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遼寧省葫蘆島附近錦西錦縣一帶地質鑛產

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遼寧省葫蘆島附近錦西錦縣一帶地質礦產

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引言

民國十九年春、本所應北寧鐵路局之邀、派恒升等赴葫蘆島、錦西、錦縣一帶調查地質、備葫蘆島築港之參考。於三月十九日自北平出發、先至葫蘆島調查、六日竣事。繼由葫蘆島西北行、經連山鎮、喂牛塲、大虹螺山之南麓、至錦西縣城。在該縣調查三日、曾西南行至上、下黑魚溝、富兒溝一帶、東至大虹螺山等處。自錦西復分兩路調查、一路沿大虹螺山之北坡、經娘娘廟、團山子、虹螺峴、沿通裕鐵路之北至錦縣、一路調查大小虹螺山之東麓、喂牛塲、龍泉寺至馬成業東北一帶。計自錦西縣至錦縣約百一十里、一日而竣。當時因限於時間、路線之外、未遑遠行也。今年春、北寧路局又邀恒升調查通裕支路附近之鑛產、遂乘機補足虹螺峴、沙鍋屯一帶及錦西縣北部之地質。此段譚君錫疇、及安特生氏曾來調查、與此次所見大致相同、不過詳略有差耳。當去歲調查之際、蒙北票煤鑛公司經理袁君滌庵派張君光正、單君志鈞隨同前往、輔助工作。及恒升等調查葫蘆島將竣之際、德日進與楊鍾健兩博士同蒞斯島、又偕往觀察、多所討論、皆裨益匪淺。爰誌於此、以示感謝。

地形

葫蘆島附近、沿北寧鐵路、東南濱海、地勢平坦。惟葫蘆島小山一列、突入海中、高者出海面約二百餘公尺、山巒起伏、綿延西南趨、與錦西一帶諸山遙相連屬。由葫蘆島海濱越北寧鐵路而西、地勢逐漸高起。然谷廣河寬、（第二版第一圖）最高山巔、出海面不過三百公尺。至錦西縣一帶、始漸陡峭。花崗岩所組成之大虹螺山、壁立

矗起、插峯削壁、高出海面約八百餘公尺、爲附近諸山之冠。自此折而東北至於義縣、大部磷礪之山嶺、多偏近於西北部、故愈西而山勢愈起。其東南自連山東北至錦縣、因接近遼寧平原之西南邊緣、僅岡陵陂陁、山勢已緩。小凌河、女兒河蜿蜒於中。大凌河迂迴於東北。各造成一沖積平原。

地層

自葫蘆島錦西以迄義縣間、露出地層頗爲繁雜、大致東南部地層較古、北部較新。地層走向略成東北西南之方向、惟因受局部地質構造之影響及侵入火成岩之作用、時有例外。且錯綜斷陷、亦殊不規則。茲據各處觀察、約分九期、而冲積層不與焉。一曰太古界片麻岩及花崗岩。二曰震旦紀石英岩及矽質石灰岩。三曰寒武紀紅綠色頁岩、鮞狀石灰岩、及竹葉石灰岩。四曰奧陶紀石灰岩。五曰上石炭紀煤系。六曰三疊紀砂礫岩。七曰下白堊紀紅色砂岩、及中白堊紀火山岩層。八曰上新統紅土。九曰洪積統黃土層。此外尚有侵入花崗岩、花崗斑岩、安山岩、及玄武岩等。試列述如後。

（一）太古界　太古界地層露頭地帶凡二、一見於連山西北、南自影壁山、北迄龍泉寺、西至喂牛場附近、組成大寺台、槐樹溝一帶之山嶺。多片麻岩、石色淺淡、富長石及石英、片麻紋理顯著。二見於葫蘆島之南海濱、多花崗岩。晶粒粗大、以長石及石英爲最富、時有偉晶花崗岩脈（第二版第二圖）及石英斑岩等侵入體。該花崗岩位於震旦紀長石砂岩之下、間有花崗岩塊包含於長石砂岩之內、體頗巨大（第二版第三圖）且有花崗岩之裂罅爲長石砂岩所填入（第一圖）故該花崗岩之生成當先於長石砂岩、或屬於太古界。

（二）震旦紀　本紀地層在調查區域之內、頗稱發育。下部爲長石砂岩、石英岩、與黑色板岩。上部爲矽質石

斷。組成八百壠、小曹屯一帶之高山。

第四區位於錦西縣城黑魚溝至四兒堡一帶、組成蓮花山、洛石嶺、連寶山、五頂山諸崇嶺。其西北、正北、東北與東南皆限以花崗岩、上有寒

第一圖

南西寺海望島蘆葫合整不者之二示表中嶂裂岩崗花界古太於充填岩砂石長

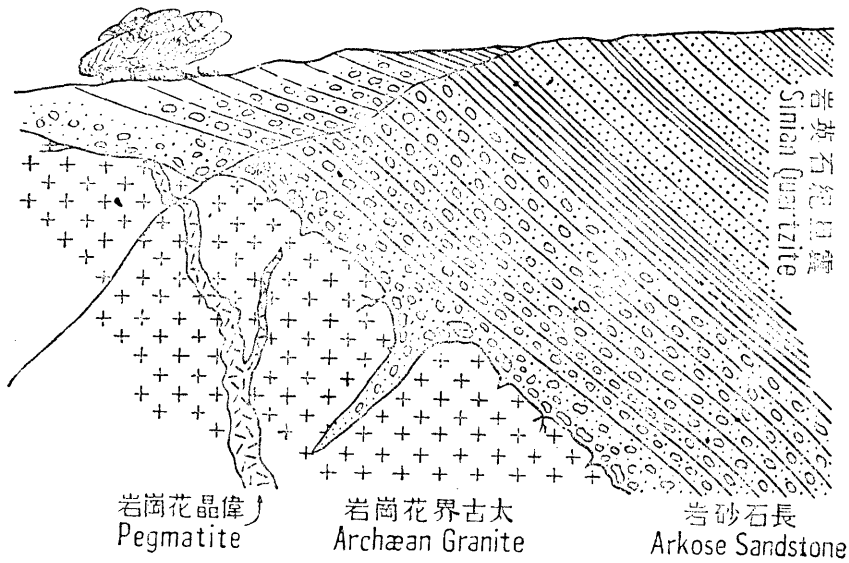


Fig. 1. Clastic dyke of arkose sandstone in the Archæan granite, south west of Wang-hai-ssu, Hulutao.

灰岩及燧石石灰岩、近其頂部夾白色石英岩。大抵岩質堅實、所成山嶺突兀嵯峩。其分佈因受斷層及逆掩斷層之錯斷與侵入岩之突衝、零散爲六區。自北而南如左。

第一區分佈於通裕支路之黃土坎至大窯溝一帶、南以逆掩斷層與白堊紀之火山岩層相接觸。在西北大窯溝附近上接寒武紀地層、二者爲假整合。此區岩石以燧石石灰岩爲最發育。在下廟子一帶、層帶重疊、至爲清晰。石質堅韌、懸崖絕壁、夾路不絕。在小洞附近、峯巒起伏、頗有洞巖之勝。

第二區分佈於虹螺峴南之支鍋山、西起板石溝被花崗岩所侵斷。西北以正斷層與寒武紀地層相接觸。東至馬成業以正斷層與火山岩層相連。自此向南至牛礌山、折而東南以至高橋站。南以逆斷層與太古界片麻岩爲鄰。本區岩石多砂質石灰岩。在支鍋山之東北坡、及黃屯一帶近其上部夾石英岩層。

第三區分佈於暖池塘之東南至劉舉人屯一帶、其北以正斷層與白堊紀火山岩層相接觸、西爲斑岩所侵、南爲花崗岩衝

武紀與奧陶紀之地層。此區岩層多砂質石灰岩。在連寶山近其上部亦夾石英岩層。（第二圖）

第二圖　錦西縣連寶山地層剖面圖

石燧 4 ；岩灰石質砂 3 ：紀旦震5—3 ；紀武寒下(岩頁可饜)岩頁質砂色紅 2 ；紀武寒中(岩灰石夏張)岩灰石狀頗 1 ：紀武寒2—1

床岩入侵 s ；岩英石 5 ；岩灰石

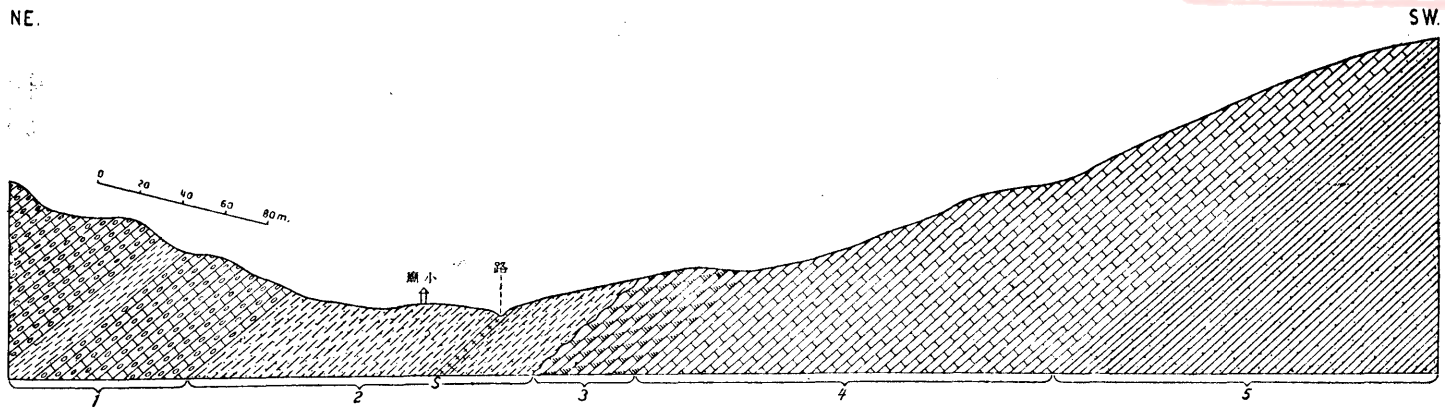


Fig. 2.　Section of Lien-pao-shan, Chin-hsi-hsien.

1—2. Cambrian; 1. Oolitic limestone (Changhsia limestone), Middle Cambrian; 2. Red sandy shale (Manto shale), Lower Cambrian;

3—5. Sinian; 3. Silicious limestone; 4. Cherty limestone; 5. Quartzite; s. Intrusive sill.

第五區分佈於小閻家溝至櫃水溜子一帶，其西與南界以花崗岩，正東及東南與斑岩相接。

第六區分佈於劾蘆島一帶，大致沿劾蘆島之南海濱而分佈。因被火成岩之侵入及斷層之錯折，其露頭復分爲四段。

第一段西起雙泉寺向東延展至望海寺，大部爲大理石層（第二版第四圖第三版第一圖）其含鐵多者風化之後，變爲深紅色之土。

第二段西起望海寺之南山，向東延展以至西山之南坡，阻於斷層。約屬震旦紀地層之下部。其層序自下而上大致如左：

1 長石砂岩、

2 石英岩間夾黑色頁岩、石英岩內水波浪及十字紋層頗顯著

3 黑色板岩、（第三版第二圖）

4 石英岩、（第三版第三圖）

5 大理石層含 Collenia cylindrica

6 白色石英岩、

7 頁岩、

長石砂岩色暗黑或微紅。在望海寺之南下與花崗岩相接。有時且包含花崗岩巨塊。石英岩深淡相間、成條帶狀、大部爲石英粒所組成。粒細勻、質頗堅實、堪供建築之材料。大理石多淡紅色、時含白色砂質圓點。

第三段西起西山之南坡、向東延展以迄東山頂之西坡、及獅子山一帶、組成擬築港灣市場處東、西、南三面之圍山、半碌山（第三版第四圖）及獅子山一帶之高山。其層序大致與第二段同、惟石灰岩因遠離花崗岩、未經變質。前曾有開採燒石灰者、但砂質過多、煉灰不佳、今已停廢。

第四段組成燈籠山一帶之高山、燈籠山之西灣石灰岩層含 Collenia cylindrica（第四版第一圖）上接白色石英岩。

地層厚度各處不一、在下廟子一帶僅砂質石灰岩與燧石石灰岩至少已在三千公尺之上。在靑石嶺一帶約二千公尺、屬震旦紀之上部。在葫蘆島一帶厚自六百公尺至八百公尺、約爲其下部。總計全厚恐不下三千五百公尺。

（三）寒武紀　本紀地層假整合於震旦紀矽質石灰岩之上、分上、中、下三部、總厚約五百五十公尺。下部爲

紅色頁岩夾薄層石灰岩。近其上部有綠色頁岩。厚可二百公尺。中部爲灰色厚層石灰岩與薄層石灰岩、中間夾鮞狀石灰岩、厚約二百公尺。上部爲薄層石灰岩、與竹葉狀石灰岩之間互層、其底部有紅色頁質石灰岩一層、與中部相分界、厚約一百五十公尺。三者均爲整合的接觸、無顯著之分界。惟岩石性質各部不同。據安特生氏報告、謂大窰溝附近寒武紀只有上部蠕狀薄層石灰岩、下與震旦紀相接觸。譚君錫疇亦云本區寒武紀地層只有上部之淡黃色薄層蠕狀石灰岩。（即竹葉石灰岩）其下各部盡付缺如。惟此次路綫所經、則紅螺峴之南鮞狀石灰岩及紅色頁岩均甚發達。在錦西縣北富隆山及落石嶺一帶亦皆見之、葫蘆島亦有相似之地層。故寒武紀之上、中、下、三部在調查區域之內、實尙發育。或有時因斷錯掩覆而不得見耳。

下寒武紀紅色頁岩或饅頭層　岩層多紅色頁岩、間雜綠色頁岩與薄層石灰岩。在虹螺峴村南其地層層序自下而上如左：

1 石英岩、（震旦紀）　2 紅色與棕色頁岩、夾灰色石灰岩扁豆層、　3 灰色薄層石灰岩、　4 棕色頁岩、　5 紅色頁岩與綠色頁岩相間疊、
6 灰紅色石灰岩、　7 紅色頁岩夾石灰岩、　8 紫色頁岩被輝綠岩岩墻所侵、　9 紅色頁岩、　10 薄層石灰岩、　11 紅色頁岩、　12 綠色頁岩、
13 淺灰色石灰岩、　14 綠色頁岩、

總厚約二百公尺、地層較爲完全。

在板石溝、大窰溝、（第三圖）洛石嶺等處、因受斷陷、僅紅色頁岩之一部存留、故層序減薄。在連寶山大部爲紅色砂質頁岩、上與鮞狀石灰岩相接、厚約一百公尺。（第二圖）在高橋村北至仇屯一帶紅色頁岩與綠色頁岩間疊成層。頁岩層薄如紙、溝谷侵蝕、紅綠相映、至爲美觀。其下與震旦紀之石英岩層相接、成假整合。

以上諸處皆未曾尋得化石。惟就其層位與岩石之性質觀之、頗似山東之饅頭頁岩層、約屬下寒武紀。

在葫蘆島震旦紀砂質石灰岩之上、有綠色頁岩與石英岩之間互層。其底部以礫岩與震旦紀地層相分界、總厚近二千公尺。構成半島之脊幹。

第三圖　錦西縣沙鍋屯剖面圖

棕紀炭石上 4　；岩礫岩砂紀叠三 3　；層岩頁岩砂紀聖白下 2　：層岩山火紀聖白 1　；(紀陶奧)岩灰石晰清理層之色灰黃 5　；層岩礫部底與層煤岩頁岩砂之色白灰及，黃質砂，石燧 8　；(紀武寒下)岩頁色綠與色紅 7　；(紀武寒上)岩灰石狀蠕與岩灰石層薄 6

(紀旦震)岩灰石

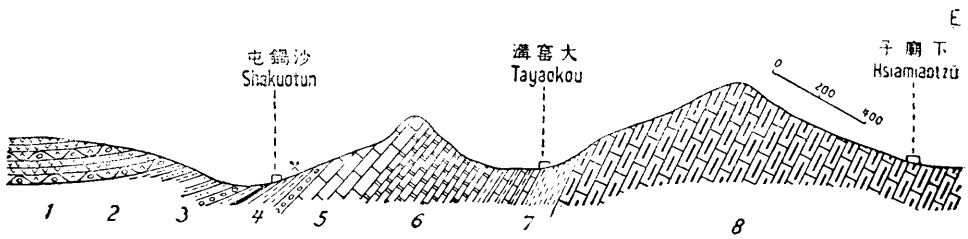


Fig. 3.　Section of Sha-kuo-tun, Chin-hsi hsien.

1. Cretaceous volcanic Series;　2. Lower Cretaceous: sandstone and shale;
3. Triassic: grit and conglomerate;　4. Upper Carboniferous: brownish yellow and grayish white quartzose sand stone, black shale & coal seams with basal conglomerate;
5. Yellowish gray, distinctly bedded limestone (Ordovician);
6. Thin-bedded limestone, wurmkalk and greenish shale (Upper Cambrian);
7. Red and green shale (Lower Cambrian);
8. Cherty and siliceous limestone (Sinian).

凡半島最高之山頂（第四版第二圖）大部爲其所組成。分佈分東西二段、西段西起台子山、向東延長、以至晾房子溝之東嶺、阻於斷層。東段西起東山頂、東至燈籠山之北坡。全系層序自下而上大致如左：

（1）變質礫岩及石英岩。礫岩卵石幾全爲石英岩、大者直徑不滿一公寸、以四、五公分者爲習見。間有一、二小片砂質石灰岩及火石、似來自震旦紀之地層。卵石圓滑、頗似海濱或湖邊久經冲磨之遞積。（2）黑色及灰色頁岩、（3）綠色及灰色薄片頁岩、夾炭質頁岩、（4）灰色石英岩、（5）淺綠色及灰色頁岩、（6）石英岩質勻細堅實、在葫蘆島西部大荒地對面之南山坡、居民開採、用供建築、（7）淺綠色及灰色頁岩、（8）石英岩、（9）淺綠色、黑色及灰色頁岩。

頁岩頗細緻、最易保存化石。但竭力搜尋、除得少許圓棒似硅化木（或爲動力褶皺所成）外、未見其他。砂岩之內多波痕及龜裂、示淺水遞積之徵象。安特生氏曾屬之於震旦紀。但在其底部礫岩之內、確見少許之火石及矽質石灰岩、爲震旦紀之夾雜物。以層位論、又在矽質石灰岩之上。中國北部震旦紀地層尚未見有如是者、故當時作者對之頗懷疑義。今春在仇屯一帶所見下寒武紀之紅、綠色

頁岩、與此殊相彷彿。層位亦極相當、遂姑屬之於此、以待將來之研究。惟下寒武紀地層在虹螺峴一帶最厚不過二百公尺、夾石灰岩薄層。今在葫蘆島厚達二千公尺無石灰岩、屬之於下寒武紀、亦殊費解。或者此區當時逼近海岸、易受遞積。虹螺峴一帶則距岸較遠、遞積較緩、因是厚度有差。又此層在矽質石灰岩之上或與關內之下馬嶺系（參閱地質專報第一號西山地質誌）相當亦未可知。

中寒武紀　鮞狀石灰岩或張夏石灰岩層　以鮞狀石灰岩爲本層之特徵。在虹螺峴村南下部爲灰色厚層石灰岩、與下寒武紀綠色頁岩相整合。中部爲深灰色鮞狀石灰岩、上部爲薄層石灰岩。總厚約二百公尺。在連寶山（第二圖）鮞狀石灰岩直覆於下寒武紀砂頁岩之上、厚約一百五十公尺。鮞狀石灰岩爲中寒武紀之標準地層。在山東張夏、河北開平盆地均有標準剖面、岩石大致相同、皆含中寒武紀之標準化石。

上寒武紀　竹葉石灰岩或鳳山系　岩層多竹葉石灰岩、在虹螺峴村南、底部有一層紅色頁質石灰岩與中寒武薄層石灰岩相分界。其上卽爲竹葉石灰岩與薄層石灰岩及頁質石灰岩之間互層、總厚約一百五十公尺。在與竹葉石灰岩相間疊之薄層石灰岩內有含三葉虫化石一薄層、厚不及半尺。新擊破之面爲灰色、岩層表面呈紅色、三葉虫各部之碎片甚多。此次採集鑑定者有 Ptychaspis suni 。在大窰溝（第三圖）安特生氏於相似層內所採集之化石、經孫雲鑄博士鑑定者有：

Trilobita

1. *Agnostus (andersonia) fengtienensis* Sun
2. *Ptychaspis walcotti* Mansuy
3. *Ptychaspis accamus* Walcott
4. *Ptychaspis chinhsiensis* Sun

Brachiopoda

5. *Eoorthis shakeotunensis* Sun

均爲上寒武紀之標準化石、約與開平之鳳山系及山東之炒米店層相當。其不同者、在山東炒米店以石灰岩爲主、間夾竹葉石灰岩層。在開平

鳳山爲頁岩、薄層石灰岩與竹葉石灰岩之間互層。今在本區僅薄層石灰岩、頁質石灰岩與竹葉石灰岩相間疊缺少頁岩。就岩石之性質言、適跨於以前二者之中間也。

以上三部、各處曝露不一、在虹螺山至大奄屯一帶上、中、下三部均稱發育。在磚瓦窯附近因被斷陷、僅留其上部。在大窯溝至南富隆山一帶僅其上、下兩部較爲發育、中部似付缺如或甚微薄。在連寶山、洛石嶺其上、中、下三部又均甚發育。在高橋至仇屯一帶僅其下部之紅、綠色頁岩露出。在葫蘆島則以下部特別發育、大部爲綠色頁岩與石英岩之間互層、組成葫蘆島之脊幹。

(四)奧陶紀　岩層以石灰岩爲主、下與上寒武紀地層相接、上界以上石炭紀之煤系、均爲假整合。上部石灰岩層厚質純、居民開採、用燒石灰。其分佈之地凡四：

一、在大奄屯、虹螺峴、至磚瓦窯一帶。底部有礫岩一層、厚約一公尺、上與寒武紀地層相分界。礫岩卵石均爲石灰岩、大小不等、角多圓滑、恆帶棕色或暗紅色之養化圈、與開平冶里東方葛利普教授所述之礫岩層無稍差別。礫岩之上爲竹葉狀石灰岩、與薄層石灰岩之相互層、共厚約二百公尺。再上爲深灰色純潔之石灰岩、厚約八十公尺。虹螺峴附近灰窯林立、全以此層爲原料。此層之上尚有二十公尺之灰黃色薄層石灰岩、與上石炭紀地層相接、全系總厚約三百公尺。

二、在大窯溝至南富隆山一帶。在大窯溝上部之灰黃色石灰岩及深灰色石灰岩悉付缺如、僅其下部之竹葉狀石灰岩與薄層石灰岩存在。至南富隆山村之西側上部之深灰色石灰岩始再出露。此處地層亦較爲減薄、總厚不過二百公尺。

三、在錦西縣城東側之小蘭家沟。僅深灰色之石灰岩層存在、下部以斷層與震旦紀之地層及花崗岩相接觸。

四、在錦西縣城之西南黑魚溝至落石嶺一帶、及錦西縣東南連寶山等處。上部灰黃色薄層石灰岩及深灰色之厚層石灰岩均尚保存。其下部之竹葉石灰岩與薄層石灰岩、則受斷層斷陷及侵入岩所衝斷（第四圖）。

第四圖　錦西縣黑魚溝剖面圖

頁 3（紀陶奧下）石化瑚珊含岩灰石淺純色灰 2；岩崗花 1
砂色赭 4；（系原太或紀炭石上）層岩礫有部底層煤及岩砂岩
岩礫與岩（三疊紀）；5 砂質石灰岩（震旦紀）

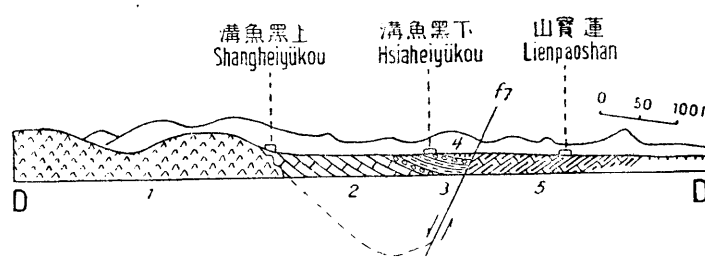


Fig. 4.　Section of Hei-yü-kou, Chin-hsi hsien.

1. Granite;　2. Gray pure limestone with Archaeocyathus (L. Ord.);
3. Shale, sandstone and coal seams with basal conglomerate (up. Carb. or Taiyuan series);　4. Red sandstone and conglomerate (Triassic);
5. Siliceous limestone (Sinian).

綜觀上述、本紀地層各處厚薄固不相同、即各部保留亦殊異致。此等差異固有因斷層而起者、如小蘭家沟是。但亦有確係原來層序、未經斷陷、此或由於上石炭紀煤系遞積以前、本區曾爲大陸、遭受侵蝕、侵蝕程度各處不同、是以有此差異也。上黑魚溝深灰色之石灰岩內曾尋得 Archaeocyathus 化石、約與河北省臨榆縣之北林子層相當、屬下奧陶紀。惟在河北開平一帶、下奧陶紀地層之上、尙有三百公尺之中奧陶紀馬家溝石灰岩。卽下奧陶紀爲層亦較厚（約四百公尺）。今在本區則盡付缺如、侵蝕之說、益足徵信。

（五）上石炭紀　地層以礫岩、砂岩、頁岩爲主、砂岩、頁岩之間夾煤層。以假整合位於奧陶紀石灰岩之上。分佈之地有三、自北而南：

一、大窰溝區、煤系底部有綠色頁岩及礫岩一層、與奧陶紀石灰岩相接。礫岩卵石均爲勻細之白色石英岩、缺少奧陶紀之石灰岩。厚度約十四公尺、地層似曾經錯動。礫岩之上大部爲黑色及綠色頁岩、厚約一百一十公尺、中夾煤層。煤系總厚不過一百五十公尺。其上爲三疊紀石英砂岩、礫岩及磨石層。

二、虹螺峴區、底部以礫岩層與奧陶紀地層相分界。地層分上、下兩部、下部爲砂岩、礫岩、砂岩呈淺灰色、粒頗粗大。礫岩爲淺灰或淺黃色、卵

石多石英岩、燧石、及砂質石灰岩等、徑大者至數寸、層厚質堅。礫岩與砂岩之間夾薄層頁岩。上部爲黑、灰諸色頁岩、與煤層相互間、間夾淺灰色薄層粘土、灰砂岩、及礫岩。愛商煤鑛北大井所穿之地層近其上部、層序自上而下如左：

1 黃土厚度未詳　2 粗砂岩四十五尺　3 礫岩十八尺　4 黑色頁岩八十尺　5 薄層煤一尺五寸　6 黑頁岩未透過

三、下黑魚溝區、僅底部之礫岩露出、在黑魚溝西南假整合於奧陶紀石灰岩之上。其東南界以斷層（第四圖。）據當地煤窰穿洞所見、地層以黑色頁岩、灰色頁岩爲最多。餘則爲泥質灰色頁岩、淡灰色粘土、黃色頁岩等、中夾煤層。

在虹螺峴及大窰溝、煤系上部黑色頁岩內及灰色粘土層中皆含植物化石、有左列四種：

1. *Neuropteris* sp.
2. *Pecopteris* sp.
3. *Sphenophyllum* sp.
4. *Annularia* sp.

均屬上石炭紀、約與河北開平煤系相當。惟其下部缺少中石炭紀之本溪系、卽在本系之內亦無石灰岩之海成層、而多底部之礫岩層、煤層亦大減薄、是其異耳。

（六）三疊紀　假整合於上石炭紀地層之上、恒追隨煤系而分佈。底部以紅色砂岩層與上石炭紀地層相分界、其上爲紅色砂岩與礫岩之間互層。岩質大抵堅實、突出煤系、組成岡嶺。居民稱之爲老墻、視爲探尋煤系之指南。在虹螺峴組成蛤蟆山、渣子山、西大嶺一帶之岡嶺、下部爲灰、黃、紅諸色粗砂岩、含礫石。上部富礫岩。礫岩卵石多粗巨、富淺紅色及灰色石英岩、總厚約一百公尺。在大窰溝至南富隆山一帶下部多淺灰、灰紅或白

色石英砂岩及磨石、上部爲紅色砂岩夾礫岩、總厚六十公尺。在黑魚溝以紅色砂岩及礫岩爲多。砂岩頗細緻、似凝灰砂岩。礫岩中之卵石均光滑圓巨、磊磊比列、大者徑在一尺之上、大部爲石英岩。本層因未尋得化石、其時代難以確定。惟在中國北部古生代地層與中生代之間、時有上下兩砂岩層。在下者爲白色石英砂岩、上爲紅色砂岩、二者之間似有間斷。如下砂岩層屬於上二疊紀。則上層之紅色砂岩似應爲三疊紀、今在本區所見多係紅色砂岩、姑屬之於三疊紀、以待將來之研究。

（七）白堊紀　分上、下兩部、下部爲砂礫岩、近其頂部時夾煤層。上部爲火山岩層、有凝灰岩、安山岩、粗面岩、塊集岩等。下部砂礫岩位於三疊紀砂礫岩層之上、其接觸處適爲沖積層所掩覆、未得詳細之觀察。然就層序推之、似仍爲假整合。岩石隨地而異、厚薄亦殊。在虹螺峴蛤蟆山之北至郜集屯一帶、下部地層以灰、黃、紅、諸色砂岩及淺棕色礫質頁岩爲主、間有火成岩侵入體。在郜集屯附近有礫岩一層、與砂岩頁岩相間疊、內含煤質。礫岩卵石多石灰岩、其上有厚數十公尺之砂岩、頁岩及含鐵粘土層等。在大荒地長嶺溝一帶、岩層以綠黃色砂岩、礫岩、綠色、淺紅色、黑灰色泥質頁岩、粘土、與白色石灰質頁岩等最多、中間夾煤層、總厚約一百公尺。沙鍋屯至南富隆山一帶岩層爲紅、灰、灰白、紫及淺綠諸色砂質頁岩及砂、頁岩等。近其上部夾炭質頁岩層、總厚約八十公尺。岩石大抵疎鬆、凡其分佈之地多成溝谷。在葫蘆島台子山南坡以斷層與其下部寒武紀地層相接觸（第五圖）。岩層有砂岩、頁岩、及礫岩。卵石有大至一公尺者、以砂岩及石英岩爲最多。間有一二塊寒武紀底部礫岩之卵石。砂岩礫岩之間有煤二層、惟厚不及一尺、且地層傾向東南、正斜入海、無開採之價值。安特生君在大荒地於頁岩內採得 Nilsonia 及 Cladophlebis、屬之於侏羅紀。後譚君錫疇在義縣相似地層之內採得

第五圖　葫蘆島西南部台子山剖面圖

1—3 葫蘆島層(寒武紀?)：1 石英岩；2 礫岩；3 岩頁　4 大理石(震旦紀)；5 礫岩，砂岩，岩頁夾煤層(白堊紀)；6 花崗岩

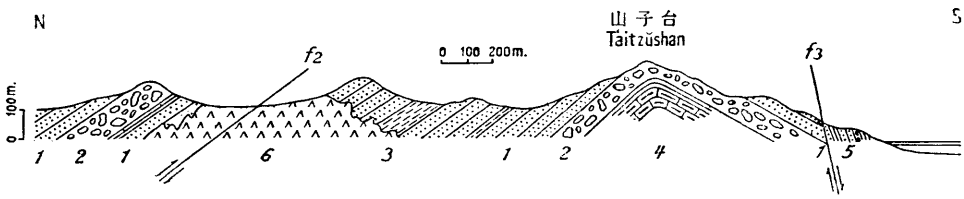


Fig. 5.　Section Through Tai-tze-shan, Hu-lu-tao.

1—3. Hulutuo Formation (Cambrian?);　1. Quartzite;　2. Conglomerate;　3. Shale;
4. Marble (Sinian);　5. Conglomerate, sandstoue & shale with coal seams. (Cretaceous);
6. Grainte.

Compeloma sp. 及 Corbicula sp. 動物化石、經葛利普教授鑑定、謂爲白堊紀之化石。譚君卽依之改屬於白堊紀、並在前篇反覆申論、大致較爲可信矣。吾等在葫蘆島台子山之南坡於灰色砂質頁岩內亦尋得 Cladophlebis sp. 化石。

下中白堊紀火山岩層不整合於下白堊紀砂礫岩層之上、底部以塊集岩層與下白堊紀地層相分界。岩石以凝灰岩、流紋岩爲最多、間有花崗斑岩及石英斑岩侵入體。凝灰岩恆成層狀、粗細堅疎不同、有棕、紅、紫、綠、灰黃等色。岩流亦多爲層狀、帶气孔、及流紋。在調查區域之內、分佈甚廣。因逆斷層之錯斷、分爲南北兩區。

一、南區、自錦縣向西延展、以至馬成業、燉台山一帶。在燉台山之西因受逆掩斷層之錯斷、一部向西凸入、經筆架山、和尙溝、千總台、上下札木溝入熱河之朝陽界。岩石下部有塊集岩、粗面岩、安山岩、凝灰岩及流紋岩。在張帽山之南嶺、夾綠色及灰黑色頁岩層。上部爲紅色及棕色之安山岩、間夾紅土層與凝灰岩。組成陳地方溝一帶之高山、峯巒矗起、巍峙挺秀。

二、北區、分佈於砂鍋屯之西北、組成大窯溝煤田西北一帶之高山、大部爲斑岩或粗面安山岩。全系總厚至少在一千公尺之上。中國北部火山岩層分佈極廣、有屬之於下白堊紀之上部者、有屬之於中白堊紀之下部者。在本區火山岩層之下已有下白堊紀之地層、似屬之於中白堊紀爲宜。

（八）第三紀　紅土層、多分佈於山谷或河旁、直覆於各紀地層之上、成明顯之不整合。在葫蘆島、下部爲紅土、上部之紅土夾石塊、底部未露出。惟在葫蘆島雙泉寺之西南、見礫岩一層、直覆於震旦紀大理石層之上、成不整合之接觸。礫岩卵石多石英岩、大者直徑至一公尺、（第四版第三圖）粘着物殊疎鬆、向西延展半里、直至海濱之洞內。按其分佈之情形、不似較老之地層。但因有粘着物、確已成礫岩、或爲紅土之底層也。在支鍋山北麓溝中、下部全爲紅土、逕覆於震旦紀地層之上。上部爲紅色土、總厚約五公尺。在小南屯之北山直覆於奧陶紀石灰岩之上、奧陶紀石灰岩中之裂罅爲其所塡塞。其情形與河北房山縣周口店之富含骨骸化石裂罅遞積無稍差異。

紅土沿山坡分佈、最高之限度不能超過三十公尺。三十公尺以上山巖顯露、石骨磷磵。三十公尺以下、大部爲紅土所掩覆。現雖溝谷縱橫、不相連續。但登山俯視、其原來在山谷中之情形、尙可依稀辨識、頗似盆谷遞積。當時溝谷必大部爲紅土所塡塞、即現在小南屯以北之石灰岩山嶺亦大約完全埋沒於紅土層之下。就當日之紅土地面言、山嶺必較今日爲低、坡緩谷平、遞積勝於侵蝕、成一進步之成年地形。

由是可推知紅土遞積之後、侵蝕又漸趨於劇烈、以致紅土又被侵蝕、構成今日之溝谷。普通侵蝕轉劇、其因有二。一爲地面之隆起、二爲氣候之潮濕、在調查區域之內、則二者似兼備也。

紅土層生成之時期、尙無相當化石證明。在小南屯之北其充塡奧陶紀石灰岩裂罅之情形、既與河北省房山縣周口店之骨骸化石層相同、性質亦復相似、約有同年之可能。或屬上新統。

（九）洪積統　黃土層、本區域內標準黃土不甚發育。大部爲次生黃土、位於紅土層之上。其內恒夾礫石及

砂層。多爲層甚薄、分佈於河旁或谷邊。

侵入岩

本區侵入岩有花崗岩、花崗斑岩、石英斑岩、輝綠岩、安山岩、玄武岩等。除花崗岩在錦西一帶區域稍廣、組成陡山巨嶺外、其餘各侵入體皆散佈零星、僅成岡阜或丘陵、無顯著之形跡。試列述如後。

（一）花崗岩　太古界花崗岩已見前述、尙有侵入時代較新之花崗岩分布頗廣、分述如下。

一、葫蘆島區復分爲東、西北、三段、西段在龍灣附近、東段在西山之南坡、與小工房之對側。皆侵入於寒武紀地之層內。（第四版第四圖、第六版第一圖）北段在小工房東北之對山。

主要造岩鑛物爲長石、石英。結晶分組細二種。晶粒粗者、質疎鬆、易風解、如龍灣一帶是。晶粒細者質勻密、抵抗風化之力强、如小工房之西南溝、尖山頂之東坡是。

二、大小虹螺山區、以大、小虹螺山爲侵入之中心、環錦西縣城而分佈、西北至馬相屯、西南至天橋頂、東至小虹螺山、南迄劉台子一帶。大、小虹螺山巍然聳立屹壁絕崖、矗入雲霄、上建蘭若、可矚海波、稱附近風景之冠。四周與太古界、震旦紀、寒武紀、奧陶紀、石炭紀各地層均有接觸。（參閱附圖）俱受其侵入而變質。鑛物結晶率多粗大、以石英長石爲最富。黑色鑛物稀少、故石色赭紅。普通易於風解、流爲散砂。其晶粒細勻者較爲堅密、抵抗風化及侵蝕之力亦大、堪供建築之材料。

在喂牛塢西南、近其邊際、有黑色條帶、呈片麻紋理、頗似片麻岩、與太古界片麻岩似不易分。但此種構造係因其侵入之際、鄰近水成岩被包圍於內、熔蝕化合而成。其變化輕微者、原來面目、尙可辨識。凡巨大花崗岩侵入體、其邊際恆有此現象、不能依此即歸之於太古界也。

（二）花崗斑岩　侵入於白堊紀火山岩層之下部、及白堊紀紅色砂岩之上部。石色灰白、斑晶顯著、有長石、石英及黑雲母三種。長石復分正長石、斜長石二類。石基完全結晶、多正長石及石英、間有斜長石、均呈細微之

第六圖　葫蘆島南海岸之岐叉輝綠岩岩牆

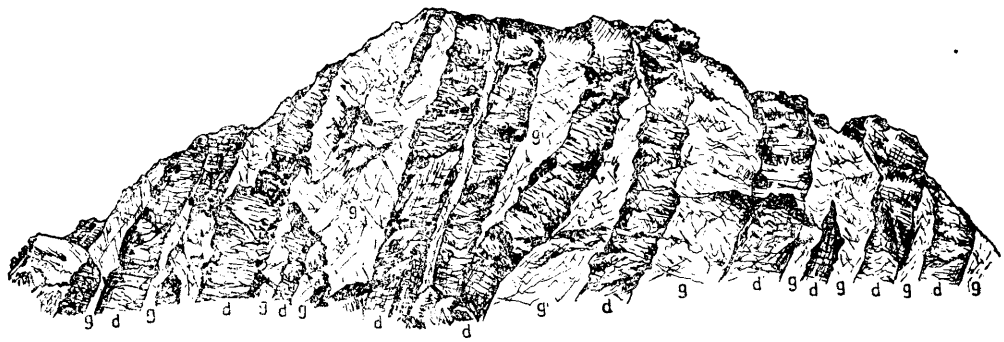


Fig. 6. The bifurcating dykes of diabase in the granite on the southern shore of Hulutao.

g 粗粒花崗岩　　d 分叉輝綠岩岩牆

g. Coarse granite.　　d. Diabase dyke.

晶粒。分佈之地凡二、一在暖池塘、嚴家洵至富有屯一帶、大致成東西之排列、侵入於白堊紀火山岩層之下部。二在錦西縣之東北境徐家溝至大荒地一帶、侵入於下白堊紀紅色砂岩之內成岩脈。

（三）石英斑岩　僅見於葫蘆島、侵入於震旦紀、白堊紀、以及花崗岩內、均爲岩墻。主要造岩礦物有石英及長石。石英斑晶較多故名之曰石英斑岩。大致抵抗風化之力甚微、在地面恒成深槽。

（四）輝綠岩　見於葫蘆島西山南坡海濱花崗岩及震旦紀地層之內。望海寺西北花崗岩中亦不少。岩牆、岩床錯縱分連、極侵入之美觀。（第六圖及第五版第一圖）岩色暗黑、時具輝石、角閃石及長石之斑晶。長石斑晶多者酷似安山岩。石質堅實、恒突出圍岩、造成石牆、與石英斑岩之凹陷成溝者適相反。

（五）安山岩　分佈於錦西縣東北境大荒地一帶、侵入於白堊紅色砂岩之內、成侵入岩層。石色灰白或灰黃、多斑駁之狀。顯微鏡下斑晶以斜長石爲最多、角閃石次之、正長石亦間有蹤跡。石基完全結晶、多針狀斜長石。在暖池塘附近、組成西山一帶之高嶺。

（六）玄武岩　石色深黑、用肉眼觀察全體結晶細緻。但在顯微

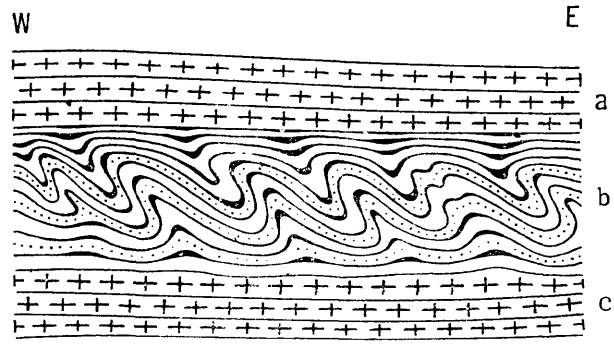
鏡下斑晶顯著、有斜長石及橄欖石。斜長石結晶完全、晶體多不甚大。橄欖石晶形不完整。石基完全結晶、由斜長石針及橄欖石晶粒所組成。其主要侵入之地爲八道河子、吳金堂至萬家屯一帶。大致追隨一大逆掩斷層面。次爲傅家屯東北方之小山。其他則零星散佈。在愛商煤鑛之西北、侵入於白堊紀紅色砂岩之下部、成爲岩脉。

侵入岩之時代　在中白堊紀本區火山爆發、灰塊凝結、構成凝灰、塊集等岩。岩漿活動、侵溢地表、成爲岩流。統稱之爲火山岩層。中白堊紀者本區火山之唯一活動期、亦即各侵入岩之主要生成期也。惟侵入岩之成分各不相同、其時間亦略有先後。大致言之、最先爲安山岩。因安山岩侵及最新之地層爲下白堊紀之紅砂岩層、在中白堊紀火山岩層中又僅發育於下部。其他各侵入岩則橫穿中白堊紀火山岩層。依此推論雖不能謂爲絕對確實、要亦不無多少根據。

次爲花崗岩、就本身言、與其接觸最新之地層爲上石炭紀煤系、曾受其侵入而變質。據此則僅能謂其生成之時期晚於上石炭紀。但在嚴家溝富有屯一帶、有花崗斑岩曾侵入於中白堊紀火山岩層之下部。其成分酷似粗粒之花崗岩、但賦體較小、侵入較高、結晶較細。若使二者果爲同源同時、其結晶之差異、僅由於生成狀態之不同、則二者侵入之時期至早亦當不能越過中白堊紀。至其晚至何時僅在虹螺山一帶尙難推斷。但由葫蘆島南海濱、花崗岩曾受斷層觀之、似亦不能晚於白堊紀。因本區主要的斷移均在白堊紀也。

花崗岩侵入之後繼爲石英斑岩及輝綠岩。因在葫蘆島石英斑岩及輝綠岩俱侵入於花崗岩之中、故其生成之時期又當晚於花崗岩。惟二者孰先孰後、則以無相交或相切之證據、不敢斷言。

第七圖　葫蘆島半嶺山北震旦紀地層內之褶皺



a, c 白色石英岩　b 紫砂頁岩及黃頁岩

Fig. 7. Typical intraformational folds in Sinian beds, north of Pan-la-shan, Hulutao.

a, c. White quartzite; b Purple sandy shale & yellow shale.

玄武岩侵入最晚。因玄武岩主要分佈大致追隨一逆掩斷層面、其侵入似在逆掩斷層之後。

地質構造

調查區域之內、地層分佈錯雜零散、構造極爲複雜。局部褶皺雖所在多有、惟不如斷層之廣遠與顯著。故言本區地質構造、斷層影響於山脈之構成、實視褶皺較爲重要、試分述之。

（一）褶皺　本區地層褶皺較顯著者有三、一爲葫蘆島背斜層、二爲黑魚溝向斜層、然均範圍狹小、不甚重要。三爲白土溝背斜層、分佈較爲廣遠、組成通裕支路以北白土溝一帶之山嶺。其餘局部曲褶、倒置褶皺、（第七圖及第五版第二圖）亦數見不鮮。但僅影響其所在之山嶺、對於全區之構造、無多大之關係。

一、葫蘆島背斜層、自葫蘆島全體觀之、似爲一不對稱之背斜層、背斜中軸偏近於島之南海濱、適在震旦紀地層露出之地帶。（第八圖）是以半島北坡之地層多傾向東北、愈近東北、地層應愈新、寒武紀之砂岩頁岩曝露。半島南坡海濱之地層反轉向東南。地層傾斜角各處不同、約自六十度至三十度。南翼有時畧急於北翼。

二、錦西縣黑魚溝向斜層、錦西縣南之富兒溝、下黑魚溝、白楊木溝以至落石嶺一帶之煤田適當一向斜層、向斜中軸逼近白楊木溝下黑魚溝、走向大致爲東北西南。白楊木溝、下黑魚溝以北之地帶當向斜層之西北翼、地層傾向東南、愈偏西北而愈古、與陶寒武、震旦、等紀之地層、

相繼露出。傾斜角約在三十度左右。向斜層之東南翼適被斷層所切斷，三疊紀之砂礫岩遂遜與震旦紀地層相接。（第四圖）向斜軸大致東北高而西南低，故愈近東北而地層愈不完全。在洛石嶺一帶僅與陶紀石灰岩組成向斜層之中心，自上石炭紀煤系以至三疊紀之地層均被侵蝕不見。（參閱附圖）

第八圖　自光頂山至望海寺剖面圖（AA）

具岩麻片 5 ；(紀陶奧下)岩灰石灰純色灰 4 ；(紀武寨上，中，下)岩灰石狀蠕，岩灰石狀鮞，岩頁色紅 3 ；(紀旦震)岩灰石質砂 2 ；岩崗花 1

石 10 ；石理大 9 ：紀旦震 10—9 ；岩礫 8 ；(?紀武寨)層島蘆葫8—7 ；層積冲 6 ，(界古太)脈岩岩崗花晶偉

岩崗花 11 ；岩板與岩英

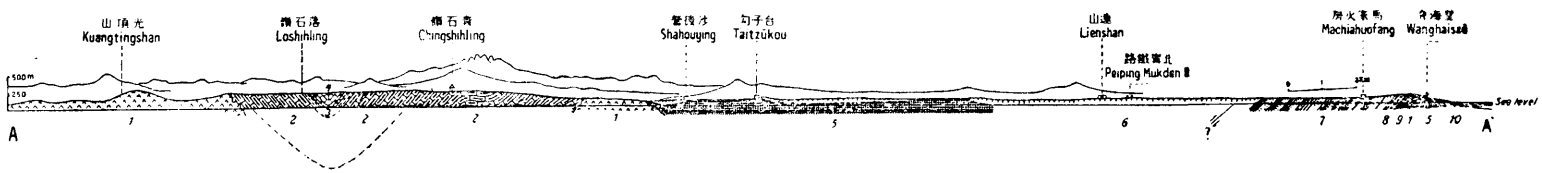


Fig. 8.　Section A A′ (from Kuang-ting-shan to Wang-hai-ssu)

1. Granite;　2. Siliceous limestone (Sinian);　3. Red shale, oolitic limestone and wurmkalk (Lower, middle& upper Cambrian);

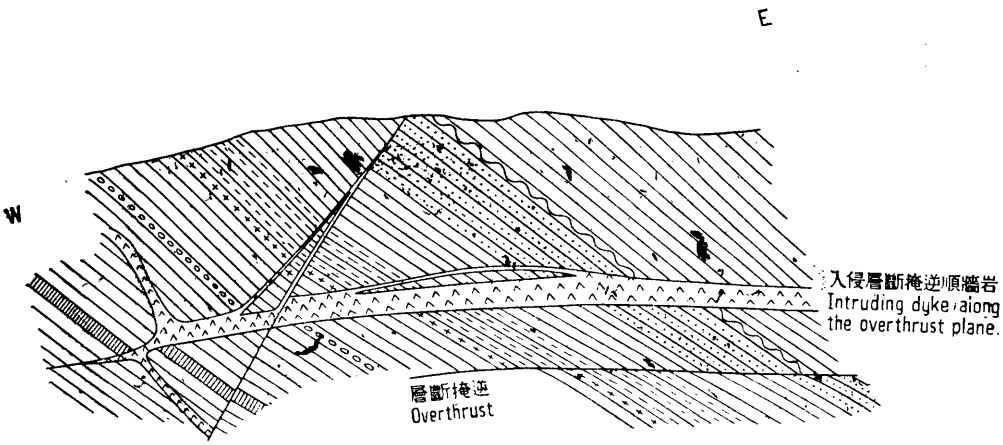
4. Gray pure limestone (L. Ord.);　5. Gneiss with pegmatite dyke. (Archæan);　6. Alluvium;　7—8. Hulutao formation; (Cambrian?)

7. Shale interbedded with quartzite;　8. Conglomerate;　9–10. Sinian;　9. Marble;　10. Quartzite, slate;　11. Granite.

三、白土灣背斜層，沿通裕鐵路西北自下廟子東南至大荒地一帶，峯巒重疊，嶺嶂綿亘，全爲震旦紀之砂質石灰岩所組成。余路線所經，僅自蘭家屯至下廟子一段，蘭家屯以東，未克調查。在下廟子一帶地層傾向西北，傾斜角在六十度左右。遙瞰蘭家屯東北之地層傾向似反轉向東南或東北。余曾疑此一帶山嶺大約爲一背斜層。否則地層傾向各不轉變。以下廟子一帶地層之傾斜角度逕行計至大荒地，則震旦紀地層之厚度將不下萬餘公尺，頗爲費解。當時在蘭家屯西北之鐵路剖面上即發見地層褶皺甚烈，間有倒置者，蓋屬局部的波皺，前說不無可信。當

第九圖　葫蘆島南海岸小逆掩斷層剖面圖

Fig. 9. Minor overthrust on the southern shore of Hu-lu-tao.



前調查陳地方溝一帶之際、曾乘便過女兒河至黃土坎村之東北、所記其當地震旦紀矽質石灰岩傾斜之方向爲東北、傾斜角約在二十五度至三十度之間、前說於是證明。背斜層之中軸偏近黃屯、白土溝一帶。中軸之西北凡震旦紀、寒武紀、奧陶紀、上石炭紀、三疊紀、上中白堊紀之地層、悉次第曝露、頗稱完全。其東北則逕被中白堊紀之火山岩層所覆蓋。二者之間、地層缺漏甚多。

（二）斷層　本區斷層甚爲發育。尤以逆掩斷層爲多。大凡逆掩斷層之發生、多由於橫力之推動。斷層面之傾斜角度平緩、常爲浮土所掩蓋、不易觀察。本區所見固有露頭清晰、確切無誤者。亦有斷層面爲浮土所掩覆而推想其爲逆掩斷層者。余所以推想其如此、蓋有左列二因。

一　沿葫蘆島南海濱局部小斷層甚多、多屬逆掩斷層之一類。斷層面傾斜角大致在二十度至三十度之間。（第九圖及第五版第四圖）

二　凡較古地層與較新地層因斷層相接觸之地、二者傾斜之方向恒大致相同。斷層面且多向較古地層傾斜。有此二因、遂推定葫蘆島之斷層多係逆掩斷層之一類。當時據此觀察事實曾疑及

君錫疇之女兒河大斷層或亦爲掩逆斷層。曾與偕同調查之德日進君相討論、德君亦頗以爲然。並舉其昔日在連山影壁山一帶之觀察、以爲佐證。謂該處有震旦紀之石英岩不連續的露頭數段、確作魚鱗狀、錯覆於太古界花崗岩之上。今年春作者乘調查通裕鐵路鑛產之便、特赴陳地方溝、大荒地一帶、以探求女兒河斷層之究屬何類。惟該處因被冲積層所覆蓋、未能得其眞相。當自虹螺峴赴沙鍋屯之路上、在筆架山之西南坡復橫逾該斷層。此處露頭較爲清晰。震旦紀之矽質石灰岩確逆掩於中白堊紀火山岩層之上、中間界以斷層角礫岩。斷層面傾向西南、傾斜角約在四、五十度之間。(第十圖)於是從前僅爲想像的逆掩斷層、又經事實之證明。據此則以下之所謂露頭糢糊、而推想其爲逆掩斷層者、亦不無多少之可信也。

第十圖　筆架山剖面圖

1 矽質石灰岩(震旦紀)；2 斷層角礫岩；3 玄武岩風化面帶綠色

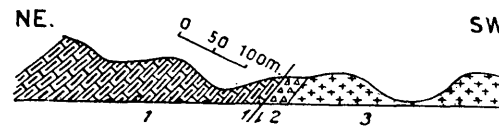


Fig. 10. A Section of Pi-chia-shan

1. Siliceous limestone (Sinian);
2. Fault breccia;
3. Basalt of greenish color in weathered surface.

一、葫蘆島各斷層、明顯之斷層凡四、屬逆掩斷層者三、正斷層者一。(1)燈籠山北面逆掩斷層、燈籠山爲矽質石灰岩及石英岩所組成、地層走向近於南北略偏東或西傾、向東稍偏南。其北爲寒武紀之綠色頁岩層、傾向東略偏北或南、與震旦紀地層傾斜之方向相差無幾、故似倒置於其下、二者之間當有斷層。惟因斷層線向東北突轉、燈籠山震旦紀之矽質石灰岩似有向北推動之勢、以致覆掩於寒武紀綠色頁岩之上、故想像其爲逆掩斷層。(2)爲西山東坡逆掩斷層、斷層線走向大致爲南北、沿西山之東坡、適位於花崗岩之中間。其東爲震旦之板岩、與石英岩層、傾向東畧偏南。西爲寒武紀之綠色頁岩層。在葫蘆島西山南坡之海濱花崗岩一部感受斷層之錯斷、變爲斷層角礫岩。斷層面傾斜向東南、是以震旦紀之地層有由東南向西北推移之勢。(3)爲台子山北逆掩斷層、斷層線亦位於花崗岩之內、適處於溝谷之中、故未見斷層角礫

岩，但其南與北均有東西之橫嶺矗立對峙，均爲寒武紀底部礫岩所組成。按二山頂部之礫岩原屬一層，因其重疊傾斜一致，遂亦推想其爲逆掩斷層。（第五圖 f_2）（4）爲台子山南坡斷層，屬正斷層，斷層線大致沿海濱，成東西方向。適位於背斜層之南翼，北爲仰側，南爲俯側。（第五圖 f_3）故白堊紀之砂礫岩還與寒武紀之綠色頁岩層相接觸。沿斷層線角礫岩殊發育。

第十一圖　沈家屯至羅石紅自圖面剖BB′

石色灰 4　；(系原太或紀炭石上)岩礫有部底層煤與岩砂，岩頁 3　；岩礫紀叠三 2　；(紀墨白)岩頁岩砂與，岩礫山火，岩灰凝，流岩 1 砂 1a；層積冲 7　；(紀旦震)岩灰石質砂 6　；(紀武寒上，下)岩灰石狀蠟與，岩灰石，岩頁色綠，色紅 5　；(層子林北之紀陶奧下)岩灰岩斑崗花 10　；(界古太)脈岩崗花晶偉具岩麻片 9　；(紀叠三)岩礫與岩砂色赭 8　；(紀墨白)層煤狀豆扁夾岩礫與岩頁，岩

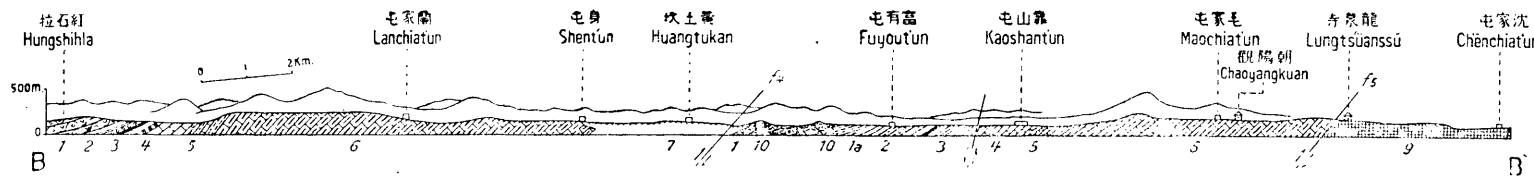


Fig. 11.　Section B B′ (from Hung-shih-la to Shin-chia-tun);

1. Lava, tuff and agglomerate (Cretaceous);
2. Triassic sandstone & conglomerate;
3. Shale, sandstone and coal seams with basal conglomerate (up. Carb. or Taiyuan series);
4. Gray limestone (L. Ord.);
5. Red shale, oolitic limestone and wurmkalk (Lower, middle and upper Cambrian);
6. Siliceous limestone (Sinian);
7. Alluvium; 1a. Sandstone, shale and conglomerate with coaly lenticules. (Lower Cretaceous);
8. Red sandstone and conglomerate (Triassic);
9. Gneiss (Archæan).
10. Granitic porphyry.

二）義縣錦西縣小凌河女兒河逆掩斷層自錦西縣西北滑石山之北西北行過小凌河至義縣沈家台轉向東北經棋盤山而東北，砂質石灰岩與中白堊紀火山岩層還相接觸，中間地層間斷殊多。（第十一圖 f_4）譚君錫疇謂此乃起於正斷層，東爲俯側，西爲仰側。仰側之砂質石灰岩組成義縣朝陽交界之松嶺山脈。西與女兒河正斷層相連。但據著者在筆架山之觀察，女兒河斷層確爲逆掩斷層（第十圖）斷層面西自

第十二圖　虹螺峴村西剖面圖

1—9 上石炭紀：1 礫岩具圓石英質砂岩礫；2 紅砂岩；3 灰色頁岩；4 白色黑色石英質砂岩；5 石英狀礫岩；6 紅色頁質砂岩；7 紅色砂質頁岩；8 黑色頁岩；9 棕色石英岩；10 灰色或深灰色石灰岩(下奧陶紀)

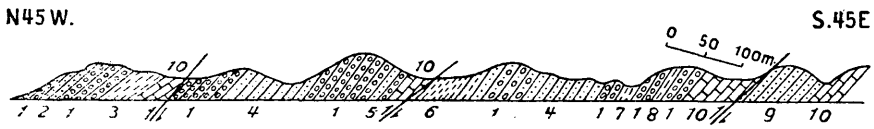


Fig. 12. A Section to the west of Hung-luo-hsien

1—9 U. Carboniferous: 1. Conglomerate with well rounded quartzite pebbles; 2. Red sandstone; 3. Gray hard shale; 4. White grit & sandstone; 5. Conglomeratic quartzite; 6. Red shaly sandstone; 7. Red sandy shale; 8. Black shale; 9. Brown quartzite;

10. Gray or dark gray thinnly plated limestone. (L. Ord.).

八道河、經筆架山、大荒地、至滑石山、與小凌河斷層相連。因此余推想小凌河斷層或原爲女兒河逆掩斷層之連續的延展、並非又自成一斷層。用此解說、較譚君之解說優勝之點有二、譚君之兩正斷層可由一逆掩斷層解釋之一也。滑石山一帶之砂質石灰岩狹長如帶、其北、南與東三面皆浮於白堊紀火山岩岩層之上、此種地層的構造似以逆掩斷層解釋之爲近理二也。惟作者未克躬歷其間、實在情形如何、究尚未敢斷言也。

三龍泉寺和尚溝逆掩斷層、小虹螺山之東、龍泉寺和尚溝之北有小山一列、東西延長如帶、爲震旦紀砂質石灰岩所組成、其南與太古界片麻岩相接觸、底部之石英岩層與板岩均未露出、其北與中白堊紀火山岩層相接觸、凡寒武紀、奧陶紀、上石炭紀、三叠紀、下白堊紀等之中間地層亦皆付缺如。再就震旦紀本身言、亦嫌爲層太薄。是以其南北兩方當皆有斷層。因其地層傾斜向北或東北。故仍想像其爲逆掩斷層、（第十一圖 f_5）震旦紀之砂質石灰岩、因之自北向南推移、故與支鍋山相隔斷。

四、虹螺峴煤田平移斷層、沿虹螺峴煤田之東南緣、有大致東北西南方向之平移斷層兩列。一在虹螺峴之東、四家子馬成業山一帶。東方白堊紀之火山岩層、向南推移、致與支鍋山之震旦紀地層相分斷。二在前金台子、靠山屯、圖山子、板石溝一帶。斷層線西側之部份、亦向南推移、在靠山屯附近、適當斷層帶、上石炭紀礫岩層與奧陶紀石灰岩錯斷重叠、至三次之多。（第十二圖）在虹螺峴村南端之小山上、二者又確示逆錯之徵象。

五、錦西縣下黑魚溝煤田斷層、錦西縣西南境下黑魚溝煤田之東南緣爲西北東南向之斷層所切斷、東南部之震旦紀矽質石灰岩爲仰側、西北部之石炭紀煤系及其上之砂岩礫岩層爲俯側、（第四圖 f_7）屬正斷層。因此三叠紀之砂礫岩層遂與震旦紀矽質石灰岩相接觸。

其他斷層　除上述各大斷層之外、局部小斷層所在多有、其較重要而顯著者、如黑魚溝之東北、爲一傾向斷層、致將黑魚溝向斜層之北端向東南推移。又沙鍋屯煤田之東北部沿小凌河一帶亦有一傾向斷層、致將小凌河東之地層向北推移約七百公尺。其他如暖池塘東南、震旦紀之矽質石灰岩突起於中白堊紀火山岩層之南。在小蘭家沟、奥陶紀石灰岩逕與震旦紀矽質石灰岩相銜接。在偏臉子附近、於震旦紀矽質灰岩分佈之地、一部白堊紀火山岩層出露。在虹螺峴煤田、炸子山、蛤蟆山原爲同一礫岩層所組成、而渣子山向南推移、以致不能相連貫。在連寶山、震旦紀石灰岩復露出於寒武紀地層之東北、殆皆由局部斷層而起也。

茲按全區主要之構造試進而言地層所以如此情形分佈之大概。按地層分佈之狀態、約可分爲五區。

一　葫蘆島區、全島似爲東西方向之背斜層所組成、又益以各逆掩斷層、故地層分佈散亂。地層之走向大致爲東西、間有偏西北與東南者。與黑魚溝一帶地層走向之爲東北西南者殊不一致。北翼地層傾向東北、以震旦紀與寒武紀之地層爲最發育。南翼傾向東南、有震旦紀及白堊紀之地層。

二　錦西區、位於連山之西、大小虹螺山之南、東起於片麻岩、東北限於虹螺山斷層。在西南黑魚溝一帶、因褶皺成一向斜層。震旦紀、寒武紀、奥陶紀、石炭紀以及三叠紀砂礫岩皆斷續露出。地層走向大致爲東北西南、至青石嶺一帶、地層走向變而爲西北東南。北至虹螺山被花崗岩所侵斷。青石嶺一帶、地層走向之轉變、或與花崗岩有關。

三　爲虹螺峴區、位於大小虹螺山之北、以虹螺山花崗岩與錦西區爲天然之分界。南起於虹螺山斷層、北

以女兒河斷層爲限。自南而北先爲震旦紀矽質石灰岩、繼以寒武、奧陶、石炭、三疊、白堊等紀之地層。在西部地層走向大致爲東西、略偏北。傾向北略偏西、傾斜角自十五度至四十八度。近其東部因受平移斷層之影響、地層走向轉變爲東北西南。地層曝露亦不完全。此區或原與錦西區相連、後因受大、小虹螺山花崗岩斜亘侵入、遂斬破爲二。

四　大荒地、砂鍋屯區、位於女兒河斷層之北、其西北部地層頗稱完全、自震旦紀以至白堊紀之火山岩層均有曝露。走向爲東北西南、傾向西北、傾斜角自三十度至五十度。在東南部震旦紀矽質石灰岩層之走向變爲西北東南、傾向東北。與西北部相連、有成背斜之趨勢。此區蓋因感受小凌河、女兒河逆掩斷層之影響自西北向東南橫移而成。

五　錦縣義縣區、位於女兒河、小凌河逆掩斷層之東。自錦縣至義縣間之地層以白堊火山岩層爲最發育。其岩層傾斜多不清晰、有時向南南東、傾斜達三、四十度。但普通較爲平緩。此區因火山岩系特別發育、大半下部地層爲其所掩覆、成不整合之接觸。或原與第三區相連續。

綜觀全區、褶皺實不如逆掩斷層之顯著。故主要構造、當仍屬逆掩斷層、各處地層多被之而裂斷。察各逆掩斷層錯動之方向、多自西北推向東南、因是知動力之來殆自西北。惟葫蘆島極東一嵎、地層錯動似自東南向西北耳。

逆掩斷層面大部掩覆不得見、故其傾斜角度頗難窺測。自葫蘆島海濱各小逆掩斷層觀之、傾斜角大抵在二十度至三十度之間。

褶皺及斷層之時期　在本區之內卽白堊紀之地層亦經受褶皺及斷陷、故褶皺及斷陷之時期至早不能超逾白堊紀。若就地形觀之、似逆掩斷層之發生略晚於褶皺。在鄰近地帶與其有相同之構造者、有熱河之朝陽北票。昔恒升嘗隨翁所長一至其地、其附近地層之構造、亦以逆掩斷層爲多。白堊紀之火山岩系多逆推於較古地層之上。上煤系與火山岩系之間有一不整合。翁所長據當時實地之觀察遂分燕山地動期爲二期、一爲緒動期、相當於上煤系及上火山岩系間之不整合。一爲主動期、凡主要之褶皺及橫移現象皆發生於此時。使此說可信、則本區主要地層之褶皺以及橫移現象之發生大約仍在燕山期也。

鑛產

本區鑛產現在以煤爲主。屬上石炭紀者三、皆在錦西縣境、一爲沙鍋屯煤田、二爲虹螺峴煤田、三爲黑魚溝煤田。屬下白堊紀者二、一在錦西縣之大荒地、二在葫蘆島。此外尙有黑魚溝之鉛鑛、白土溝之白土及奧陶紀之石灰岩。奧陶紀石灰岩、質純層厚、不僅能燒石灰、且可供製水泥、試分述如左。

（一）錦西縣沙鍋屯大窰溝煤田

位置　煤田位於錦西縣境西北隅、南富隆山、沙鍋屯、趙家屯一帶。大窰溝通裕煤鑛公司適居中央、因以名焉。自沙鍋屯東至北寧鐵路女兒河車站約六十里、通裕煤鑛公司曾築通裕支路以相連貫。西南至錦西縣城亦約六十里。

煤田自東北向西南延展、成東北西南之斜谷。東北自二佛廟接義縣屬之缸窰煤田、西南經南富隆山入熱河朝陽縣連葦子溝煤田、總長不下五十餘里。其兩旁峯巒起伏、夾谷不絕。南爲奧陶紀與寒武紀之石灰岩、北爲三疊紀之砂礫岩與白堊紀之火山岩層。

煤層　夾於砂岩、礫岩及頁岩之交疊層中。煤層走向在二佛廟一帶、平均爲北五十度東、向西北傾斜、傾斜角自四十度至五十八度。此處地

層似受極大之變動、故間有傾斜東南或西北者、傾斜角有時增至六、七十度。在大窰溝一帶煤系上礫岩之走向爲北六十度東、向西北傾斜、傾斜角六十五度。在紅石磴子一帶走向爲北五十度東、向西北傾斜、傾斜角五十度至六十度。在富隆山及葦子溝一帶、走向北四十度東、向西北傾斜、傾斜角二十度至三十度。大概言之煤田中部傾斜較急、而兩端稍平緩。中部傾斜約自五十度至七十度、東北端自三十度至六十度、西南端自二十五度至三十度。

煤層多寡各處不一、厚薄變化亦殊劇烈。有同一煤層自六十尺減薄至五六寸者。在大窰溝一帶通裕煤鑛公司所採見煤兩層、上層厚約五呎、稱爲北槽。下層厚二十呎、稱南槽。兩槽間距約一百六十呎。在西南朝陽縣葦子溝一帶、據安特生調查謂有煤七層、其厚度如左：

第一層	厚十呎	
第二層	厚十呎	
第三層	厚十呎	
第四層	厚五呎至九呎	
第五層	厚者至二十呎	
第六層	厚十呎	
第七層	厚三呎至四呎	

在葦子溝以西聞煤層復加多至十九層。但據毛勒調查則謂煤田西南端僅有煤三層、上層厚二十呎、中、下兩層厚自十呎至十五呎、有時能增至二十三呎至四十呎。在煤田東北端高麗井子一帶有煤層四、厚自三呎至五呎。在東平地現在土窰所採僅有煤一層、厚約九尺。

煤量　本區因煤層多寡不定、厚薄不一、煤量估計、殊難確切。若就各處開採所知、煤層實爲不薄、前途非無希望。惟從鑛業情形觀之、昔日煤田南北一帶小窰林立、近則大半廢置。即通裕煤鑛公司以新式之鑛業、近亦不能維持而以停工聞、則又似煤層在地下決非若何樂觀者。茲爲愼重計以東平地九尺煤層（即最薄之煤層）約合三公尺爲煤田平均之厚度、三十三公里爲煤田延展之長度、（義縣朝陽部份皆計入）

一・二爲煤之比重。計至沿煤層傾斜二百公尺、約有儲量二十五兆噸。若以半數爲已採或因地層變動而遺棄者、現在所存至少尚有一千二百五十萬噸。若計至地下直深五百公尺、儲量可增至九十五兆噸。減去三分之一、尙有儲量六十兆噸。但此皆以九公尺爲平均厚度、而如大窯溝葦子溝等處、則據從前調查煤層之厚並不祇此、已如前述、則可希望之儲量或亦尙不止此數。但本區煤層既不規則、地下情形尤欠明瞭。此次估計只能示其大概、必須俟逐段細察、併加以鑽探方可以具體計算也。

煤質　大部爲有煙煤、帶樹膠有光澤、因被火成岩所侵一部變爲無煙煤。大窯溝通裕煤鑛所採兩層屬有煙類、質强靱、色漆黑、出井塊末爲六與四之比。易燃燒、火焰長。在小凌河附近及小凌河以北上兩層爲烟煤、下兩層變爲無煙煤。在葦子溝一帶、第三層爲無烟煤、餘均爲煙煤。據舊日分析、及此次採集分析之結果、其焦性團結、灰份不甚高。茲將分析之成分列左：

煤層	水份揮發份	定炭	灰份	灰色	硫磺	比重	焦性	淡質	發熱量（加洛利）	分析機關
通裕煤鑛下層煤第一號	三・二九	三二・七五	五三・四七	一〇・一九	黃灰	〇・五九	一・二四	粘結	〇・五九	七〇四〇	日本明治鑛業有限公司
通裕煤鑛下層煤第二號	三・五〇	三三・〇一	五〇・三六	一三・四四	黃灰	一・三三	一・三九	粘結	〇・八五	六一〇五	同上
通裕煤鑛上層煤	五・八三	三三・七一	五三・一三	一八・三五	灰	〇・八一	——	粘結	——	六六〇〇	舊農商部工業試驗所
通裕煤鑛第一坑下層	二・四〇	三三・五一	四八・〇九	一六・〇〇		〇・六八				六六八九	
通裕煤鑛夾槽	二・二七	三二・三二	四五・三〇	三〇・二三	淡紅			不粘結		五四七	地質調查所
東平地夾槽	二・一〇	三五・一三	四三・七一	一九・〇七	灰色			粘結		六〇三三	地質調查所

鑛業　在通裕煤鑛公司未開辦以前、本區各處小窯林立、如溝道、小窪、老窯溝、桃樹窩、杏樹窩、趙家屯、楸皮溝、二佛廟等處均有居民採掘。繼因通裕公司用新法採煤、產量多而價值廉。舊法採煤難與競爭、遂均行淘汰。惟通裕公司於民國十二年五月二十二日鑛洞猝遭焚毀、又告停工。現在僅有小窯四處、土法採掘、又恢復昔日之舊觀也。

通裕煤鑛公司　原爲商人王岐山單詠春等爲開採錦西縣大窰溝龍尾巴等處煤鑛而組織、成立於前清光緒三十一年。至光緒三十二年添招商人羅裕堂股五十萬兩、遂安置機器、開鑿直井、正式採掘。當時有工人四百餘名、每日出煤約一百八十噸。惟困於運輸、不克暢銷。旋又添招陳應南、李祥光等資本、由鑛廠修築鐵路與北寧鐵路之女兒河站相連接、（即現在之通裕支路）以利運輸。並在外埠如女兒河、錦縣、營口、天津等處設立分廠以廣銷路。惜因地下工程未能適宜進行、每日出煤不能增多、（僅一百二十噸）繼有虧累。至民國七年復增招安川敬郎日股、改名爲中日合辦錦西縣大窰溝煤鑛有限公司、仍未有進步。民國十二年日股收回、同年五月、鑛洞猝遭火災、地下工程均行焚毀。自是日益不支、至十四年公司無法維持、宣告停辦。通裕鐵路亦隨之停駛。是後一切工程日就摧壞、當恆升調查之際、各處房舍大半頹圮、在其鑛區以內僅小窰三處、兩處在大窰溝鑛廠附近、共有工人三十餘名、日出煤十餘噸。第三處在鑛廠東北元東平地、有工人七、八十名、日出煤三、四十噸。均就斜坑用人力向上担負。鑛場職員坐收二分七厘之抽分、爲維持生活之費用。

通裕公司原有規模甚大、在民國四年通裕鐵路未成之前、已築斜井六口、直井一口。斜井高七尺、上寬八尺六寸、下寬十尺、用木柱撐其頂及兩旁、木柱之間、且襯以木板。其中三口專爲出煤、下餘三口則一方向上運煤及挑水、一方向下填石及運木。直井用磚圍砌、專備抽水及出煤之用。地下有平巷五道、第一、第二東西延長約二千餘尺、第三、三千二百餘尺、第四、五千八百餘尺、第五被水所浸。採煤用房柱與長牆混合法。炭柱縱橫一百尺間、開一下煤斜坑、自下向上採、留二十尺煤柱以保存坑道。採掘之後、均塡以石塊。地下潛水太多、抽水機小、故利用分段抽上。第一段高三百六十九尺、第二段高三百六十二尺、均用三寸水管。第三段高一百零八尺、第四段高一百五十六尺、均用一寸八分水管。通風用自然通風法、以蒸汽管通過之坑道、作爲上風坑道。燈火全係露燈。運煤出井、均用捲揚機。斜井鋪鐵軌、軌道重九磅、寬二十吋、共有裝四分之一噸煤車三十輛、裝三分之一噸煤車五十輛。單火筒鍋爐六口、口徑四呎四吋、長二十呎、火箱七呎三吋、長三十呎。壓力一百三十磅。捲揚機七架、第一號徑九吋、衝程二呎。第二第三第七筒徑十二吋、衝程二呎。第四、第五、第六較小。此外尚有機器廠一所、內備竪鑽機二台、螺旋機四台、平鑿機一台、橫鑽機一台。鍛工廠四處、磨工廠一處。地下工人共有七百餘名、日夜分三班、每班八點鐘。工價之高低、按出煤之多寡。塊煤一噸大洋四角五分、末煤三角五分。每日每人可採二噸。地上工人二、三百名、雜夫每日工價二角至三角。當時一日出煤約一百二十噸、每噸售價五元。本地一日可

銷四十五噸。一噸成本平均採掘費四角、加公司開銷、坑木機器職員及工人薪俸、約合二元、共約二元四五角。比較售價每噸可獲利二元五角。由此觀之、尙非無希望也。

強業煤鑛公司　強業煤鑛公司在大紅石磴村東南約三華里、與大窯溝公司相距不過八里。以一南北河谷與紅石磴村相通。當恆升調查之際、大紅石磴村適爲土匪所佔據、未能前往。聞該公司開採仍習用土法、鑛區爲八百九十九畝。

(二)錦西縣虹螺峴煤田

位置　虹螺峴煤田在虹螺峴鎭之西南偏西。距縣城約五十里、東距北寧路女兒河車站約三十五里、距陳家庄車站約三十里、距通裕支路邰集屯車站十里。煤田東西延長約五公里、在蛤蟆山之東麓受平移斷層、煤系向南推移、一部且受錯斷、被掩覆不見。三叠紀砂礫岩層遂逕與奧陶紀石灰岩相接觸。然礫岩之下、似仍當有煤系之存在也。煤田之南爲寒武紀、奧陶紀石灰岩所成之小山、北爲三叠紀砂岩、礫岩層所成之丘阜。煤系屬上石炭紀。愛商煤鑛在其東部、地勢較闊、東距虹螺峴約五里。

煤層　夾於煤系之下部。據歷來開採所知、西部層數較多、惟厚各不過三尺、東部煤層少而較厚、自七尺至二十尺。現愛商煤鑛開採之部分有煤三層、惟厚薄各地不同。塲東所採爲第一層、厚七尺至十二尺、塲西所採爲第二、第三兩層、第二層厚自二尺至七尺、第三層厚自七尺至十五尺。塲西北另有煤一層、厚三尺半、或爲第一層以上之煤層。在臥龍泉現在寶興小窯所採、有煤兩層、厚各一尺。就其開採之位置觀之、頗偏近煤系之上部、或確爲第一層以上之煤層。

煤量　本區煤田煤層厚薄既不規則、煤層多少又未盡悉、在此情形之下、欲確計其煤量實嫌失據。以下所計不過僅就開採部份所知煤層之數目與厚薄、假定煤田全部均皆如此、爲約畧之估計、以備大概之參攷而已。

茲爲愼重計以四公里爲可採煤田之長度、第一層煤平均厚八尺、第二層平均厚四尺、第三層平均厚十一尺、凡第一層以上厚不及三尺之煤皆棄而不計、總計煤層厚度爲二十三尺、約合七公尺。以二十五度爲煤層之平均傾斜角、一・二爲煤之比重、計至直深三百公尺、儲量約爲三十餘兆噸。若計深至五百公尺、儲量可增至四十九兆噸。設以三分之一爲已採及將來開採所遺棄之數量、尙有三十餘兆噸。惟此數字是否可

靠、尙難斷言。如僅就愛商煤鑛開採一段言、此數尙失之於小。一因第二號直井最上之一層如不爲第一層、則爲上三層以外之一層。其厚度約三尺半、尙可開採、並未計入。二因第三層爲開掘直井時新發見之煤層、但直井深度未及二百尺、直井以南煤系分佈尙寬、有夾疊煤層之希望。然則煤層總厚固不止七公尺、煤量亦應隨之增加。惟據開採者言、煤層向西有遞薄之趨勢、證諸昔日煤田西段小窰羅列、今則皆廢、亦自可信、蓋此不能盡歸諸經營之未當也。使此推論果屬確實、則全區儲量恐尙不及上計之數字。總之欲求精確之計算、尙有賴於鑽探。昔日此區開辦各鑛皆斤斤於一隅之得失、未能爲全區之鑽探、以致煤層多少、厚薄變遷與延展情形皆不明瞭。地面設施、工程進行、無所根據。作輟無常、屢遭阻礙、虛耗資欵、日就凋敝、良可惜也。

煤質　因本區近侵入岩、煤爲半有烟煤。據開採者言、第一層灰份多、僅可供燒石灰之用。第二、第三兩層煤質較佳、質不甚重、光澤不強、水份少、不含硫、出井統煤鷄子以上之煤塊、約佔百分之十五。據分析之結果、其成分如左表。

煤層	水份揮發份	定炭	灰份	灰色	硫	焦性	發熱量（加洛里）	分析室
愛商煤鑛第三層	一・五〇	一四・五〇	七〇・〇〇	一四・〇〇	白	無	七三〇〇	北票煤鑛
全上	一・〇五	一〇・三〇	七一・二三	一七・四二	淡褐	無	半團結	五八一五	舊農商部工業試驗所
寶興煤鑛第二層	〇・二三	一四・二三	七〇・九四	一四・六〇	灰黃		半團結	七四四二	地質調查所

鑛業　本區煤鑛發達殊早、其初小窰林立散亂無章。清末天益官鑛開辦、繼以虧累停工。民國三年由愛商煤鑛公司承辦、原有財產作爲官股。至民國五年大事興工、建築房屋、安置機器、開鑿直井、斜井。採煤工作均用新法。歷年產煤、民國十年四千零九噸、十一年九千二百零八噸、十二年一萬九千四百七十二噸、十三年一萬六千七百一十九噸、十四年一萬六千九百噸、十五年二萬零三百一十七噸、十六年二萬一千八百三十六噸、此爲極盛時代。自是之後、又漸趨減少。民國十七年僅出一萬二千九百噸、至十九年九月十五日復因入不抵出賠累停工。當恆升今春調查之際、凡各立井均行廢置。鑛場僅有工人一百三十名、由斜井用人力向外拖拽。駐鑛人員坐收抽分、每日所出約在六十噸左右。在鑛場

一噸售價大洋八元五角。礦守鑛人言、如每日能出煤白噸（即每月出煤三千噸）、每噸成本約合大洋四元一角六分、其分配如左表。

項目		全月總數	每噸攤派
直接工料費	包工採煤費（參觀附表一）	四千九百七十元	一、六五六元
	監工裡工及修理費（參觀附表二）	一千七百六十元	〇、五八八
間接工料費	起重費（參觀附表三）	一千二百二十一元	〇、四〇七
	抽水費（參觀附表四）	一千四百二十八元	〇、四七六
普通修繕費	機器修理工三百元 料三百元	六百元	〇、二〇〇
	地面土木修理工料		
普通管理費	包括職員薪金警兵費差役工資等項	七百二十元	〇、二四一
普通辦公費	包括捐稅租利川資交際公益津貼獎勵等項	四百元	〇、一三三
庶務雜費	包括福食雜用郵電文具燈火等項	五百八十元	〇、二九四
合計		一萬一千六百七十九元	四、一六〇

附表一　包工採煤費表

掘煤工資	二、六三〇（元）
開洞工資	四六〇
支柱工資	二三〇
棚料	一、六五〇
合計	四、九七〇
每噸平均成本	一、六五六（元）

附表二　井洞工費表

修理洞道	一六六（元）
修加棚子	七六
臨時雇工	六七
裡工修理	燈油一成在內　二〇四
棚料	八〇〇
井口裡工	三四〇
監工	一一一
合計	一、七六四
每噸平均成本	〇、五八八（元）

附表三　起重費表

開絞車工資　匠頭工薪攤派在內	八三（元）
蒸汽動力費	一一〇〇
機器斟油	八三
機器鋼繩損失折舊	（從略）
合計	一二二一
每噸平均成本	〇・四〇七（元）

附表四　抽水費表

開泵工資　匠頭工薪攤派在內	八六（元）
蒸汽動力費	一三〇〇
機器斟油	四二
機器損毫折舊	（未詳）
合計	一四二八
每噸平均成本	〇・四七六（元）

每噸約計可獲利四元三角、當地每日至少能銷售百噸左右。然則使該礦經營得宜、固非無希望也。

寶興煤礦公司　礦場在臥龍泉、位於愛商煤礦之西略偏南、相距不過三里。此區原爲舊德聚煤礦公司礦區。德聚公司爲張鴻志所組織、成立於民國三年十一月、報領礦區二百七十畝。民國四年土法採煤、當時工人多至四百名、每日出煤約四十噸。旋因礦內出水太多、舊法排水需工甚衆、無法維持而停工。迨至民國十九年鄭世錦等始又組織寶興煤礦公司、在德聚公司舊坑之北方報領礦區一方里。土法開採、斜洞背地層傾斜之方向而進、深約一百四十尺。現有工人四五十名、每日出煤約二十五六噸。煤分優劣兩種、劣者灰份甚高、僅可供燒石灰。每噸售價約四元二角。優者每噸售價五元六角。

(三)錦西縣黑魚溝煤田

位置　黑魚溝煤田在縣城西南三十里。東距葫蘆島七十里、位於羣山之中、交通不便。東與震旦紀砂質石灰岩成斷層接觸、西爲奧陶紀所成之長嶺。煤系保存于二山谷之中間、東北自尖山屯起、西南至富兒溝一帶。

煤層　煤層露頭有三、在下黑魚溝東北一帶小窯所採僅一層、厚自三四尺至丈許。惟各處厚薄頗不一致。走向爲北四十五度東、傾向西北或東南、傾斜角自二十度至四十五度。

煤量　煤田延長約五公里。若以煤層平均厚一・五公尺、傾斜角三十度、煤之比重爲一・二、計至三百公尺以上儲煤量約有十兆噸。惟本區煤層數目尚未確悉、厚薄情形亦欠周詳、故上計數目是否極低、尚難斷定。煤質屬半烟煤、現有小窯數處開採、作輟無常、產額甚微。

(四)錦西縣大荒地煤田

煤田在虹螺峴北大荒地部集屯一帶、傍近通裕鐵路、屬白堊紀。在大荒地東北鐵路斷面中、多砂岩及礫岩、中夾極薄煤層。本系分佈面積實不甚小、(地質附圖)在義縣、阜新一帶確有可採之煤層。惟在本區尚無試辦者、故煤層之多寡厚薄、皆未明瞭、有經濟價值與否、尚待試探也。

(五)葫蘆島台子山煤田

葫蘆島西南隅台子山南坡之海濱及張家墳溝一帶、有少許之白堊紀砂礫岩露出、西北以斷層與寒武紀地層相接觸。僅露砂岩、頁岩及礫岩、

夾煤層二、惟各厚不及一尺、傾向東南、煤系之重要部份已斷陷入海底、似無開採之價值。

(六)錦西縣之鉛礦、硫黃、石灰、白土及建築石材

錦西縣西南上黑魚溝之西、楊家帳子一帶、產方鉛礦與黃鐵礦、生存於奧陶紀石灰岩中、成脈狀或囊狀。礦脈寬大處約五、六尺、長七、八尺、大約與附近之花崗岩有生成之關係。前因日人收買礦砂、居民多事開採。凡有露頭處、均經採掘、幷將鉛砂在百分之七十以上者、悉行選擇售去、所餘之黃鐵礦尙堆積坑中、本地居民每用以製硫黃。現則均以成本高而停工。

燒石灰者大率開採奧陶紀之石灰岩、其分佈之地、均在錦西縣境、如黑魚溝、落石嶺、連寶山、虹螺峴附近之靠山屯、小南屯、大奄屯以及沙鍋屯附近之富隆山等處。考石灰岩不但能燒石灰、且爲製水泥之主要原料。我國邇來建築日繁、水泥需要日急、國內水泥公司至今僅十餘家、每年所產不過二三百萬桶而全國銷費在民國十四年已達三百四十萬桶、所供遠遜所求。故至今仍須仰賴外國水泥輸入、以補不足。輸入之量在民國十一年爲一百一十餘萬桶、價值約四百萬元、在民國十五年爲八十七萬餘桶、約三百餘萬元。利權外溢爲數不貲。今在本區、石灰岩賦量既富、(地平面以上之儲量計約爲七十二兆餘噸)附近又有大窰溝煤田供給燃料。方今葫蘆島正在築港、相距不過九十里、交通亦稱方便。就地位論實與唐山啟新洋灰公司有同一之優點。設能建廠製煉、前途希望、可無待龜卜也。

白土礦乃震旦紀矽質石灰岩變質風化而成。在黃土坎北山有開採漂洗者。主要用途爲坊牆及漂白紙糧之用。惟其如何分佈、儲量多少、因該處患匪、未克往勘。

建築石材中有虹螺山及葫蘆島各處較新之花崗岩、震旦紀之矽質石灰岩、奧陶紀之石灰岩、及三疊紀之石英砂岩。惟現在用途均尙狹隘、僅葫蘆島、錦西、虹螺峴等處有開採者。


Siaolingho
KUEISHAN
Tatsitun
Hsiapanshihkou
Sisanchiatzŭ
Tamakou
Szŭfangtai
Wanghutun
Shahopu
Hualoukou
Sanchiatzŭ
Chenchiakou
Tsuichialing
Chiangchiatun
Suchiawatzŭ
HUASHIHSHAN
Ichialin
Paimiaotzŭ
Tawapu
Chaochiatun
Shakoutun
Taiyaokou
Hsiamiaotzŭ
Mutsiangkou
Shuitsuankou
Kutangkou
Sungshukou
Hungshihla
Tahungshihla
Peifulungshan
Nanfulungshan
Lanchiatun
Kaoliszŭ
Shentun
Hsiasungshukou
Shangwentsiukou
Tanyaokou
Changchiakou
SHUANGTINGSHAN
Changlingkou
Tatingshan
Wangiwukou
Huangtukan
Tanuangti
Shaotsitun
Yaofanghotzŭ
Paimiaotzŭ
Shachinkou
Patalhotzŭ
LIHUSHAN
Pichiashan
Yangkuangshantun
Wuchint'ang
Shangchamukou
Hsiachamukou
Lihutun
PICHIASHAN
Hsiawopeng
Fuyoutun
Sanchiatzŭ
Wofuszŭ
Yingshoupu
Kaotaitzŭ
Chinchengpu
Wopeng
Nuanchiht'ang
Hoshangkou
Sanchiatzŭ
Kuchengtzŭ
Mouchiafen
Ershihli
Yangchiaw
Chouchiatun
MAANSHAN
Yenchiakou
Hunglohsien
Nanlamaan
Sinchuangtzŭ
Chuanwayao
Paowopeng
Papelung
Tsienpanchuang
Shuangtaitzŭ
Taoliuhotzŭ
Liuchuijentun
Sikou
Tuanshantzŭ
Kaoshantun
Patsiangyingtzŭ
Lotsiaotun
Liuchiatun
Shuangmiaotzŭ
Masiangtun
Peitiehyao
Chentun
Machengyeh
Yatzŭkou
Changtzŭkou
Yuantun
Chungtiehyao
Tutun
Sungchiakou
Maochiatun
Wentun
Ertaoho
Chentun
Nanling
Howopen
Nantiehyao
Hsiangshuiho
Chaoyangkuan
Hsiatun
Siaotientun
Niangniangmiao
Machuantzŭ
Wanghaiszŭ
Shuangiungszŭ
Santaitzŭ
Shihhui
Pechiawopen
Hsiangshuitaitzŭ
Chentun
Tungtsingpu
Shangtientzŭ
Laoyehmiao
TAHUNGLOSHAN
HUNGLOSHAN
Tsingtuitzŭ
Wangchiaw
Tientun
Tungkou
Lungtsuanszŭ
Hoshangtun
Chiutun
Laoyehmiao
Pienyentzŭ
Peitinientzŭ
Tsaotun
Wangchiatun
Chenchiatun
Chiukutun
Kaochiaochengtzŭ
Tiaochiaotzŭ
Chatzŭyao
CHINSIHSIEN
Touchiatun
Lungwangmiao
Siaotungkou
Fuchiatun
Tuanmuchung
Fangshenkou
Huchiatun
Liuchiatun
Choutiehtun
Tenitun
Weinjuch'ang
Taszŭtai
Shangtzŭ
Siaolingtung
Siaolanchiakou
Huaishukou
Wuchiatun
Wanghsitun
Kaochiao
Wuchialing
Wangtun
Hoshangkou
LIENPAOSHAN
Weiniuch'ang
Siaoszŭtai
Chienchuchiayao
Lichiatun
Anchiatun
Peipientaotzŭ
Ertaokou
Panchiatun
Loufang
Yaolanchiakou
Shangchanglingshan
Laokuapu
Pailukou
Hungchiyingtzŭ
Sunchiatun
TIENCHIAOTING
Pientaotzŭ
Kaochiatun
Changlingshan
Siaomachiakou
CHINGSHIHLING
Shihhuiyaotzŭ
Tatzŭmen
Kaoshantun
Tashan
Shangkantzŭ
KUANGTINGSHAN
Paimiaotzŭ
Sutun
Taitzŭkou
Sinchiatun
Tsuanyenkou
LOSHIHLING
Chinchiatun
Tsienyu
Shaouying
Talienpao
Tungmengchiatun
Wangchiakou
Shuikoutzŭ
Houshihchiayu
Hungts'aokou
Fushoutun
Juniukou
Choulahotzŭ
Siaotungshan
Shangheiyukou
Kangyao
CHIENYUSHAN
Sikuankou
Tungkuankou
Sanimiao
Kungchiatun
Yangchiachangtzŭ
Tsienshantun
LAOYEHMIAOHOUSHAN
Tsienshihchiayu
Liuchiatun
Shenchiatun
Liwopeng
Shangtushukou
Shanlichailoutzŭ
Hsiaheiyukou
Paiyangmukou
Takungchiakou
Peilaopien
Wangchiatun
Changchiatun
Shangkuankou
Yingpishan
Changchiatun
Maochiatun
Laoyehmiao
Nanlaopien
Szŭerpu
Hsiakuankou
Hsiatushukou
Shanwaichailoutzŭ
Siaomachiakou
Mifungkou
Weichialing
Tungtsienshantzŭ
Liutaitzŭ
Lungwangmiao
Ert'aitzŭ
Siaopemashih
LIENHUASHAN
Shangtuerkou
Yenchiatun
Tsichiakou
WUTINGSHAN
Niengankou
Tsienwamiao
Changchiakou
Yingp'an
Lienshan
Tapemashih
PINGTINGSHAN
Shuikoutzŭ
Siyangts'aokou
Yangts'aokou
WUYUNSHAN
Chichiakou
Tuanshantzŭ
Wuliho
Chuchiatzŭ
Shangchangmaohotzŭ
Changtun
Hsiachangmaohotzŭ
HSINGYASHAN
Tanchangkou
Siaokaichou
Changchiatun
Lienshan Station
Chaotun
Laohukou
Hochiatun
Sankuanmiao
Huishan
Titsangszŭ
Kaopatun
Yuhuangko
Chuanwayao
Shihhuiyao
Chenchiatun
Paitientzŭ
Hsiatatzŭkou
Yangchiatun
Tsaochiatun
Tsichiatun
Liutiaokou
Hulutao
Kuotun
Waishihla
LUNGSHAN
Shangchiashan
Yingp'an
Wuchiatzŭ
Shangtatzŭkou
Laohoshangtun
Machiahuofang
Tzuershan
Shanchengtzŭ
Panlashan
Lifenfangtun
Tayinghok'ou
Laotaokou
Shuangshupu
Chakou
Haochiatun
Tahuangti
Wanghaiszŭ
Tenglungshan
Wangchuan
Wanglokuotun
Hsiachashan
LATZUSHAN
Szŭfangtai
Latzŭshan
Fujoutun
Lungwan
Shuangtsuanszŭ
Fantun
Tamuhushan
Siaomuhushan
Kot'engtun
Miehchialing
Yaowangmiao
Wangtun
Siaonanchuang
Maochiatun
Chinchialing
Shihmen
Shangfanchiakou
Paitaotzŭ
Shangtsaoshan
Silatzŭshan
Kants'aoling
Yuehliangshan
Naichiatun
Ertaohotzŭ
Chaoyuehkou
Chuchiayaotzŭ
Paimashih
Tungyaochan
Panlashan
Toutaohotzŭ
Sanchiatzŭ
Paitayu
Tingchialing
Sipalipu
Chinchialing
Taling
Peiping Mukden Railway
A
A'
B

葫蘆島附近錦西錦縣一帶地質略圖

GEOLOGICAL MAP OF CHINHSI AND CHINHSIEN DISTRICTS NEAR HULUTAO LIAONING PROVINCE

BY H. S. WANG 王恒升
T. F. HOU 侯德封 測

SCALE 尺例比

1 0 1 2 3 4 5 6 7 8 9 10 Km. 里公

LEGEND 例圖

界古太 ARCHAEAN	紀旦震 SINIAN	紀武寒 CAMBRIAN	紀陶奧 ORDOVICIAN	紀炭石 CARBONIFEROUS	紀疊三 TRIASSIC
AR 岩麻片 Gneiss	Hi Hq 岩灰石及岩灰石質砂 Siliceous limestone & Quartzite	Cu Cm Ci 岩灰石狀鮞岩質色紅 岩灰石葉竹與 Red shale oolitic limestone and wurmkalk	Oi 岩灰石 Limestone	Cu 層煤及岩質岩砂岩礫 Conglomerate, sandstone, shale & coal seams	T 岩礫與岩砂 Sandstone & Conglomerate
紀堊白下 L. CRETACEOUS	**紀堊白中 M. CRETACEOUS**	**統新最 MODERN**	**岩崗花 GRANITE**	**岩斑 PORPHYRY**	**岩武玄 BASALT**
Ki 層煤及岩質岩砂 Sandstone, shale, clay & coal seams	Km 層岩山火 Volcanic formation	M 層積冲 Alluvium	gr	P	b
線高等 CONTOUR LINE	**線層斷 FAULT LINE**	**路鐵 RAILWAY**	**流河 RIVER**	**城縣 CITY**	**路道及鎮村 TOWN & ROAD**
尺公十五距高等 Contour-interval 50 meters					

第二版說明

EXPLANATION OF PLATE II.

第二版

Pl. II

第一圖　錦西縣福壽屯南之寬廣河谷.

Fig. 1. The open, broad River valley, South of Fushoutun, Chinhsihsien.

第二圖　錦西縣沙後營北片麻岩內之偉晶花崗岩牆.

Fig. 2. The Pegmatite-Dyke in the Archaean gneiss, North of Shahouyin, Chinhsihsien.

第三圖　葫蘆島望海寺南太古界花崗岩巨塊陷含於震旦紀底部長石砂岩內.

Fig. 3. The Archaean granite blocks enclosed in the basal arkose sandstone of Sinian age, South of Wanghaissu, Hulutao.

第四圖　葫蘆島雙泉寺西南之大理石崖岸.

Fig. 4. Sea shore of marble cliff, Southwest of Shuangchuanssu, Hulutao.

1

2

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第三版說明

EXPLANATION OF PLATE III.

第三版

Pl. III.

第一圖　葫蘆島雙泉寺附近之大理石海岸.

Fig. 1. Steep Sea Shore of marble, near Shuangchuanssu, Hulutao.

第二圖　葫蘆島望海寺東南之震旦紀黑色板岩立壁.

Fig. 2. Cliff of Sinian black slate, Southeast of Wanghaissu, Hulutao.

第三圖　葫蘆島望海寺東南之蝕餘石英岩.

Fig. 3. Residual cliff of Sinian quartzite, Southeast of Wanghaissu, Hulutao.

第四圖　葫蘆島半嶝山之震旦紀板岩與石英岩.

Fig. 4. Sinian slate and quartzite of Panlashan, Hulutao.

1

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第四版說明

EXPLANATION OF PLATE IV.

第四版

Pl. IV.

第一圖　葫蘆島燈籠山西海灣之 *Collenia cylindrica* 層.

Fig. 1. The *Collenia cylindrica* bed in an inlet to the west of Tenglungshan, Hulutao.

第二圖　葫蘆島西山之礫岩層與石英岩層.

Fig. 2. The Conglomerate & Quartzite bed of Hsishan, Hulutao.

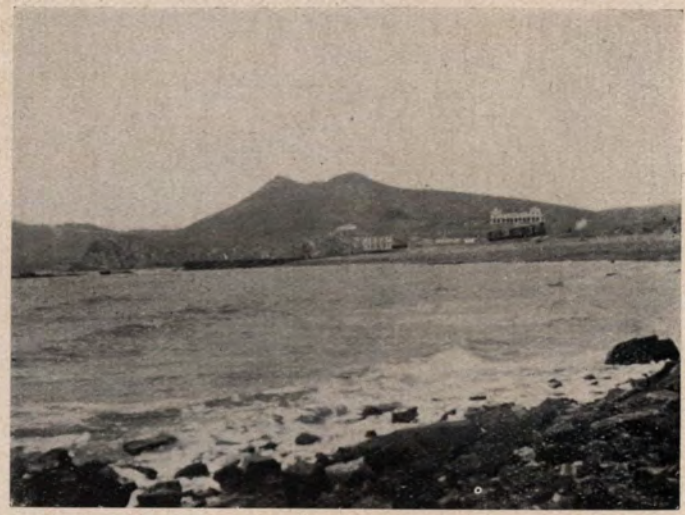
第三圖　葫蘆島雙泉寺西南之疎鬆礫岩層.

Fig. 3. The loose conglomerate bed, Southwest of Shuangchuanssu, Hulutao.

第四圖　葫蘆島西山南坡之花崗岩海岸.

Fig. 4. The granitic sea shore on the Southern slope of Hsishan, Hulutao.

1



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3

4

第五版說明

EXPLANATION OF PLATE V.

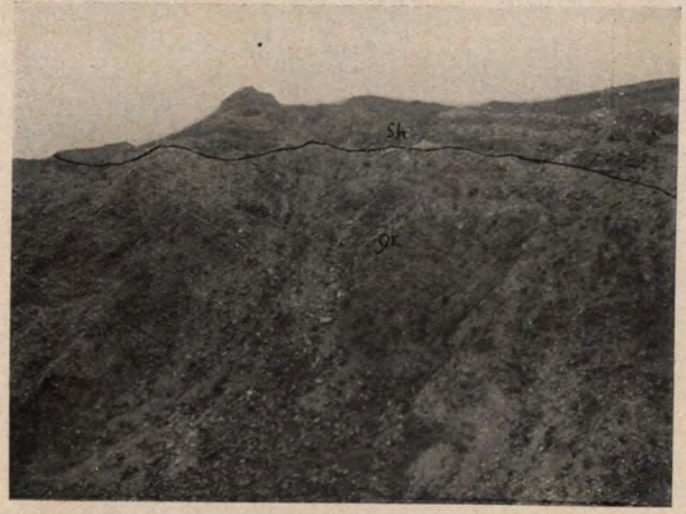
第五版
Pl. V.

第一圖　葫蘆島柳條溝東花崗岩與葫蘆島層頁岩之接觸面.
Fig. 1. The igneous contact between the green shale of the Hulutao formation and the granite, east of Liutiaokou, or Willow Valley.

第二圖　葫蘆島西山南坡花崗岩中之分叉輝綠岩牆.
Fig. 2. The Diabase Dyke in the granite on the Southern slope of Hsishan, Hulutao.

第三圖　錦西縣蘭家屯西北砂質石灰岩之倒置褶皺.
Fig. 3. The overturned foldings of the Sinian Siliceous limestone to the northwest of Lanchiatun, Chinhsihsien.

第四圖　葫蘆島西山南坡海濱之小逆掩斷層.
Fig. 4. The minor overthrust of the Sinian black slate, on the Southern slope of Hsishan, Hulutao.



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GEOLOGY AND MINERAL RESOURCES OF CHINHSI AND CHINHSIEN DISTRICTS NEAR HULUTAO, LIAONING PROVINCE.

(With 5 Plates & 12 Text Figures).

By H. S. Wang (王恒升) & T. F. Hou (侯德封).

INTRODUCTION.

The region surveyed is situated in the south-western part of the Liaoning Province. It covers a greater portion of the Chinhsi district (錦西), western part of Chinhsien (錦縣) and the whole area of Hulutao or the "Gourd Island" (葫蘆島). The latter has long been thought to be the best place for an ice-free harbour and harbour construction has once begun. The construction was, however, interrupted until last year (1930) when the authorities of the Peining Railway Administration determined to start the long stopped work.

On the request of Mr. C. Y. Kao (高紀毅), the director of the Peining Railway to investigate the geology as well as the mineral resources of Hulutao and its vicinities, we started on the 19th March, 1930, from Peiping by the Peining Railway. Only 6 days were spent on the very Island, and four days for the neighbouring districts. A greater part to the northeast of Chin-hsi district was surveyed by H. S. Wang alone during one week in April, 1931 along the Tungyü Railway (通俗鐵路).

Thanks are due to Messrs. K. C. Chang (張光正) and C. C. Shan (單志鈞) of the Peipiao Coal Mine (北票煤礦公司) for they have helped us throughout the whole work. During the last two days of our trip in 1930, we were joined by our colleagues Père Teilhard and Dr. C. C. Young (楊鍾健) with whom we had profitable discussions.

TOPOGRAPHY.

Most of the area surveyed is an advancedly dissected hilly region with open valleys (Pl. II, Fig. 1) and moderate elevations. Only in the northern and the western part, are there some high peaks and bold mountains rising at from 500 to 800 meters. They are mostly composed of granitic intrusion as Tahungluoshan (大虹螺山) and Hsiaohungluoshan (小虹螺山); and occasionally characterized by the Sinian siliceous limestone and volcanic lavas of Cretaceous age.

Among the rivers in this area, Nüerhho (女兒河) is of the first magnitude to be mentioned. It meanders from west to east in the northern part and forms the sole main drainage on the north of Tahungluoshan. In its lower reaches, it joins the Hsiaolingho (小凌河), which flows from the hilly region in the north-western part of the Chinhsien district.

To the south of Tahungluoshan, there are many other small streams, flowing in a south-eastern direction. They are called by local names as Ssuerh-puho (四兒堡河), Lienshanho (連山河) and Erhtaoho (二道河), etc.

STRATIGRAPHY.

Almost all the old formations from Archaean up to early Mesozoic as Sinian, Cambrian, Ordovician, Carboniferous up to Triassic, are all represented here. Cretaceous beds have also a good development. For Tertiary we have only pliocene. The Pleistocene was locally represented by loess.

Archaean gneiss and granite:—Typical Archaean gneiss, occurs between Yingpishan (影壁山) north of Lienshan and Lungchuanssu (龍泉寺). Here the gneissic structure is well developed, with feldspars and quartz as the prominent composing minerals. Pegmatite dykes (Pl. II, Fig. 2) occasionally intrude into it.

On the southern side of Hulutao the gneissic structure becoming less conspicuous, the gneiss thus turns to a granitic appearance. However, the Archaean age is proved beyond any doubt by the fact that granitic boulders are included in the basal arkose sandstones of Sinian age (Pl. II, Fig. 3) and further the arkose sandstone fills the fissures of the granite when in contact (Fig. 1).

Sinian system:—This is the best developed system in the area studied. It lies unconformably in Hulutao upon the Archaean granite and chiefly includes arkose sandstone, quartzite (Pl. III, Fig. 3), black slate (Pl. III, Fig. 2, Fig. 4), and shales in the lower part; toward the upper siliceous limestone as well as flinty limestone intercalating with white quartzite predominate (Fig. 2). When intruded by granite, the limestones are metamorphosed into marble, for instance, the shore-cliff on the southern side of Hulutao (Pl. II, Fig. 4, Pl. III, Fig. 1). In a small embayment to the west of Tenglungshan (燈籠山) in the eastern part of the same small peninsula, there occurs a bed of siliceous limestone containing abundant *Collenia cylindrica* (Pl. IV, Fig. 1), an index fossil of Sinian age.

The rocks of this formation are usually of very hard and tough character and resistant to weathering, thus forming bold mountains and high ridges. They are of wide distribution and attain at least a thickness of 3500 meters.

The Cambrian system:—Disconformably lying upon the Sinian formation is the Cambrian system. It is divisible into three parts and the total thickness is about 550 meters.

The lower part contains chiefly red and green shales intercalating with limestone lenticules. The sequence in descending order to the south of Hungluo-hsien (虹螺峴) is as follows:

1. Green shale
2. Light gray limestone
3. Green shale
4. Red shale
5. Thin-bedded limestone
6. Red shale
7. Purple shale cut by a diabase dyke
8. Red shale intercalating with limestone
9. Reddish limestone
10. Red shale intercalating with green shale
11. Brownish shale
12. Gray thin-bedded limestone
13. Red & brown shale intercalating with lenticular limestone
14. Quartzite (Sinian)

The whole thickness is about 200 meters.

In other places as at Panshihkou (板石溝), Tayaokou (大窯溝) (Fig. 3), its thickness greatly decreases due to local faults. No fossil has yet been found, but, however, on the basis of its similarity both in lithological character and stratigraphical position to the Manto shale in Shantung province, it is referred to lower Cambrian age.

In Hulutao above the Sinian system occurs an enormous shaly formation which consists chiefly of green shales and quartzite with a basal conglomerate. This formation constitutes most of the high hills and has been considered by Dr. J. G. Andersson as of Sinian age. But in the basal conglomerate, we have found among the pebbles some flint and siliceous limestone which were most probably

derived from the Sinian rocks. Further, the green shales look very like those of lower Cambrian age. It, however, has a thickness of about 2000 meters much too great for the lower Cambrian so far known in North China. It may be equivalent to the Hsiamaling formation of the Western Hills of Peking, or it may be even Jurassic. In the Geological map, we still refer it to Sinian.

In the middle division, oolitic limestone intercalating with thick bedded limestone becomes preponderant. It is about 200 meters thick and is most probably equivalent to the Changhsia limestone of middle Cambrian age.

The upper division includes chiefly, wurmkalk thin-bedded limestone and shaly limestone. The latter contains trilobite, *Ptychaspis suni* to the south of Hungluohsien. At Tayaokou (Fig. 3), in the same formation, Dr. Andersson some years ago collected the fossils from which the following species have been determined by Dr. Y. C. Sun.

TRILOBITA

1.	*Agnostus (anderssonia) fenglienensis*	Sun
2.	*Ptychaspis walcotti*	Mansuy
3.	*Ptychaspis accamus*	Walcott
4.	*Ptychaspis Chinhsiensis*	Sun

BRACHIOPODA

5.	*Eoorthis Shakuotunensis*	Sun

All of them are typical upper Cambrian fossils, and therefore prove the age of the formation bearing them. Its thickness in the vicinity of Hungluohsien is about 150 meters.

The Ordovician system:—This contains conglomerate, shale and wurmkalk at the lower part, dark gray, thick bedded limestone and brownish thin bedded limestone in the upper. The thick bedded limestone is usually of a pure character and is extensively mined for burning lime.

It occurs in four different zones: (1) from Tanantun (大奄屯) to Chuanwayao (磚瓦窰); (2) from Tayaokou to Nanfulungshan (南富隆山); (3) at the vicinity of Hsiaolanchiakou (小蘭家溝); (4) from Heiyükou (黑魚溝) to Laoshihling (落石嶺). The thickness varies in different localities. It is 300 meters at Tanantun but at Tayaokou, due to the absence of the upper part, the thickness deceases to 200 meters. Such a difference is most probably due to the Pre-carboniferous erosion which has widely prevailed in northern China.

At Heiyükou in the dark gray limestone, we collected a large simple coral looking closely to *Archeaocyathus*. The same fossil has been found in Peilintze formation of lower Ordovician age in Linyü (臨楡) basin, Hopei province.

The upper Carboniferous system:—This lies unconformably upon the Ordovician limestone usually with a layer of conglomerate at the base. It consists chiefly of sandstone, shale and conglomerate with workable coal seams in the upper part, constituting the three coal fields, namely, the Hungluohsien coal field, the Tayaokou coal field and the Heiyükou coal field. The latter is of synclinal structure, the coal series occurring in the center of the syncline (Fig. 4). At Hungluohsien, the following plant fossils have been found in the sandy shale.

1. *Neuropteris* sp.
2. *Pecopteris* sp.
3. *Sphenophyllum* sp.
4. *Annularia* sp.

Here the thickness is about 150 meters.

The Triassic system:—Disconformably above the Carboniferous coal series is a formation composed chiefly of conglomerate, grit, white and red coarse sandstones. It frequently forms a low range of ridges rising above the the coal series as at Hamashan (蛤蟆山) and Chatzeshan (渣子山), etc. No fossils have yet been found in it; it is provisionally assigned to the Triassic age from its lithological character as well as the stratigraphical position similar to those upper red sandstones occurring between Mesozoic and Palæozoic formations of other regions in N. China. Its thickness varies from 60 to 100 meters.

The Cretaceous system.

The lower Cretaceous:—This division consists of alternating beds of shales, clays, red, purple, and grayish white sandstones. Toward the upper part, greenish shale, sandstone and conglomerate becomes predominant intercalating at some place, with coaly or carbonaceous lenticules, which may be proved of economic importance as in Yihsien (義縣).

There are three zones where it outcrops; the first is the area from Fuyiutun (富有屯) to Yingshoutun (鶯首屯). The second is the low valley lying just to the north of the Tayaokou coal field. In both places, it lies disconformably upon the Triassic sandstones. The third is on the southern slope of Taitzushan (台子山), where it is in fault contact with the Sinian strata (Fig. 5).

It yields the following plant fossils at Taitzushan and Tahuangti (大荒地).

1. *Nilsonia* sp.
2. *Cladophlebis* sp.

In Yihsien (義縣), Mr. H. C. Tan has collected from the equivalent beds *Compeloma* and *Corbicula* which are considered by Prof. Grabau as of lower Cretaceous age.

The middle Cretaceous volcanic formation:—Lying unconformably upon the lower Cretaceous sandstone, is an enormous series of volcanic rocks amounting to no less than 1000 meters. In the lower part, the chief rock types are agglomerate, tuff, andesite and trachy-andesite. In the middle and upper, trachyte and rhyolite predominate, occasionally with red clay and shales as on the southern slope of the hill, south of Chentifangkou (陳地方溝). To the north of Tayaokou, it constitutes high ridges bordering the coal field.

Volcanic rocks are widely distributed in North China, and are considered by some geologists as the upper part of lower Cretaceous or by other as middle Cretaceous. As it is, here, underlain by the strata of a lower Cretaceous age, the writer tentatively put it in the middle Cretaceous.

Pliocene:—This is represented by red clay. It occurs chiefly in in valleys or on the low slopes of many hills. In the western part of Hulutao, a layer of loosely consolidated conglomerate (Pl. IV, fig. 3) is taken as its base. To the north of Tanantun, it fills the clefts or fissures of the Ordovician limestone just in the same condition as at Choukoutien (周口店), Fangshan hsien (房山縣), in Hopei province. But no fossils have been found. Its thickness is about 5 meters.

Pleistocence:—Primary loess is of rare occurrence. Most of the loessic material are interbedded with gravels and sandy layers.

IGNEOUS ROCKS

Granite:—generally of a pinkish color and coarse in crystallization. Orthoclase and quartz are the essential mineral constituents. It often constitutes high cliffs as at Tahungluoshan and Hsiaohungluoshan.

Granite porphyry:—Usually of a granitic appearance but strongly porphyritic. The mineral constituents are essentially the same as those composing the granite. It intrudes as dykes both into the Cretaceous sandstones and the volcanic formation.

Quartz porphyry:—Of light color and porphyritic character. The phenocrysts are mostly quartz occasionally with feldspars. It occurs as dykes in the granite on the southern side of Hulutao.

Diabase:—Occurring as complex dykes in the granite on the southern side of Hulutao (Pl. V, Fig. 2 ; Text figure 6). It is of a dark color and porphyritic in texture ; hornblende and feldspars are the prevalent phenocrysts.

Andesite:—Either as sills or as dykes in the lower Cretaceous red sandstones. Under microscope, the phenocrysts are mostly plagioclase and hornblende ; occasionally with orthoclase. The groundmass is holocrystalline composed essentially of microlitic feldspars.

Basalt:—Usually of a dark color and dense in texture. Among the component minerals, plagioclase is the most predominant ; olivine in the next. Groundmass is holocystalline composed of microlitic feldspars and olivine granules. It specially occurs along a thrust plane from Pataohotzu (八道河子) eastward to Wanchiatun (萬家屯) ; occasionally as dykes, as in the red sandstone to the north of Aishang Coal Mine (愛商煤礦公司).

Age and order of eruption:—Within the area studied, the youngest formation intruded is the volcanic series of middle Cretaceous age. It is probable that at the same time as tremendous eruptive activity of the period there took place intrusive of various magma at deeper level. But as shown by petrographic study, the intrusive bodies greatly vary in mineralogical composition, and also they are different in order of eruption. Field observations revealed the following sequence.

The first and perhaps the earliest Mesozoic igneous intrusion or intrusions in this region are most probably the andesite. This is inferred from the fact that it occurs essentially in the lower part of middle Cretaceous volcanic formation and it has never been found actually intruding into younger formation other than the red sandstone in the lower part of middle Cretaceous.

Then followed the granitic batholiths, the most prominent of which are the two intrusions of Tahungluoshan and Hsiaohungluoshan. They frequently show contact metamorphism, as coverting limestone into marble, shale to slate, but the metamorphosed zone is usually of small extent. Typical granite, rarely occurs in the Cretaceous beds. Its younger age is inferred from the fact that we have found granite porphyry with which the granite most probably asso-

ciates in the middle part of the volcanic series both at Yenchiakou (嚴家溝) and Fuyiutun (富有屯). It can not, however, be later than Cretaceous because it has been faulted on the southern shore of Hulutao in Cretaceous time.

Most of the granitic bodies are frequently intruded by quartz porphyry and diabase which are therefore of a still younger age. As they have no intersections or cross-cuttings with each other, their relative order of formation is hard to say. But on account of their complementary composition, they may be contemporaneous eruptions of the same source from magmatic differentiation.

After the granitic intrusion, there came the tectonic movement which resulted in foldings and faultings. This was ensued by the basaltic injection which not infrequently found their way along the lines of tectonic weakness.

GEOLOGICAL STRUCTURES

The geological structures of this region studied are of very complicated character with the scattered distribution of the sedimentary formations largely intruded by igneous rocks. As shown in the accompanying map, most of the major structures are due to faults either normal or reverse. Local foldings are of minor importance. The following is a brief description of the recognized major tectonic features.

I. Foldings.

Hulutao anticline:—Hulutao, an eastward projected promontory from the main land, is essentially an unsymmetrical anticline (fig. 8). The anticlinal axis extends roughly in an ENE-WSW direction with southern limb more strongly inclined dipping at 40°-60° to SSE. The northern limb, on the other hand, usually dips to NNW at 30°. It is interrupted on the north by an extensive granitic intrusion.

Heiyükou (黑魚溝) *syncline:*—Just acrossing Heiyükou, there occurs a syncline which is composed of Triassic sandstone at the center and upper Carboniferous, Ordovician, Cambrian and Sinian on the northern limb. The southern limb was faulted with the Triassic sandstone directly against the Sinian limestone. Its axis runs approximately in an ENE-WSW direction, pitching to the west. This is why that it gradually narrows toward the east. Since the Carboniferous is a coal bearing series, it constitutes the coal fields of Heiyükou, Paiyangmukou (白楊木溝) and Pingtingshan (平頂山), etc.

Paitukou (白土溝) *Anticline:*—North of Nüerhho (女兒河), near Paitukou, the Sinian siliceous limestone forms another anticline with its axis trending approximately NE-SW. Its north-western limb at Hsiamiaotzu (下廟子) dips north-westward at an angle of 60°. The southern limb being less inclined dips 25°-30° toward NE.

II. Faults.

Faults of Hulutao:—All the conspicuous faults in this region are of the reversed type with only one exception. They are altogether four in number as follows:

1. Overthrust of Tenglungshan (燈籠山). The strike runs approximately from east to west. North of the fault line, the hills are composed of green shale and quartzite of the Hulutao formation; to the south, occurs the Sinian limestone of much older date. As both dip to ESE, it gives a reverse order in superposition and thus suggests an overthrust.
2. Overthrust of Hsishan (西山). At the eastern slope of Hsishan, the Sinian slate and quartzite dipping ENE, are in direct contact with a granitic intrusion, within which occurs fault breccia on the southern shore of Hulutao. Farther west, are the green shale and quartzite of the Hulutao formation which dips generally in the same direction. Such an abnormal superposition suggests another overthrust.
3. Overthrust, north of Taitzushan (台子山). This is recognized by the repetition of the basal conglomerate of the Hulutao formation on the tops of the southern and northern hills, north of Taitzushan. Both dip to north and between them occurs a granitic intrusion (Fig. 5) within which runs also probably the fault line.
4. Normal fault on the southern slope of Tai-tzu-shan. On the southern slope of Taitzushan, the Cretaceous sandstones and conglomerate are brought by a fault in direct contact with the Hulutao formation, all the intervening formations such as Ordovician and Carboniferous being absent (Fig. 5, f_3). Just in the contact fault breccia is prominent. The fault line runs approximately from east to west and is more or less parallel to the coastal cliff.

Hsiaolingho (小凌河) *and Nüerhho* (女兒河) *overthrust:*—The fault line more or less coincides with the valley of Hsiaolingho and Nüerhho (Fig. 11, f_4) and thence is derived its name. Near the eastern part, a narrow strip of the

Sinian limestone is bounded on three sides by the volcanic formation, suggesting evidently an overthrust. This is also proved at the western foot hill of Pichiashan (筆架山), by a good exposure of the fault plane which dips at 40° to the Sinian bed (Fig. 10).

Lungchunssu (龍泉寺) *and Hoshangkou* (和尚溝) *overthrust:*—North of Lungchunssu and Hoshangkou a low range of hills is formed by the Sinian limestone which lies directly upon the Archaean gneiss on the south and is overlain by the volcanic formation on the north. There are therefore some strata missing both above and below. Such abnormal contact would naturally suggest two faults, the reversed character of which, is inferred from the apparent conformable relation.

Faults near Hungluohsien (虹螺峴):—There are two rows of horizontally shifted faults near the north-eastern rim of the Hungluohsien coal field. The first is located just to the east of Hungluohsien with southern shifting of the volcanic formation on the east. The second is marked at the vicinity of Kaoshantun (靠山屯), and Tuanshantzu (團山子), where the sedimentary formations to the east of the fault line were shifted northward. The basal conglomerate of the upper Carboniferous coal series constitutes an easily recognized horizon; it is near Kaoshantun affected by three horizental shifts. (Fig. 12.)

Normal fault of Heiyükou coal field:—South of Yangmukou (楊木溝), both the Triassic sandstone and the Carboniferous coal series are brought in fault contact with the Sinian limestone. It strikes in an ENE-WSW direction with the up throw on the southeast (Fig. 7).

Besides the faults described above there are still some others of less importance.

III. Date of folding and faulting.

Within the area studied, even the volcanic formation has been effected by the tectonic disturbances. This would naturally put the date of the movement to post-middle Cretaceous. Due to the absence of younger formation above Cretaceous, except the Pliocene red clay, the upper limit in age is difficult to determine directly. However, in the neighbourhood of Peipiao (北票) where the orogenic history is better known, Dr. Wong assigned to the folding and overthrusting an upper Cretaceous age (Yenshan movement, Phase B). This

would probaly apply here also. But as some of the folds as the Hulutao anticline and the Heiyükou syncline for example, are clearly cut by faults there seem reasons to believe that normal faulting has been produced in a later period say Mid-tertiary.

MINERAL RESOURCES.

Coal is the most important mineral riches in the region studied. There are two coal bearing formations, the upper Carboniferous and the lower Cretaceous. Coal of Carboniferous age is worked in three distinct fields namely the Shakuotun (沙鍋屯), the Hungluohsien and the Heiyükou coal field. Their probable reserve as well as their composition are summerized in the two following tables.

The Cretaceous coal series includes two coal fields (1) at Tahuangti and (2) at Taitzushan. Both contain only a little coal, and are therefore, of less economic importance.

Beside the coal resources, there are still galena, pyrite, limestone and white clay. The former two occur as veins and pockets in the contact zone of limestone with granite. They have been mined some years ago but are now largely abandoned.

Ordovician limestone is frequently worked for burning lime, wherever developed. As it is pure in composition and rich in reserve it may prove of economic value for future cement work.

TABLE I

Coal field	*Total thickness of workable coal seams*	*Probable reserve*	*Possible reserve*	*Classification*	*Mines*	*Daily output*
Shakuotun field	3 meters	60,000,000 ton	95,000,000 ton	Bitumite	Tungyü coal mine Chiangyeh coal mine	40-50 ton
Hungluohsien field	7 meters	30,000,000 ton	49,000,000 ton	Anthracitic bitumite	Aishang coal mine Paohsing coal mine	60 ton 25 ton
Heiyükou field	1.5 meters	10,000,000 ton		Anthracitic bitumite	Yungching coal mine	10 ton

TABLE II

Seams of coal mines	*Moisture*	*Volatile matter*	*Fixed carbon*	*Ash*	*Color of ash*	*Sulphur*	*Nitrogen*	*Coking quality*	*Calorific value*
Lower seam No. 1 of Tungyü coal mine.	3.29	32.75	53.47	10.19	yellowish gray	0.59	0.59	caking	7,046
Lower seam No. 2 of Tungyü coal mine.	3.50	33.01	50.36	12.44	yellowish gray	1.22	0.85	caking	6,105
Upper seam of Tungyü coal mine.	5.82	22.71	53.12	18.35	gray	0.81	—	caking	6,600
Thinner seam of Tungyü coal mine.	2.27	22.31	45.30	30.12	light red	—	—	non-caking	5,847
Thinner seam at Tungpingti, Tungyü coal mine.	2.10	35.12	43.71	19.07	gray	—	—	caking	6,023
3rd seam of Aishang coal mine.	1.50	14.50	70.00	14.00	white	nil	—		7,300
3rd seam of Aishang coal mine.	1.05	10.30	71.23	17.42	light brown	nil	—	semi-caking	5,815
2nd seam of Paohsing coal mine.	0.23	14.23	70.94	14.60	grayish yellow	—	—	semi-caking	7,442

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Geology and Mineral Resources of Chinhsi and Chinhsien Districts Near Hulutao, Liaoning Province

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