亦悉記述於內、茲分爲數部論之於左。

一、由奉天至本溪縣田師付溝煤田所見之地形　自奉天赴本溪乘安奉車東南行。初見爲平原滿布農田。繼見蹺一低嶺即現山谷、寬達數里或至十數里。近本溪縣城山勢漸猛、鐵路有時穿經山洞、然轉察溝谷之狀況、仍爲寬緩。至本溪改乘騾馱東南渡太子河、該河水面之寬、在此不及百公尺、深約一公尺左右、驢騾及大車皆可穿渡、安奉路於此架有鐵橋、行人來往、可經橋之兩邊鐵板。渡河復東南行一百二十里至田師付溝、沿路雖數蹺山嶺、然坡勢甚緩、谷形如在距本溪八十里之小市附近所見、寬蹺三里、即近山脊之細溝、如在棒槌

磊子所見、亦俱相當之平闊。田師付溝煤田擬有田師付溝茂杉松河、此二河之兩岸、已如平面地形圖所示、廣布農田現尙集色甚老之地形。惟如在雷劈磊子及所述二河之分水嶺三個嶺子等處、每現峻陡之石厓、而雷劈磊子高達五十公尺、俱爲侏羅紀煤系上部礫岩所構成、此蓋由於侏羅紀煤系中部多頁岩、侵蝕較速、故其上部礫岩傾陷現爲陡崖也。

二、由奉天至西安及由西安至開原所見之地形　由奉天乘奉海車東北行、地勢微有坡阜、大致平坦。途經撫順山勢始稍急、然撫河上遊之河床較太子河尤爲廣闊、各田畝間之溝谷、亦甚寬緩。踰清源縣及海龍屬之山城子鎭、則山勢轉趨低緩、遠望之崗阜起伏、若隱若現。折而北經東豐直至西安煤田、地形仍相似。西安煤田陰其北部大黑山二座營等玄武岩構成之山勢、稍爲高峻外、凡由煤系片麻岩或粗面安山岩等組成之脊阜、率高出溝谷不過數十公尺。由西安西遷西豐、路約九十里、可通大車、中間曾經一山脊、大車可直衝而上、其崗阜之低、坡谷之緩、於此益見。自西豐至開原可乘輕便火車、沿路所見之崗阜地形、仍完全與西安西豐間相同、惟近開原則漸易爲波浪形之平原、回望崗阜、沿平原邊際纍纍密布、忽起忽伏、儼如海船離岸後、在船上之遙望大陸也。

三、由開原經長春至吉林及由吉林至蛟河煤田所見之地形　開原縣城距南滿路之開原驛車站、尙有十八里。自開原車站東北抵長春、仍悉爲微有起伏之平原。自長春改乘吉長路東行、初爲平原、繼見孤獨之低山脊、縱橫星列、各山脊間則界以廣原、此種地形直達吉林省城。該城跨松花江之右岸、由此易吉敦路火車渡江東南行、穿經老爺嶺山洞、車在洞內行約可五分鐘、此洞與松花江鐵橋俱爲吉敦路著名之工程、老爺嶺附近

森林密茂、人煙絕稀、再東南達蛟河鎮、沿路山勢雖盛然溝谷之寬闊山坡之平緩、仍現侵蝕甚深之地形、蛟河煤田沿拉法河流域完全現一盆地狀、盆地之四周、山勢高聳、脊頂相望、高出於拉法河谷約在二百至四百公尺、而低阜之間則又每現爲寬平之草甸、或已闢爲農田、較西安東豐一帶之崗阜、纍纍各高出其溝谷、恒僅三四十公尺。盆地之內、則崗阜纍纍、各高出其溝谷、恒僅三四十公尺、而低阜之間則又每現爲寬平之草甸、或已闢爲農

結論　統察所述之地形、大致可別爲四種。一爲波浪形之平原、如由奉天至長春沿路所見之地形是也。二爲纍纍之崗阜、如在東豐西安一帶及蛟河煤田附近所見是也。三爲散布之孤獨低山脊區、如在吉林長春間及奉天本溪間之所見是也。四爲較高峻之山嶺區、如在本溪田師付溝間及吉林蛟河間之所見是也。第二之崗阜地形、每發育於岩石易受侵蝕之區。由第二之平原區至第四之山嶺區、中間恒隔以第二之崗阜區、或隔以第二之崗阜區而第四山嶺間之溝谷形亦率寬闊平緩、顯示侵蝕程度甚深、大抵與維理士氏在山西直隸一帶所稱之唐縣期地形頗近似、而屬於半老壯年期。第一平原上壤下之地形、或者亦相同。不過由奉天北達長春一帶自構成壯年地形後、地盤下降、原來之地形、遂悉爲土壤所覆蔽。在山嶺與平原間之過渡地帶、下降較緩、則僅一部爲土壤覆蔽、較高之山脊、尚能現露於地表、遂構成第三之散布低山脊區。故由大致言之、奉天吉林一帶山地之地形、似甚簡單、悉爲半老壯年期。僅於開原長春間、偶於平原上現有細溝、表示近來或局部漸有上升之趨向。

吉林省穆稜密山二縣地質鑛產記要

王恒升

緒言

調查區域居吉林之東部、南始中東路之下城子站、沿穆稜河東北達密山縣城、東西寬可二十里、南北長約三百里、以俄國測製八萬四千分之一地形圖爲基圖。主要鑛產首推煤田、俄地質家阿也爾特以及本所翁所長均先後曾涖是地。升之來原注意鑛產、擬極煤田之分佈、爰自哈爾濱抵穆稜煤鑛。旋阻於軍事、被招返平、僅勘查穆稜河之東岸、闢土大言、自雞冠山西北逾穆稜河、經滴道河勃利縣、直達富錦之雙崖山、煤田尚斷續相連云。

地文

山脈　本區域爲完達山之餘脈、自東北來以穆稜河分爲東西二枝、聆達嶺綿亘於西、黃窩集山聳峙於東、山峰重疊、峻嶺巉巖、最高山峰高出海面約九百公尺、高出當地水面約七百公尺（平陽鎮南山青溝嶺）、其餘高出海面率在六百公尺至八百公尺之間。惟山旁河谷地勢略低、雖然亦多在百餘公尺之上（高出當地水面）。自中東路之下城子站、沿穆稜河東北行可五十里至八面通、兩岸多晶質片岩、上覆玄武岩流、峭壁岌然、時嶺綿亘。惟河岸既迂、地勢平緩、穆稜煤礦鐵路臨之而修築焉。八面通南北、砂岩露出、質較疏鬆、故地勢稍平、河谷漸寬、谷內爲沖積層、寬可十里。北至亮子河、亮子河迤北、爲變質岩所分佈、山勢復峻、亦谷懸崖絕壁、斷續不絕、以達梨樹鎮梨樹溝之西岸、穆稜煤鑛在焉。達梨樹鎮可五十里、至黃泥河子、玄武岩季面下、[illegible]

當晉省之汾河諸今河谷兩側復低窪迴瑗、而谷之中間、又滯淖積層、假復可分爲兩期者。惟觀察簡略、難以斷論、至詳細議論、則須俟諸將來耳。

地層

穆稜密山二縣、富火成岩、其著者如中生代之花崗岩第三紀之玄武岩。選積岩層甚不完全古生代僅見二疊石炭紀之變質岩、上接中生代之侏羅紀煤系、及白堊紀之一、石炭二疊紀之變質岩系、本系岩石以雲母晶質片岩爲主、間含大理石、分佈之區凡二、一分佈於下城子之北、八面通之南、一在白石砬之東側、雲母晶質片岩、富雲母、色深黑、片理整齊。大理石色淡白、可以煉石灰、故下城子之東北二里許、以及白石砬附近、皆有石灰窰之蹤跡。惟因受火成岩之侵入、變化甚烈、分佈凌亂。兼煉石灰者多苦之。雲母晶質片岩、在下城子之北、其片理傾斜率急峻、恒在四五十度左右、間有直立者、極波狀之致。白石砬東方之大理石、突起於花崗岩中、傾向東南、傾角約在二四十度之間、全部變質甚劇、無化石可尋、故假定其爲二疊石炭紀者、全取法於阿也耳特。因本系含大理石原似海像、而滿州中生代之地層無海相者、有之則皆屬諸古生代。但古生代之寒武奧陶紀地層、在南滿極甚發育、而中東路左右以現在所知甚不完全。惟二疊石炭紀尚有確定之化石、（中東路站二層甸子東南有腕足類化石頗似二疊石炭紀之生物海參威有確定二疊石炭紀之含化石地層。）今本層之分佈、適位於一者之中間、以其屬之於二疊石炭紀、其變質甚烈者、或由於花崗岩之侵入歟。全系傾斜紋亂無定、故厚度甚難估計、大約言之、至少當在一千公尺以上、

二穆稜煤系（上侏羅紀）　全系分上中下三部、均富砂岩、下部砂岩夾凝灰岩、中部砂岩夾煤層、厚五六尺、即

穆稜煤鑛所開採之煤層。上部砂岩夾頁岩、其分佈南始亮子河、北達鷄冠山西徂穆稜河、東抵小黃泥河子之東側。在平崗一帶、上覆玄武岩流、頗似中斷、惟溝底谷側露頭明顯、其連續殆無疑問。全體岩石大致較疎鬆、抵抗風化之力弱、故所成山嶺率多低緩、其層傾斜隨地而異、故多波皺。梨樹鎭一帶地層、傾向爲南六十度西、傾角約在十度至十五度之間、惟上極溝頂(小尖長溝)傾斜已逆反。在小黃泥河子一帶地層、傾向爲南三十度東或正南、傾角亦在十五六度之間。本系恒爲花崗岩所侵入、岩石受其酷炙、砂岩變爲石英岩、及含石墨之黑質片岩、如柳毛河之南側、老達子溝以及梨樹鎭之西北、向陽鎭之東山胡家燒鍋諸處皆是也。

本系之頁岩中、產植物化石、此行在小尖長溝所採得者、有下列三種。

Cladophlebis brownliani.

Coniopteris sp.

Plagiophyllum sp

在小黃泥河子所採集者、率多破碎不堪鑒定、其經前人所採得而已經鑒定者尙多、茲綜列一表如左。

名	穆稜河右	小尖長溝
		+
	+	+
	+	
	(+)?	
		(+)
	—	

化石	地			
	滴清河 西	透道河 東	小黃泥河 下	小北溝 中段
Cladophlebis browniani	+			
Ruffordia goeppertti				(+)
Coniopteris sp.	+			+
Plagiophyllum sp.		+		+
Elatocladus Sudzamoides	+	+		+ +
Cladophlebis dinticulata	+			
Pityophyllum nordenskoidü	(+)	(+)	(+)	(+) (+)
Cladophlebis sp.	(+)			
Ginkgo	(+)?			
Neocalamites carreri		+		

圖　第

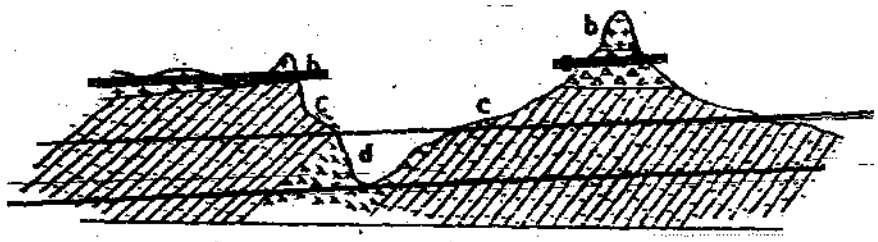


Fig. 1. Section at Kuaban 華山斷面圖; b, basalt 玄武岩; c, coal series (Mukong) 穆崗煤系; d, diabase 輝綠岩; e, basaltic tuff 玄武質凝灰岩。

以化石論顯似上侏羅紀之產物、全系厚度至少在二百公尺以上。

三、猴石溝系（白堊紀）　全系大部爲礫岩所組成、其子石富石英及黑石英岩、他如帶赭色之長石斑岩、黑有之子石之體積、大小不一、其大者直徑可一、三公寸、小若豌豆數公分、均極圓滑、無稜角、呈被水冲徙之特徵。岩質堅實、風蝕之後、或絕壁矗起或峭峯孤立（蓮花山）、或背物狀人狀、奇形詭態。猴石溝即爲該礫岩分佈之一區、孤石屹立尖首聳肩、狀似猿猴、遂因之而得名焉。其分佈北起大尖長溝、南迄亮子河之北岸、西始穆稜河之西岸、東達青溝嶺之西側、厚可二百公尺、尚未尋得化石、惟在亮子河西南岸之黑色頁岩內、見植物之遺痕、然大抵破碎不清楚、難以鑑定。茲定其爲白堊紀者、因穆稜煤系以砂頁岩爲主、而本系則多礫岩、似應另立一系、但穆稜煤系已定爲上侏羅紀、故將本系屬諸白堊紀也。本系地層褶皺甚劇、在亮子河北之南岸、南岸、背斜向斜接踵起伏、極淡疊之大觀。

四、長石砂岩層　覆於猴石礫岩系之上、分佈於亮子河之兩岸、砂粒粗鬆、含長石、故帶肉紅色、抵抗風化之力較弱、多組成低崗與礫岩層異、厚一至二百公尺。傾斜緩急無定、在胡家店之東側、幾成水平、在縱皮傾斜約在二十度左石（第一圖）。以岩石之性質論、與猴石溝系不同、故另分爲一系、約亦爲白堊

紀之一部。

五、紅土層　分佈於樸皮溝以東里許位玄武岩流之下色赭紅間亦有得曾於其中尋得木化石、約為第三紀之地層。

六、沖積層　大抵沿河床谷底兩面分佈、細者為泥砂粗者有石塊、厚自三四公尺至五六公尺不等、恆為極肥美之農田、為第四紀之產物。

火成岩

本區域之火成岩以雲母花崗岩及玄武岩為主其他零星小塊亦有之試擇述如左

一、雲母花崗岩　(甲)分佈　平岡迤南沿小穆棱河之上流、兩面分佈侵入於穆棱煤系之中故穆棱河兩岸無其蹤跡、惟由穆棱河西望、峯巒亘遙峙於穆棱煤系低山之外者、皆該花崗岩也、迨愈平岡之南端、分佈於穆棱及小穆棱河之中間、至老達子溝斷面正東、分佈於雞毛河左右、以及小黃泥河子之正南、平岡迤北、露頭僅限至平陽鎮之東南、復蟲起為崇山、自是峯巒相望、以及馬蓮河、孤遠河之北、復據於玄武岩、至五鎮遺跡皆有見於穆棱河之兩岸、以迄密山縣城之東山。(乙)性質　岩石之性質隨地面異、在梨樹鎮之西北、石色灰白晶粒較粗、同類斑晶造岩礦物富長石及水晶、黑色礦物含黑雲母及磁鐵礦、長石中正長石多於斜長石、老碧溝一帶、黑色礦物每平行排列、示晶質片岩之狀態結構、屬遠河一帶、晶粒較粗、水晶與長石量幾相若、少黑雲母與磁鐵礦、五鎮迤北有現片麻岩結構者、富石英、其結晶勻緻、石質堅實者、居民恆用為建築之材料。(丙)時代　穆棱煤系既受其侵入而變質、故其侵入之際、當在上侏羅紀之後、其於玄武岩流層、尚無明顯之接觸、惟玄武石

第　三　圖

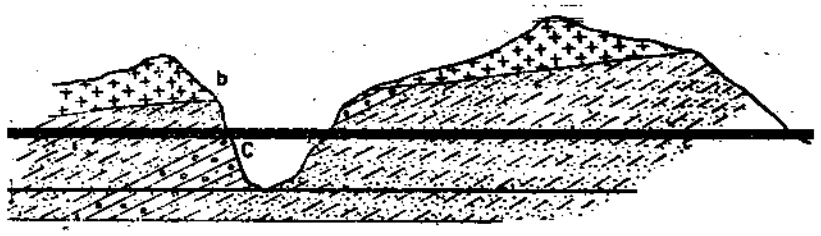


Fig. 2. Section at Chiupikou 濮皮敏剖面圖; b, basalt 玄武岩; c, feldspathic sandstone 長石砂岩;

溝層之摺皺、與穆稜煤系恒相一致。而其摺皺之原動力、又似由花崗岩侵入而起者、然則其侵入、或亦在猴石層遞積之後、而屬諸白堊紀歟。

二、玄武岩　(甲)分佈　南姑馬橋河、北逾穆稜河、以達大小鍋盔諸山、西起穆稜河、東抵石頭河、其他零星分佈之地、如小穆稜河上流、以及向陽鎚之北嶺、誠一岩流橫溢之大觀也。凡玄武岩流所組成之山、雖崇嶺峻峙、而嶺巔率濶平、(乙)性質　石色黝黑、岩質堅實、間有具氣孔者、如小黃河子之東山巔、有成柱狀構造者。如楸皮溝之北山、結晶牽細緻、以白色橄欖石、針狀長石爲最多、磁鐵粒亦不少。橄欖石時成斑晶、風化之後、變爲紅色伊鼎石、間有含鐳鐵鑛者、總之其岩石性質變化尙少也。(丙)時代　玄武岩流之上下、皆無確定化石、故其年代頗難定論、惟中國新統爲中國斷陷發生最顯著之期。本區玄武岩雖似水平、而實則均已傾斜、但其斜角僅在三四度之間、故難以識別、但間有斷陷、其斷距有達二百公尺以上。設該斷層發生於中新統、則玄武岩必先中新統而橫溢、或亦屬於漸新統歟。

三、零星小侵入體　重要者凡三(甲)爲輝綠岩、露出於張家街之孤山橋、侵入於穆稜煤系內(第一圖)。岩色灰黑、其黑色輝石斑晶及長石、黑白相間、極斑駁之狀。顯微鏡下爲綠色、劈開顯著、間有雙晶、長石以鈣鈉長石爲多、恒成多晶。其輝石在

石基完全結晶、爲長石磁鐵粒及角閃石所組成、間含少許燐灰石。(乙)(丙)皆爲花剛岩、其成分大致與花剛岩相若、一見於黃泥河子之東南、一見於下城子之東北、前者侵入於穆稜煤系之內、後者侵入於二疊石炭紀之變質岩中。當其與大理石相接觸、恒發生接觸生成之鐵礦、但賦量甚微、故無人注意也。

構造

本區斷層與褶皺均甚複雜、其上又覆玄武岩流、有時至難觀察而調查區域有限、所見均屬東鱗西爪、實不足以藉此以定全局之構造、茲特將其重要者、分述如左。

一、褶皺　本區地層局部褶皺甚多、每行不及數里、而地層傾斜之方向恒數易、向斜背斜相接觸、故不足專名之也。小尖長溝之北山、砂岩層多傾斜向西西南、傾角約十二三度、北逾山坡、則傾斜爲東東北、成一背斜層（第二版GG）。自小尖長溝南逾橫嶺、經大尖長溝、再逾二小山溝、地層傾斜之方向恒數易、向斜背斜相接觸、故不足專名是迄太華山、地層之傾斜方向凡五易、復造成二小背斜及二小向斜層（第二版GG）。其他地層傾向大致爲東東南（小北溝）、東南（小黃泥河子）、或正南（小黃泥河子之東南）、不現褶皺之勢。

二、斷陷層　其重要者凡二、一在八面通之南、斷層面之趨向大致爲西西北、東東南、南爲仰側、北爲俯側。因斷層之關係、使二疊石炭紀之變質岩層、與白堊紀之長石砂岩相接觸（第二版QQ、E_3、E_2）。一爲石頭河子斷層、斷層面之趨向、大致沿石頭河子、西爲仰側、東爲俯側（第二版CC）。該地玄武岩因受斷層之斷陷、而不相連續。其他小斷層尙多、如梨樹溝之斷層、小尖長溝南嶺上之斷層、平陽鎭南山之斷層（第二版CC^1）、以及亮子河南溝之斷層（第二版FF^1）皆是也。

二、褶皺與斷層之時期　本區地層其屬白堊紀（猴石系及長石砂岩層）者、已經褶皺。但第三紀之玄武岩不受其影響、故褶皺之發生在白堊或白堊紀之後、而先於第三紀、彰彰明甚。考主要地殼運動、恒與火成岩之侵動相並行、本區既有白堊紀之花剛岩、而反覩褶皺之排列、又似與花剛岩息息相關係者、然則褶皺之起、其白堊紀歟。

斷層發生之時代、凡有二期、一先於玄武岩流之橫溢者、八面通東南之斷層屬之、其俯仰兩側、悉有玄武岩流、但其高度悉相等、似未受斷層之影響、故斷層之發生、當先於玄武岩流。惟玄武岩流橫溢之際、地面已甚漏平（第二版 Fig. 2, Fig. 3）、故在玄武岩流未噴發之前、其已經悠久之侵蝕、殆無疑義、意者其與褶皺同時、而屬諸白堊紀歟。一後於玄武岩流者、其他各斷層悉屬之、或發生於中新統、蓋中國白堊紀以後之主要地殼運動、當首推中新統、當時地殼運動、以斷層爲主、地層之傾斜次之。今試觀本區之玄武岩、多受斷褶、其斷距有達二百公尺以上者、而玄武岩又悉被傾斜、皆與上述之地殼運動性質相若、或非偶然也歟。

鑛產

本區鑛產以煤爲主、其次爲金及石墨、餘如鐵鑛則賦量甚微無開採之價值矣茲分別述之。

已開採者有二區、一在小尖長溝、爲申俄官商合辦之穆稜煤鑛、一在小黃泥河子、爲裕邊煤鑛。

穆稜煤鑛　爲中俄官商合辦之煤鑛公司在小尖長溝內、自中東路之下城子、有自築之鐵路、直達鑛區、爲運煤之用。採法爲新式、現有立井二、每日出煤可七八百噸、惟預計將來可出煤二千噸云。鑛工每日作工者、約千五百人。所採之煤僅一層、厚自五尺至六尺、中夾灰白石帶。煤層傾斜、在尖長溝向西西南、傾角在十二三

度之間、逾尖長溝之北嶺、煤層傾斜反轉向東東北、成一背斜層。其所儲煤量在尖長溝以煤田寬五〇、四公里、煤層傾斜十二度、煤層厚約一、五公尺、煤比重一、二、凡直深一千公尺以上之煤、悉可開採、計約爲四三五四五六〇〇噸。在小北溝者、因傾斜較陡、茲以二十五度計、儲量約爲二一七七二八〇〇噸、煤爲有烟煤、其成份參閱後表、大致灰份及水份較多、故煉焦性甚劣。

裕邊煤鑛　位小黃泥河之西北、西南望穆稜煤鑛、可六十里、但平岡橫阻、交通不便。原爲袁大章所報領（民國三年）、名密西煤鑛、後轉入於徐鼒志、始易名裕邊。開採全用土法、有斜井二、每年出煤僅可六百噸。共有煤三層傾向東南或正南、傾角約十五度。上層厚約三尺、中底二層厚可六尺、上層與中層相距僅丈許、中底兩層相距四尺。水份及灰份、後表均不多、故成份頗優、兼能煉焦。茲以煤田寬五、〇四公里、煤層約四公尺、傾角十五度計、儲量約爲九一九二九六〇〇噸。

合以上三處之煤量、共計已爲一五七二四八〇〇〇噸。視阿也爾特所估計、已多一二七三五二〇〇〇噸、而滴道河尚不在內。昔翁所長曾估計全區大約儲煤有一〇〇〇〇〇〇〇〇〇噸。著者此次勘察之後、覺阿君實估計嫌少也。

煤之分析表

地名	分析處所	水份	揮發份	定炭	灰份	硫	發熱量	符號
穆稜		四•三三	二八•九〇	五〇•六二	一五•八〇	〇•三五	六三六二	
小尖長溝（八次分析平均）		四•二四	二九•四二	五二•三三	一三•八〇	〇•一一	六六二七	

溝道河		五・六七	二四・六三	六〇・九二	八・七八	〇・六九	六九一三
小黃泥河子		二・八八	三〇・七四	五六・〇八	一〇・三〇	〇・四一	六八八〇
小黃泥河子		〇・九五	三〇・四〇	六〇・二〇	九・〇〇	〇・四八	七一一四
小黃泥河子		一・一五	二七・九九	六三・七八	七・〇八	一・二〇	七一九八
小黃泥河子	農鑛部地質調查所	一・二七	二四・五七	六七・四四	六・七九		八〇〇〇
							Bm₂

金鑛僅砂金一處、生於沖積中、在亮子河之楸皮溝內。民國元年爲蕭惠良所報領鑛區約一千六百二十晌、旋因鑛苗不佳、遂行停工。去歲稜川金鑛復開渠試探、然河之兩旁、悉爲長石砂岩層、設金之來源、仍在太古界片麻岩內、來源非遠、恐無致富之希望也。

其餘尙有石墨鑛及鐵鑛、前者生於老達子溝以迄柳毛河一帶、似因受花剛岩之侵入而生成、然成分富者無多、餘皆貧劣。鐵鑛一在白石砬、爲花剛岩內之一細脉、屬磁鐵鑛、一在下城子之東北、爲大理石、受花剛岩接觸而生成之鑛床、然率皆貧瘠、似無開採之價值。

黑龍江省嫩江兩岸之地質

譚錫疇
王恒升

引言

民國十七年秋、承黑龍江常主席及北票煤鑛公司經理袁滌庵先生之邀、赴東三省調查煤田十月十四日自北平至奉天、凡分兩組、一組調查打昂路南端熱河阜新一帶煤田、王君竹泉黃君汲清任之、一組調查打昂路北端黑龍江屬布西嫩江克山諸縣煤田、嚋與升任之。阜新煤田、煤量煤質俱優、交通較便、堪資開採（王君另有報告）。嚋等所勘煤層、大抵瘠薄、賦量較寡、鮮大規模開採之價值、然天賦若斯、是亦無可如何者。顧此行也雖未探得較好煤田、但觀布西諸縣地質、其地層非太古界片麻岩、即白堊紀之火山岩（煤層即夾於火山岩中是以瘠薄）。及第四紀之冲積層、惟嫩江之北及東北、見下白堊紀黑色頁岩、有煤與否尚不可知。擴觀北滿含煤最富之地層、多屬侏羅紀（鶴岡穆稜）及第三紀（札賚諾爾）。凡上二層、今在該四縣中皆未之見、故嫩江流域實少大煤田之希望、將來探勘當盡力於松花江流域也。茲賴此行得黑省將來尋煤之方向、其亦失之東隅、收之桑榆者歟。

嚋與升十月二十一日在瀋陽謁常主席、二十四日抵龍江、逾三日自龍江出發、歷經訥河布西嫩江克山依安五縣、往返一千三百餘華里、阻於河稽於雪、於十一月二十六日始返龍江、沿路浮土蓁厚、植物繁滋、（第六版乙圖）又覆冬雪、地層露頭稀少、其詳細之次序、次第之變遷、頗難勘察、茲篇所記、不過僅就觀察所得再誌其大概耳。

地文

河流　本區域河流以嫩江爲主幹、東北及北以小興安嶺、伊勒呼里山與黑龍江爲分水界、西以大興安嶺與額爾古訥河爲分水界、納三嶺間之水、南入松花江、支流繁多、其大者、左有庫爾奇河、鄂多河、古巴河、謨魯爾河、科洛河、訥謨爾河、烏玉爾河、右有訥要爾河伊斯肯河、喀奈河、剌都河、多布庫爾河、歐肯河、甘河、滾河、霍日里河、（霍日里旗意烟筒）諾敏河、阿倫河、音河、雅魯河、綽勒河、陶爾河。夏季水淺僅尺許、即小汽船亦不能航駛焉。

地勢　本區域地勢、約可分爲平原岡阜山嶺三帶、自中東路之昂昂溪站、經龍江省會、以迄拉哈站爲平原帶。原野瀰佈、絕少岡阜、大率爲冲積層所組成、多砂礫、地磽瘠、但亦有可耕者。山嶺與岡阜頗難劃分、二者恒遞嬗相間、無一定之界限、概言之自拉哈站迤北博根里西南嫩河之東克山縣城之西、率爲岡阜帶、雖岡坡逶斜、地形逐波而大抵坡緩谷淺、少立壁懸崖、其最高諸嶺、高出海面約三百八十公尺、高出鄰近嫩江水面、僅一百八十公尺、地勢大致北高於南、東高於西、嫩江自北向南奔流、訥謨爾河諸水恒由東而西者、職是故也。以氣壓計粗測之結果、拉哈站高於龍江省會三十公尺、訥河縣城低於拉哈站約十公尺、拉哈站訥河左右岡阜、高約二十公尺至六十公尺、依拉哈高於訥河七十公尺、其左右岡阜高約十公尺至九十公尺、嫩江縣城附近、受河流之侵蝕、地勢稍平、低於依哈拉四十公尺、四周岡阜高自十公尺至三十公尺、博根里高於嫩江縣城約三十公尺、其鄰近岡嶺、高約四十公尺至一百四十公尺、克山縣城、高於泰安鎭三十公尺、岡嶺高十公尺至百公尺、泰安鎭高於訥河縣約二十公尺、其岡嶺高自十公尺至六十公尺、全帶大致爲冲積層及露出岩層二者所組成。山嶺帶多在嫩河之西岸、南起布西縣城新基、北達九峰山、在江之東者、南起訥河之開闊淺、北達嫩江縣之柳

屯、地勢崇峻、絕壁懸崖、時矗立於河旁谷側間、最高諸峰、高出海面約四百三十公尺、高出附近嶽江水面約二百五十公尺、如甘河之九峰山五家子（一名莫哥里旗語峰乳意）之西南山、其餘率在三百公尺至三百六十公尺之間、低於三百公尺者、大抵皆谷底河套或河渠兩岸之低岡也。甘河巴彥街一帶、地勢稍殺、然亦多在二百四十公尺之上、地勢大致西北高而東南低、土爾蘇（旗語地窩舖意）位於布西之北而偏西、距布西約六十里、高於布西八十公尺、自大庫馬居士爾蘇之北而偏東、距土爾蘇約二十里、高於土爾蘇約八十公尺、自大庫馬東北行四十五里、爲特穆呼珠、位於霍日里河之北岸、高幾與大庫馬相埒、又三十五里爲五家子、低於土穆呼珠約十五公尺、又五十五里爲巴彥街、高於五家子約二十公尺、自巴彥街西北行二十里至奎勒河口、高於巴彥街二十公尺、又三十五里達九峰山、高於奎勒河口四十公尺、巴彥街居嶽江之西北、距嶽江九十里、高於嶽江約四十公尺、此其大略也。

地文期　因地形之不同、地文概可分爲三期、一布西期、二蔣家屯期、三甘河期、試繪述如左。

一布西期　凡高出海面三百二十公尺以上之地面悉屬之、試以一線連最高諸山頂、雖略現灣曲而甚微、原來之一侵蝕平原、遂復見於目前、代表一老年地形、該地面最完美之區、一在五家子之北、一在十里金之南、一在甘河下游兩岸、（第三版）雖已溝谷縱橫、（第三版第二剖面）而原來之地形尚可辨識、（第五版甲圖）故每於山谷河身、輒覺崖迴嶺環、地勢崇峻、及已攀登嶺巔、舉目瀰平、絕少峰巒苟不俯視溝谷、髣髴身在一大平原之上、構成其地面之岩石、自太古界之片麻岩迄白堊紀之火山岩悉有之、蓋白堊紀火山岩噴發之後、繼以侵蝕期、東山就谷、使當時地面成一大侵蝕平原、其時期或歷第三紀之大部、約與維理士在燕晉間之北台期相

第一圖

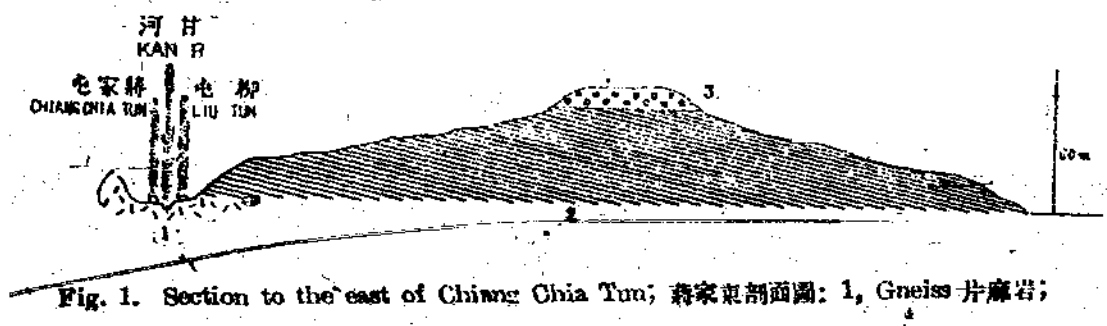


Fig. 1. Section to the east of Chiang Chia Tun; 蔣家東剖面圖: 1, Gneiss 片麻岩; 2, Grey shale of Neugkiang Form. 嫩江層頁岩; 3, Pebbly bed consisting of largely Gneissic gravels 礫石層大部係片麻岩礫。

當、惟不如北台地面侵蝕之甚耳。

二蔣家屯期　蔣家屯東、下白堊紀黑色頁岩之上、有河流沖積礫石一層、高出現在甘河水面約七十公尺、(第一圖)礫石多片麻岩、似代表一舊河底者、環巴彥街低嶺環峙、其高度約二百八十公尺、低於最高山巔一百公尺、(第三版第一剖面)試以一斜線一連最高山頂、復畫出原來布西期之地面、一連高三百公尺之低嶺、第二線遂斜伏於第一線之下、似布西期之地面復被侵蝕者、惟當時地形、谷廣河寬、坡勢遞緩、(第三版第二剖面)河流蜿蜒其上、一部侵蝕、一部遞積、(蔣家屯東礫石層)成二半壯年之地勢、或與維理士河北省之唐縣期相當。

三嫩江期　蔣家屯地面高出現在河面約七十至五十公尺、其間絕壁深峽、矗立豆剖、(第三版第二剖面)爲一成年期之地形、似蔣家屯期之後、本區域地面再被掀而隆升侵蝕復活者、沿甘河及嫩江兩岸最爲發達、故名之爲嫩江期。甘河下游、(第四版)其蜿蜒故道、復被深切、峽谷屈折、更爲地面隆起之明證。蓋蔣家屯期、其地形原爲二半成年勢、坡緩地平、河流蜿蜒、及地面隆起、舊有河流仍循其故道、惟侵蝕復活、遂沿其屈折故道而深切、故峽谷極屈曲之態、或與維理士之汾河期相當。

河北省汾河期之後尙有所謂馬蘭板橋二期者、馬蘭期代表黃土之遞積、板橋期代表最近之侵蝕、今在本調查區域之內、皆不甚顯著、惟遍地浮土蓁厚、嫩江甘河之河谷、又大抵寬於河身、河流蜿蜒其中、(第六版甲圖)兩岸夾沖積層、爲一成年之形勢、似嫩江侵蝕又繼以遞積者。意者浮土及河谷沖積層之生成、即相當於馬蘭期、現在最新之河身、爲板橋之代表歟。但黑龍江遠隔河北二千餘里、南北相差、氣候懸殊、地文變遷、固未必盡相同也。

嫩江之歷史一欲研究嫩江之歷史、必先明瞭其現在之狀況。嫩江導源於伊勒呼里山、自是南流、雖兩岸地勢峻緩無定、而大致皆蜿蜒於山嶺間、迄布西縣城基、始入平原、支流繁多、漑流區域固定、布西縣城迤北、峽岸立壁疊起、大抵河谷寬於河身、中滯沖積層、河流屈曲折其上、(第六版甲圖)迨近其成年期、河牀大致平緩、惟北斜於南。自布西縣城北至庫勒淺、每一公里高約二・三公寸、自庫勒淺北至博庫淺、每一公里高約五十八公寸、故水流北急而南緩、其各支流河牀之斜度、大致與嫩江相若、(訥謨爾河下游即訥河縣城附近每一公里高約二・三公寸適等嫩江)更爲嫩江在成年期之佐證、蓋幼年之河流、率多谷狹岸陡、皆異乎現在之嫩江、惟其河身多灘接立壁、或其幼年期所造成者、此嫩江自幼年以迄現在之大略也。茲更言甘河以推論嫩江幼年期以前之歷史。

甘河爲嫩江之支流、導源於大興安嶺之東坡、蜿蜒東南流、在蔣家屯之東南入於嫩江。蔣家屯迤西、峽谷屈曲、似原來蜿蜒故道又被深切、爲一順向河(Consequent River)者、巴彥街西北、地形崇峻、甘河破嶺而出、兩岸立壁夾峙、頗若峽谷、惟立壁之頂接以斜坡、試以一線連之、微成凹曲之狀、(第五版乙圖)似代表一舊有河谷、更

爲甘河乃一順向河之佐證。但甘河原爲嫩江一支流、故嫩江之生成至晚當先於甘河、嫩江亦爲一順向河也。當其在蔣家屯期之際、谷廣岸平、迂迴緩流、一部遲積、（蔣家屯礫石）一部侵蝕、成一老年河流、迨後地面隆升、（嫩江期）侵蝕復活、但仍循其故道、遂造成現在兩岸之立壁、還其幼年狀態、惟侵蝕不息、河床漸平、河流漸寬、水流漸緩、兩岸冲積層因之生成、河身蜿蜒其上、而成現在之成年期。

前言地文、曾以蔣家屯期比諸維理士之唐縣期、嫩江期比諸汾河期、唐縣期約在上新統、汾河期在洪積統、然則嫩江之肇始在上新統、其復活或在洪積統歟。

地層

本區地層至爲單簡凡分五系一片麻岩系屬太古界、二震旦石英岩系屬震旦紀三嫩江頁岩系屬下白堊紀、四甘河火山岩系屬上白堊紀、五冲積層、試分述之。

一太古界片麻岩系　佔本區之大部、分佈之地凡四、（第一版）一在布西縣南部者、南起布西縣新城基、北逾大庫馬、大部在嫩江之西岸、間有逾河而東者、如阿河淺及大河淺附近之小山。二在特穆呼珠左右者、沿霍日里河兩岸。三在甘河下游者、西起薩馬街之東側、東抵蔣家屯、南沿薩馬街至博爾旗大道、北逾甘河。四露出於博根里附近者、沿科洛河向東延長、在博根里東、更逾科洛河而北、岩石大抵淺淡或灰白或棕黃片麻岩、結構不甚顯著、多花剛岩侵入體、依卜旗之西方、特穆呼珠左右、以及薩馬街東南四十里至博爾旗之溝中、皆此類也。有含黑色包體者多雲母、含長石及石英斑晶、如特穆呼珠東北之小山、有結晶細密色稍深者、如伊卜旗至土爾蘇大道北側、距土爾蘇約十餘里之山嶺、其呈片麻構造者、惟於阿河淺薩馬街及博根里諸處見之。有時

含有石英脈及水晶結晶、在博羅旗附近、且有螢石脈、色綠紫、土人誤之爲翠石、岩質大抵堅實、受河流侵蝕、時露絕壁、多構成本區之山嶺帶、主要造岩鑛物、富長石石英及黑雲母、似山東泰山系、故屬之於太古界。

二薩馬街石英岩系　僅見於薩馬街之東南、(第二版)不整合於片麻花剛岩之上、厚可二百公尺、岩石爲灰白色、岩質堅實、故亦多成小邱、岩層趨向大致爲北東、傾角不詳、因其直覆於太古界片麻花剛岩之上、與河北震旦紀下部石英岩層相似、或屬於震旦紀。

三嫩江頁岩系　露出於柳屯之東山坡、(第一版)自是向東延長、經嫩江縣城、直達距博根里西南約二十里一帶、博根里北之魏家窩舖(距博根里約二十里)亦見之、岩石色或灰或黑灰或藍灰、岩質細密間有微孔、在魏家窩舖一帶、含石灰質甚多、有可稱爲灰岩者、岩層傾向隨地而異、柳屯之東、傾向北六十五度東、斜角約十二度、在博根里西南、傾向南五度西、斜角在五度左右、含甲殼類化石、間有甚富者、分大小兩種、植物化石亦時見之、化石層近下中部、(第二版)產化石之地凡二、二在魏家窩舖、一在博根里西南二十里至嫩江縣大道兩側、其化石經粗略之鑑定、約有下列三種。

甲　甲殼類

1　Estheria cf. middendorfi

2　Leperditia sp.

乙　植物

1　Cephalotaxopsis sp.

第二圖

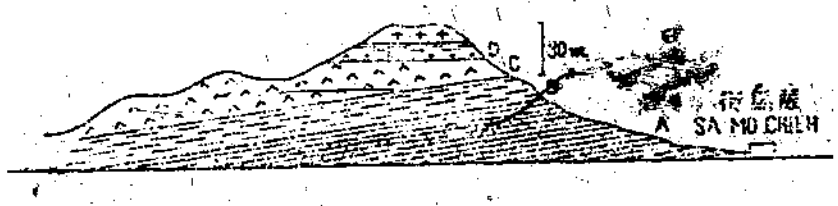


Fig. 2, Section to the west of Samochieh 薩馬街西剖面圖: A, Sandstone and Shale 砂岩及頁岩; B, Greenish white tuff 白色帶綠凝灰岩; C, Andesite tuff, dark and dense 安山凝灰岩黑而緻; D, White tuff and breccia 白色凝灰岩及角礫岩; E, Basalt 玄武岩。

以化石論、頗似賴士氏（Reis）之特曉層 Tunga Formation 及維蒂目 Witim Formation 因上二層皆含有 Estheria middendorfi、且與嫩江岩相距不甚遠也。該二層之時期、昔日雖意見紛紜、但賴士以及葛利普（Prof. A. W. Graban）教授近來之研究、均斷其屬下白堊紀、且與美國第三次探險隊 The Third Asiatic Expedition 在蒙古所定之下白堊紀層相比擬、然則嫩江系亦屬諸下白堊紀歟。

該系露頭不整、層厚不詳、大略估之、當在五百公尺以上、東西兩端皆不整合於太古界片麻岩之上、最發育於嫩江附近、故名之爲嫩江系。

四甘河火山岩系　在本區之內、分佈較廣（第一版）嫩水以西、南始十里金之南、經特穆呼珠五家子巴彥街、以達九峰山、惟特穆呼珠附近、因斷層之影響而間斷、自巴彥街而東南、經薩馬街、連續不斷、以至依斯坎、其他如博根里及克山縣泰安鎮附近、亦皆有其分佈、岩石種類龐雜、凡安山岩粗面岩流紋岩玄武岩以及凝灰岩火山角礫岩悉有之、惟浮土蓋厚、露頭稀少、分層關係甚難觀察、殊可惜耳。但概言之、南自十里金、北迄巴彥街、東抵依斯坎、大致以安山岩流爲最多、間有粗面岩及流紋岩、安山岩流之下有凝灰岩、火山角礫岩、（或灰白或灰綠）砂岩、頁岩以及粗砂岩、煤層即夾於砂岩頁岩之間、鐵鎬山（第二圖）依斯坎（第三圖）九峰山皆是也。粗面岩及流紋岩覆於安山岩之上、分佈於巴彥街

第三圖

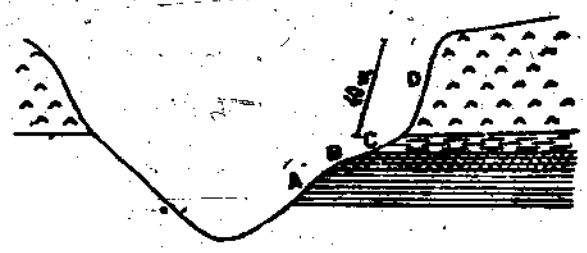


Fig. 3. Section behind Yisuikan 依斯坎後剖面圖: A, Black shale with coal seam 黑頁岩夾煤層; B, Whith sandstone 白砂岩; C, Green and grey tuff 綠及灰色凝灰岩; D, Andesite 安山岩。

以迄將軍窩裏一帶、其他如五家子北、約三千里河之北岸亦見之、巴彥街西北甘河峽間、粗面岩之上有礫岩一層、其礫石多片麻花崗岩粗面岩、以及流紋岩礫岩之上、(第二版)復見玄武岩分佈於九峰山一帶、其他如巴彥街之西南山、傳家窩舖西側、薩馬街之西山、鐵鎬山之最上層、以及博根里附近悉見之、有時礫岩層絕跡、直覆於安山岩流之上。

安山岩色多深黑、富氣孔、孔內恆被瑪瑙及水晶所塡充、其結晶大致勻淨、間有含斑晶者、以鈣鈉長石爲最多、粗面岩及流紋岩、大率色淺淡、流紋岩時顯流紋及乳球構造、斑晶分石英及長石兩種、長石有正長石及斜長石之分、石基大部爲玻璃質、粗面岩之斑晶多玻璃長石、玄武岩色黝黑、風化者爲紅色、有氣孔者、孔內亦多被瑪瑙所塡塞、惟瑪瑙核恒包一綠色薄皮、其長石大部多成長方體、鈣鈉長石、平行排列、顯流動之遺痕、黝黑色鑛物多輝石及磁鐵粒。凝灰岩有灰白及綠色兩種、其顆粒粗者、長石及石英尙可辨識。岩層傾向隨地不同、鐵鎬山一帶、傾向南四十度西、傾角在十五度至十五度之間、依斯坎北山、傾向南八十度東、傾角約十五度、九峰山一帶、傾向東南、將軍窩裏、傾向東北、博根里一帶、傾向西南、全系岩石率多堅實、所成山嶺大抵峻拔、其頁岩內含植物化石多不完整、產化石之地凡二、一在鐵鎬山、一在將軍窩裏、所產化石有。

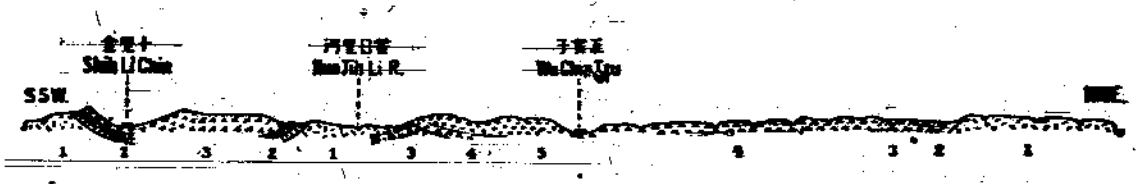


Fig. 4. Section from Shihlichin to Kanho R. 十里金至甘河剖面圖: 1, Gneiss and granite (Archaean) 太古界片麻岩及花崗岩; 2, Sandstone and tuff 砂岩及凝灰岩; 3, Andesite 安山岩; 4, Trachyte and rhyolite 流紋岩及粗面岩; 5, Basalt 玄武岩; 2-5 Upper Cretaceous, 2-5 上白堊紀。

其餘多細枝、不易鑑定、鐵鎬山砂岩內有種子化石、形橢圓、大如莞豆、九峰山煤層之下、有木化石、以地層與岩石之性質論、與熱河之朝陽系多相彷彿、蓋朝陽系岩石、亦多火山岩內夾煤層、二者似同屬諸上白堊紀也。

3. Ozokanowskia sp.
2. Zamites sp.
1. Cephalotaxopsis sp.

五冲積層　其分佈南始龍江、北達訥河北之喀達泥哈、(第一版)近龍江省會多細砂、訥河拉哈站左右多砂礫、礫石大者自一公分至數公分不等、多瑪瑙石英火山岩以及片麻花崗岩、恒組成岡阜、高約二三十公尺、爲河流所冲積、一部或爲上新統之產物、一部屬第四紀也。

構造

本區地層大致傾斜平緩、傾角約在十度至二十度之間、但亦有達四十餘度者、如紅窰南側之凝灰岩、將軍窩裏之頁岩、是其構造原本較簡單、惟以浮土厚掩、即河旁山谷間地層之傾斜、亦多難測、故欲詳言其構造、勢有所不能也、茲篇所述不過僅其大概耳。

地層傾向大致西南或南、故其走向多西北與東南或東西、自十里金至巴彥褶皺

街一帶、雖全爲甘河火山岩系所分佈、但十里金附近地層、傾向東北、巴彥街一帶向西南、頗似一向斜層、（第四圖）滾河附近、近向斜層之中心、自巴彥街至嫩江縣城一段、似爲一背斜層、柳屯嫩江頁岩系地層、傾向東北、巴彥街一帶甘河系地層向西南、甘河兩岸片麻花剛岩、當背斜層之中心、惟該背斜、東南狹而西北寬、或褶皺之初、背斜軸原非水平、西北高而東南低歟。

其他較小褶皺尙多、如甘河至將軍窩裏一帶、兩地相距甚邇、而地層傾向已殊、前者向東南、後者向東北、似爲一小向斜層、依斯坎迄缸窰一帶亦如之、惟背露頭不整、難以詳言、故簡略之。

斷層　較大者凡二、（一）特穆呼珠斷層、斷層面大致沿霍日里河、其走向爲北北西南南東、東北爲俯側、西南爲仰側、（第四圖）因受該斷層之影響、太古界片麻花剛岩、復露出於特穆呼珠左右、而斜插入於甘河火山岩系之間。（二）博根里斷層、斷層面大致沿科洛河之南岸、（第七圖）其走向爲東向東西北西、西南爲仰側、東北爲俯側、使片麻花剛岩、復與甘河火山岩系成斷層之接觸。

其他小斷層亦多、如九峰山之東南坡、依斯坎北山之東坡、煤層猝斷、受褶皺及斷陷之地層、有屬諸上白堊紀者、故其斷陷及褶皺之時期、當在上白堊紀之後、其前於何時、尙無較新地層、以資研究、惟中國北部之地動期、一在白堊紀之末、一在中新統、或上新統、其褶皺或屬諸前者、而斷陷之一部、有屬諸後者之時歟。

本區域古生代地層、僅見震旦紀之石英岩系、不整合於太古界片麻若之上、震旦紀之後、逕接下白堊紀之嫩江頁岩系、凡自寒武紀以迄中生代之侏羅紀地層、悉缺如、成一大不整合、故下白堊紀之先本區域有一攸

久成陸塊期、或古生代及中生代一部之地層、原未遞積、或曾經遞積、而旋被侵蝕、迨下白堊紀始復低降、窪下之區積水爲湖、遂成嶺江頁岩系、下白堊紀之後、塊殼又發隆起、遞積間斷、故上白堊紀之砂岩頁岩、（中夾煤層）又不連續於嶺江頁岩系之上、上白堊紀之末葉、火山爆發、若流橫溢、先多安山岩、繼以粗面流紋諸岩、終以玄武岩、火山噴發、塊殼變動、地層褶皺、侵蝕復活、經第三紀之二部、遂造成布西一大侵蝕平原、布西期之地殼、又起隆升、侵蝕再熾、布西平原復遭侵蝕、迄上新統、復溶其型成一半成年之地形、當時谷廣河寬、地勢平緩、河流蜿蜒、一部侵蝕、一部遞積、故有蔣家屯東、及拉哈站附近之礫石層、迨後地面又復隆起、侵蝕復活、舊有河流、多循其屈曲故道下切、故甘河現蜿蜒之夾谷、而嶺江兩岸遲接立壁也（嶺江期）、迨後嶺江侵蝕、河床漸平、河谷漸寬、水流漸緩、河谷之中、遂積淤砂、河流曲曲、以欣現在嶺江二成年之形勢。

礦產

本區礦產以煤爲主、雖此次調查目的爲探煤、而天賦不豐、實非逆料所能及、茲將較重要者、縷述如左。

一、九峰山煤田（第五圖）

位置與交通　位於布西縣東北境、據甘河之右岸、東南距巴彥街可五十里、距嶺江縣城約百三十里、南距龍江省會約四百五十里、由龍江溯嶺江而上、經拉哈站、可直達嶺江縣屬之四家子、由四家子入甘河、再溯甘河經巴彥街以達九峰山、其陸路或由布西經特穆呼珠五家子巴彥街、或由訥河經博爾旗巴彥街、或由嶺江縣城經蔣家屯薩馬街巴彥街、然率皆山路崎嶇、交通不便。

煤層煤質與煤量　夾於甘河火山岩系之中、近煤層多砂岩頁岩據現在所知者、僅有煤一層、厚六尺、但有達

九峰山煤田地質圖
GEOLOGICAL MAP OF THE CHIU FENG SHAN COAL FIELD

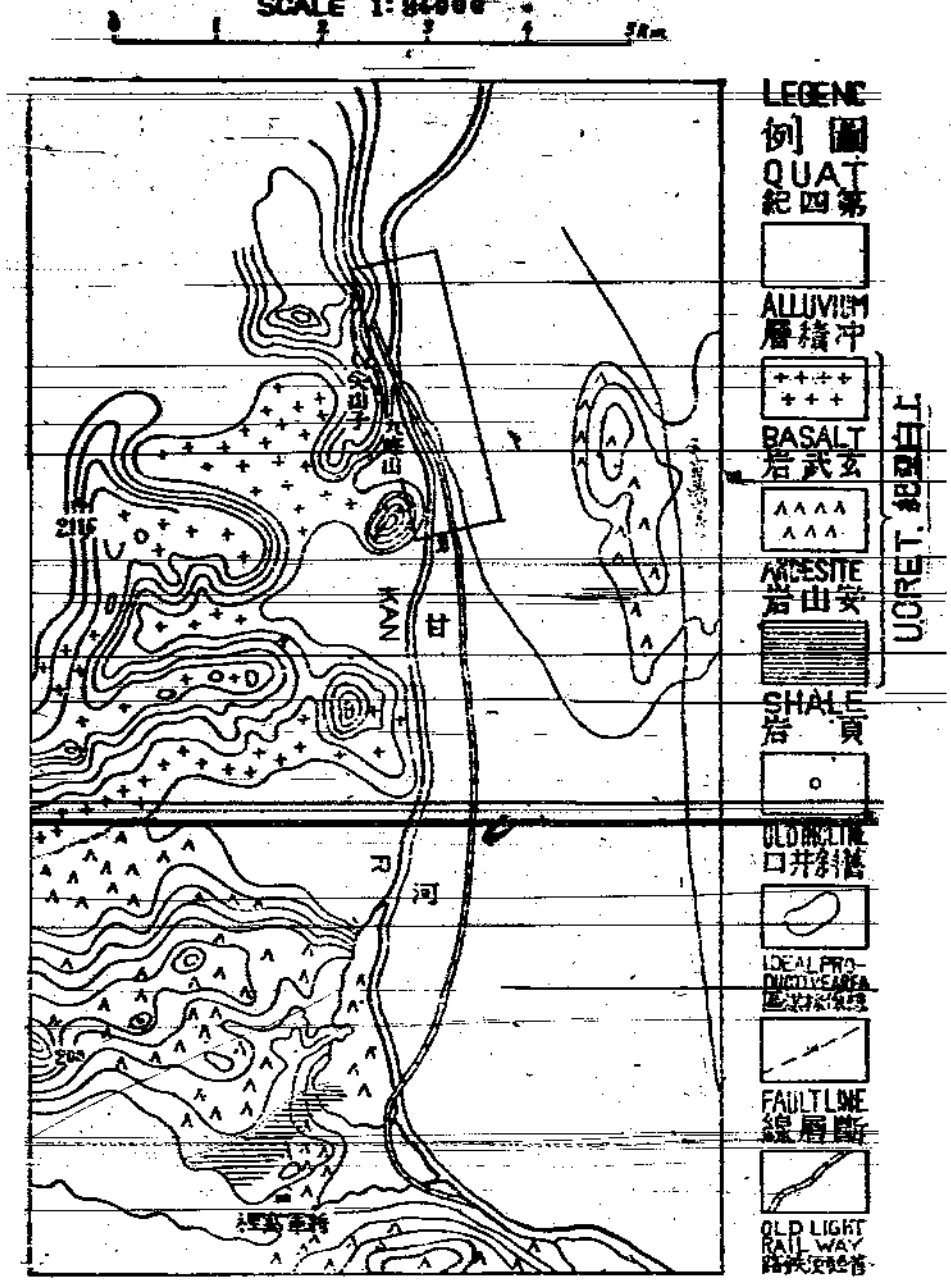


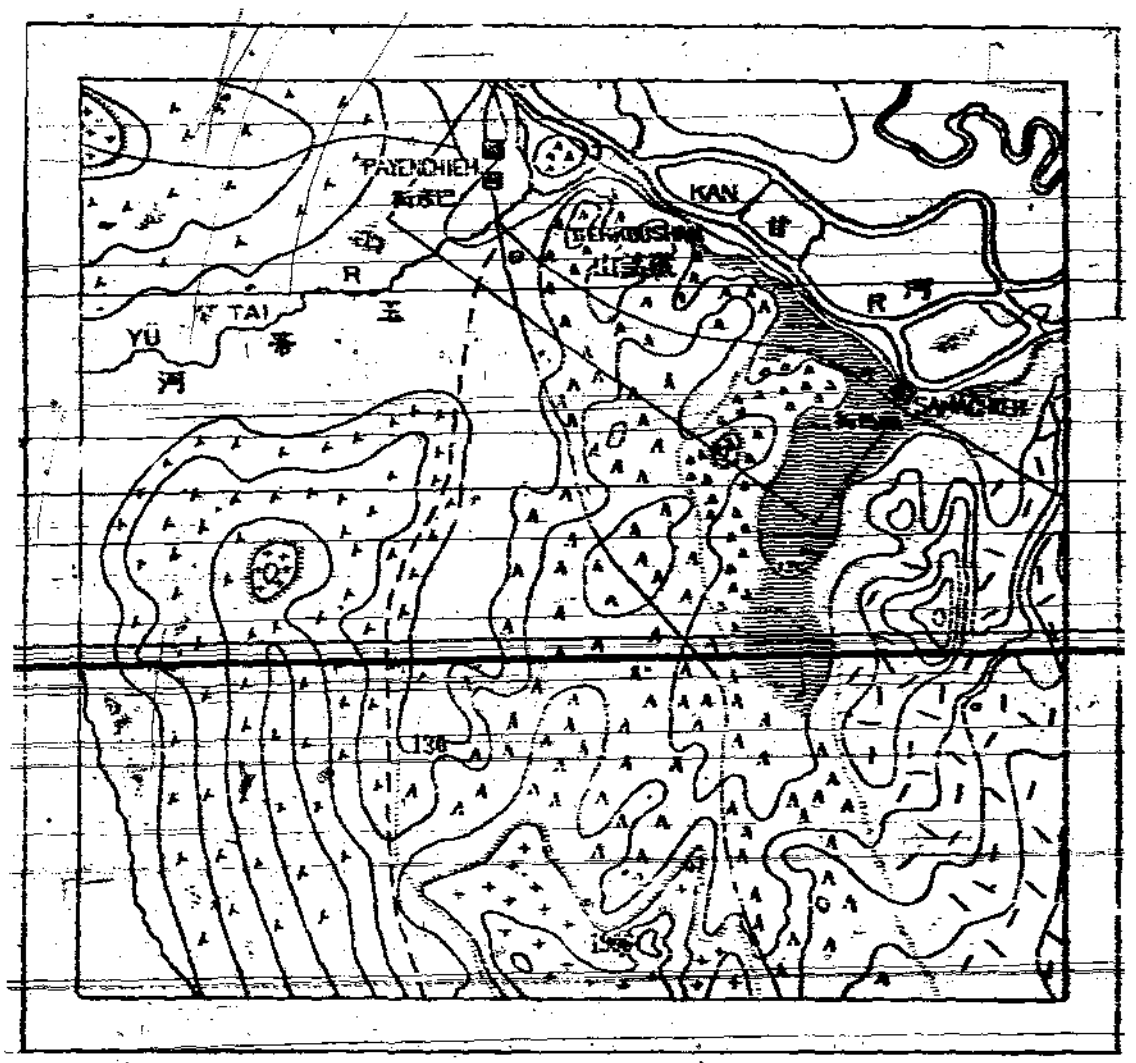
Fig. 5. 第五圖

揮發分幾達百分之二十二、不能煉焦、煤層露頭甚稀、此次調查正值冬季、往返僅一日、時間迫促、且阻於甘河、欲言煤量、實難失據、下之估計、乃單就所知煤層分佈之區域、以言其大概耳、茲以煤層平均厚二公尺、傾角二九尺者、中夾岩石、層厚自六寸至八寸、其傾向大致爲南七十度東、傾角平均二十度、近斷層處、有至六十度者、遂斜趨於甘河之下、斷層有二、一在西、一在南、煤爲次有烟煤、燃燒少烟無臭味、本所金君分析之結果、（參看第一表）灰分佔百分之十三、

鐵窰山煤田地質圖

GEOLOGICAL MAP OF THE TIEH KOU SHAN COAL FIELD

SCALE 1 : 84000



LEGEND

例圖

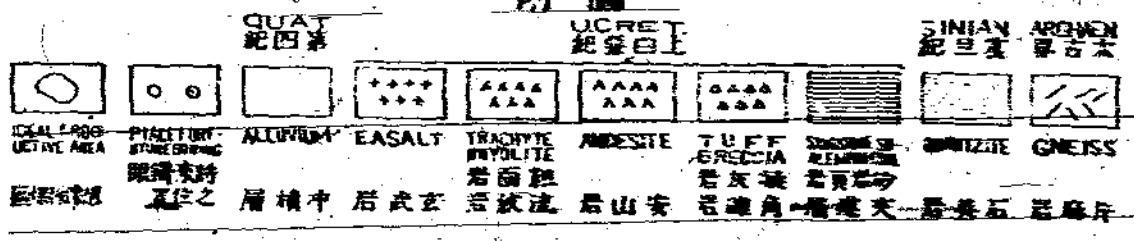


Fig. 6 圖六第

十度、長二公里、(第六圖)比重一·一二凡直深三百公尺垂上者悉可開採、約得煤量爲五百二十六萬二千噸、

但昔日已開採一部、今之餘者更無幾矣。

沿革　清宣統元年程德全督黑龍江、提倡實業、適有孫敬臣者聞土人言九峰山產煤、報之於省、遂派王顯興辦之、初用土法開採、旋命金純德（今布西總管）督理之、惟因運輸困難、宣統三年興築輕便路、鋼軌重二十鎊、路寬二英尺、自博爾旗蜿蜒西北約百二十里、建橋四十八座以達九峰山、得此煤始可運省、每年出煤共約二千餘噸、有斜井一、深二十五丈、通風井二、築房數十間、民國五年巴彥街橋毀、因之停工、今之存者、僅頹垣敗瓦、（第七版甲圖）即昔之斜洞亦傾圮而難入矣。（第七版乙圖）

二、鐵鎬山煤田（第六圖）

位置　據甘河之右岸、位巴彥之東南薩馬街之西北、距巴彥街凡四里有奇、薩馬街可三里、西北遙對九峰山、其交通大致與九峰山相若、惟較近五十四里有奇耳。

煤層煤質與煤量　亦夾於甘河火山岩系地層之間、近煤層以灰色及綠色頁岩棕色或綠色砂岩爲多、頁岩內含植物細枝化石、砂岩內多種子化石、僅見煤一層、厚由三尺至四尺二寸、傾向南四十四度西、傾角約十五度、甘河在其北、故背斜甘河、本所金君分析、（參看第二表）含灰分百分之九・一六、揮發分佔百分之四四・三四、次於九峰山之煤、幾爲褐炭、其儲量以傾斜十五度、長約五公里、厚約二・公尺、採直深三百公尺計之、約有六百九十五萬四千噸、因傾斜平緩、煤量富於九峰山、然此不過就已知之煤層厚度而估計、如向下煤層漸厚、則儲量可增、如煤層減薄或不連續、則儲量可減、故興辦之初、必須鑽探、鑽探之地位、一宜在薩馬街之西南、一宜在巴彥街之正南、（第六圖）二鑽果皆得煤層且不甚薄、方可著手興工也。

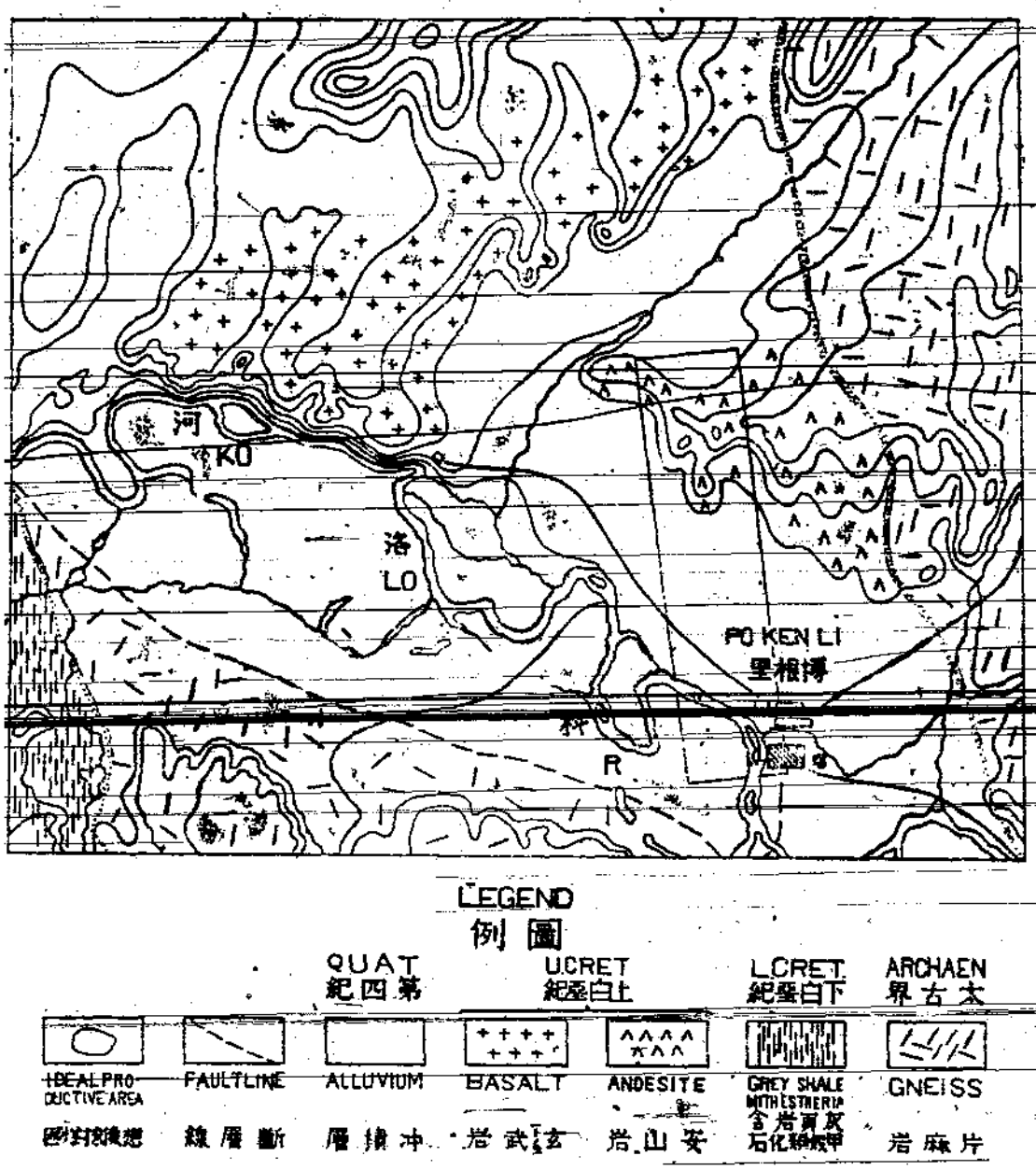


Fig. 7. 第七圖

沿革　鐵鎬山爲由博爾旗至九峰山輕便鐵路所經之地當時鑿山築路偶見砂岩及頁岩似含煤層、遂集工試探、掘一斜井、（第八版甲圖）深由二尺至四尺二寸、向西南傾斜、即九丈遇煤一層、厚上述之煤層也、旋因水大停工、布西總管金純德君今年重建新屋擬復試探焉。

其他如依斯坎三（鐵鎬山東南六十里、據嫩江之西岸、南望訥河縣城一百六十里、）之北

山、(第八版乙圖)於民國十年曾採得煤一層、厚約三尺七寸、上爲砂岩、下爲黑頁岩、(第四圖)傾向南八十度東、傾角約五度、惟其四周悉爲安山岩、似無大希望、其南三里之松樹嶺亦曾試採、僅見頁岩、蓋夾於火山岩中之煤層、厚薄變化恒急、且常不相連續、甘河煤田之無大價値者職是故也。

三、嫩江縣博根里煤田(第七圖)

位置　位於嫩江縣城之東北可七十里、科洛河經過之、自是蜿蜒而西以會嫩江。

煤層煤質煤量　煤層夾於黑色頁岩中、厚不足三尺、且有岩石薄層、發見於一農家鑿井內、煤層傾向西南、其西南阻於斷層、今嫩江縣實業局長呂君現正試探、據謂博根里北七里地、掘井時亦曾見煤、似煤層有連續之希望、茲以煤層傾斜十五度、厚一公尺、煤田長四公里、凡直深三百公尺以上之煤悉可開採計之、約有五百五十六萬三千二百噸、煤質尙佳、(參看第一表)可以煉焦、將來運輸科洛河尙可利用、以鎗於嫩江縣、苟爲小規模之開採、籌備得人、或可獲利也。

四、克山縣政字二十八號井煤田

位置與交通　位於克山縣之正西、秦安鎭之東北、東距克山約八十里、西南望秦安鎭可十五里、秦安鎭齊克鐵路經過焉。

煤層　亦發見於一農家水井中、附近概爲低崗、浮土深掩無露頭、據蘇香圃君(當時探煤人)謂煤層夾於頁岩之中、傾斜甚陡、在六七十度之間、向南傾斜、厚度不詳、煤質爲次烟煤有光澤、燃燒帶臭味、後馬振卿君曾用俄鑽師試探無結果而罷、然其密邇齊克鐵路、運輸便利、設天賦稍厚、尙有小作之希望。

第二表　煤之成分

煤產地	本所化學實驗室分析號數	水份	揮發份	定炭	灰份	灰色	發熱量（加路里）	符號及煉焦性
九峯山 甲	七二	一二・二八	三〇・八九	五三・七三	一三・〇〇	黃棕	六四八九	Bl 不能煉焦
九峯山 乙（瑤穗煤礦公司分析 一九二五）		三・七九	三八・八四	五六・〇二	一・三五		七六一四	Bl 可煉焦
鐵山	七三	五・四四	三四・三四	四一・二六	九・一六	淺灰		C 不能煉焦
博嘎里	六九	三・五四	三四・六三	五二・八三	九・〇三	紅棕	七二三〇	Bl 可煉焦

統觀以上三煤田、鐵鎬山博嘎里煤田、儲量較富而不確、九峰山雖較確而量少、交通困難、煤田又正在甘河之下、夏雨暴漲、河套橫溢、即選擇一適當築井之地而不可得、將來工程困難、可以想見、其餘如克山依斯坎、則更無論矣。惟三省邇來經營鐵路不遺餘力、打昂已成、齊克將竣、聞齊嫩正在計畫、將來交通便利、人烟稠密、薪木伐盡、需煤必急、今袁訥河縣杵子、一古磅（一九・八尺長一・八尺寬六・六尺高）價約五十元、（哈洋連運費）煮用一爐計二、古磅杵子、可供六個月之用、若用煤則四噸足矣、四噸之煤、（每噸十五元計）價值六十元、二古磅杵子計百元、其比爲百與六十、則將來煤之需要、因人口衆多而增加、設齊嫩路成、再築支路至巴彥街、則九峰鐵鎬二山之煤鐵、尙未可量也、其餘尙有瑩石鐵釭料土頗料諸鑛、瑩石鐵在博爾讓附近、爲冶鐵熔劑之主料、赤爲玻璃工業及弗酸工業所必需、每噸售價自九元（鋸平）至二十元、以輸出日本爲大宗、將來中國工業發達、需要必多、設賦量不薄、（噸升限於時間未往調查）交通便利、亦可開採、釭料土在依斯坎之北、原爲凝灰

岩、多長石、富養化鉛、故可爲燒缸之原料、顏料鑛在喀達泥哈附近南距訥河縣城約二十餘里、夾於沖積層內、似爲細土而富褐鐵鑛者、用水冲洗、去其碎滓、可做粗質顏料、現已有人開採矣。

BULLETIN

OF

THE GEOLOGICAL SURVEY OF CHINA

Number 13 June, 1929

CONTENTS

GEOLOGY OF THE COAL FIELD OF FUHSINHSIEN, JEHOL PROVINCE — C. C. WANG & T. K. HUANG

THE ELIMINARY REPORT ON THE GEOLOGY OF SHAOSHIH COAL FIELD, PENCHIHSIEN, FENGTIEN PROVINCE. T. K. HUANG

GEOLOGY OF SOME COAL FIELDS IN LIAONING AND KIRIN PROVINCES C. C. WANG

THE GEOLOGY AND MINERAL RESOURCES OF MISHANG AND MULENG, KIRIN H. S. WANG

GEOLOGY ALONG THE VALLEY OF THE NENGKIANG RIVER, HEILUNGKIANG H. C. TAN & W. S. WANG

MINISTRY OF AGRICULTURE AND MINES

THE GEOLOGICAL SURVEY OF CHINA

AFFILIATED WITH THE NATIONAL RESEARCH INSTITUTE

Peiping (Peking).

BULLETIN

OF

THE GEOLOGICAL SURVEY OF CHINA

Number 13 June, 1929.

CONTENTS

GEOLOGY OF THE COAL FIELD OF FUHSINHSIEN, JEHOL PROVINCE ... ... C. C. WANG & T. K. HUANG.

A PRELIMINARY REPORT ON THE GEOLOGY OF HSIAOSHIH COAL FIELD, PENCHIHSIEN, FENGTIEN PROVINCE ... ... T. K. HUANG.

GEOLOGY OF SOME COAL FIELDS IN LIAONING AND KIRIN PROVINCES ... ... C. C. WANG.

THE GEOLOGY AND MINERAL RESOURCES OF MISHANG AND MULENG, KIRIN ... ... H. S. WANG.

GEOLOGY ALONG THE VALLEY OF THE NENGKIANG RIVER, HEILUNGKIANG ... ... H. C. TAN & W. S. WANG.

MINISTRY OF AGRICULTURE AND MINES

THE GEOLOGICAL SURVEY OF CHINA

AFFILIATED WITH THE NATIONAL RESEARCH INSTITUTE

Peiping (Peking).

BULLETIN

OF

THE GEOLOGICAL SURVEY OF CHINA

Number 13 June, 1929.

CONTENTS

		PAGE
GEOLOGY OF THE COAL FIELD OF FUHSINGHSIEN, JEHOL PROVINCE	C. C. WANG & T. K. HUANG	1
A PRELIMINARY REPORT ON THE GEOLOGY OF THE HSIAOSHIH COAL FIELD, PENCHIHSIEN, FENGTIEN PROVINCE	T. K. HUANG	13
GEOLOGY OF SOME COAL FIELDS IN LIAONING AND KIRIN PROVINCES	C. C. WANG	17
THE GEOLOGY AND MINERAL RESOURCES OF MI-SHAN AND MULENG, KIRIN	H. S. WANG	25
GEOLOGY ALONG THE VALLEY OF THE NENGKIANG RIVER, HEILUNGKIANG	H. C. TAN & H. S. WANG	32

MINISTRY OF AGRICULTURE AND MINES

THE GEOLOGICAL SURVEY OF CHINA

AFFILIATED WITH THE NATIONAL RESEARCH INSTITUTE

Peiping (Peking).

GEOLOGY OF THE COAL-FIELD OF FU-HSIN HSIEN JEHOL PROVINCE

By C. C. Wang & T. K. Huang

With 1 plate and 4 figures

Introduction

The coal field of Fuhsinhsien, Jehol, has been visited by several previous investigators, notably Moller and Andersson. Moller spoke of the Tertiary age of the coal series, but being a mining engineer he reasoned wrongly in the geological problems. It was Dr. Andersson who first assigned the Jurassic age to the coal series. Concerning the economic aspects both of them made but a few vague statements. In November 1928 we had the opportunity to carry out a comparatively detailed survey of the coal field, in which we found plenty of plant remains proving the Middle Jurassic age of the coal series. Much attention has also been paid to the distribution of the coal seams and the sampling therefrom. The following is a full account of our observations.

Position and Communication

The coal-field is situated near the south-eastern border of Jehol. In its center lies the city of Fuhsinhsien whence radiate three main roads. One road runs in a south-eastern direction for 60 li to Pataohao, which is crossed by the Tat'ung railway and in 60 li from Tahushan, the terminus station of this line and a station on the Peking-Mukden line. Another road connects the district city with the town of Hsinglit'un in the east in the distance of 90 li, the latter town being also a station on the Tatung railway. A third road leads southwestward for 140 li, via Tsinghomen to Yihsien, which is a station on the Chinghsien-Peipiao railway. Communication is more difficult on the first road than on the other two roads, since the first runs across a range of ancient gneiss while the other two passes through levelling countries or broad valleys. At present all transportation is handled by mule carts; this is not only slow and clumsy but is constantly threatened by day-light robbery on account of the unsettled conditions in these

parts of the country. Since the topography offers no difficulty it is hoped that railways will soon be built to connect the coal-field with commercial centers, and in so far as the richness of the coal reserves in considered such an undertaking is urgently needed.

Topography and Physiography

We approached the coal-field from its south-eastern side. At Pataohao the country appears to be flat or gently rolling. As one looks toward the west from Pataohao station, one sees long and high ranges with rugged peaks. Thus we expected to climb precipitous cliffs amongst these very mountains. But as we approached them we found them with rather gentle slopes, intercepted by wide and mature valleys. The sky-line, more-over, is even instead of being irregular It was only at Chanyükou (單于溝), halfway between Pataohao and Fuhsinhsien, that we began to see steep hills and narrow ravines. Seven to 8 li further west we reached a range which, though of reasonable height, can be crossed by mule carts—of course with difficulty.—Standing on this range one overlooks the coal field of Fuhsinhsien with its wide, plain-like valley of the Hsiho.

The coal-field trends from north-east to south-west. It is bounded on both sides by more or less parallel ranges of ancient gneiss with a general height of 300 meters above the valley bottom. It is about 30 li across, to the north-east it ends in a maze of low hills but to the south-west it extends for an unseen and unknown length. In the middle of the coal field runs the river Hsiho in meandering courses, which opens to the river Talingho south of Tsinghomen.

The physiographic features are very interesting. The earliest stage ascertainable is a stage of peneplanation. The peneplane is represented by the decidedly even sky-line of the ranges, and is specifically marked by a flattopped range just south-east of the village Ch'ichiatze (七家子). It extends for nearly 10 li and has a height of some 400 meters above the valley bottom. The broad valley of the Hsiho and the fine-dissected hills of the gneiss complex undoubtedly represent another stage—a stage of maturity. Besides these mature valleys there are V-shaped valleys, or gulches rather, developed on the gentle slopes of the ranges. Good examples of them can be observed south of Changhata (長哈達) and Sunchiawan (孫家灣), and north of the hill Pachiatzehoushan (八家子後山). In the Peipiao coal field, which is less than 100 kilometers further west, cañons are remarkably developed in the *Hungtu* or red-clay formation. The deep gullies in this coal field have the same characters as those in the Peipiao region, but they

are not so deep and so extensive simply because the red clay here is generally absent. Thus we have three physiographic stages one following another: 1, a stage of peneplanation; 2, a stage of maturity and 3, a stage of vertical cutting, i.e., a young stage.

Stratigraphy

All the older formations including the whole Palæozoic and early Mesozoic are totally absent from the coal-field, only part of the Jurassic and of the Cretaceous being represented by sedimentary rocks which lie unconformably on gneiss complex. The stratigraphic succession is tabulated a follows:

Fossiliferous pyroclastics of Tuhulu—Lower Cretaceous.
Red conglomerate—Lower Cretaceous.
Coal Series of Fuhsinhsien—Middle Jurassic.
Andesitic lavas—age undetermined
Ancient gneiss complex.

THE GNEISS COMPLEX.—This consists chiefly of median-grained granite-gneiss with intrusions of coarse granite and pegmatites and of numerous basic rocks. The granite occurs mostly in massive form while the basic intrusives are in the form of dikes or sheets. Apart from these rocks there are hornblende and mica schists which can be clearly observed in the neighborhood of Tapakou and in the south-east of Yangkou. The schistosity is very distinct with a general dip toward the north-west, the dip angle ranging from 45° to 80°. The contact between the schist and the gneiss is everywhere unconformable. Quartzite has been found in the north-west of Tuhulu, it is so much distroted and jointed as to obliterate the bedding.

The gneiss complex has a wide distribution. It embodies all the ranges on both sides of the coal-field, and in fact all the mountainous region between the Fu-hsin coal field and the Pataohao coal-field is composed of nothing but gneiss, schist and quartzite with later intrusions. The isolated hill Pachiatzehoushan, north-west of the district city, is also made up of gneiss which has been thrusted from the north-west as will be explained later.

The age of these rocks cannot be determined but can be conjectured. The gneiss is undoubtedly the oldest and seems to be comparable with the Taishan Complex of Bailey Willis. The schist and quartzite are much younger and can be correlated with part of the Wutai System of the same author.

THE ANDESITIC LAVAS.—Between the north-western boundary-range and the coal field proper there is a belt of low-hill country entirely composed of andesitic rocks. These rocks vary widely in composition and are generally intensely altered by weathering. Most of them are undoubtedly extrusive but part may be intrusive. Their contact with the gneiss complex has not been observed but an unconformity is to be inferred. With the overlying coal series they are in apparent conformity but the existence of a disconformity is highly probable since the coal series begins wit' a basal conglomerate consisting of andesite pebbles (see Fig. 2 in Chinese text).

The age of the andesite cannot even be conjectured. It may be Palæozoic as well as early Mesozoic, but it cannot be younger than Middle Jurassic. Similar rocks has been found in the Pataohao coal field and in the Peipiao coal-field. Since these regions are so close to one another and since the andésites occur invariably below a Jurassic coal series, it is not without reason to suppose that these rocks are contemporaneous.

THE COAL SERIES.—This consists of shales, sandstones, conglomerates, and coal seams with a prevailing yellow or yellowish green color. The total thickness of the coal series is difficult to determine owing to the extensive covering by detritus and alluvium, it may be roughly 1,000 meters. The presence of the conglomerate in the formation is a conspicuous feature. It occurs both in the basal and in the upper part; the basal conglomerate can be seen at Pachiatzehoushan and in the north-east of Yentaiyingtze, this being composed largely of pebbles of volcanic rock with a maximum diameter of 1 foot. The conglomerate in the upper part is typically developed in the hills south of Sunchiawan, the pebbles are usually of gneiss and occasionally of quartzite with a diameter ranging from 2 feet to 1 inch.

The distribution of the coal series is very regular, occupying a long and continuous belt from Chaotaiyingtze to Tuhulu, a distance of approximately 70 li. It is interrupted by a fault in the north-east, while in the south-west the boundary is not known for we had not enough time to make investigations in that direction.

Fossils have been found at Sunchiawan. From a yellowish shale alterating with sandstone in a gully south of the village seven species have been obtained, they are:

Dicksonia gracilis (?) Heer—Most abundent.

The specimens at hand agrees with Heer's species in every respect, only that the venation in general is not clearly shown.

Podozamites lanceolatus Lindley and Hutton—Very common.

Ginkgo cf. digitata (Brongniart)—A single leaf.

Pityophyllum nordenskiöldi (Heer) Nath.—Represented by numerous scattered leaves.

Pterophyllum sp.—Not uncommon.

Eladocladus sp.—Several foliage shoots.

Pagiophyllum sp.—Crowded foliage shoots.

From the dump near a native mining pit the following species have been collected:

Podozamites lanceolatus Lindley and Hutton
Ginkgo cf. sibirica Heer
Pityophyllum nordenskiöldi (Heer) Nath.

Judging from the above lists we can see that our flora, though a rather poor one, is closely related to that of the Middle Jurassic (Brown-Jura) of Amurland of Russia.[1] *Dicksonia gracilis*, *Podozamites lanceolatus*, *Ginkgo sibirica*, and *Pityophyllum nordenskiöldi* are typical fossils from Amurland and E. Siberia. Though *Ginkgo digitata* does not occur there, *G. huttoni* is present which has been made a variety of *G. digitata* by the distinguished palæobotanist A. C. Seward. Only *Eladocladus sp.* and *Pagiophyllum sp.* are decidedly absent in the Russian localities. With the Tetori flora of Japan the present flora also has five species in common, which are the ones specifically identified i.e., *Dicksonia gracilis*, *Podozamites lanceolatus*, *Ginkgo digitata*, *G. sibirica*, and *Pityophyllum nordenskiöldi*. The Tetori flora,[2] as is well known, has been correlated with that from Amurland. Thus we are forced to conclude that the Fuhsing coal series is of Middle Jurassic age.

Now let us correlate the coal series of Fuhsinhsien with formations occuring in neighbouring regions. At Pataohao there is a coal series from which are obtained the following species:

Dioonites kotoi Yokoyama
Ginkgo digitata Brongniart
Phoenicopsis speciosa Heer
Pityophyllum nordenskiöldi (Heer) Nath.
Czekanowskia sp.
Podozamites sp.

1. Mem. de l'acad. imp. des Sci. de St.—Petersbourg, Serie VII, Tome XXII, No. 12, 1876.
2. Journ. of the College of Sci. Imp. Univ., Tokyo, Japan, Volume III, Pt. 1.

Nageirpeis sp.

Taxodium sp.

The first four species are according to Kryshtofovich,[1] the rest are quoted by H. C. T'an.[2] Most of these species are typical in the Tetori Series of Japan, even though some of them are not found in the Fuhsing coal field. Since the Stratigraphic succession in the Pataohao coal field is the same as that in the Fuhsing coal field, which is only 60 li or 30 kilometers from the former, it is strongly believed that the coal series in both places are contemporaneous.

Here disharmony arises: Mr. H. C. Tan, who has good experience in Mesozoic stratigraphy of northern China, held the opinion that the Pataohao coal series is of Cretaceous age, and he went further to state that all the coal series immediately below the wide-spread tu-ffconglomerate are no older than the Cretaceous.[3] It must be remembered that the sole palaeontological evidence of such a correlation lies in a species of Pelecypoda, *Corbicula anderssoni* Grabau, and some species of gastropoda of the genus *Campeloma*, which, according to Dr. Grabau,[4] have similar but not identical forms in the Laramie Series of western North America. It is doubtful whether correlation based on similar forms from widely separated countries can have much scientific value. Furthermore, the occurrence of *Corbicula anderssoni* in the coal series itself is questionable, since we have found it in the rhyolite breccias which lie disconformably on the Fuhsing coal series. At any rate correlation by molluscan shells cannot, in this case at least, be relied upon. Here one must naturally raise the objection that plant fossils are in general more unreliable than animal fossils. This may be true in other instances but cannot be applied, to the present case, since we are dealing with floras, not with separate species, of adjacent countries. Who can deny the possibility, and indeed the probability, that species native to the forests of Angaraland migrated southward into northern China in Middle Jurassic times?

THE RED CONGLOMERATE.—This formation consists chiefly of red and green clay, shales with occasional thin conglomerates. In the upper part conglomerate predominates though red clay-shale is present at intervals. The pebbles of these conglomerates are entirely of gneiss and quartzite with variable diameters. Best exposures of the formation can be seen in the neighborhood of Yangkou and Wa-

1. Bull. Geol. Soc. of China, Vol. III, No. 2, pp. 105-108.
2. Bull. Geol. Surv. of China, No. 8, p. 23.
3. Bull. Geol. Soc. of China, Vol. VI, No. 1, pp. 53-59.
4. Bull. Geol. Surv. of China, No. 5, pt. 2, p. 183.

fang. It has the same strike as the coal series but the existence of a disconformity is possible. In the south-east it is interrupted by a fault so that its total thickness cannot be calculated. No fossils have been obtained from it since it occupies the same stratigraphic position as the well-known tuff-conglomerate, it may be roughly correlated with that formation. The point to be noted is that volcanic rocks seem to be rare in this case.

THE FOSSILIFEROUS PYROCLASTICS.—West of Tuhulu Brewery (Shao Kuo) there occurs a prominent circular hill surrounded by outcrops of the coal series which has a gentle dip toward the southeast. Near the top of this hill there is a bed of rhyolite breccia about 6 m. thick (see Fig. 3), above which is a fossiliferous bed, swarmed with *Corbicula anderssoni* Grabau and numerous gastropod shells. These fossils are poorly preserved but the occurrence of *Corbicula anderssoni* cannot be questioned. The interesting circumstance to be noted is that they are embedded in exactly the same rhyolite breccia as that from the underlying bed. No explanation for this is more natural than that they lived in rivers or lakes at a time when volcanic outbursts were violent in adjacent regions, and consequently volcanic fragments of all sizes were time after time hurled by explosions or washed by heavy showers of rain into the waters which were made home by these unfortunate creatures.

The age of the formations in which was found *Corbicula anderssoni*, was fixed by Dr. Grabau as probably Upper Cretaceous.[1] The objections to such an assumption have been stated in the foregoing paragraphs, we shall only mention here, that the fossiliferous bed of Tuhulu is undoubtedly higher in stratigraphic position than the coal series, and that possibly it rests on the latter with a slight unconformity. At any rate, it cannot be older than the red conglomerate formation, but it may be younger. Thus its Cretaceous age becomes apparant if not real.

Igneous Rocks

Igneous rocks play an important role in the coal field of Fuhsinhsien. The types already known are diabase, andesite, trachyte, and rhyolite breccia. We shall treat them briefly in the following descriptions.

DIABASE.—The rock is dark in color, weathering greyish brown or green. It is holocrystalline with crystals of rather coarse size. The predominent minerals are

1. Loc. cit.

plagioclase and pyroxene; the plagioclase mostly belongs to the labradorite variety with lath-shaped, hypidiomorphic crystals usually surrounded by large crystals of brownish augite, forming the so-called ophitic structure. The crystals of augite have a tendency to form phenocrysts but idiomorphic crystals are absent. Magnetite is the most abundant accessory.

Diabase occurs at Saitaoling and in the neighborhood of Paomawuchi. It is, no doubt, of intrusive origin.

Andesite.—The composition and texture of this rock are very variable. Some have a holocrystalline texture as those from Hamawuchi; others have a microlitic groundmass, while still others are vesicular, the vesicles being filled by white silica or greenish alteration products. In general the rock is strongly weathered so that it is hard to discriminate the mineral constituents. Roughly speaking, the feldspars are predominated by the lime-containing varieties, while augite and hornblende form the principal mafic minerals which are always in greenish particles. Black mica and magnetite are also important constituents. Olivine seems to be very rare, some variety of pyroxene probably therefore that mineral, for it is distinguished by the inclined extinction under crossed Nicols.

The distribution and stratigraphic relations of the andesite have been mentioned already.

Trachyte.—Occurs on the hills north-east of Paomawuchi. It is hard, dense and compact. The phenocrysts are white orthoclase needles and some reddish prismatic crystals. The last might be formed from the alteration of hornblende crystals. The groundmass is usually composed of microlitic crystals but sometimes appears glassy. Besides a little anorthite and quartz is not seen.

Rhyolite breccia.—White or greyish white in color more or less porous in texture. It consists of fragments, angular or slightly rounded, of various sizes. The size varies from that of an egg to fine dust. Under the microscope these fragments are found to be made up of groundmass and two kinds of phenocrysts orthoclase and quartz. Besides there are occasionally seen biotites sometimes of a rather fresh appearance, while decomposed biotite and magnetite are present but uncommon. Another fact worth noting is that some fragments are composed almost entirely of small feispar crystals in a more or less parallel arrangement—trachytic structure. The natural history of the rock here in question has been discussed.

Structural Geology

The sedimentary strata in the coal-field, including the coal series and the red conglomerate, have a general dip toward the south-east, the angle being very regular, usually about 25°. Only in the south of the district city at Michiawan and Changkata have we encountered strata with steep dips ranging from 35° to 40°. Generally speaking the sedimentary rocks underwent little folding, but folding on a smaller scale is not uncommon. North of the village Pachiatze, near the southern slope of the gneiss hill, the strata of the coal series are intensely folded as can be seen in some of the gullies (see Fig. 2).

Faults are numerous. The largest is the boundary fault of the coal field, which separates the coal series from the gneiss complex. It trends in the direction NE-SW. As can be seen from the map, it extends from the east of Chentaiying-tze to the south-west of Yanghsu, a distance of more than 60 li. It is without doubt that it is a normal or gravity fault, the actual contact being observed at various points along the fault line. The displacement of the fault cannot be calculated at present, all that can be said is that it is considerable and that it increases from the south-east toward the south-west.

Apart from the big fault, there are smaller ones. East of Changkata the red conglomerate ends abruptly into the gneiss, this being due to a fault which runs across the boundary fault. Another fault occurs near Hsingti. There the outcrops of the coal series generally dip south-eastward while the strata exposed along the River Hsiao take a W.S.W. dip, these beds being red and green shales and conglomerates of the lower part of the red conglomerate formation. The circumstance can best be explained by the existence of a fault. Again in the vicinity of Chentaiyingtze exposures of the basal conglomerate of the coal series can be seen to dip eastward. But 4 or 5 li further east gneiss comes into view. A fault is thus inferred. Now the structure of the gneiss hill (Pachiatzeshan) in the south-west of the district city is to be explained. Typical andesite exposures were found everywhere around this hill except the southern side where we find the basal part of the coal series instead. That the gneiss is allochthonous seems to be the most rational explanation, that is to say, it was transported from somewhere else, probably from the south-west, by a tangential movement resulting in overthrusts.

Coal Reserves

COAL SEAMS.—Coal seams of economic importance occur only near the upper part of the coal series. According to the columnar section (Fig. 4), revealed by diamond-boring at the Japanese coal-mine, the coal series contain three principal horizons of coal seams. The upper horizon consists of three seams with a total thickness of 3.4 meters. The middle horizon has also three seams with a total thickness of 8.6 meters, at present most of the output being from this horizon. The lower horizon has only two seams and is about 1.7 meters thick. The upper and the middle horizons are separated by some 60 meters of shales and sandstones while the middle and the lower horizons, by 24 meters of similar rocks, 12 li south-west of the Japanese mine is the village Michiawopu where, according to the Feng-tien Mining Bureau, only one seam about 4 meters thick has been worked. Twenty li further south-west is Sunchiawan. At this place two seams, the upper 3 meters the lower 3.4 meters, are being worked by native methods. Between the seams there is a parting of sandstone and shale about 2 meters in thickness, it sometimes thins out so that the two seams coalesce. Five li south-west of Sunchiawan is another coal-producing locality, Wulungkao, where the existence of a coal seam of 8 meters has been reported.

From the above it can be seen that the thickness of the workable coal seams already known varies from 4 to 8 meters. The seams at present worked in the different localities seem to belong to the same principal zone. South of Wulung-kao the seams rapidly decrease in thickness. At Tuhulu a seam of merely 1 meter in thickness was discovered. The coal from this seam contains much ash and has a very low heating value. Mining on large scale cannot be recommended at this place.

QUALITY OF THE COAL.—It was stated by Moller that the coal from the Fu-hsing coal field is of poor quality. Andersson was also of the opinion that the coal seams contain too many stony partings. These investigators did not do justice to the coal seams. According to our observations, partings appear to be rare while the coal from the native pits is largely in lumps sometimes of unusual size. The samples from the different localities have been analysed, the results being tabulated below:

Locality	Moisture	V. M.	F. C.	Ash	Color of Ash	Heating Value
Hsingchiou	9.60	28.32	52.08	10.00	light pink	6930
Michiawopu	3.64	30.32	52.54	13.50	brown	7045
Sunchiawan (1)	9.69	32.61	50.10	7.54	light yellow	6650
Sunchiawan (2)	9.96	31.64	55.27	3.13	silver grey	9385

It can be seen from the above table that the coal from Sunchiawan is the best. Next to it is the coal from Hsingchiou, while that from Michiawopu occupies the third place. If we attempt to classify them according to Dr. Wong's method,[1] the coal from Sunchiawan will be called high-grade lignitic bitumite (BC_2) and very high-grade, low-rank bitumite (Bl_1) respectively. The coal from Hsingchiou will receive the name medium-grade, low-rank bitumite (Bl_3), while low-grade, low-rank—bitumite (Bl_4) may be assigned to the coal from Michiawopu. The samples from the last two localities were taken from coal heaps exposed for months. If they were taken *in situ* better results might be obtained.

Analysis for the coal of Hsing Chiou, according to some Japanese records, is as follows :

Moisture	Volatile Matter	F. C.	Ash	Heating Value
12,00	35,00	42,50	10,00	6090

The name will be medium-grade lignitic bitumite (BC_3).

On the whole the coals from the Fuhsing coal field are similar to those from Fushun and Hsian in Fengtien Province. Examples of these coals are given in the following table for comparison :

Locality	Moisture	Volatile Matter	F. C.	Ash	Heating Value	Source of Analysis.
Fushun	6.37	39.34	48.15	5,25	6780	Japanese
Hsian	4.42	39.28	47.69	8.61	6468	Fengtien Arsenal.

According to these analyses, the Fushun coal is to be called high-gradeignitic bitumite (BC_2), this being the same as some of the coals from Sunchiawan. The Hsian coal is medium-grade lignitic bitumite (BC_3) and is comparable with coals from Hsingchiou.

QUANTITY OF THE COAL.—Though the area of the coal field is very extensive, yet the important coal seams are confined to a belt of about 40 li from Chingwatze to Hanchiatien. Beyond these localities the coal seams thin out rapidly and become poor in quality so that they may be excluded from calculation. For convenience we divide the coal-field into three parts according to the change in thickness of the seams. If 600 meters be assumed as the maximum depth of mining, the coal reserves will be as follow :

(1) Between Chingchiawatze and Laochünmiao, the dip of the seams is 15°

1. Bull. Geol. Sur. of China, No. 8, p. 33.

while the thickness is 6 meters, all taking the average. The length is approximately 5,000 meters. The reserve will be 90,000,000 metric tons.

(2) Between Laochünmiao and Kuochiawan, the average dip is 20°, the thickness being taking as 4 meters. The seams have a probable extension of [illegible] meters. The reserve is calculated as 26,367,000 metric tons.

(3) Between Kuochiawan and Hanchiatien, the extension of the seams is assumed 10,000 meters, with a mean thickness of [illegible] meters and a mean dip of 20°. The reserve amounts to 130,812,000 metric tons.

The total reserve of the three areas amounts to [illegible] metric tons, or roughly 260,000,000 metric tons. Since all the indicated coal seams in the coal field are included in the calculation, this can be taken as the total reserve of the whole coal-field.

For descriptions on the mining industry the reader is referred to the Chinese text.

熱河阜新縣煤田地質圖

A GEOLOGICAL MAP OF THE COAL FIELD OF FU-HSING-HSIEN, JEHOL.

測清滅黃東竹王
Surveyed by C. C. Wang & T. K. Huang

民國十七年十一月
November 1928

一之分萬十尺例比
Scale 1:100,000

尺公十三距線高等
Contor Interval 30m.

Red Conglomerate

Lower Cretaceous

Coal Series

Middle Jurassic

Archaeozoic & Proterozoic

Gneiss

Faults

Rhyolite Breccia

Trachyte

Andesite

Diabase

A PRELIMINARY REPORT ON THE GEOLOGY OF THE HSIAO SHIH[1] COAL FIELD, PEN CHI HSIEN FENGTIEN PROVINCE.

By T. K. Huang

With 1 Plate

Introduction

In October, 1928 Mr. C. C. Wang and I took instructions from Director Wong to investigate some coal fields in Fengtien and Jehol. Arriving in Mukden, after a conference with the local authorities, we decided that, for the saving of valuable time, Mr. Wang was to go to Kirin alone while I took the task to make a topographic survey of the Hsiaoshih coal field in Penchihsien. On the fourth day of my arrival at the latter place I was suddenly recalled to go back to Mukden, so that I had little opportunity to thoroughly investigate the geology, both theoretical and economic. The following is only a brief report of a preliminary nature; I do not pretend that it is free from possible errors.

The Hsiaoshih coal field has first been visited by von Richthofen during his extensive and epoch-making explorations in our country. Later the Geological Institute of the S. Manchuria Railway Co. has sent scientists to investigate the coal field and its neighboring mineral-producing regions. Their report[2] tells little about the geological aspects though the nature of the coal resources has been adquately accounted for. Since I have not obtained reliable data on the latter it is pertinent to devote more space on the former.

Position and Communication

The coal field is situated in the eastern mountainous region of the Penchi district. In its center is the large village Hsiaoshih, which is 80 li east of Penchihsien. It costs one day and a half for pack-animals to go from Hsiaoshih to Penchihsien, for the road is of the worst nature and runs across precipitous ranges.

1. As has been rightly stated by Richthofen, the correct spelling is not Hsiaoshih but Hsiausörr, which is exactly the local pronunciation.
2. Fenghuangcheng, Explan. Text to the Geol. Map of Manchuria. Geol. Inst., S. Man. Rail. Co., Dairen.

Canoes can be seen on the Taitzeho which flows through the coal field but the water is shallow and the current is rapid so that only rafts can be used during the winter months.

Topography

Lofty mountains and rocky cliffs are the predominent topographic features in the south-eastern part of the Penchi district. To this the Hsiaoshih coal field is no exception. But, since the strata of the coal series are generally composed of soft material, and thus suffer rapid denudation flat countries are not wanting. Roughly speaking the coal field is surrounded by high limestone mountains amongst which is a stretch of alluvial plain. Through this plain meanders the Taitzeho from east to west while a tributary, the T'angho, comes from the southern mountains and opens into the main river north of Laomukuo. The physiographic features are most striking. The meanders of Taitzeho frequently assume the shape of an oxbow, at the convex side of which rise typical limestone cliffs but at the concave side there is usually a new-moon shaped belt of flood plain. The cliffs are high and rocky but gorges are absent; the river has a swift current and a clear water but cataracts or rapids are unseen. The physiographic stage has gone beyond early youth but has not reached maturity, it is most probably in the late youth.

Stratigraphy

It was described by Richthofen[1] that the strata exposed near Hsiaoshih (Hsiaosorr) consist of coal series lying upon Ordovician (Untersilur) limestone, which are succeeded downward by wurmkalk and globulitic limestones. So far as my observations go his statement is right, only that the globulitic (oolitic) limestones seem to be very rare. The coal series is predominated by grey shales in the lower part, but in the upper part grey or greyish yellow sandstones become more common. Conglomerate is rare. Thin limestones occur in the lower part not infrequently. There is always a bed of red shale about 20 meters thick, appearing near the contact with Ordovician limestone. The total thickness of the coal series is less than 200 meters. It may be correlated with the coal series of Penchihu, the lower part being the Penchi Series and the upper, the Shansi Series. Rocks younger than the Shansi Series are completely eroded.

1. 'China' Vol, II, p. 98.

Structural Geology

Generally speaking the coal series near Hsiaoshih form a basin, cut by numerous faults. The basin is longer in a E-W direction which is the direction of the fault-lines. Surrounding this basin are limestones all dipping inward with a dip of from 30° to 70°. The rocks of the coal series lie disconformably on these limestones, so they assume the same strike and dip as the latter. For convenience in description we divide the coal-basin into two parts. The western part lies in the west of the alluvial plain; it is a uniformly eastward-pitching syncline with an axis trending E.W. The limbs are marked by two hill ranges formed by the resistant sandstones in the upper part of the coal series. The eastern part of the basin lies in the east of the alluvial plain, and is bordered by a prominent limestone range. It is also in the form of a syncline but has been distorted by faulting. The two parts are undoubtedly connected below the alluvium covering which is 50 meters deep at most.

Faults are numerous in the coal-field, but in general they have only a small displacement and moderate length, while their strike is in an approximately E.W. direction. Only the important ones will be mentioned here. Along a ravine south of the western syncline there occurs a fault of considerable displacement, which separates the coal series from the Ordovician limestone. The former dips north at 30° and forms the range north of the ravine, while the latter dips south at 30°–40° and forms another range south of the ravine. Limestone outcrops also found on the slope of the northern range but they have the same dip as the coal series, proving that they are part of the downthrow. North-east of Hsiehchiaweitze along the left side of the Taitzeho, Ordovician limestones form vertical cliffs with a dip toward south by east. If there be no change of structure the rocks forming the hills west of the river-ox-bow will still be limestones, but instead of such one finds yellow shales. The existence of a fault is to be inferred. Again in that stretch of rolling country east of the village Shangshanchengchai red shales, typical in the basal part of the coal series, can be clearly observed, so that at least part of the coal series is exposed here, its relation with that of Mapingkou being best explained by a fault following approximately the course of the Taitzeho. Finally south of Mapingkou, the coal series ends abruptly into a limestone hill-spur, a small fault is thought to be the cause.

The nature of the faults can hardly be determined in the coal field itself. Before my arrival at Hsiaoshih I have found an extensive thrust fault along the route from Penchihsien to Hsiaoshih. The fault trends from west to east for an

observed length of 30 li. At a certain place it was positively determined that Sinian quartzite had been thrusted from the south against Cambrian strata. Since the strike of the faults in the coal field is also E.W., they are probably thrust faults too.

Economic Geology

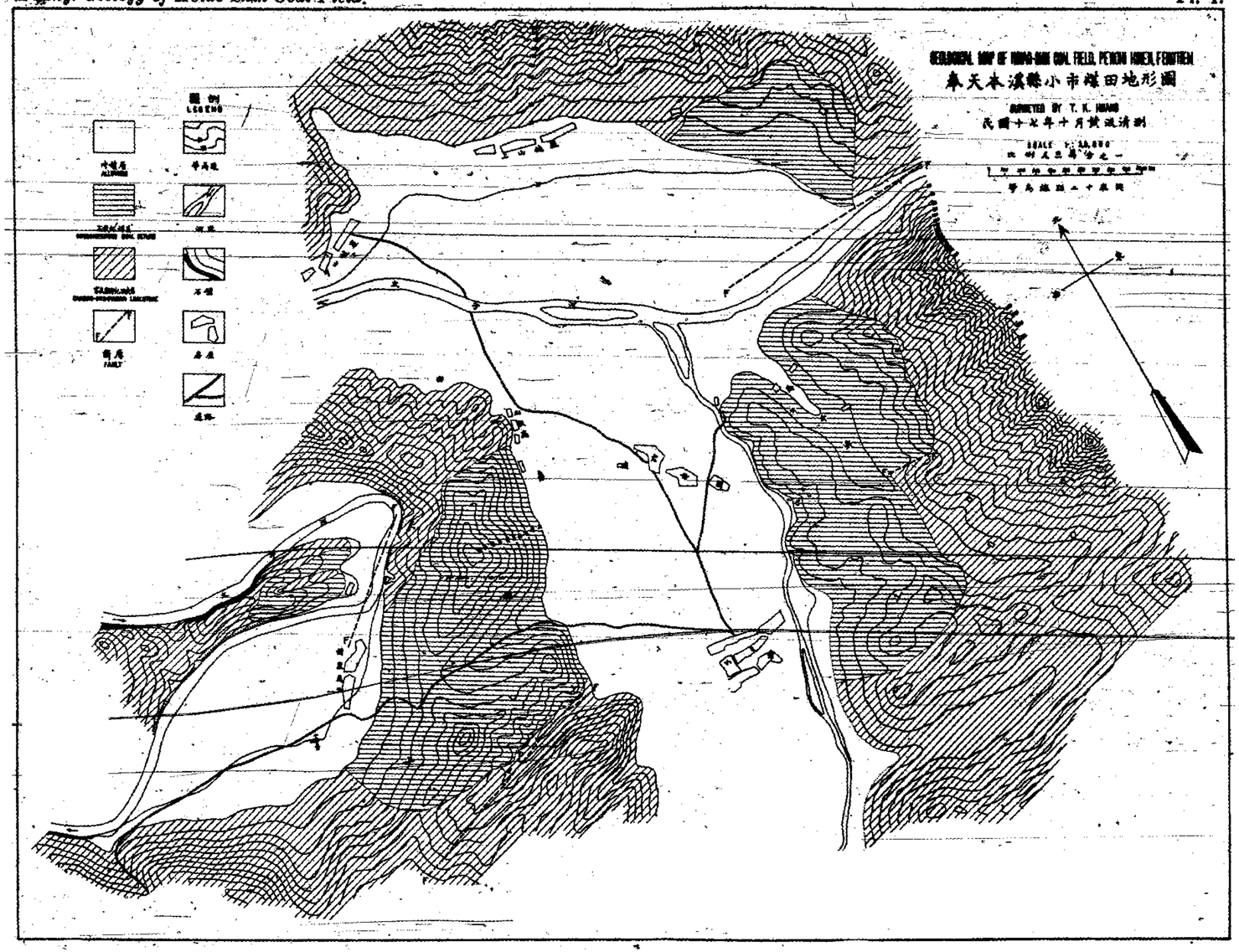
COAL SEAMS.—At the time of my investigation no actual mining of coal could be seen, only abandoned native pits with dumps of black shale are scattered here and there on the hill slopes. It was therefore impossible for me to examine the characters of the coal seams. According to the verbal statement of the native miners there are several coal seams of from 1 to 3 Chinese feet in thickness. The Geological Institute of Dairen also reports the thickness of coal seams as from 0.3 to 1 meter. The seams are confined to the middle part of the coal series below the thick sandstone.

QUALITY OF COAL.—The coal generally belong to the anthracite variety of a poor quality. They contain a large percentage of ash and are obtained usually in the form of small prices, termed "Cha-tze" by the villagers. Occasionally they appear in lumps much prized in this region.

THE COAL RESERVES.—Since the thickness of the coal seams is not definitely known it is difficult to calculate the coal reserve. To be optimistic, we may assume 1 meter as the thickness of the workable seams, while the length and the width of the coal field are taken as 3 and 1.5 kilometers respectively. The average dip of the seams is assumed 30°, the specific gravity of coal being probably 1.5. Thus we get a maximum reserve of 7,000,000 metric tons. Since the seams are very rarely 1 meter in thickness and since the middle part of the coal field has been eroded and is covered with alluvium, the actual reserve is probably less than one half of this amount. Fifteen li north-east of Hsiaoshih there is another coal-producing locality, Ch'uanshuihotze, but time did not permit me to make investigations there.

Summing up we may state that the coal of the Hsiaoshih coal field is poor in quality and trifling in quantity. There can be no gain to apply modern method of mining.

Besides coal, iron ore, probably hematite, has been found in the red shale near the contact between the coal series and the Ordovician limestone. Formerly the ore has been smelted by native methods but with no success. It seems that it is insignificant both qualitatively and quantitatively.


GEOLOGICAL MAP OF HSIAO-SHIH COAL FIELD, PEIKOU HSIEN, FENGTIEN
奉天本溪縣小市煤田地形圖
SURVEYED BY T. K. HWANG
民國十七年十月黃汲清測
SCALE 1:50,000
LEGEND
圖例

GEOLOGY OF SOME COAL FIELDS IN LIAONING (FENGTIEN) AND KIRIN PROVINCES

By C. C. Wang

WITH 5 PLATES AND 8 FIGURES

The coal fields visited by the author in May-June 1928 are three in number. They are here briefly summarized, all the details are referred to the Chinese text.

I. Tienshihfukou Coal Field, Penchi District, Liaoning Province

Tienshihfukou is a tributary of Taitzuho river running westward to Liaoho river. The coal field is at 120 li S.E. from Penchihu station on the Mukden-Antung Railway.

There may be distinguished three principal formations:-

1. Cambro-Ordovician limestone.—Usually forming high and rugged hills. Thickness about 1000 m.

2. Permo-Carboniferous coal series.—This series contains ten coal seams of which the 2nd and 9th seams respectively 6 and 4 feet thick are the best. At Kungchiapotzu the following plant fossils were found:

Neuropteris sp.
Callipteridium trigonum Franke
Pecopteris (*Asterotheca*) *hemitelioides* Brongn.
Sphenophyllum verticillatum Schloth.

The coal series is overlaid by a mill stone grit.

3. Jurassic coal series.—This series was formerly mistaken by Japanese previous writers[1] as Carboniferous. The Jurassic age is now well established by structure and fossils. The difficulty of distinction lies in the fact that the Jurassic is every where in this field in fault contact with the Carboniferous, so that it is not possible to observe their normal succession. And some times the Jurassic formation is in direct succession over the Cambro-Ordovician limestone.

Three parts may be distinguished. The lower part consists of a 100 feet thick coarse conglomerate often forming cliffs. The middle part contains sandstone shale and coal seams, 200 feet thick. The rocks are transformed into quartzite and slate near the granite contact. At Leipileitzu, east of Weichiapao-tzu, I found :

Cladophlebis nebbaensis
Palyssia Mandschurica
Gschanoskia rigida Heer

and on the S.E. of Tapao

Coniopteris hymenophylloides Brongn.
Equisetum sp.

The upper part of the Jurassic series again consists of a conglomerate similar to the lower part but at its basal part there is often a thin bedded sandstone frequently showing prints of fossil plants. The upper sandstone is often much indurated by metamorphism to form hard quartzite covering top of the hills as Sankuo-ling, Leipileitzu.

The Jurassic series contains, according to the prospecting work at S.E. of Tapu, 10 coal seams all above 2 feet thick. From the 1st to the 6th the seams are good anthracite best suitable for house heating. The seams from the 7th to the 10th are semi-anthracite used for local iron smelting. The 2nd and 3rd seams are the thickest respectively 5 feet and 4 feet thick.

The field is much broken by a number of normal faults as shown in the geological map. The Jurassic coal bearing series however forms a flat syncline in about E.W. direction with the synclinal axis lying between Tapao and Weichiapao-tzu marked by the ridge of the upper conglomerate (see Pl. IV, section BB).

The coal reserves of Carboniferous and Jurassic ages are respectively calcuted to be 5,000,000 tons (bituminous) and 43,000,000 tons (anthracite and semi-anthracite).

Only one mining company is operating with an annual production of 6,000 to 7,000 tons.

II. Hsian Coal Field, Liaoning Province

This coal field lies at a short distance from the North gate of the district city of Hsian on the northwest of Hailung. The coal field is now connected by at deranct line of a foot 100 li to the Fenghai (Fentien or Mukden to Hailung) Railway. The latter rail line is to be prolonged northward to reach Kirin.

The geological formations are :

ARCHEAN GNEISS.—Extending on the south-west of the coal field.

TRACHY-ANDESITE.—A gray compact rock, sometimes amygdaloid, showing trachytic texture under the microscope. The andesitic rock constitute low hills forming the south east and north border of the coal field.

BASALT.—This is a black and compact rock which occurs at Taheishan on the NW. corner of the coal field.

Both andesite and basalt are erupted before the deposition of the Mesozoic sediments. There are ample evidences that the Mesozoic coal series overlies these volcanic rocks. If the overlying coal series is considered Cretaceous as will be discussed in the following, these volcanics lavas are probably post-Jurassic and pre-Cretaceous in age. The author therefore does not believed the intrusive origin of the rocks as were pretended by Japanese geologists.[1]

MESOZOIC COAL SERIES.—The coal bearing series of Hsian field is unconformably overlying the above mentioned three formations and probably separated from the gnessic mass on the west by a fault. This series has a thickness of over 200 meters, but the exposure is not complete. As far as is known by the boring of the Hsian Mining company, there are three workable coal seams. The following table shows the thickness of the seams according to the different borings :

Boring	Seam 1	Seam 2	Seam 3
No. 1	1.5	3.5	5 meters
No. 2	0.5	3.5	1.2
No. 3	0.5	3.5	7.5
No. 4	Only one seam.		

The coal seams are therefore vary variable in thickness. The seams are similar in composition and contain about 10% moisture, 34% volatile matter, 52% fix. carbon and only 4% ash. This should be called "lignitic bitumite" or B C according to Dr. Wong's Classification.[2] This class of coal is characteristic of the coal series specially developed in the North-Eastern Provinces and were believed to be of Lower Cretaceous. The age determinination was so far based upon fossil insects, and pelecypoda[3] mostly in comparation with Shantung and Szechuan fossils. Stratigraphically it is clear that there is in the north eastern provinces

1. China Mining Journal No. 40 & 67.
2. W. H. Wong, Classification of Chinese coals. Bull. Geol. Surv. China. No. 8.
3. A. W. Grabau, Cretaceous fossils from Shantung, Cretaceous mollusca from North China. Bull. Geol. Surv. China, No. 5, part 2.

including Jehol an important series distinct from and younger than the usually called Jurassic coal series. The latter has its type in the Peipiao coal series in Eastern Jehol and the Tienshihfukou coal series in Liaoning for instance. Whether the younger Mesozoic coal series is Upper Jurassic or Lower Cretaceous is of course a question to be more definitely decided by palaeontology, and it is possible that some conflict of conclusion may exist between the few animal fossils and the plants fossils which have not yet been well systematically studied. A number of plant fossils of this younger series in Hsian have been collected and provisionally identified as follows:

Podozamites lanceolatus Lindl. et Hutt.
Ginkgo sp.
Coniopteris sp.
Divonites sp.
Pinus nordenskjoldi Heer
Baiera gracilis Bunt.
Ginkgo ledida Heer

The strike and dip of the strata are very variable at different places, and the structure is some times very complicated. Broadly speaking, the Mesozoic coal series forms a syncling with its axis striking NW-SE, but the syncline is cut by an important fault on the SW. The study of the detailed structure is rendered very difficult owing to the extensive covering of soil and alluvium. The topographical part of the geological map of the Hsian-field as appended to the report was taken from the mining map of the Hsian Mining Company which is a detailed one with countour invertal of 5 meters only. The relief is in reality very gentle and even the hills are covered by the soil up to the top.

The total reserve of this coal field is estimated at 50,000,000 tons. The Hsian Mining Company is a semi-government enterprise and has at the time of the visit a daily production of 300 tons making about 90,000 tons a year. The coal is chiefly used by the Fenghai Railway, the arsenal, spinning mill and electrical plants in Mukden.

The coal has, according to the analysis made in the Survey's laboratory, the following composition: moisture 7.68; Vol. mat. 28.68; Fix. carb. 47.73; Ash 15.91. This corresponds to Bl_4 or low carbon bitumite according to Dr. Wong's coal classification.

While the Palaeozoic slate and quartzite are much disturbed, the late Mesozoic coal series is clearly unconformable with them and shows only broad and gentle

folding. Broad speaking the coal series forms a flat syncline striking NNE-SSW. The NW limb of the syncline lies at Chiushan, Tatun, Louchuankou, Sanchiakou etc. while its SE limb passes by Wulintun, Neitzushan, Tangchiaweitzu and Shantung. At Sanchiakou, however, the coal series has been observed to be in fault contact with the old slate and quartzite. It is probable therefore that the NW limb of the syncline has been cut by an important fault taking away part of the coal bearing strata.

The distrophic history may be summarized as follows: At first period probably at the end of the Jurassic (if the upper coal series is considered as Cretaceous) there took place a strong orogenic movement accompanied by granitic intrusion. This was followed by the quiet period during which the coal series of Hsian and Chiaobo was deposited. Then intervened again the second period of folding and faulting which has affected the Cretaceous coal serious. The exact age of the period is still unknown. It may not be impossible that is as late as mid-Tertiary.

The Chiaobo coal field is not worked until recently. Although several concessions have been already taken since it became known that the Kirin-Tunhua railway shall pass by, but very little work has been done in the way of prospecting and exploitation except perhaps the Neitzushan mining company which has opened three tunnels each deep 350-360 feet producing every day about 30 tons. The total reserve is estimated at 350,000,000 tons on the basic of the average thickness of 2 meters of coal seams.

III. Chiaohochen Coal Field, Ngemu District, Kirin Province

This coal field is situted close to the Huifaho an affluent to the Sunghuakiang or Sungari River. The newly built Kitun (Kirin-Tunghua) Railway directly passes across the field which is by far the most important coal field, in this railway zone. There is much talking about the prolongation of the Kitun Railway to the Korean frontier to be connect with the Korean sea port.

The principal geological formations are:

LATE PALÆOZOIC SLATE AND QUARTZITE.—These much metamorphozed rocks occur on the border of the coal field often strongly folded with steep dips. The outcrops are chiefly found along the area of Mitzushan and Wulintun on the east and Sanchiakou on the West. The age is unknown. It is tentatively correlated with the Permo-Carboniferous age because the black slate sometimes contains graphite as on the east of Wulintun, which is probably due to the metamorphism of coal.

MESOZOIC GRANITE.—This is as a rule a medium grained granite poor in black minerals. It occurs almost all sides around the coal field. The rock seems to be poorer in quartz where it is near the coal series and rich in silica at a greater distance from the coal series. Microcline is often present quartz often shows variable and rolling extinction. Such seems to be the result of strong pressure which have been existed upon the granite. The granite mase may be separated by the coal series by slate and quartzite as is the case near Nantatun and Sanchiakou. But it may be in direct contact with it as can be observed near Chinchan, Tangchiaweitzu, Shansung etc. The coal series as will be described in the following, is believed to be Lower Cretaceous (with the same reason as has been made with the Hsian coal series). The granite is probably older than the coal series as the latter is not metamorphozed and the granite forms all round the border of the coal basin but does penetrates into it. On the other hand it seems that the granite intrusion can not be very old as the Palaeozoic rocks are metamorphosed. It is probable that the intrusion is post Jurassic and in relation with the post Jurassic by pre-Cretaceous volcanic activity as witnessed by trachy andesite in Hsian. The Jurassic coal series of Tienshihfukou is also intruded by granitic rock.

The granite here is much more extensive. It extends over the entire region from N.W. of Chiaohochen to the vicinity of Kirin, a distance of over 240 li. The well known range Laoyehling, across which the Kirin-Tunhua railway has to cut a very difficult tannel, is also constituted by this granite.

LATE MESOZOIC COAL SERIES.—This series may be subdivided into two parts: a lower part consisting of conglomeratic arkosic sandstone as is found at Chiushantatun and Neitzushan occurs at Tengchinmitzu, Shansung etc. The coal bearing part immediately overlies this basal conglomerate. The upper part, as is observed at Kouching and Sanchiakou etc., consists at the base of pale gray sandstone with occassional conglomeratic bed (also containing granite and other igneous rocks) above this comes an alternation of thin bedded black shale and sandstone. The total thickness of the whole series is difficult to determine owing to the extensive covering of the soil. A rough estimate would be 400-500 meters. From Neitzushan, the following fossil plants have been obtained:

Pinus pardeanbieldi Hr.
Podozamites lanceolatus Hr.
Baiera gracilis Bunb.
Adiantites sp.

The first two species are the most commonly found in the Chiaoho coal field, which is also the fact in the Hsian coal field. The two coal fields are there of the same age and what has been said about the Hsian coal series may well be applied here and needs no repetetion.

According to the observations made in the outcrops and in the mining works, there are six coal seams at Neitzushan the thickest of which attains 9 feet, the total thickness of all seams is 21 feet. The coal seams are reduced to 2 only at Tungchiaweitzu respectively 1.5 and 6 feet thick.

IV. Physiography of the Region traversed by the South Manchuria, Mukden-Antung, Mukden-Hailung, Kirin-Changchun and Kirin-Tunhua Railways

1. From Mukden to Tienshihfukou.—The route goes from a flat plain richly covered by cultivated field, into a mature hilly region. The hills attain conspicuous height near Penchihu which the railways has to pass by several tunnels but there still the valleys are widely opened and slopes gentle. From Penchihu to Tienshihfukou the journey was made on mule across the Taitzuho river and continued further SE-ward over 120 li, crossing several ranges of moderate height and gentle slope. As is shown by the geclogical map of Tienshihfukou the erosion is already very advanced resulting in rolling hills extensively cultivated. Only the most resisting rock as the upper conglomerate of the lower Jurassic coal series leaves a few abrupt cliffs such as Leipitzu 50 meters high.

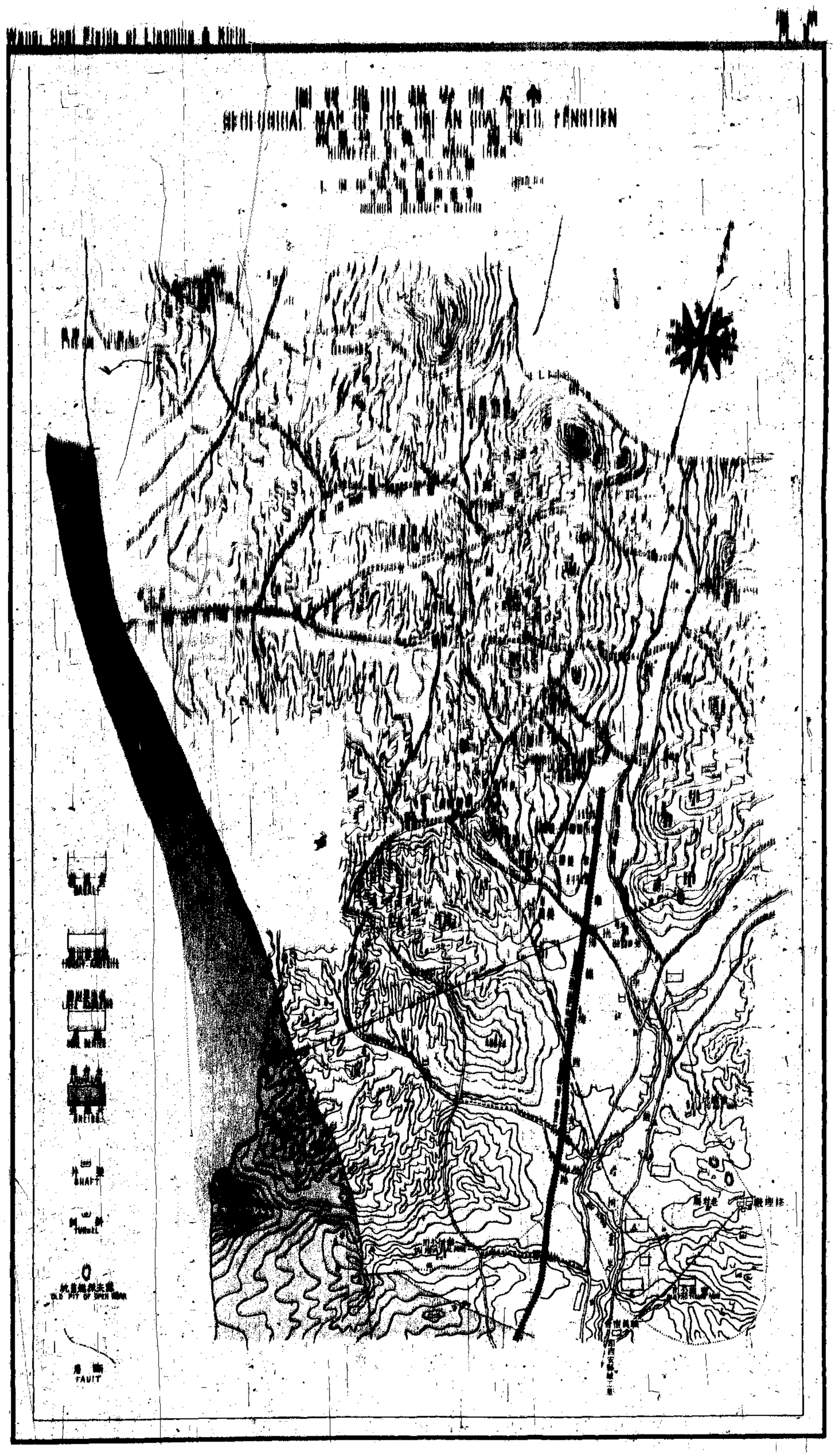
2. From Mukden to Hsian and from Hsian to Kaiyuan.—The Mukden-Hailung Railway runs on a gently hilly region. The Hanho valley is still broader than the valley of Taiyuho. All the tributaries also have wide valleys. From Hailung northward to Tungfeng the topography is very gentle. In the Hsian coal field all the ridges are only a few tens of meters high above the wide valley bottom. From Hsian westward to Hsifeng a distance of 90 li the route crosses a small ridge which can be easily passed by cars Hsifeng is now connected by a light railway with Kaiyuan a station on the South Manchuria Railway. Looking back eastward the topography is characterized by gently rolling hills like waves on a sea.

3. From Kaiyuan through Changchun to Kirin and from Kirin to Chiaoho.—From Kaiyuan to Changchun the railways runs on a rolling plain. On the Changchun-Kirin Railways one can see isolated hills separated by broad plains,

From Kirin to Chiaoho, Laoyehling is the most conspicuous ridge across which a long tunnel was cut for the railway. But even in the Chiaoho region the advancedly mature topography prevails. The granitic hills around the coal basin range from 200 to 400 meters in height above the Lafaho river valley. Within the coal basin, low hills only 30-40 meters high are scattered in broad and flat plain still more levelled than in the Hsian basin.

From the above descriptions, four topographic types may be recognized; (1) A rolling plain between Mukden and Changchun; (2) Low and gentle hills as in Tung-feng, Hsian, Chiaoho etc.; (3) Scattered isolated hills and ridges as between Kirin, Changchun and between Mukden and Penchihu and (4) More rugged and mountainous region as between Penchihu and Tienshihfukou, and the Laoyehling range.

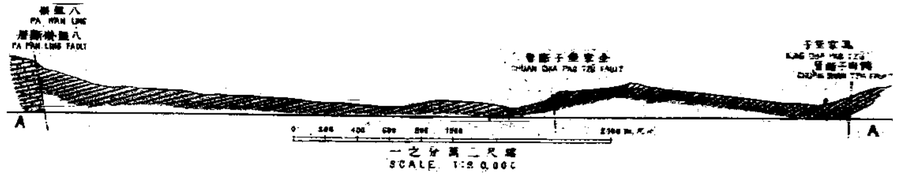
The second type is usually constituted by the easily eroded rock formation. The third type is often found between regions of the first and fourth types. The second type may be also intermediatly between the latter two. Even in the regions of the fouth type, the erosion is already so advanced as to well compare with the Tanghsien stage established by B. Willis in the submature region between the Hopei (Chihli) and Shansi. The plain of the first type is all covered by soil and alluvium, under the cover there is most probably the mature topography as observable in the more hilly region on the east. The relation between these topographically different regions may be found in the gradual sinking of the Liao-ho valley on the west in comparison with the region east of Mukden-Changchun railway so that the advanced mature topography is gradually buried in the sinking region. In other words the author's observation leads to the conclusion, that the relative relief between the Liaoho plain on the west and the eastern Manchuria hills on the west is due to the sinking of the former rather than to the uplift of latter. The absence of the any new down cutting is a conspicuous feature of all the region traversed. An exception should be made however with the region between Kaiyuan and Changchun where small gullies have been recently opened on the plain indicating a recent uplift of this region. This is probably a local counter-movement of the gradual sinking of the Liao plain.


SHAFT
TUNNEL
FAULT

圖質地田煤鎮河蛟縣穆額林吉
GEOLOGICAL MAP OF THE CHIAO HO CHÊN COAL FIELD, Ê MU HSIEN, KIRIN

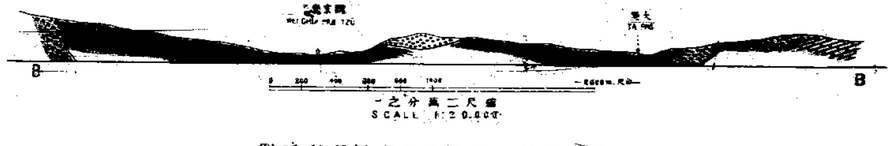

奉天本溪田師付溝煤田地質圖
GEOLOGICAL MAP OF THE TIEN SHIH FU KOU COAL FIELD, PEN CHI HSIEN, FÊNGTIEN.
民國十七年春王竹泉測
SURVEYED BY C. C. WANG, 1928.
縮尺四萬分之一
SCALE 1:40,000
等高距二十公尺
CONTOUR INTERVAL 20 METERS
石炭二疊紀
石灰岩
LIMESTONE
下煤系
LOWER COAL SERIES
下侏羅紀
下部礫岩
LOWER CONGLOMERATE
中部頁岩與砂岩
MIDDLE SHALE & SANDSTONE
上部礫岩
UPPER CONGLOMERATE
上煤系
UPPER COAL SERIES
花崗岩
GRANITE
基性侵入岩
BASIC INTRUSIVE ROCK

孔家堡子與八盤嶺間地質剖面圖
A A. SECTION BETWEEN KUNG CHIA PAO TZU AND PA PAN LING



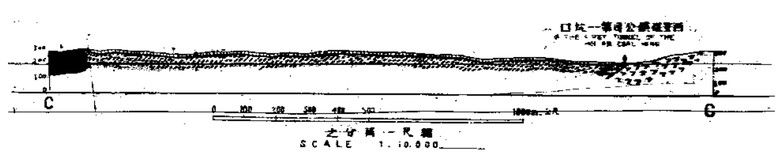
一之分萬二尺縮
SCALE 1:50,000

大堡與魏家堡子一帶地質剖面圖
B B. SECTION THROUGH TA PAO AND WEI CHIA PAO TZU



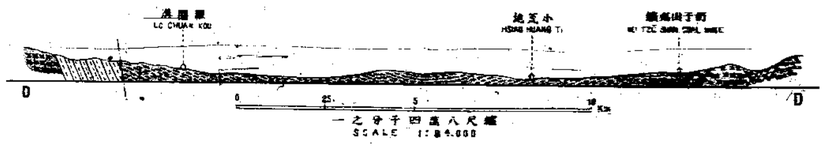
一之分萬二尺縮
SCALL 1:20,000

西安煤礦公司採區南部地質剖面圖
C C. SECTION S. OF THE HSI AN COAL MINE

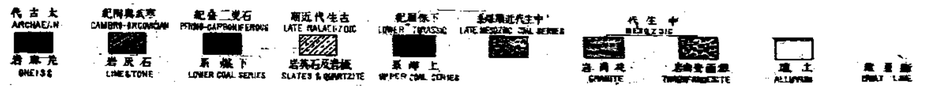


之分萬一尺縮
SCALE 1:10,000

圖面剖質地間溝圈罩與山子奶南鎮河蛟
D D. SECTION BETWEEN NEI TZU SHAN AND LO CHUAN KOU, S. OF CHAO NAI CHEN



一之分千四萬八尺縮
SCALE 1:148,000



圖形柱井鑽司公礦煤安西
COLUMNAR SECTIONS SHOWING THE STRATIGRAPHIC SUCCESSION IN THE BORING HOLES OF HSI AN COAL MINE.

井鑽號四第
BORING HOLE NO. 4.

中生代煤系 MESOZOIC COAL SERIES	8-56	CLAY	土 質
	1-88	YELLOW COARSE SANDSTONE	黃砂質粗岩
	1-01	YELLOWISH CLAY	土質黃色
	9-40	COAL SEAM	層 煤
	5-97	YELLOW SANDSTONE	岩砂色黃
	6-50	WHITE GRAY ARGILLACEOUS SANDSTONE	岩砂質土色白灰
	0-34	DARK SHALE	岩質色黑
	9-44	GRAY SANDY SHALE	岩質質砂色灰
	0-15	WHITE SANDSTONE	岩砂色白
	1-88	BLACK SANDY SHALE	岩質質砂色黑

井鑽號二第
BORING HOLE NO. 5

第四紀 QUATERNARY	5-10	SOIL	壤 土
不整合 UNCONFORMITY	10-28	GRAY CLAY	土質色灰
中生代煤系 MESOZOIC COAL SERIES	0-66	BLACK ARGILLACEOUS SANDSTONE	岩砂質土色黑
	12-17	COAL SEAM	層 煤
	1-88	GRAY SHALE	岩質色灰
	0-55	COAL SEAM	層 煤
	0-14	WHITE GRAY SANDSTONE	岩砂色灰白
	2-81	GRAY SHALE	岩質色灰
第三紀 LATE MESOZOIC	9-44	WHITE GRAY SANDSTONE	岩砂色灰白
	4-12	GRAY SANDY SHALE	岩質質砂色灰
	5-85	WHITE SANDSTONE	岩砂色白
	1-61	BLACK SHALES	岩質色黑
	1-64	WHITE SANDSTONE	岩砂色白
	1-19	GRAY SHALE	岩質色灰
	0-31	COAL SEAM	層 煤
	4-5	GRAY ARGILLACEOUS SANDSTONE	岩砂質土色灰
不整合 UNCONFORMITY			
侏羅紀 JURASSIC		TRACHY - ANDESITE	岩山安質粗

井鑽號五第
BORING HOLE NO. 5.

第四紀 QUATERNARY	5-00	SOIL	壤 土
不整合 UNCONFORMITY	4-10	CLAY	土 質
中生代煤系 MESOZOIC COAL SERIES	5-80	YELLOW COARSE SANDSTONE	岩砂質色黃
	7-70	COAL SEAM	層 煤
	2-70	GRAY SHALE	岩質色灰
	14-75	YELLOWISH ARGILLACEOUS SANDSTONE	岩砂質土色黃
	0-33	YELLOWISH SHALE	岩質色質黃
	4-48		
	1-80	GRAY SANDY SHALE	岩質質砂色灰
第三紀 LATE MESOZOIC	16-01	GRAY ARGILLACEOUS SANDSTONE	岩砂質土色灰
	2-88	GRAY SANDY SHALE	岩質質砂色灰
	3-39	GRAY SANDSTONE	岩砂色灰
	0-80	COAL SEAM	層 煤
	4-88	BLACK SANDY SHALE	岩質質砂色黑
不整合 UNCONFORMITY			
侏羅紀 JURASSIC		TRACHY - ANDESITE	岩砂安質粗

井鑽號一第
BORING HOLE NO. 1.

第四紀 QUATERNARY	0-85	SOIL	壤 土
不整合 UNCONFORMITY	1-30	WHITE YELLOWISH COARSE SANDSTONE	岩砂粒粗色質白
中生代煤系 MESOZOIC COAL SERIES	16-65	BLACK SHALES INTERBEDDED WITH THIN SANDSTONE	質質岩質色黑 間細岩砂層
	5-54	COAL SEAM	層 煤
	0-81	WHITE GRAY SANDSTONE	岩砂色灰白
	2-61	COAL SEAM	層 煤
	0-17	GRAY SANDSTONE	岩砂色灰
	2-05	GRAY SHALE	岩質色灰
第三紀 LATE MESOZOIC	6-56	WHITE-GRAY SANDSTONE	岩砂色灰白
	0-21	BLACKISH SHALE	岩質色黑
	1-76	GRAY SANDSTONE	岩砂色灰
	1-66	COAL SEAM	層 煤
	1-18	WHITE GRAY SANDSTONE	岩砂色灰白
不整合 UNCONFORMITY			
侏羅紀 JURASSIC		TRACHY - ANDESITE	岩山安質粗

THE GEOLOGY AND MINERAL RESOURCES OF MI SHAN AND MULENG DISTRICTS, KIRIN*

By H. S. Wang

With 2 Plates and 2 Figures (in the Chinese Text)

Introduction

The Muleng-Mishan coal fields extend over wide areas from a short distance north of Hsia cheng tzu, a station of the Chinese Eastern railway, north and north-eastward to yet little known limit, having an approximate E-W width of 20 li and N-S length of 300 li. The author has not been able to study the complete extension of the fields owing to the disturbed condition prevailing in that region at the time of his visit. It is known for instance that important coal field exists north of Muleng river at Ti-tao-ho, Peilien Hsien probably extending further northward till Sang yen shan in the district of Fuching south of Sungari.

The accompanying map is reduced, so far as the topography is concerned, from the russian map on 1:84,000 in which the heights are expressed in sagen approximately equivalent to two meters. The geology was surveyed by the author in 1928.

Physiography

The region under study is an advancedly dissected plateau widely covered by Tertiary basalt. Under the basalt, there occur different rock formations as granite, conglomerate, coal bearing shale and sandstone etc. which were already eroded to an advanced mature stage before the basaltic covering. A later uplift results in a renewed vertical cutting to which is due the formation of the present Muleng river valley 200-300 meters deep. The valley is however usually flat and often wide with fertile alluvial ground where agriculture is being quickly developed by the immigrants from China Proper. The highest summits attain about 900 meters above the Sea level and 700 meters above the valley bottom. Heights of 600-000 meters are of common occurrence while the greater part of the country is constituted by rolling hills of 100-200 meters above the ground surface.

Summary by W. H. Wong.

Stratigraphy

METAMORPHOSED PERMO-CARBONIFEROUS ROCKS. [illegible] in two [illegible]ed areas. A larger area occurs between the two railway stations [illegible] and Hsiachengtzu. Mica schist and marble predominate. A smaller area is [illegible] east of Paishih la. In both areas [illegible] of lime burning kilns can be found. The rocks are however thoroughly metamorphosed by granite intrusion and are in greatly disturbed condition. No fossils could be found. The Permo-Carboniferous age is temporarily assigned following the example of Dr. [illegible] who has well studied the region. Considering the fact that [illegible] fossils have been found SE of Erh-zen-tien-tzu, a station of the [illegible] railway, it seems not improbable that Permo-Carboniferous formation originally consisting of shale and marine limestone may occur also here but locally metamorphosed to an unrecogni-zable state by the Mesozoic granite. The formation is [illegible] of the Muleng coal series.

UPPER JURASSIC MULENG COAL SERIES. This series mostly consists of sand-tone. The lower part contains however [illegible] of [illegible]. [illegible] of the middle part. The upper part is composed of sandstone and shale. This series extends from the Liang[illegible] valley in the south to [illegible] in the north as far as the author's observation goes. It extends eastward further than Huangnihotzu and westward across the Muleng river. The [illegible] is often interrupted by younger rocks and basalt covering but it is very likely that there is an almost continuous field within the limits stated although the whole structure is complicated by local folding and faulting. The real limits of the extension of the coal field have not been observed. Neither the total thickness of the coal series could be accurately measured, owing to the generally flat and almost horizontal position of the strata. A rough estimate of the thickness would be [illegible] meters at least.

Near Lishuchen, which was formerly a small village but is now become quite a prosperous city since the operation of the Muleng mines, the sandstone dips to S 60° W at 10-15°. The south-westward dip still prevails in the small [illegible] kou in which are situated the two shafts of the Muleng coal mines and the [illegible] Chien-chang kou so that the overlying conglomeratic formation gradually appears on the top of the hills. In the valley of [illegible] Huangnihotzu the coal series dip to SE or due S at 15° approximately.

The coal series is often metamorphosed by the granite intrusion producing quartzite and graphitic schist such as can be observed of Laotatrukou, NW of Lishuchen, E of Hsiangyangchen etc.

From Hsiaochengtzu kou where are situated the Muleng mines, the following plant fossils have been found.

Cladophlebis [illegible]

Coniopteris sp.

[illegible] sp.

Those found at Hsiaokuangmiho are too fragmentary for determination. Together with other fossils found by previous workers, the distribution of the flora so far known may be summarized by the following table.

	[illegible]	[illegible]	Hsiao-kuangmiho	Hsiaoyeh-kou	Hsiao-chiao-ch'engkou	North of Muleng Co.[1]
[illegible]	–					
[illegible]				+	+	
[illegible] sp.	–			–		
[illegible] sp.		–		–	+	+
[illegible]	–	–		– –		+
[illegible]	–					
[illegible]	–	–	+	–)(–)		(+)?
[illegible] sp.	–	–				
[illegible]	–					
[illegible]		–				

The general character of this flora indicates the Upper Jurassic age of this series.

CRETACEOUS(?) HOUSHIHKOU CONGLOMERATE. This conglomerate contains pebbles of various composition, quartzite, porphyrite and gneiss. The size of the pebbles varies from a few millimeters to 2 or 3 centimeters in diameter, all well rounded. Owing to its hardness this rock often constitutes higher ridges and abrupt cliffs. The name of Houshihkou, an upper affluent of the Tachienchangkou is just derived from the ape-like shape of certain mass of conglomerate at that place. This formation is especially conspicuous between Liangtzuho and Muleng ho. The thickness is about [illegible] meters. No fossil can be found but imperfect trace of plants. This conglomerate is apparently at least conformable with the underlying coal series. The Cretaceous age is but hypothetically assumed. Although generally flat the strata are locally very much disturbed. Such is the case south of the lower course of Liangtzu ho where a succession of anticlines and synclines can be observed.

[1] North of the mapped area.

CRETACEOUS (?) ARKOSIC SANDSTONE: This sandstone overlies the Houshihkou conglomerate and occurs chiefly on the two sides of Liangtzuho. While the underlying conglomerate often forms rough ridges, the arkosic sandstone in question only gives rise to lower and rolling slopes. It is almost horizontal near Huchiatien north of Liangtzuho and dips 30° S in Chupikou south of that river.

Igneous Rocks

BIOTITE GRANITE: As can be easily seen from the accompanying map, a large area of granite occurs north of Lishuchen extending from west of Muleng river, in its S-N course, to its east till the upper source of Huangnihotzu. In this area, the coal bearing sandstone of Upper Jurassic age has been observed to be clearly metamorphosed by the intrusion. Another large area occurs on the two sides of the lower course of Muleng river below Hataho, extending widely north eastward till the eastern hills of Mishan district. The rock is often used for building stone. The granite often constitutes high and rough hills uncovered and probably having never been covered by the basalt. There exist however lower points topped with basalt as N and W of Laotaitzukou.

The granite intrusion is post-Upper Jurassic as testified by its metamorphic effects upon the coal series, but no contact has been observed with the Houshihkou conglomerate. As however the latter seems to be conformably folded with the coal series and the granite intrusion must be related with the folding, there seems little doubt that the granite is post-Jurassic or probably Cretaceous in age.

The petrographic character of the granite varies at different places. North of Lishuchen it is white grey rather fine grained slightly porphyritic with orthoclase more abundant than plagioclase and much quartz. South of Chuliuho it is of coarser texture rich in quartz but with less mica and magnetite. Banded structure has been observed north of Sansotung.

BASALT: It covers over wide area, forming flat plateau or mesa. Columnar structure is sometimes present. The rock is usually fine grained composed of microlitic plagioclase, olivine often in phenocrysts and magnetite grains. It is hard and compact but sometimes amygdaloid. The lava flow shows often a small dipping angle 3-4°. It is sometimes faulted with a vertical throw as much as 200 meters.

MINOR INTRUSIONS: Small bodies of granite are found at several places. The granite may be intruded into the supposed Permo-Carboniferous rocks as NE of

Hsiachengtzu or into the Jurassic coal series as SE of Huangnihotzu. When in contact with the marble iron ore often occurs, but no workable deposit has been found.

Diabase dyke occurs in the coal series at Kushan near Changchiachieh. The rock is shown by the microscope to be holocrystalline, composed of polysynthetic plagioclase, magnetite and hornblende with small amount of apatite. The phenocrysts are augite and feldspar.

Structure.

It is very difficult to have an exact idea of the general structure of the region under study because of undecided and rather complicated character of folding and faulting and the extensive covering of the basalt. The following is mentioned only as record of the scattered observations so far made, with no claim to general understanding or definite conclusion.

FOLDING: Local foldings are very frequent although the strata are generally in flat position. The dip of strata changes very quickly within restricted area. As far as can be inferred from the scattered observations, there is an anticline structure north of Hsiaochienchangkou, in the valley the sandstone dips to SWW at 10 - 14°, while north on the hills the dip turns to NEE. From Hsiao chienchangkou westward to Tachienchangkou and still further to Taihuashan there can be observed still two small anticlines and two small synclines. (Pl. II Sect GG). From the general distribution of the Mesozoic formations, it seems that the general strike is E-W with the dip to the South, so that younger rocks gradually appear south of the Muleng coal mines till Liangtzuho valley where the arkosic sandstone becomes predominent. However north of Lishu kou the dip seem to show some tendancy of turning eastward, thus we have observed dip to SEE at Hsiao peikou, SE at Hsiaohuangnihotzu and again due S at SE of the latter without the possibilty of observing any clear folding. It was Dr. Wong's idea that there may be a general dome-like structure with the granite mass north of Lishukou as the center and the coal series all round it and generally dipping away from it. This would explain the reappearance of coal field at Titaoho north of Muleng river. Much more extensive and more accurate observation is still needed to justify any general conclusion.

FAULTING: Two more important faults can be recognized from the geological map. One fault occurs south of Pamientung bringing the Permo-Carboniferous rocks in contact with the younger Mesozoic arkosic sandstone (Pl. II G.G, E.F,

CC). The direction of the fault is NWW-SEE. Another fault occurs along the river Shihtouhotzu with the down-throw on the east so that the plateau basalt on the two sides of the river is vertically displaced one with respect to the other (Pl. II, CC). Smaller faults are frequently encountered.

DATES OF DIASTROPHISM: The folding affects all the Mesozoic formations but not the basalt and there must have been a long time past before the pouring out of the lava flow since the latter covers an advanced mature topography. The folding is therefore post-Jurassic and pre-Tertiary, therefore probably Cretaceous. Movement of faulting may have played at two different periods. The fault south of Pamientung cuts through the Mesozoic rocks but does not affect the basalt which remain at the same level. It is therefore pre-basalt probably of the same period as the Cretaceous folding. The Shihtouhotzu fault clearly cuts across the basalt. In the assumption of Oligocene age of the basalt, this fault is probably Miocene. To this same movement is probably due the slight tilting of the basalt flow.

Mineral Resources

COAL: Coal is the principal mineral richess in this region. There are two areas where mining industry is already started. (1) The Muleng coal mining company has its concession in Hsiaochienchangkou south of Lishuchen. Only one seam is worked thick of 5 to 6 feet with a thin intercalation of shale. The coal reserve of this area including Hsiaopeikou totals at about 64,300,000 tons. There may be lower coal seams which are now not yet known. The company has now two vertical schafts producing about 800 tons a day. The mines are dicretly connected to the Chinese eastern railway by a branch line constructed and operated by the company itself. (2) NW of Hsiao huangniho there are known three coal seams respectively 3, 6, 6 feet thick. Only a small mine, the Yupien company, is operating there. The total reserve of this area is roughly estimated at 91,900,000 tons making the grand total 157,000,000 tons. Owing to the imperfect knowledge of the detailed structure, these estimates can but be considered as very preliminary. As already mentioned above extensive coal field further north and east are not included.

The composition of coal is variable. The Hsiao huang ni-ho coal is good coking while the Muleng coal is non caking bituminous.

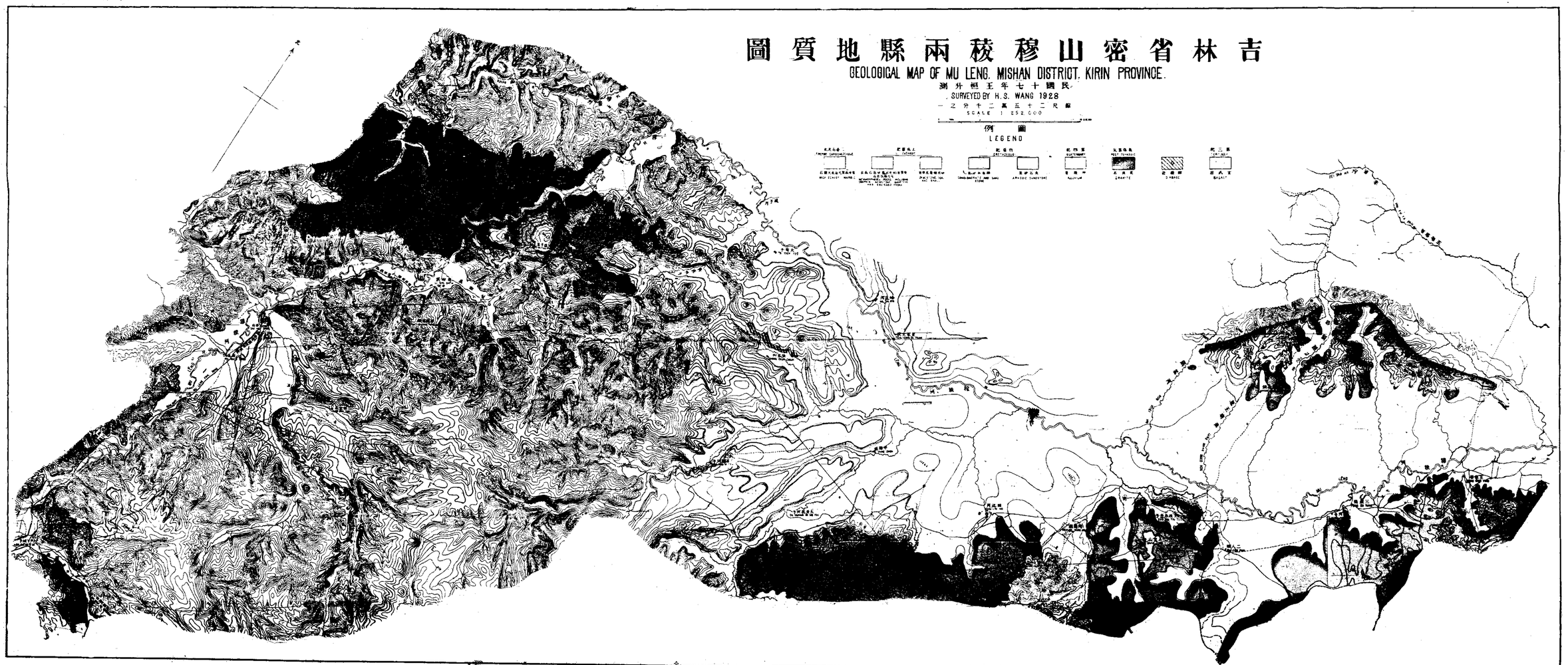
	Moist.	Volat.	Fix. carb.	Ash	Sulphur	Calor. power
* Muleng	4.31	28.90	51.62	15.30	1.35	[illegible]
* Hsiao chien-chang-kou (average of 8 anal.)	4.24	30.42	52.32	13.30	1.[illegible]	[illegible]
* Titaoho	5.07	34.63	56.02	3.38	1.34	[illegible]
* Hsiaohuang-ni-ho-tzu	2.88	30.74	[illegible]	11.30	1.42	[illegible]
*	0.75	30.40	60.[illegible]	1.[illegible]	1.4[illegible]	[illegible]
*	1.55	37.[illegible]	53.35	[illegible]	[illegible]	[illegible]
	2.27	24.57	67.44	[illegible].70	1.30	[illegible]

According to these analyses the Muleng coal (chiefly from Hsiao chien-chang-kou) is a low grade low rank bituminous B1, while the Hsiaohuang-ni-ho-tzu coal is a high to medium grade medium rank bituminous [illegible] in Wang's classification.

Gold.—Gold has been washed from the alluvial deposit in the [illegible] south of Liangtzuho. As the country rock consist of the Archean gneiss, there seems to be no serious hope of success.

OTHER MINERALS.—Iron ore is produced by the granite contact but no rich deposit has yet been found. Graphite is also produced by contact metamorphism between Laotzemiao and Liu mao kou, but only in scattered occurrence.

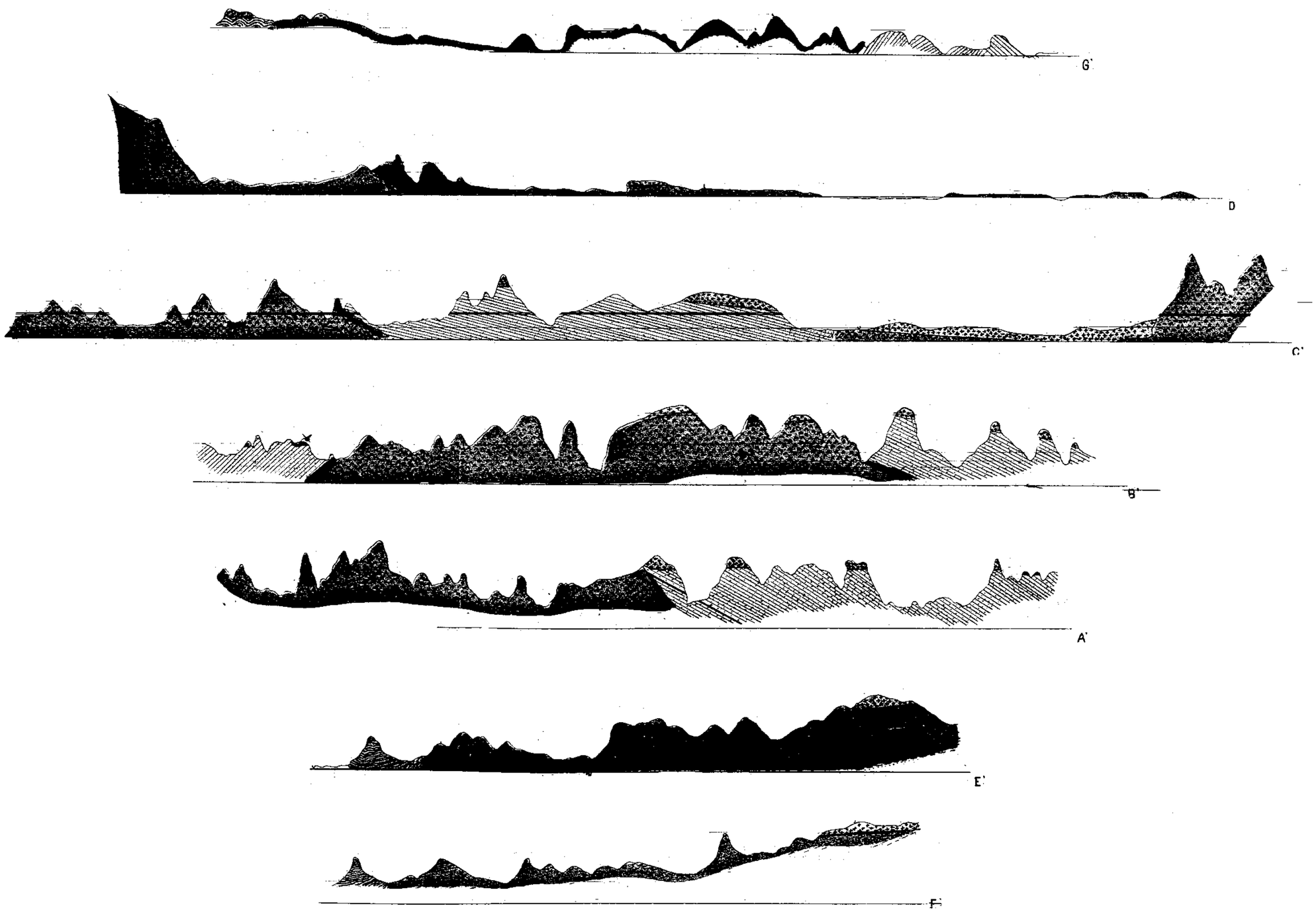
* Data kindly supplied by Mr. [illegible]. The last analysis is made by Mr. K. T. King in the Survey laboratory.


吉林省密山穆稜兩縣地質圖
GEOLOGICAL MAP OF MU LENG, MISHAN DISTRICT, KIRIN PROVINCE.
測外桓王年七十國民
SURVEYED BY H. S. WANG 1928
一之分十二萬五十二尺縣
SCALE 1 252,000
例圖
LEGEND

穆稜密山兩縣地質剖面圖

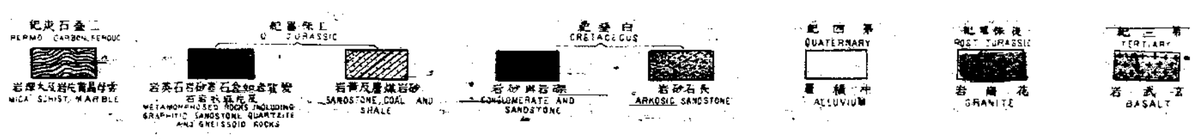
THE GEOLOGICAL SECTIONS OF MI-SHAN, MULENG DISTRICTS

之分十八萬二十尺例比平水
HORIZONTAL SCALE 1 : 180,000
一之分萬二尺例比立垂
VERTICAL SCALE 1 : 20,000



例圖

LEGEND



GEOLOGY ALONG THE VALLEY OF THE NENGKIANG RIVER, HEILUNGKIANG PROVINCE

By H. C. Tan & H. S. Wang

With 8 Plates & 7 Figures.

Introduction

The area under study was visited by the authors in the winter of 1928 to study the mineral resources, especially the coal, along the two projected railway lines, one from the capital Lungkiang (龍江省會) to the city of Nengkiang (嫩江) or Mergene, and the other from the same capital to that of Koshan (克山), in Heilungkiang province. It is situated approximately between latitude 47° to 49° 40′ N and longitude 120° to 126° E, covering nearly the whole district of Naho (訥河) and five partly others, namely the eastern part of Lungkiang (龍江縣) and Puhsi (布西縣), the southern part of Nengkiang (嫩江縣), the northern part of Yian (依安縣), and the western part of Kcshan (克山縣). But all the coal fields are not so good as we originally expected and therefore the chief result of this excusion is only a general understanding of the geology of the region considered.

Physiography

River.—The area is mainly drained by the Nengkiang River, which originates from the Ilkuri Alin mountain (伊勒庫里山) and flows southward to the east of Talai (大賚) where it empties itself to the Sungari River (松花江). Its drained area is well defined by three principal ranges, which, when mentioned in order from the northeast to north and then southward, are the Hsiaohsinganlin (小興安嶺), the Ilkuri Alin and the Tahsinganlin (大興安嶺) respectively. The former two separate it from the Amur River (黑龍江) while the last acts as a water shed with the Argunsk River. There are numerous tributaries, among them, we may mention the Kuerchi R. (庫爾奇河), the Oto R. (鄂多河), the Cupa R. (古巴河), the Molo R. (謨魯河), the Kolo R. (科洛河) the Namuerh R. (訥謨爾河) and the Wuyuerh R. (烏玉爾河) on the east, the Nayao R. (訥要河), the Yissuken R.

(依肯河), the Konai R. (哈奈河), the Latu R. (拉都河), the Tupukuerh R. (多布庫爾河), the Oken R. (依肯河), the Kan R. (甘河), the Huojihli R. (霍日里河), the Namin R. (諾敏河) the Ahlung R. (阿倫河) the Yin R. (音河), the Yalu R. (雅魯河), the Chaolei R. (超勒河), and the Taoerh R. (陶爾河) on the west. They either flow in nearly a NW-SE direction or NE-SW direction and most of them meet their trunk, namely the Nengkiang River, in acute angles. Even during the summer the water of the Nengkiang River is sometimes one foot deep and therefore is navigable only for small boat.

MOUNTAINS.—All the mountains in this country are ridges or branches of the famous Hsingan Range which is in fact characterized mostly by comparatively low and broad ridges, the highest hill-tops of which seldom exceed 430 m above the sea level. They approximately trend in a E-W or NW-SE direction (Pl. III), which is followed by the tributaries of the Nengkiang River. However, the latter, flows just transversely to them, resulting in a compartively steep but broad valley across.

They are mostly confined to the western side of the Nengkiang River, commencing from the city of the Puhsi district and extending thence northward directly to the bank of the Kanho R. Occasionally, eastward crossing the river, they show their moderate boldness, for instance, as those on the opposite side of Yissukan (依斯坎). There are no connections between them and the geological structure, while, on the other hand, the most important factor which underlies their formation seems to be the resistence of their composed rocks. Therefore, it is highly probable that they are resulted from erosion rather than by construction.

PLAIN.—It extends from the capital Lungkiang both northward to Lahachan (拉哈站) and eastward to Taianchen (泰安鎮), of the Yian district. It is formed essentially by alluvium which consists of largely fluvital sand and of partly cultivated soils. No marked ridges are found, except some very slow and gentle undulations just near the bank of some rivers. It gives all the characteristics of a constructive plain, or a plain formed by deposition.

RIDGES.—Between the mountain region and the plain, there stretches a zone which is characterized by low ridges, most of their tops seldom rising to 360 m above the sea level. They are in general slow in undulation and precipitous walls or cliffs are, if ever present, of very rare occurrence. They cover the region from Lahachan both northward to Nengkiang city or Mergene and eastward to Taianchen of the Yian district. Most of the rocks composing them, are largely gravels or

rocks of moderate resistance, for example, as the tuff of the Kanho formation in the vicinity of Taianchen and the gray shale of the Nengkiang formation in the neighbourhood of Mergene. Archæan gneiss is only encountered in the surroundings of Pokenli (博根里), where the ridges tend to rise in hight, giving their way to mountains.

PHYSIOGRAPHIC DEVELOPMENT.—As a result of studying the topographical features as well as the geological structures, three distinct physiographic stages have been recognized, namely, the *Puhsi peneplane*, the *Chiangchiatun stage* and the *Nengkiang cutting* in this area. They will be described in a moderate detail in "The Physiography along the Nengkiang River, Heilungkiang province" on the bulletin of the Geological Society, China. The following description is only a brief summary.

The Puhsi peneplane.—The Puhsi peneplane now rises to about 320 m. or more above the sea level and is about 140 m. higher than the water level of the rivers in its neighbourhood. Although it has been deeply dissected, yet its original surface can still be distinguished by the highest flat-toped hills which rise approximately to the same elevation. When one travels along the valley of the river, he will be impressed by the high complexity of a multitude of both large and small valleys dissecting a comparatively low, broad and gently undulating hills or ridges. But as he ascends from the valley bottom to the top of the mountain and look down upon from them, he would hardly feel that he has just been on a mountainous district like this, if not for the deep dissection of the valleys (Pl. III, Section A, B).

The best places where it well recognized are found on the round and smooth ridges to the north of Wuchiatzu (五家子) or Mokoli (莫哥里). (Pl. V, Fig. A) and the highest hills along the southern bank of the Kanho R. from Samachieh (薩馬街) to Chiangchiatun (蔣家屯). Other remnants but more isolated are shown by the 320 contour on Pl. III. It covers all the rocks from Archæan to Upper Cretaceous and seems to be independent to the geological structure (Fig. 4). It is, therefore, undoubtedly an erosive peneplane which was formed by a long erosion from the Upper Cretaceous time to a part of Tertiary.

The Chiangchiatun stage.—This stage is characterized by both low ridges which are about 100 m. lower than the surface of the Puhsi peneplane but 70 m. higher than the present river bed; and a layer of gravel (Fig. 1) on the top ridge just to the east of Chiangchiatun. It is highly probable that the latter was a remnant of an ancient river deposit, its present position being uplifted after its

deposition. Taking the bottom of this very gravel as the river bed of that time and connecting the top of the ridges with the highest summits of the mountains, namely the surface of the Puhsi peneplane, we may conjecture the original topography at that time. It advanced to aid maturity, and therefore was characterized by broad open, flat valleys and low, smooth ridges (Pl. III Section A, B): beds of the rivers were all graded and their sediments were discharged at favourable places—the Chiangchiatun gravel. Therefore this stage was partially destructive and partially constructive. Its other remnants are the gravel bed, surrounding Lahachan and the area enclosed by the 260 contour on Pl. III.

The Nengkiang cutting.—The valley of the Nengkiang River is now and then bordered by fairly steep walls, which rise from the bottom about 70 m high and are quite contrast with those just above them as the latter often slope gently upward to the highest summit (Pl. III, Section B). This indicates another uplifting of the region in question subsequent to the Chiangchiatun stage and in consequence reopened a cycle of another erosion—the Nengkiang cutting. This assumption is farther substantiated by finding the "In-grown meander valley" (Pl. IV) of J. L. Rich[1] along one of its tributaries, namely, the Kanho River. It meanders upon the upland of the Archæan gneiss and has the characteristic steep bluff, along the concave and down valley banks and slip off slopes descending gently to the river on the inside of the loops. As expressed by C. F. Marbut.[2] "The average width of any upland meander belt is a function of the elevation of the stream above grade at the time when meandering was commenced". The elevation of the stream above grade is, evidently, a result of an uplift of the region or some other equivalent such as the lowering of the local base level of the stream.

Now the bed of the Nengkiang River is quite graded and its valley is wider than the present river channel (about as 15 to 10 times wide). In the valley, occurs already flood plain upon which, the Nengkiang River meanders, now impinging one side of the rocky wall and then the other (Pl. VI, Fig. A). It undoubtedly carries its erosion beyond the canyon-stage and produces a valley, indicating that the uplift of the Nengkiang cutting has ceased for some time, during which, down-cutting of the river gave its way to latteral cutting. The final result was that the valley was widened, and the bed was graded and in consequence flood plain came into existence.

1. The Jour. of Geology Vol. XII (1914), pp. 470-474.
2. Missouri Geol. Survey Bull. Vol. X (1896), p. 102.

Stratigraphy

The region surveyed is partly occupied by rocks of Upper Mesozoic, namely the Cretaceous, with alluvium and partly by the oldest rocks, the Archæan gneiss. There is only one belt just to the south of Samachieh where occurs a quartzite formation which is provisionally correlated by the authors with the basal quartzite of Sinian age. There are altogether five different formations which are generally summarized in the columnar section of Pl. II. All the other Paleozoics as well as the lower part of the Mesozoic are completely wanting and therefore there must be a great hiatus riot to Cretaceous time during which the missing rocks were likely to be eroded away if ever present. The following is a brief description of the character and distribution of all the different formations which we encountered.

THE ARCHÆAN GNEISS.—There are four main areas in which it is well exposed (Pl. I); they are the southern part of the Puhsi district commencing from the Puhsi city northward to Takuma (大麻馬), the vicinity of Temuhuchu (特穆呼珠) along the Huojili River, the lower course of the Kanho River from Samachieh to Chiangchiatun and the neighbourhood of Pokenli respectively. It is generally brownish yellow or brownish white in color; the gneissoid structure is only occasionally developed, for example, as those found to the south of Samachieh and in the neighbourhood of Pokenli. It is sometimes intruded by granitic intrusions, one of which just behind the village of Temuhuchu, encloses dark inclusions which are especially rich in biotite and is rarely sporadic with phenocrysts of feldspars. In general, they are very resistant to weathering and therefore frequently constitute the high ridges or bold mountains of the area considered.

THE SAMACHIEH QUARTZITE FORMATION.—It is only developed just to the south of Samachieh where it unconformably overlies the Archæan gneiss (Pl. I). In general, it is of a grayish white color and very resistant to weathering. Its thickness is estimated to be about 200 m. and from both its petrographical character as well as its stratigraphical position, it is very likely equivalent to the basal quartzite of sinian age.

THE NENGKIANG SHALE FORMATION.—This is either a gray, blackish gray or bluish gray shale of a rather fine and uniform texture; occasionally it becomes calcareous, for example, as that occurring at Weichiawopu (魏家窩鋪) about 20 li north of Pokenli. It is typically developed in the vicinity of Mergene or the Nengkiang city and so derives its name. The two other places where it outcrops are one about 20 li to the southwest of Pokenli, and one at Weichiawopu about 20

[illegible] to the north of the same village. At both localities, it is fossiliferous, the fossils, as a result of a preliminary determination by the authors, including the following:

[illegible]

[illegible]

[illegible]

Plantae

[illegible]

As revealed by the fossils, it is very similar to the [illegible] and [illegible] formations of the [illegible] region, for all of them carry the characteristic *[illegible]*. If this suggestion is not very far from the truth, its age, as recently revised by Prof. A. W. Grabau, may be lower [illegible].

Its outcrops are very incomplete and therefore its whole thickness is rather difficult to be measured. However, [illegible] estimated from its distribution, it is at least of 500 m thick.

THE [illegible] FORMATION.—The formation is named after the [illegible] river for it is well developed along the middle course of this river from [illegible] to [illegible] (九[illegible]) [illegible]. In the latter locality, it is rather famous for its production of coal which has been mined for some time.

[illegible] consists of sandstone, shale and occasionally coal seams; the upper contains principally extrusives including andesite, trachyte, rhyolite, basalt and pyroclastics such as tuff and volcanic breccia.

The andesite is usually of a dark color and vesicular in texture, the vesicles being frequently filled with both chalcedony and agate; occasionally it is dense. The constituent minerals are mostly multiple twinned [illegible], brown hornblende and magnetite. When it is porphyritic, the phenocrysts contain usually hornblende and [illegible].

The trachyte and rhyolite are both light colored rocks of a dense texture. Occasionally the latter shows fluidal as well as spherulitic structure, and the former is porphyritic, the phenocrysts being largely sanidine. The rhyolite, when porphyritic, contains both quartz and feldspars, including orthoclase and plagioclase, as the phenocrysts. Their groundmass is usually glassy.

The basalt is dark in color when fresh and red when weathered. It is

1. Stratigraphy of China, Pt. II, pp. [illegible]
2. Op. cit. pp. [illegible]
3. Op. cit. p. [illegible]

either dense or vesicular, the vesicles being filled with agate which is frequently covered by a green coating. The constituent minerals contain principally lath-shaped labradorite and mafic minerals, including both augite and magnetite. The feldspars are occassionally parallelly arranged, giving a flow structure.

There are two kinds of pyroclastics, one being grayish white, the other of a greenish color. Most of them are very fine, only a few are fairly coarse, containing both angular fragments of xenocrystic origin and quartz, sanidine. The matrix is largely glassy, occassionally showing a perlitic structure.

In regard to the distribution of this formation, there are three main districts where it occurs.

1. It commences from the South of Shihlichin (十里金) northward passing through Temuhuchu, Wuchiatzu to Payenchieh (巴顏街). From the last mentioned locality, it extends both northwestward to Chiufengshan and southeastward to Yissukan. Within this region it is interrupted by Archaean gneiss only at Temuhuchu where occurs a fault. The lower part is well exposed at Shihlichin, where it contains essentially coarse sandstone and tuff fig. 4; at Tiehkoushan (鐵鉤山) where we found greenish sandstona, and black shale intercalating with coal (fig. 2); at Chiangchunwoli (將軍窩裡) and Chiufengshan where occur both sandstone and shale intercalated with coal. The andesite is well developed both at Yissukan (Fig. 3) and Tiehkoushan. To the west of the last mentioned locality it underlies the trachyte as well as the rhyolite, both being essentially confined to the northwest of Payenchieh. The basalt frequently forms the topmost layer of the three successive lava flows, and, is occasionally underlain by a layer of conglomerate, for example, as along the southern bank of the Kanbo R. about 10 li to the northwest of Payenchieh (Pl. II).

2. In the vicinity of Pokenli, we [redacted] both basalt, andesite and tuff. Below the tuff the lower part with coal seam is present.

3. Between Taianchen and the city of Koshan, it forms low ridges or small hills and is essentially composed of tuff. The tuff is usually very fine and of a fresh white color. About 15 li to the north-east of Taianchen, coal seam occurs below the tuff.

It is usually very poor in fossil which, when present, is often poorly preserved. There are, however, three places where they yield plant fossils namely Tiehkoushan, Chiangchunwoli and Sungshuling (松樹嶺) about 3 li to the south of Yissukan respectively. They include the following genera:—

Cephalotaxopsis sp.

Zamites sp.

Czekanowskia sp.

Besides, both fossil wood just below the coal seam of Chiufengshan and seed remains in the sandstone of Tiehkoushan were found. As revealed by the fossils, as well as its stratigraphical position and the petrographical character, it is probably equivalent to the Chaoyang series of Jehol, which has been assigned by Mr. Tan as an upper Cretaceous age.

THE ALLUVIUM.—It is composed mainly of sand and gravels, the latter including largely igneous pebbles, such as agate, trachyte, porphyry, andesite, and rarely gneiss. The pebbles range in size from one cm. to 4 cm. in diameter and are in general waterworn. Its distribution commences from Lungkiang on the South to Kotaniha (格達泥哈) on the north. As all of it are unconsolidated, it forms the greater part of the plain, and rarely low ridges as in the vicinity of Lahachan. Its age probably ranges from late Tertiary to Quaternary.

Geological Structure

Though the geological structures of this region are not very simple, as revealed occasionally by the steepness of the inclination of the strata, yet it is still difficult to describe them detailly from such a rapid reconnaissance like this. However, some major tectonic features have been recognized which will be described as follows:

FOLDING.—There are one major syncline (Fig. 4) and one anticline. The former lies between Shilichin and Payenchieh while the latter occupies the region from the last mentioned locality, namely Payenchieh to Nengkiang city. The axis of the syncline generally trends in SW-NE direction and so the strata on its southern limb near Shihlichin dip northeastward while those on the northern limb at Payenchieh dip south-westward. The anticlinal axis generalty trends in a SE-NW direction, nearly perpendicular to that of the syncline just above mentioned. Its western limb is formed by rocks belongs to the Kanbo formation, while the eastern limb, by the Nengkiang shale. There are still more folds, but all of them are very local in occurrence and therefore no special description will be given.

FAULTING.—Two major faults have been recognized in the filed, one near Temuhuchu, the other in the vicinity of Pokenli. The fault line of the former nearly coincides with the course of the Huojili River (Fig. 4) while that of the latter is followed by the Kolo River (Fig. 7). As a result of these faults, the rocks

of the Kanbo formation are interrupted by the Archæan gneiss which usually situates on the up-throw side.

THE DATE OF THE FOLDING AND FAULTING.—As to the age of the folding, we can only say that it took place after the extravasation of the Upper Cretaceous extrusives, because they were also affected by this disturbance. The date of the faulting may be contemporaneous to that of the folding or still younger. Regarding their upper limit, it is rather uncertain for no formations are yet found in this area, which serve as a criterion to fix it. However, if we compare them with those in other regions where both the character and the age of the textonic disturbance are well established and we may catch some clue to determine it, though not exactly. As studied by Dr. Wong, the folding in Peipiao, Jehol, reached its acme by Upper Cretaceous, and as remarked by Dr. Andersson, most of the major faults in North China, took place at Mid-Tertiary; the date of folding in this region fell mostly probably to the former period while that of the faulting to the latter.

Economic geology

Among the mineral resources in this area, coal is the most important. There are four districts where coals are known to be present. They are Chinfengshan (Fig. 5, Pl. 7, Fig. A, B) Tiehkoushan, (Fig. 5, Pl. VIII, Fig. A), Pokenli (Fig. 7) and the 28th Chiengtzu or well of cultivated field of Koshan district, respectively. All of them belong to the Kanbo formation and have been described detailly in the Chinese part. The following table is a summary of the former three which have been well surveyed. The fourth is only reported to be found in a well, while its distribution as well as its thickness is very uncertain.

Locality	Reserved quantity (metrictons)	Composition				Calorific Value	Symbol
		Moisture	Volatile matter	Fixed carbon	Ash		
Chinfengshan, Puhsi district	5,262,000	12.38	20.89	53.73	13.00	6489	Bl_4
		3.79	38.84	56.02	1.35	6714	Bl_4
Tiehkoushan Puhsi district	6,954,000	5.14	44.34	41.36	9.16		C_3
Pokenli Koshan district	5,563,200	3.54	34.63	52.83	9.00	7130	Bl_3

Besides, there are also fluroite and fine clay which has been contaminated by limonite. The latter occurs at Kotaniha just beside the road from Naho city to Mergene, and is mined for pigment. The former is reported occurring in the Archæan gneiss not very far from Poerhchi (博爾旗). Unfortunately the authors had no time to visit it.

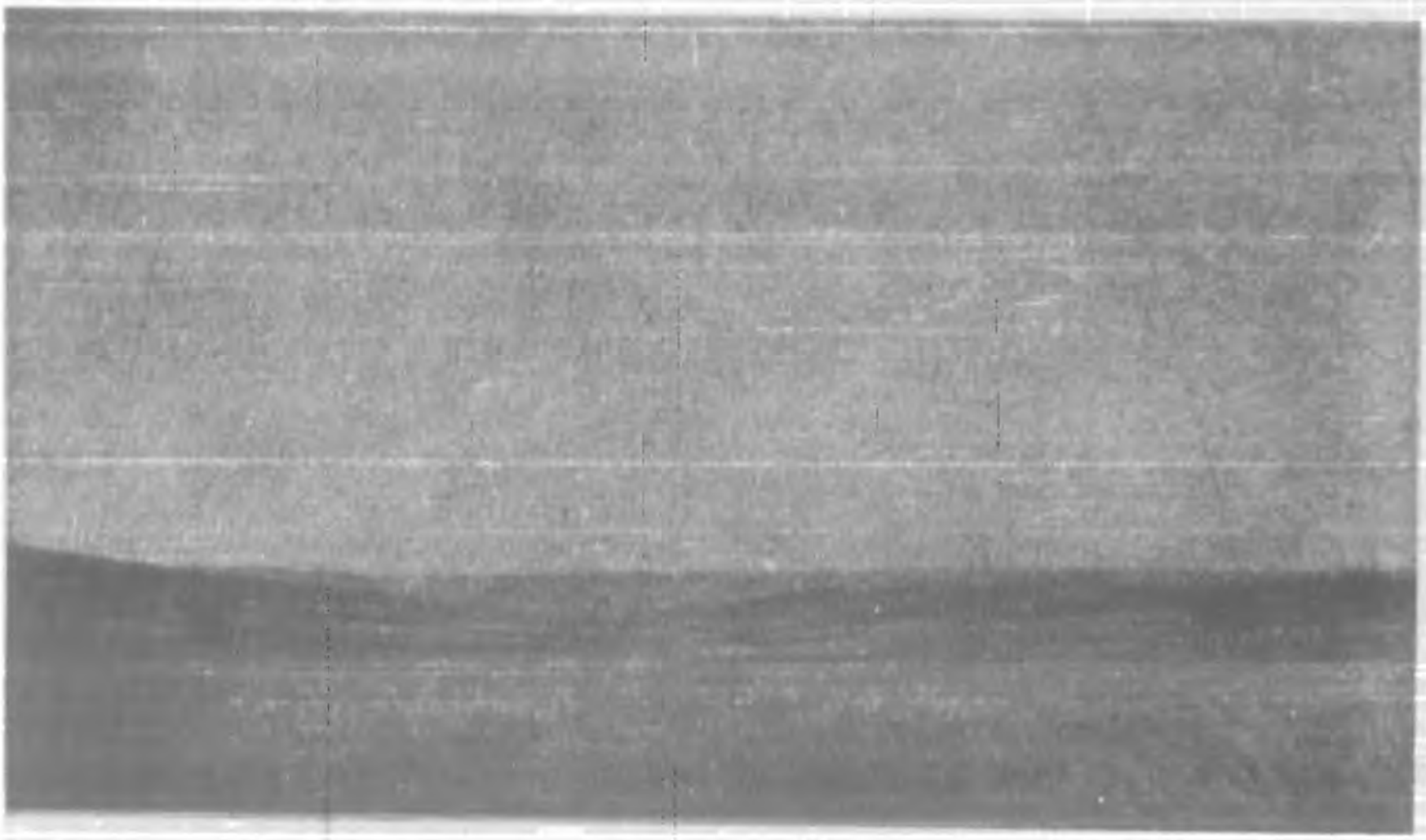


FIG. A. The Peneplane of the Puhsi Stage (布西期) about 6 km. to the northwest of Wu Chia Tzu (五家子), Pu Hsi district; looking westward.

FIG. B. The Peneplane of the Puhsi Stage (布西期) cut by the Kan River, about 9 km. to the NNW of Pa Yen Chieh (巴彥街), Pu Hsi district.

Fig. A. The Meandering of the Něng Kiang River to the East of Yi Ssu Kan (依斯坎), Pu Hsi district.

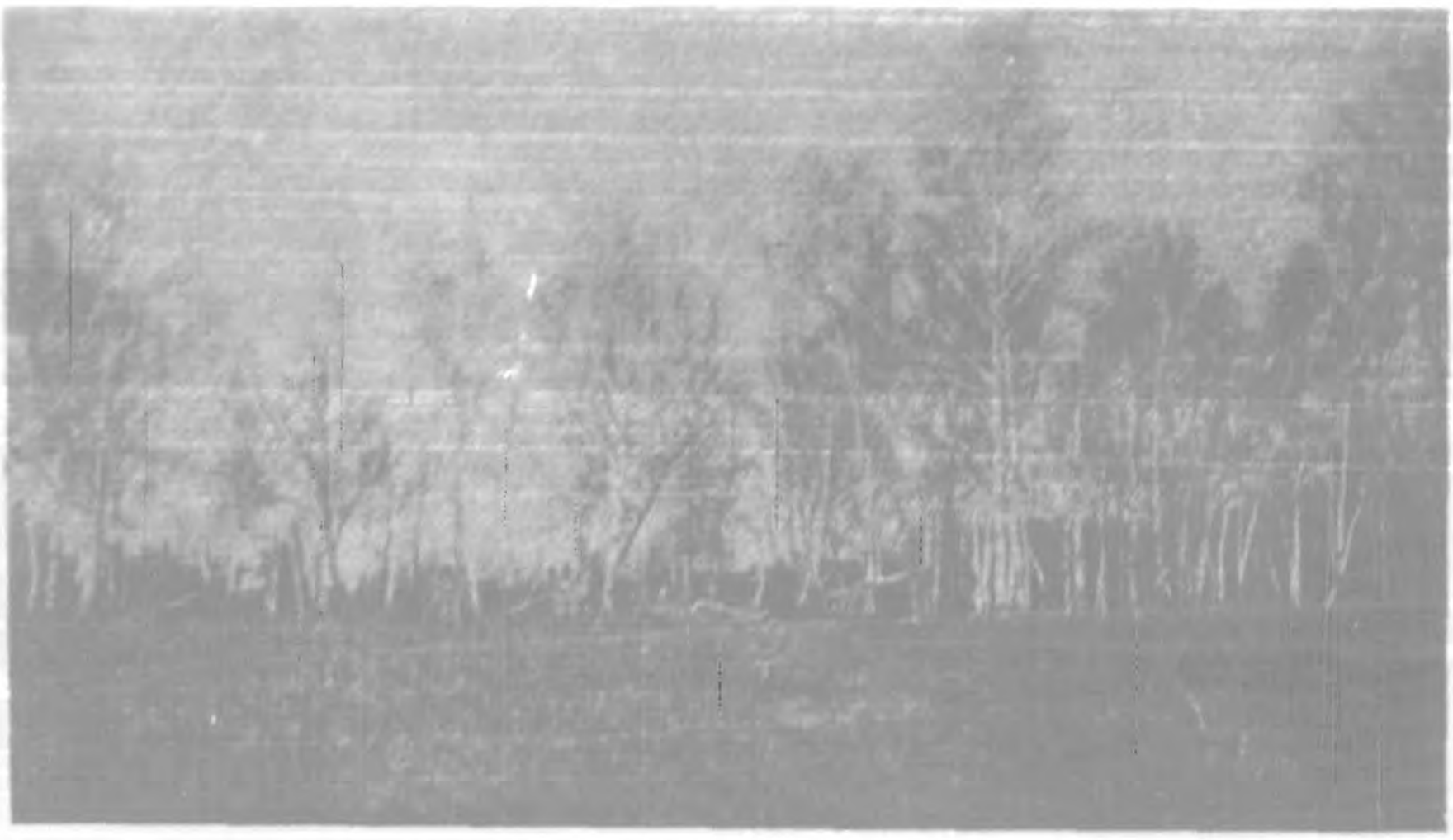


Fig. B. The birch forest and the bushes thickly covering the ground about 20 km. to the North of Wu Chia Tzu.

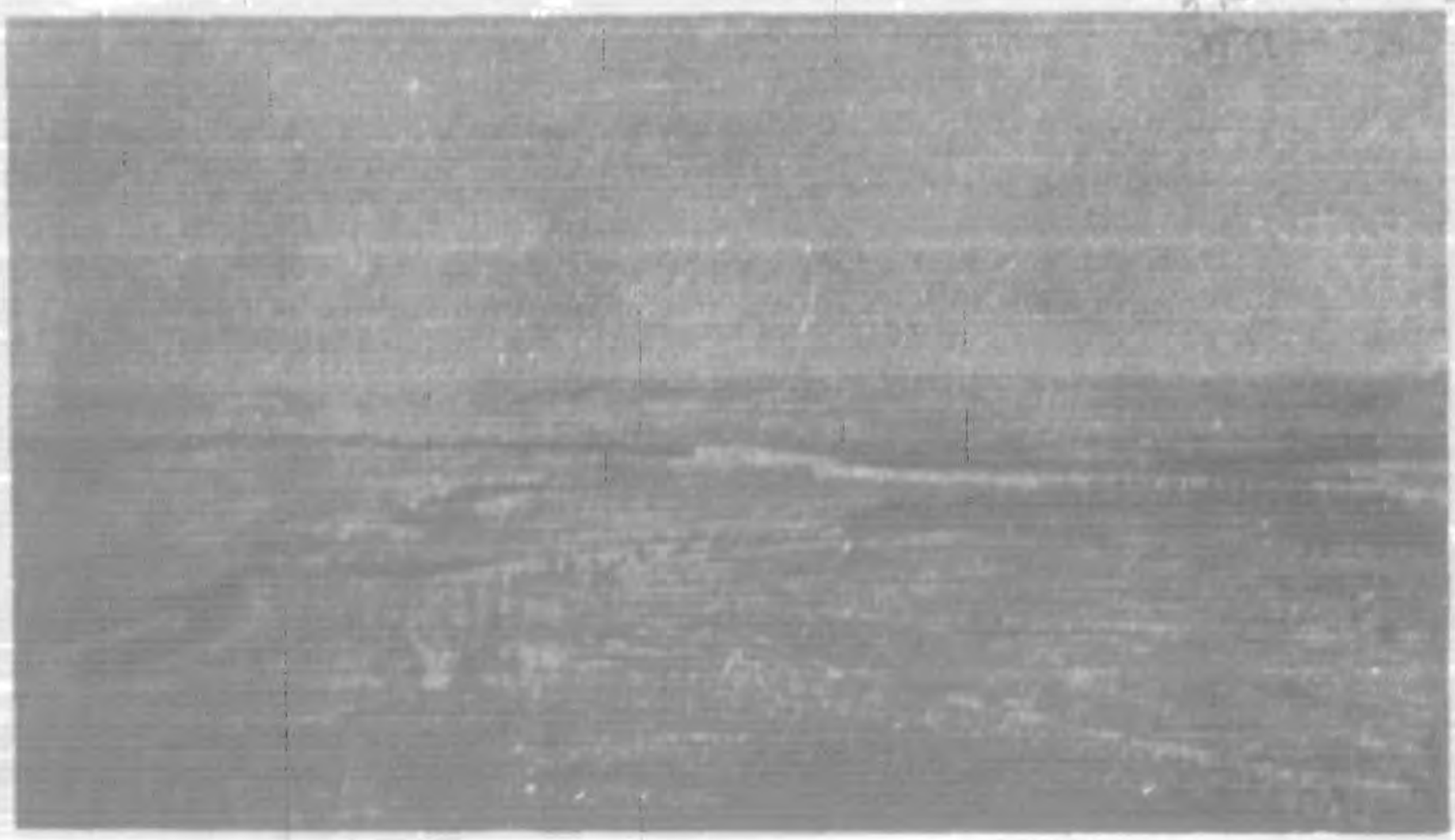


FIG. A. The ruined buildings of the Kanho Coal Mine (甘河煤礦) at Chiu Feng Shan (九峯山).

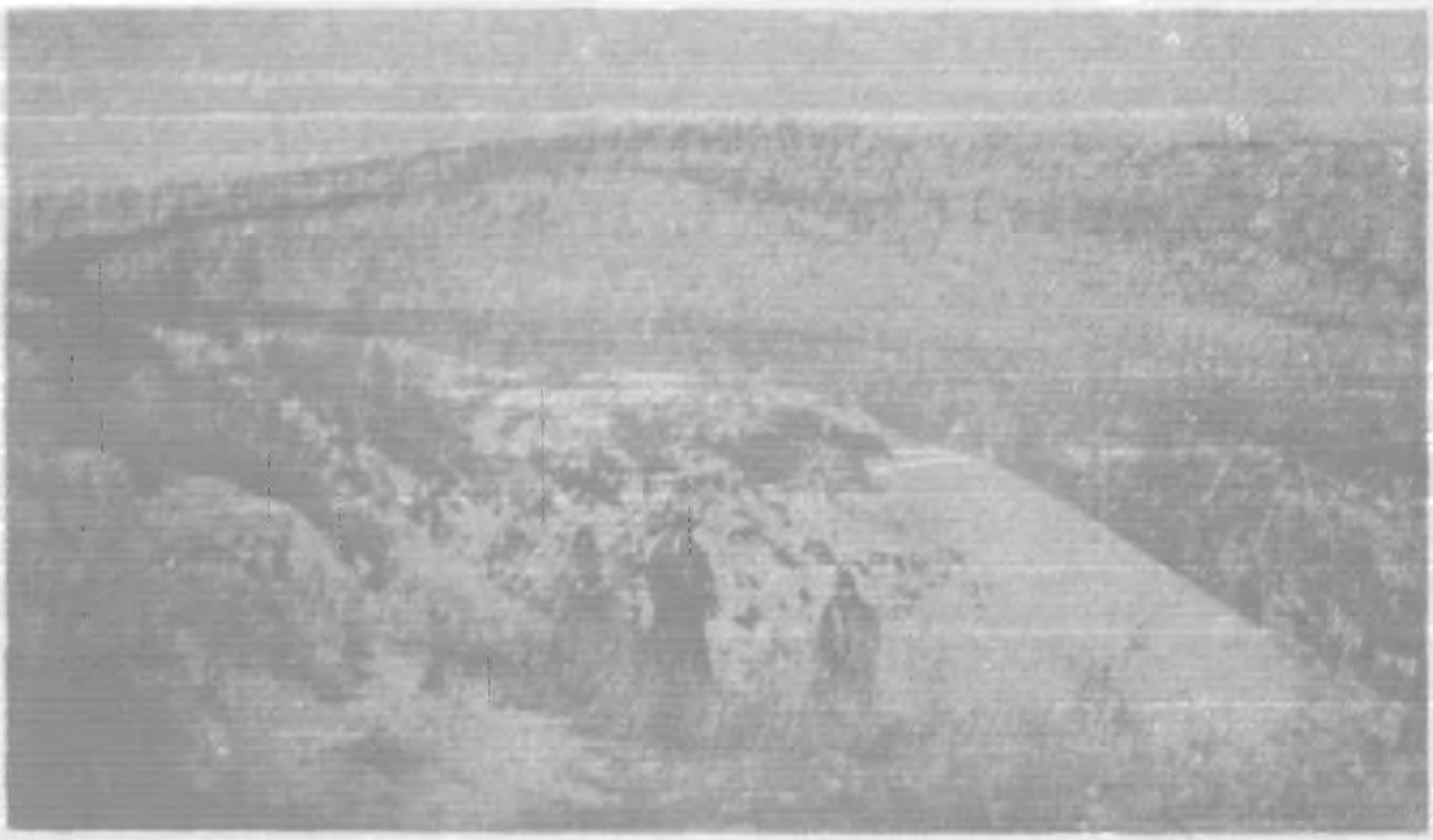


FIG. B. The old incline of the Kanho Coal Mine at Chiu Feng Shan.

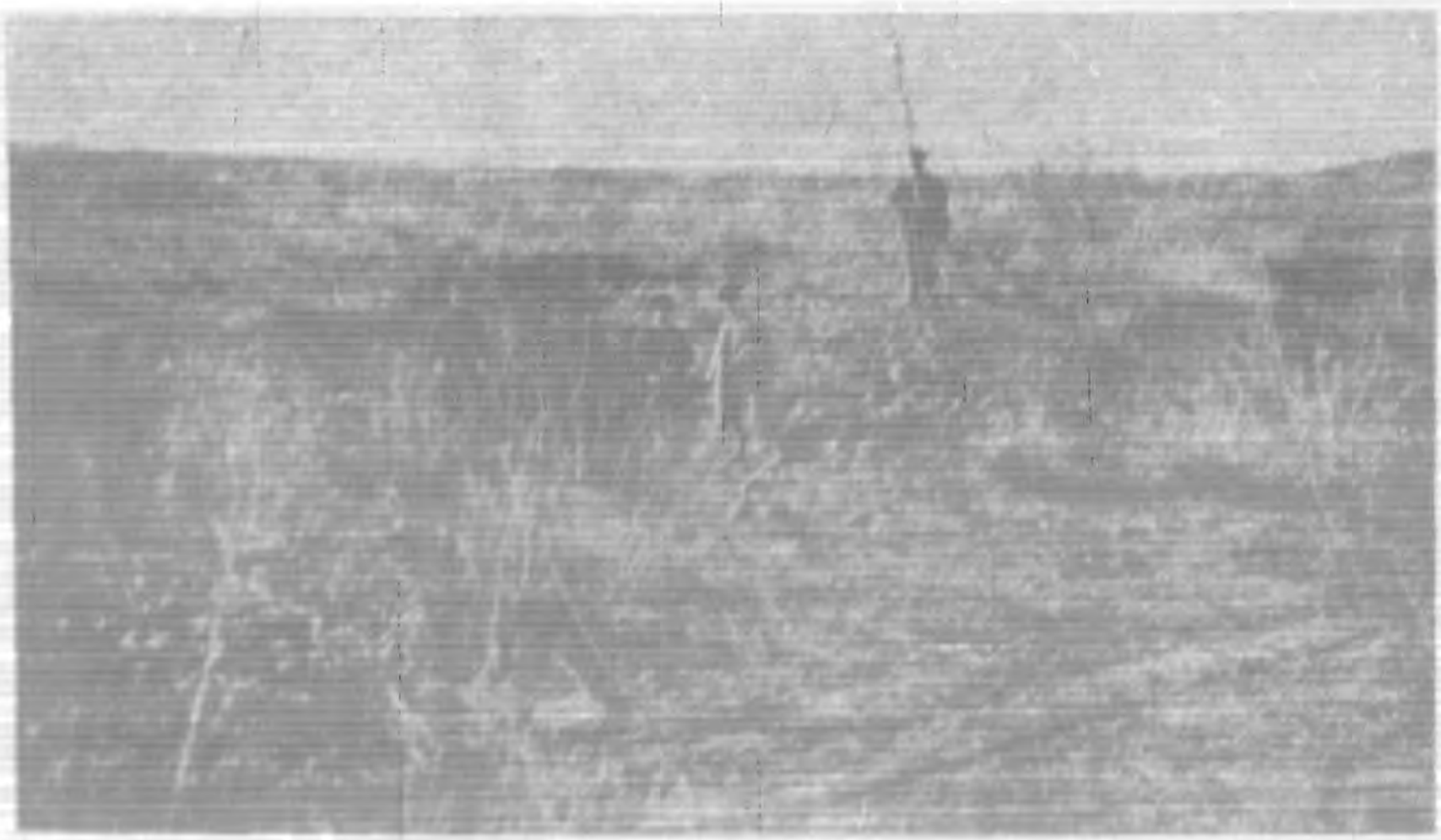


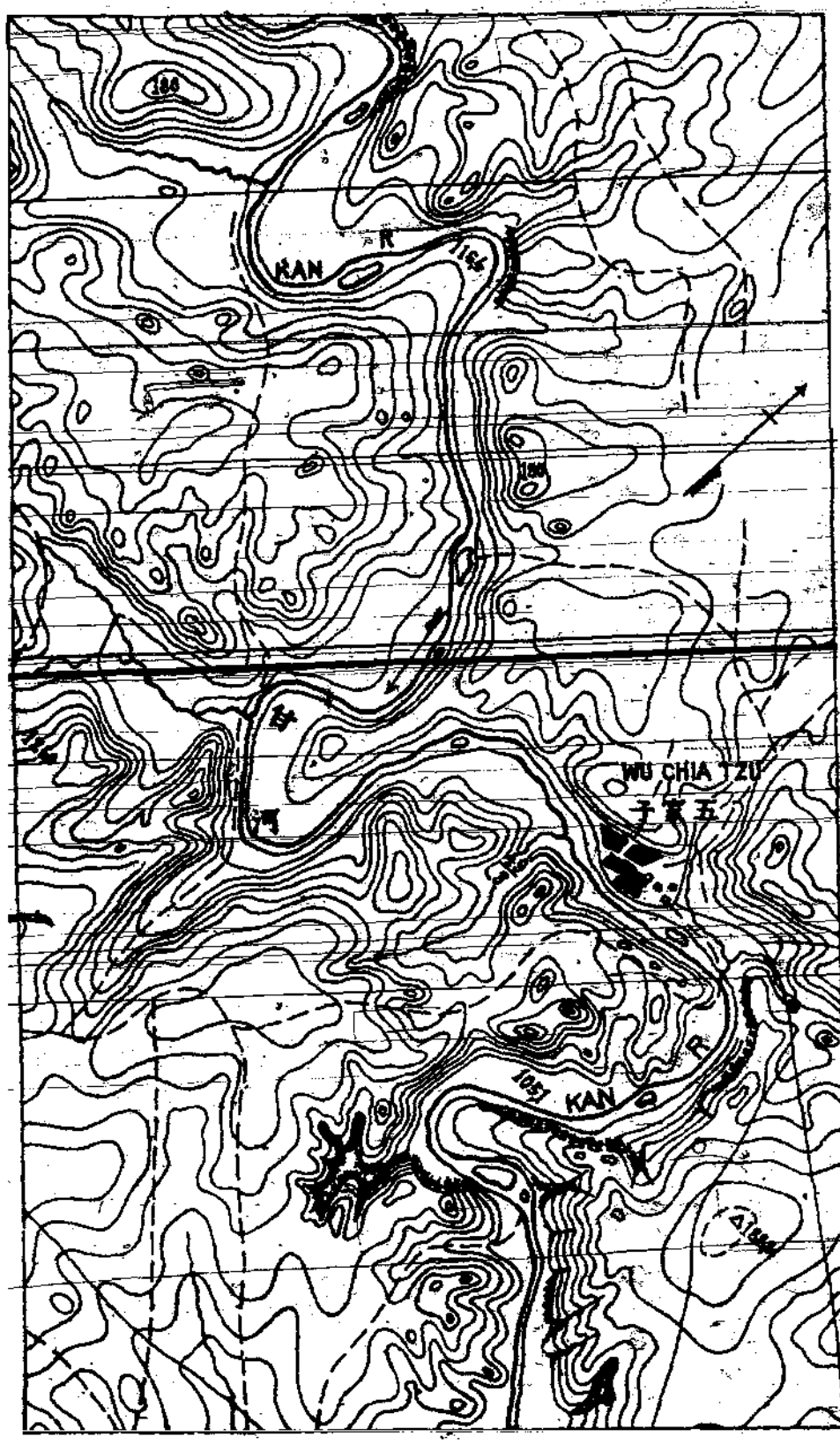
Fig. A. The old prospecting incline of Tieh Kao Shan (鐵鎬山).

Fig. B. The old prospecting pit (marked by ✕) behind Yi Ssu Kan, (依斯坎).

谷蜿蜒河甘

THE MEANDERING VALLEY OF THE KAN RIVER

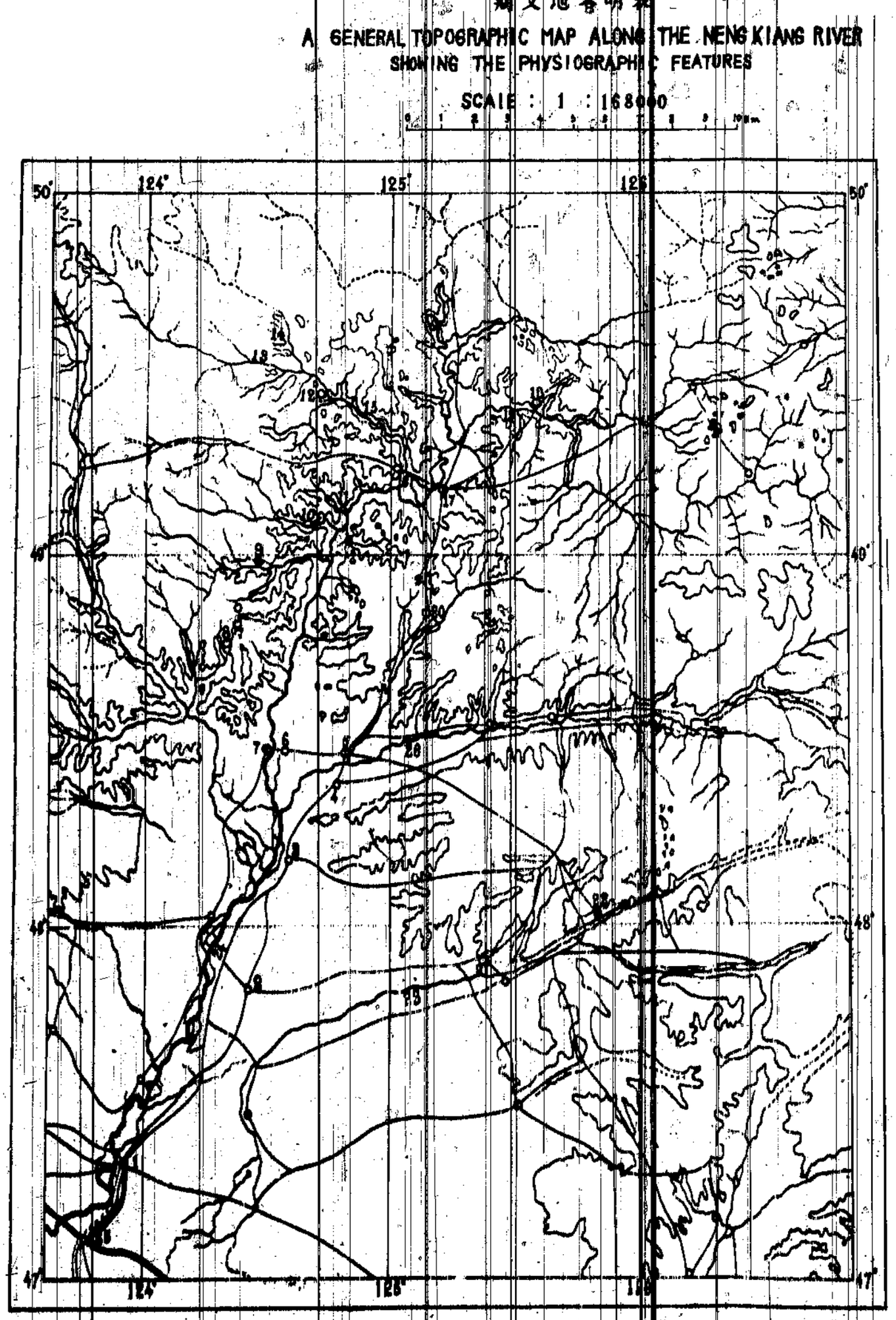
SCALE 1 : 84000



嫩江流域地形概圖

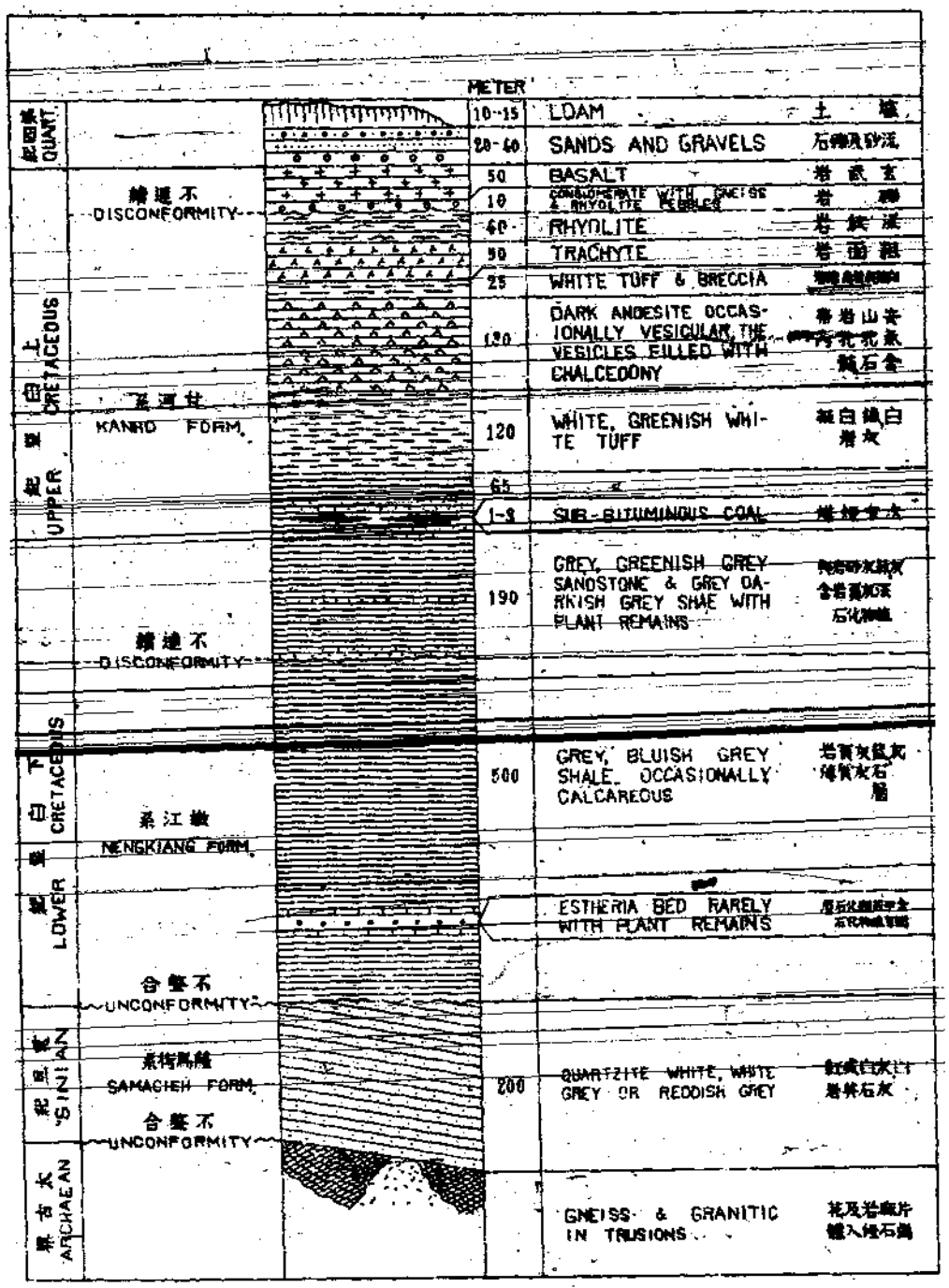
A GENERAL TOPOGRAPHIC MAP ALONG THE NENG KIANG RIVER SHOWING THE PHYSIOGRAPHIC FEATURES

SCALE : 1 : 1680000



圖面剖狀柱層地縣四山克汪嫩河訥西布

A GENERALIZED COLUMNAR SECTION OF STRATA IN PUHSI-NAHO NENGKIANG & KOSHAN DISTRICTS



黑龍江省布西嫩江訥河克山龍江諸縣地質略圖

GEOLOGICAL MAP OF THE PU HSI, NÊNG KIANG, NO HO, KO SHAN AND LUNG KIANG DISTRICTS, HEI LUNG KIANG PROVINCE.

第一版
PL. I.