北京濟南幅

一百萬分之一

中國地質圖說明書

譚錫疇主編

民國十三年十二月

地質調查所測製

商務印書館印行

中國地質圖總例

一、本圖分幅印行分幅方法係仿照國際協定一百萬分之一世界地圖分幅辦法每幅面積佔緯度四度經度六度

二、每幅右角除載與世界地圖對照之行列數目外並標明圖內最重要之地名二處即作爲幅名

三、本圖地質均係中國地質調查所所自測大抵係自二十萬分之一較詳之圖縮繪而成但其他材料亦均儘量參考

四、每幅均附一說明書載明幅內地質礦產之大概

五、此係初版未完之處後再修改

中國地質圖北京濟南幅說明書目次

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第一章　總論

一　範圍

本幅範圍、縱自東經一百十四度起至一百二十度止、橫自北緯三十六度起至四十度止、包有京兆直隸口北道南部津海保定大名三道、幾佔山東全部、卽東臨濟南二道之大部、膠東道之西部、奉天綏中縣河南安陽縣各具一隅、山西僅有沿邊數縣。

二　根據

本幅地質最大部份、均經實地調查。民國六年至九年、譚錫疇君調查山東西部地質。九年秋又偕李捷君調查幅內直隸地質。山西範圍、係根據王竹泉君調查。此外又參據安特生新常富二君局部調查、面積較少。其分劃具載圖幅。關於地形者、根據山東陸軍測量局測製二十萬分之一山東地形圖、德國陸軍參謀處測製二十萬之一直隸及山東輿地圖、此外如順直水利委員會所測之水道圖、京漢津浦二鐵路之沿線剖面圖、以及本所測製各處礦床地質等圖、參考所及、共計四十餘種、高度之注明數目者、均以大沽口平均海面爲基礎。

第二章　地形

一　山地

茲所謂山地者、凡平原之外有岩石露出之地皆是、非必有劇烈褶曲、如地質學上所謂由造山作用所成之山

脈也。茲略述地面形勢、應與地質構造章參合觀之。

太行山　京漢鐵路線以西、地勢驟高、有時危巖壁立、是爲太行山脈。在本幅內完全與京漢路線平行、作南北走向。太行山之山脊、大部猶在本幅西界之外、故本幅所見、每當其東麓。其山名隨地而異、（一）在井陘獲鹿稱臥龍山者、至靈壽則爲靈山。（二）自井陘南境東延至獲鹿元氏間、有封龍山、北爲金珠嶺、東爲青龍山鳳凰山。（三）入元氏境名九泉山、迤東南爲蟠龍山、又南名萬花山、（四）蟠亘於贊皇臨城之界、最高者稱天台山、東北入贊皇境爲孤山五馬山、東向入臨城境爲白雲山、此皆太行山之東面前列也。復東則成爲較低之岡阜、斷續起伏、以入於平原。（五）聳立於臨城西境者爲三峯山、東向俗名屹了寨山、東南入內邱爲太子嶺、漸卽於沿平原岡阜。（六）綿亘於邢台沙河西境者有拷栲洪山、向東北有東山老薛山、再東北又有車箱山臥虎山。（七）入河南武安北境有張廣山鑛山、東向至縣東北爲儒山、東北至武安沙河之交有鳳凰山。（八）巍峙於武安磁縣間者曰鼓山、東北延長爲紫金山。（九）向南延長安陽境內者則爲艾山。此皆隨地立名、要皆太行山脈之東側。其地勢大抵沿平原先見較低岡阜、岩石爲較新之礫岩粘土或紅砂岩、其下往往蘊有煤田。復進、山巒陡起、高至數百乃至千餘公尺。岩石以古生代之石灰岩元古界之片岩片麻岩及石英岩爲主。太行山脈之範圍大抵自獲鹿縣起向南延長、至河南北部、始折往西南、蓋已出本幅南界之外矣。

恆山　太行山之北、實爲一高原地、其高度往往自一千五百公尺至二千公尺以上。言地理者恆稱恆山爲太行山脈之首、茲姑總以恆山名之。在本幅內、北起廣靈、南抵曲陽、連亘數百里。（一）起於廣靈大同之間者爲六稜山、高一千七百餘公尺、蜿蜒而東、經陽原廣靈蔚縣間曰夏山。（二）綿亘於廣靈靈邱之間、東經蔚縣南部、有

魚皮嶺、迤向東北爲小五台山、入淶鹿界。(三)聳立於靈邱之南者曰太白山、高二千五百公尺。東向入淶源縣境、分爲二支、一支東北行爲黃安嶺、一支曰五迴嶺。東入易縣境、又分趨易縣北部者有奇峯嶺、東北入淶水界曰紅崖山。在易縣之南部者有狼牙山、(或瑯琊山)東接原野。(四)蜿蜒於阜平縣境者爲大茂山。(主峯所在尚未考悉)東南入曲陽唐縣界至曲陽之南曰黃山。山勢陡落而爲原野、恆山高原東盡於此矣。

北京西山　以在北京西故名。西接恆山、東沒於原野、西起百花山、高約二千四百公尺、山脊方向自西南向東北。迤東山勢稍低、歧爲三支、隨地異稱。北支東北行、山嶺最著者爲廟安嶺大寒嶺髻鬟山、東逾渾河爲妙峯山。中支爲花木嶺爲九龍山、逾渾河猶起伏未已、再東沒於北京之西、南支東南趨突出者爲豹耳山、(北嶺主峯)迤東爲花安山、再東山勢陡落、成原野焉。

燕山　在直隸東北部、蟠亘於玉田豐潤遷安灤縣屬境、袤延數百里。大致分爲兩帶、中隔空谷。北帶蜿蜒於玉田豐潤北部遷安南境山、勢不甚高、每在三四百公尺之間。南帶多在灤縣境、山勢橫列、西南兩方夷爲平原、逾灤河爲碣石山。

碣石山　主峯極巔實在撫甯、而山脈則蟠亘於昌黎撫甯盧龍三縣屬境。昌黎撫甯兩縣之交、巍然聳立、高約五百米突。西支抵灤河、與燕山山脈對峙、東支經撫甯臨榆境、沒於海。

以上言本幅西北二方面之山地。越冲積平原而孤峙於本幅之東南隅者、則爲山東山地、以泰山之脈爲脊首。

泰山　其主峯在泰安縣北境、巍然聳立、高出海面約千五百公尺。周圍約百數十里、而支脈四出、蜿蜒甚遠、隨地異稱。脈之所向約大別爲四支。一支東北趨、蟠亘於泰安歷城境者曰長城嶺曰橛山、在萊蕪曰大屋山、在章

邱附近曰長山、在博山曰岳陽山、在益都曰臥虎山、東與魯山之脈相接。一支東南向、至泰安南境、突起爲徂徠山、至萊蕪新泰間爲新甫山、東抵蒙陰境、遙對魯山。一支西出、蔓延於長清者爲馬山、在肥城之西曰陶山、至東阿之南有大寨山、再西山勢陡落、夷爲原野。一支西南行、經泰安西肥城南、爲鳳凰山與埠山、西南山勢猶未盡。

魯山　居山東之中部、狀頗雄偉、高千餘公尺。南北綿延數百里、西接泰山、東望沂山、主峯在博山蒙陰交界、向北延長、蟠亘於博山益都臨朐屬境。山峯以方山青龍山鳳凰山堯王山爲最著、至益都北部夷爲原野。南向入蒙陰沂水境、山勢屈曲、嶺谷盤繞。在沂水境有九頂連環山。

沂山　主峯在臨朐南部、而支脈四出。北支經臨朐東境、有牛山靈山、入昌樂有方山孤山、濰縣西境有黑山、東境爲常靈公山孤立於原野。東支入安邱境爲唐王山城頂山、東至諸城昌邑縣屬、山勢低落。東南支經沂水境入莒縣北部。西南支蟠亘于沂水北境、有北平山。西北支蜿蜒于臨朐南部、以米山嵩山爲著。

二　河流

本幅河流、皆注于渤海。除黃河源遠流長、運河縱貫南北外、餘皆發源于直隸山東河南山西及察哈爾境內、通常約數百里、至多不過千餘里。濱海溝渠至數十里者亦有之。統計爲數頗衆、而可通舟楫利運輸者蓋寡。黃河運河而外、惟灤河大清河子牙河小清河等數流而已。綜攬本幅河流、大致可分兩組、一直接入海、各有流域、不相連屬。一滙歸海河、由大沽口入海、支幹聯絡、統系秩然。

海河　一名沽河、自天津東南流、由大沽口入海、長約九十里、可行輪船。海河原由五大河流在天津會聚而成、五大河流者曰北運河永定河大清河子牙河南運河、是也。

北運河　有二源、一曰白河、源出獨石口外、一曰潮河、源出古北口外。兩河在密雲城南會、始稱北運河、南流入本幅區域。納沙河通惠河至天津北合永定河、再與諸水匯于天津、河可通舟楫。昔日糧船由天津運往京師、必取道于此、今則多取陸路矣。

永定河　上游曰桑乾河、源出山西、至直隸涿鹿縣、東合洋河、總稱渾河、東南流入本幅區域、納西山東部之水、至石景山出山、水始縱流、屢有河患。至清康熙間改稱永定河。東南流、鳳河挾龍河小渾河涼水河南流來會、又東南合北運河、抵天津。河水多挾泥沙、易於淤積。大抵自良鄉以下、河底高於河外田地、兩岸全恃堤防、無運輸之利、而多汜濫之患。

大清河　支流紛繁、大者有四、曰白溝河、上游稱拒馬河、爲大清河之北支。古稱淶水、源出淶源。東流至房山縣張坊東南乃分歧。正河屈曲而南、納北中兩易水、東南流、至容城白溝鎭與支流合。支流自張坊東流、先後納胡良河琉璃河龍泉河、凡西山南部之水悉入之。迤向西南流、合正河於白溝鎭、自此以下、通稱白溝河。東南流入大清河。曰長流河、爲大清河之別支。源出易縣境。東南流、納雹河。南易水、源出易縣南境。東南流至徐水縣、合於長流河。流入西淀。曰依城河、上游稱唐河、爲大清河之中支。古稱恆水、亦名滱河、源出山西渾源縣。東南流入本幅。至定縣境、初由定縣東南流、達安國、至清道光間、乃改向東北流、奪陽城河正瀆。又東北流納九龍河、至安新縣界有方順河合府河來會。府河卽清苑河、穿保定城東出者也。又東流、左納徐河、（亦稱漕河）東流經安新城北、遂名依城河。入西淀。曰瀦龍河、上游稱沙河、爲大清河之南支、卽古泜水、（訛爲派水）源出繁峙縣。入本幅區域、至安國縣南境、滋河挾五道溝自西南來會。滋河源出山西五台縣、入直隸靈壽縣境東流、原入滹沱河、今與

沙河會。沙河既納滋河、東北流、孟良河自唐河故道來會、遂名滹龍河。東北流入西淀。後三河均匯入西淀、由淀東出、始名大清河。至新鎮縣北、納白溝河、再東入東淀、出淀至天津、與諸水會、河水暢流、可通舟楫。

子牙河　爲滹沱河滏陽河合流後之總稱。古稱衞水、源出山西繁峙縣。入本幅平山縣境、有治水合桃水來會。滹沱河在山西境、行萬山中、不能橫決。至平山始入平地、水勢散漫、東南流至豪嵩縣境、而河患起。歷代改流、紛歧迭出、滏陽河以北、滹龍河以南、皆其縱橫貫注之區。清同治七年以前、滹沱故道本自藁城城東南流、合滏陽河、又東北至獻縣爲子牙河。同治七年、乃改自藁城東北流、經晉縣分爲北中南三支。經深澤安平饒陽至獻縣西、三支會合、循大洋河槽北行、經河間任邱而以文安大窪爲壑。清光緒七年、乃於獻縣西古洋河東岸朱家口另闢引河一道、東西長三十里餘、引滹沱河水至獻縣城北、由子牙河西岸仍歸故道。而滏陽河乃循滹沱舊行南道、挾諸水自西南來會。滏陽河原名滏水、源出磁縣西境。東流、折而北至任縣、入大陸澤、有洺河沙河及七里牛尾小馬等河合流來會。出澤東北流、甯晉泊滙集泜洨槐沟李陽諸河注之。又東北流。至獻縣合於滹沱河、卽稱子牙河、東北流至天津。滏陽河自納寧晉泊諸水後、河流始暢、可通小舟。及合滹沱、水勢愈大、舟楫往來、爲津南重要水路之一。

南運河　運河爲吾國唯一縱河、全以人力爲之。南抵杭州、北達畿輔、統名運河。本無南北之分、惟在本幅區域、運河從天津至畿輔一段、水南流、天津以南水北流、以天津爲總滙、茲稱南運河者、所以別於北運河也。河由衞河合會通河而成。衞河源出河南輝縣、入本幅納恆河漳河、東北流至臨清、會會通河。會通河爲山東運河之北段、自南旺湖西北流來會、兩河既會、始稱南運河。北流至天津、會子牙河大清河永定河北運河而成海河、東南

注於渤海。

黃河　自河南出山入平原、河始汜濫、歷代移道改流、爲患甚鉅。今自開封而東至蘭封縣北、迤向東北流至山東壽張縣、入本幅區域。又東北流、分道入海。河在本幅區域內、暢通舟楫、尙饒運輸之利、惟下流常衝決潰溢。具詳專書、茲不盡述。

小淸河　源出山東歷城縣。源泉瀆突頗高、名趵突泉、水北流出城垣、轉東北流入海。河水暢流、可通舟楫。由河口上溯可達濟南北關、內地運輸頗利賴焉。

徒駭河　上游有二支、爲古趙王河及金線河。二河合流後、橫越運河、稱徒駭河。納得勝河及趙牛河、東北流、有沙河來會、又東北流。此河水流不暢、時常涸竭、惟下段進海處水勢尙盛。

馬頰河　與徒駭河大致平行、而在其西、在本幅內者、由直隸淸豐縣起、經南樂入山東境、逾運河、蜿蜒東北流入海、水勢不暢、與徒駭河同。

淄河　源出山東魯山之陰。東北流出山、至廣饒縣東、折而東流、瀦爲淸水泊。出泊北流、注於小淸河。水勢不旺、春冬時常涸竭。

溙河　源出沂山西麓。曲折北流、經臨朐縣東出山、迤向東北流、丹河合白浪河來會、又東北流入海。在臨朐南有源泉一道、水甚盛。溙河至此納泉水、水流始暢、然亦不利轉運。

濰河　有數源。在本幅內者、自諸城起、北流納渠河及汶河、再北經昌邑縣東、蜿蜒北流入海。濰河源出深山、支流甚多。大抵沂山以東之水悉入之、故水勢較淄河溙河稍大。至昌邑境內、偶有小舟往來。

膠河　上游支流頗多。在本幅內有五龍河、北流、蜿蜒於平度昌邑界上、納平度西部之水、曲折北流入海。水勢不盛。

沂河　源出魯山之陽、支流頗多。衆支會合後、蜿蜒東南流。源泉尙四時不涸、至沂水南境。夏秋水盛時可行小舟。

汶河　源出魯山之陽、與沂河源僅一嶺之隔。衆支合流、經萊蕪縣南、蜿蜒西流、入泰安縣境、有漯河自東北來會。汶河乃西南流、經泰山徂徠山之間、泰山以南徂徠山以西之水悉入之、轉而南出境。河水常流、四時不竭。

灤河　源出獨石口外。自會熱河、水勢始大、曲屈東南。流入本幅、納青龍河、蜿蜒南流。至樂亭縣、分爲二支、一支東南流入海、一支南流入海。灤河水流暢通、可行舟楫、溯河而上、可達熱河、直隸東北部重要水道也。

薊運河　爲多數小河滙集而成。至薊縣城南、始名薊運河。南流入本幅、納洵河。東南流、右納鮑邱河、左納還鄉河。南流、有七里海塌河淀兩引河自西來會。又南流、迤東由北塘口入海。河水暢流、可通舟楫、明季船達薊縣南前清濬之、運漕供陵糈。至今內地運輸猶利賴之。

洋河　在本幅區域內者、惟下流一部。由撫寧北境流經撫寧縣西南、折東南流入海。河水暢通、四季不涸。

陡河　源出燕山之陽。蜿蜒南流、經唐山之東開平之西、南流改稱淵河。有沙河自東北來會、南流入海。

上述河流、均爲本幅區域重要水道、而動與全部或一地方之利害攸關。其便交通利運輸者有之、河水氾濫爲患者亦有之。其他河渠尙多、惟非源流短淺、卽終年乾涸、河身大都淤塞。在運河東岸有多數乾河、以閘與運河通、當運河水勢浩大時、每用爲宣洩之具、導水下流、庶免河患。

以上係述重要河流。尙有窪田低地、河川經流之處、往往瀦水成巨浸、面積廣闊、或稱淀澤、或稱泊海。惟水面漲縮、頗不一定。夏秋雨期、一片汪洋、冬春淀形縮小、甚至有涸竭者。最著如白洋淀三角淀寧晉泊大陸澤七里海塌河淀。就中惟白洋淀終年積水、向未乾涸、餘均視雨量之多寡爲漲縮焉。

三　平原

此平原爲世界大平原之一。東西寬度、沿北緯三十九度、自大沽口至徐水縣以西山麓、寬約二百公里。沿北緯三十八度、自徒駭河口至石家莊以西太行山麓、寬約三百四十公里。南北長度、在本幅內者已長至四百四十公里。尙向南延長、遠出於本幅範圍之外。

幅內所注高度、以大沽口海平面爲基準。向西漸高、進至北京僅四十公尺。京漢鐵路線、大致與太行山脈平行、最高點不過七十公尺左右、(在河南安陽縣附近)餘皆在五六公尺之間。沿津浦鐵路線、德縣二十二公尺、滄縣十公尺、天津則約五公尺而已。大抵保定以東、高度皆在十公尺以下、地勢既卑、故積水獨多焉。

平原地質、皆爲冲積層。沿山一帶、則黃土較多。由此以下直達海濱、則惟見砂層礫層壚埴粘土、以及次生黃土、交互成層。大抵土性腴美、利於種植。除有水災之地外、餘皆人烟繁集、稱爲富庶之區。

冲積之厚度、頗難測度、今尙未有深井深鑽貫透冲積層而直達其下之岩石者。北京東城離西山露岩約二十五里之地、有一七百〇八尺之深井。經過冲積層後、遇一甚厚之紅土。此紅土是否爲直覆於岩石上之上新統紅土、尙難確證。假曰然也、則冲積層之厚、已在現代海面七百尺之下、離山更遠者或更加深。此冲積層之下部、是否有海底沉澱、今難證明。若誠全爲河流冲積、則必其地隨積隨降而後可。視察近狀、河流沉積速力亦頗不

弱、於積壅塞、到處有之。前乎此者殆沉澱尤速。故此七百乃至千尺以上之沖積層、其生成之時代、在地質史上當不甚速。意者其地盤之沉降亦與有力焉歟。

但就最近之地史言、渤海岸是否沉降、抑經隆昇、學者迄無定說。就沖積層之厚度言、固若有沉降之勢。然主隆昇之說者、則以河流淤積之速、沿海砂線之廣爲證。甚者更援據紀載、證明歷史時期內海岸時時向外伸張。考其實、似皆不足爲定論。天津一帶地層中是否確有海生化石、至今未有明證。卽濱海之地或稍延長、亦未可以一隅沖積之現象、遽認爲地盤隆起之確據。此問題之樞紐、當於地層中之化石求之、而今尙未足以論及此也。

第三章　地層系統

一　太古界　泰山系

地層　山東泰山地層、時代最古、其他地層無出其前者。其岩石以片麻岩片麻花崗岩爲主、間有結晶片岩、夾有偉晶花崗岩及其他侵入岩脈、種類甚多。偉晶花崗岩脈及石英脈內時有金銅鉛銀等礦多少不等。

分佈　泰山系在山東分佈極廣、自泰山東向大屋山魯山嵩山沂山皆屬此系、南又成徂徠新甫等山、濰河對岸又成平度掖縣間之黃山。此系岩石所在、每產砂金。直隸東北如臨榆撫寧盧龍三縣、及奉天綏中縣之一隅、西北自易縣西陵經紫荊關五迴嶺、以至阜平平山二縣、西部如贊皇臨城內邱三縣迤西一帶山地、皆此系分佈所及。

二　舊元古界　五台系

地層　此系以山西五台山爲模範地點、與泰山系常不整合。地層層理較爲顯著、走向傾斜易於認識、與上下

他系地層皆不整合。細辨之又可分爲數統、其間又或各不整合、極爲複雜。岩石常見者、有結晶片岩片麻岩等、片岩以雲母片岩或角閃片岩爲最著。有時黑色礦物減少、成爲長英片麻岩、以片理細而晶粒小、得與泰山系片麻岩區別。又有石英岩大理岩綠泥片岩等、爲泰山系所未見。石英岩色白質堅、變質頗深、砂粒原形往往難見。大理岩多見於直隸西部、或全體結晶成白色、有時爲細粒灰色、往往含鎂頗多、石綿滑石多生其中。侵入岩頗多、如花崗岩長英岩安山岩等。

分佈　本幅內山東各地此系極稀見。惟膠縣南七寶山一帶有片岩片麻岩大理岩等、夾磁鐵礦及石榴子石、又有螢石脈內夾方鉛礦。又掖縣粉子山及黃山、有雲母片岩滑石片岩及白色之大理岩等。平原以西、此系發育極廣。在山西靈邱境內、直隸滦源西部及曲陽行唐靈壽平山四縣境內者、以雲母角閃等片岩及細粒之片麻岩爲多。在獲鹿南境贊皇境內及元氏臨城內邱邢台西境者、片麻岩片岩兼夾石英岩大理岩綠泥片岩等、常含石榴子石、大理岩內時有石棉。在盧龍灤縣境內者、有雲母片岩及細粒花崗片麻岩含磁鐵礦頗多。安各莊附近又有偉晶花崗岩脈、內含電氣石。

三　新元古界　濠沱系

地層　總分之可得二部。下部爲白色或紅色石英砂岩、夾有板岩頁岩及少許礫岩。砂岩層面往往有雨痕波紋。上部爲矽質石灰岩、含燧石結核頗多。有時見黑色頁岩或板岩。二部地層與其下之五台系顯不整合。上部灰岩及頁岩之間及其上之寒武紀地層、走向傾斜常相一致、然其間仍恐不相連續。岩石變質較淺、與古生界水成岩無異、但至今未得確定化石。此系又名南口系或震旦系。

分佈　此系在本幅北部發育甚盛。直隸西北與山西鄰接處、及沿平原一帶山地、至曲陽縣附近爲止、分佈極廣。石英岩厚約二百公尺、矽質石灰岩厚約一千公尺。在陽原蔚縣南境、滹源西境、及廣靈靈邱大同天鎭境內、本系直覆於五台系之上。在蔚縣涿鹿滹源易縣滿水徐水滿城定縣唐縣曲陽境內、則多直覆於泰山系之上。在宛平西境清水河谷、矽質石灰岩之上有黑色頁岩四百至七百公尺、此地特名爲下馬嶺系、蓋以地名名之也。南至房山滹水易縣之交、厚度減至百公尺左右、至易縣南境、僅厚五十公尺。黑色頁岩當爲矽質灰岩最上之一部、對於其上之寒武系、則形似整合、實不連續。自平山以南太行山一帶、此系時隱時現、而矽質灰岩厚度頗減。平山井陘獲鹿境內厚約六十公尺、至井陘南境七寺附近頓減至三四公尺、再南則寒武系直接於石英岩之上矣。石英岩之上部、在井陘東南獲鹿南境元氏贊皇東境及臨城之一部者、夾有鮞狀赤鐵礦層、惟厚度不大、愈南愈薄、至邢台沙河境內、僅二三寸而已。石英岩層面、又時現雨點波紋、爲淺水沉澱之特徵、在本幅東北、此系亦甚廣。分佈於盧龍遷安撫寧昌黎灤縣境內者、多爲石英砂岩及礫岩、其中礫岩之多、爲他處所少見。矽質石灰岩、則除上列各縣外、並分佈於豐潤玉田遵化薊縣等地。在山東者、此系厚度大減。在山東西部如泰安新泰等縣僅有薄層矽質石灰岩夾於泰山系及饅頭頁岩之間、厚僅數公尺、時或不見。往東則此系漸多、博山東境臨朐南部及沂水蒙陰境內、除矽質石灰岩外、兼有黑棕色頁岩砂岩、總厚數十公尺。濰縣馬司一帶本系砂岩延長二十餘里、底部爲礫石、直覆於太古界之上、礫大如卵。

四　寒武紀

地層　就岩石言、可分爲二部。在下者爲饅頭頁岩、紅色、夾砂岩及薄石灰岩。在上者爲九龍石灰岩、大部份呈

鮞狀、鮞石或爲球狀或爲橢圓、直徑自一公厘至一公分不等。中部間夾綠色頁岩、上部時有礫狀石灰岩、因其形似、亦名爲蠕狀石灰岩。此系含三葉虫及腕足類化石、而三葉虫爲尤多。此系與凍沱系似整合而實不連續、故其所覆之古地層、時代頗不一致。

饅頭頁岩在山東西部者、厚自八十至百三十公尺、西部較厚、東部稍薄。直隸山西所見、厚自七十公尺至一百五十公尺、更有厚至三百餘公尺者、大致南部較北部爲薄。山東饅頭頁岩曾得三葉虫之 Redlichichia, Ptychoparia 腕足類之 Hyolithes, Steinotheca 等化石。饅頭頁岩之上、卽爲九龍石灰岩、與饅頭頁岩常想整合。在山東西部者、厚至四五百公尺、細分爲張夏石灰岩崮山頁岩炒米店石灰岩三段。(所用地名皆津浦路濟南至泰安間之站名)張夏段內有 Anomocare, Drepanura, Ptychoparia, Dorypyge, Menocephalus, Solenopleura 等三葉虫、及 Stenotheca, Orthis 等腕足類化石。崮山段內、有 Crepicephalus, Teinistion, Dorypyge 等三葉虫。炒米店段內含 Ptychaspis, Illaenurus 三葉虫及 Orthis。直隸東北九龍石灰岩尙厚、至直隸西部及山西交境、則厚度漸減、不過二百公尺左右、中部頁岩不明。

五　奧陶紀

地層　本系純爲石灰岩、大部份成分頗純故爲石灰業及水泥業之上品材料。在山東濟南甚爲發達、故亦名爲濟南石灰岩。化石中以頭足類之珠角石 Actinoceras 爲最多、故亦名珠角石灰岩。化石種類詳見古生物誌。山東最厚處達八百五十公尺、直隸山西較薄、約六七百公尺、向西北方向有漸趨漸薄之勢。其層位下與寒武系相整合、故有濟南石灰岩者、其下必有九龍石灰岩。上與石炭紀煤系雖不連續、而形式上亦相整合、故在本

幅範圍內煤業與石灰業時相追隨。蓋地層之關係使然也。

寒武奧陶紀層之分佈　此二紀地層在本幅內常相連續、故并言之。山西廣靈境內饅頭頁岩與矽質石灰岩之間、有時見紅色礫岩厚約四五公尺、率爲矽質灰岩所成、呈稜狀。鮞狀蠕狀灰岩層不甚厚。奧陶紀灰岩暴露不全。在宛平房山境內及涿縣淶水西北部、寒武奧陶紀地層覆於黑色頁岩層之上、上接古生代煤系。寒武紀地層露頭較少、最發育者厥爲奧陶紀灰岩。寒武紀地層與通常所見稍異、頁岩爲紫綠等色、中夾灰岩頗厚、鮞狀蠕狀灰岩不甚發育。奧陶紀灰岩間夾灰質頁岩、與花崗岩接觸處往往變爲大理岩、色白質潔。在直隸西部、寒武奧陶兩紀地層、俱覆於矽質灰岩層之上、上接古生代煤系、在直隸西南部獲鹿井陘等處、寒武奧陶紀地層位於矽質灰岩層之上、有時灰岩缺失、直與石英岩層接觸。寒武紀地層與元古地層之不連續、此亦一證也。在元氏贊皇臨城內邱、寒武奧陶紀地層直位於石英岩層之上、上有古生代煤系。饅頭頁岩層呈棕紫赤各色、有時含劣質赤鐵礦。鮞狀灰岩內鮞石顆粒較小、蠕狀灰岩常有塊狀或層形之矽質、惟有時不甚發育。奧陶紀中則有純潔灰岩、煤田邊際極爲發育。

在邢台沙河磁縣武安安陽等處、寒武奧陶紀地層蓋兩有之、而奧陶紀灰岩發育尤著。下部緊接元古石英岩層、上部屢爲火成岩衝動、致多彎折。饅頭頁岩含雲母甚夥、并夾薄層灰岩、略具鮞狀。奧陶紀灰岩下部一層、質極不純、粗鬆多孔。上部質潔、可燒石灰。在直隸東北部灤縣境內、及昌黎豐潤盧龍一部、寒武奧陶紀地層直位於矽質灰岩層之上、上接古生代煤系。兩紀地層均甚發育、惟饅頭頁岩層內未見薄層灰岩。奧陶紀灰岩上部質純淨、用燒石灰。在山東山地北部、寒武奧陶紀地層分佈甚廣、依次整列、毫無缺失。饅頭頁岩層底部與矽質

灰岩層接觸處、大致爲一種淺灰綠色灰質頁岩。其所夾灰岩爲層甚多而頗薄、分占上中下三部、非若直隸境內之厚集於中部者。崮山頁岩露頭顯著、介於鱗狀灰岩與蠕狀灰岩之間、呈凹陷狀。蠕狀灰岩最上部質頗龐雜、與奧陶紀灰岩劃分頗易。分佈於安邱境內及昌樂濰縣莒縣一部者、蠕狀灰岩倍極發育、其他各層僅微露踪跡。大致下與太古元古兩界地層爲斷層所阻隔、上與凝灰礫岩層成不整一之接觸。

六　石炭二疊紀

地層　石炭二疊二紀地層、在本幅範圍內密相連續、直接覆於奧陶紀石灰岩之上。介於其間之志留泥盆二紀地層則毫無踪跡、地史殘缺至此、世所稀見。二紀地層煤礦最富、故稱爲煤系。本幅範圍內重要煤田、大多數爲此煤系所成。因中國北部侏羅紀亦有煤系、間亦頗富、故此石炭二疊二紀煤系、又稱之爲古生界煤系、以別於中生界煤系。

就觀察所得、本煤系除少數煤田岩層略有變更外、其餘大致可以比較、據岩石性質、約可分爲下中上三部。自直覆奧陶系之底部起、至紡錘虫石灰岩爲其下部、以粘土及泥質頁岩爲主、中夾類似凝灰岩之重岩、底部每含赤鐵礦、量微質劣。煤層萃集之處爲中部、岩石以頁岩砂岩爲主、含重要煤層、幷夾薄層石灰岩、內含腕足珊瑚等化石。不夾煤層者爲上部、岩石以彩色泥質頁岩砂岩爲主、間夾綠色硬質緻土。

上述煤系、中部之上層多植物化石、如羊齒葉封印木鱗木蘆木楔葉木輪木等。據開平煤田所見、曾經鑒定者、其時代在石炭紀至下二疊紀之間。據葛利普氏研究動物化石之意見、則本系中部之下層屬下石炭紀及中石炭紀、而上部則亦謂當屬二疊石炭紀、二者之間當有間斷。

古生界煤系露頭之位置、大抵一面緊靠奧陶紀灰岩之山、一面漸低入平原、爲黃土冲積等所掩、益以褶曲及斷層之影響、故全系厚度往往不易確計。曾就露頭測定者、如山東淄川礦山附近、得二百三十二公尺、大奎山得二百八十四公尺、至博山之黑山則減爲二百零三公尺。直隸開平煤田趙各莊以東、測得二百零八公尺、趙各莊以西、有厚達二百八十公尺者、磁縣煤田及六河溝煤田中僅產煤部份、曾已測得厚在一百三十公尺以上、全系當遠在二百公尺之上。在西山則有厚至四百公尺者。煤層厚薄等、詳見礦產章。

分佈　茲將全幅範圍內重要煤田之煤系情形、節述如下。

淄川博山煤田　分佈於淄川東南博山北境及益都一部、煤田內礦山大奎山黑山三山煤系顯露頗明、曾經詳勘、另有報告、見地質彙報第四號。茲僅舉礦山古生代煤系之地層如下、以見一斑。

一　棕紅色粘土厚四公尺半。

二　淺黃白色粘土、時帶赤色、厚二公尺。

三　類似凝灰岩之重岩及彩色粘土、厚十公尺。

四　紅黃色粘土、厚半公尺。

五　不純之灰質岩、石厚半公尺。

六　棕黃色粘土、厚半公尺。

七　淺綠灰色粘土與淺紅黃色砂岩相間而生、上部含有黑色泥質頁岩、厚六公尺。

八　紡錘虫灰岩、厚四公尺二。

以上爲煤系下部

九　黑色頁岩、其堅實部份成爲硯石、(含有煤層)厚十二公尺。

十　淺綠灰色硬砂岩、厚一公尺二。

十一　淺綠黑色薄層頁岩與淺綠色砂岩相間而生、(似含煤層)厚六公尺。

十二　輝綠岩層、(威利斯稱玄武岩流)厚一公尺。

十三　黑綠色薄層頁岩、(似含煤層)厚三公尺。

十四　輝綠岩層厚四公尺。

十五　淺綠黑色薄層頁岩、(含有煤層)厚七公尺。

十六　彩色(灰紅紫棕淺黃)薄層疎鬆泥質砂岩、厚五公尺半。

十七　石灰岩、含腕足類化石、厚一公尺半。

十八　黑灰色薄層頁岩與黃色砂岩相間而生、(含有煤層)厚七公尺。

十九　灰色薄層鬆質砂岩與黃色堅實砂岩相間而生、厚五公尺。

二十　黃色鬆質砂岩、下部夾有紫色泥質砂岩、厚二十一公尺半。

二一　黃色砂岩與含鐵硬砂岩相間而生、厚十四公尺。

二二　黃色鬆砂岩與淺綠黑紫色泥質頁岩相間而生、(含有煤層)厚十四公尺。

以上爲煤系中部

二三　黃色鬆質粗砂岩、含小顆礫石、厚六公尺。

二四　淺黃白色粗砂岩、下部夾有紫灰色泥質頁岩、厚七公尺。

二五　黃色硬砂岩與紫棕灰色泥質頁岩相間而生、厚五公尺。

二六　紫棕灰色泥質頁岩、厚七公尺。

二七　黃棕色雲母質砂岩、厚八十公分。

二八　紫棕灰色泥質頁岩、厚二公尺半。

二九　輝綠岩層、(威利斯稱玄武岩流)厚二公尺。

三十　紫棕灰色泥質頁岩、厚五公尺。

三一　輝綠岩層、厚二公尺。

三二　紫棕灰色泥質頁岩、厚五公尺。

三三　黃色鬆砂岩厚三公尺半。

三四　淺綠黃色砂岩、下部每呈赤色、厚十公尺半。

三五　紫棕灰色泥質頁岩、厚十四公尺。

三六　黃色砂岩、厚十一公尺。

三七　輝綠岩層、厚三公尺。

三八　白灰色堅實砂岩、厚半公尺。

三九　淺綠黃色鬆砂岩、厚三公尺。

四十　輝綠岩層、厚八十公分。

四一　淺綠黃色泥質頁岩、厚十三公尺。

以上爲煤系上部

章邱淄川煤田　分佈於章邱南部淄川西境、其西端伸入歷城屬地、與淄博煤田以斷層相隔。地層次序質性大致不甚軒輊。上中下三部重要地層、如紡錘虫灰岩、含腕足類化石灰岩、以及上部彩色泥質頁岩砂岩、均應有盡有。惟煤田北方逼近長山安山岩巨塊、致煤系內侵入岩層寖多、全系厚度及煤層間距大受變動、有時相差殊甚。

萊蕪煤田　分佈於萊蕪南境。煤系中部下部露頭較廣、上部多被冲積層埋沒、或爲斷層截去、濟南灰岩之上卽泥質頁岩層、上爲紡錘虫灰岩、再上爲煤系中部岩石、可見者爲含腕足類化石之灰岩及黃色砂岩。在煤田東西兩端、上部岩石如紅紫色泥質頁岩及淺黃綠色砂岩亦時暴露。煤系三部、大抵與淄博所見無異、惟紡錘虫灰岩與含腕足類化石灰岩之間、距離較近、但重要煤層確亦夾在中部也。博山南境蒙陰北境及蒙陰萊蕪交界煤田一分佈於博山黃家庄一帶、東西延長不過數里、北阻於斷層而盡。地層存留者、爲下煤系及中煤系之一部、餘均爲斷層截去。一分佈於蒙陰草埠附近、延長亦只數里。地層可見者有含腕足類化石灰岩及淺黃綠色砂岩、北絕於斷層、蓋亦僅殘餘其下部中部也。一分佈於蒙陰萊蕪之交、露頭不廣。下接濟南灰岩。上有中生界地層、但似不見石英砂岩。煤系與上覆之地層或爲斷層接觸、分佈頗狹、亦似缺其一部者。

昌樂煤田　分佈於昌樂縣境之東南隅荊山窪地方、東西既不發展、而南北尤狹。地層大部爲冲積層所掩沒。濟南灰岩之上先見含鐵層、再上有灰岩、類似煤系下部之紡錘虫灰岩、惟未見化石。次逾黃土爲棕色及綠色頁岩、夾淺黃綠色泥質頁岩、似屬於中部者。與片麻岩層接觸處、見有白色硬砂岩。

臨朐煤田　分佈於縣城之西南五井莊附近、延長約三數里。逼近濟南灰岩、而成斷層接觸。地層率被掩沒、可見者僅灰色泥質頁岩及黑色頁岩。舊窰及岩渣甚多、大抵含有煤層而爲煤系之中部。

臨淄西境煤田　分佈於城西鳳凰山一帶。因逼近閃長岩、大部已重受薰灼、變爲黑色硬質岩石、內以石英岩爲多。變質較淺部份、猶可識其爲煤系地層、並偶見一種白色砂岩、彷彿當於含煤層之下部者。

灤縣開平煤田　分佈於灤縣西境及豐潤一部。露頭可分二區、一爲唐山一帶、露頭不廣、而構造複雜、一爲開平至林西一帶、露頭成帶狀。沿開平盆地北東兩緣、因逼近平原、地層多被黃土埋沒、全系未能畢露。而同一地層往往隨地而異、茲就各處所見露頭略述梗概。

趙各庄煤系露頭尙多、以灰色黑色頁岩爲主、夾以含鐵砂岩及耐火粘土等層、下部有灰質頁岩。林西煤系露頭甚少、濟南灰岩之上、可見者爲灰色紫色頁岩凝灰岩硬質粘土及淺黃色砂岩、其與上之紅色砂岩層下之濟南灰岩層、均無明顯接觸。馬家溝煤系暴露不全。濟南灰岩之上爲黃灰色泥質頁岩、內夾白色粘土、稍帶紫赤色、上爲黑色灰質頁岩、厚不及一公尺、含腕足類化石極多。惟此層在趙各庄以西及唐山一帶灰質增加、直變爲灰岩並含紡錘虫及珊瑚海百合等化石甚夥。上爲一種黑色薄層頁岩、與淺黃色砂岩相間而生、似夾煤層。再上爲黃白色粗砂岩、間帶赤色、惟上覆黃土、未能目覩本系與赤色砂岩層之接觸也。唐山古生代煤系煤

田構造複雜、地層殊多錯亂。煤系可見者、濟南灰岩之上、緊接含鐵頁岩、厚約五公尺、上爲凝灰岩、厚約五公尺、上爲耐火粘土厚約二公尺、又上爲黃灰綠色砂岩厚約十八公尺、再上卽紡錘虫灰岩厚約一公尺。自此以上、爲本系含煤層部份、以粘土爲多、呈黃白灰綠棕紫各色、夾白色赤色砂岩及黑色頁岩、間有礫岩、含重要煤層。再上爲白色粗粒砂岩、地層露頭不復能目擊矣。

北京西山一帶煤田　分佈於宛平縣西部及房山縣北境西境。煤系暴露雖廣、而煤質甚劣、其價值殊不足與他處古生代煤系相提並論。地層下部大抵爲黑色暗灰色及灰綠色頁岩板岩片岩、夾有煤層、因變質作用、往往含黃鐵礦紅柱石及空晶石等。上部爲礫岩砂岩頁岩、砂岩一部有時變爲石英岩。詳見葉君良輔之西山地質誌。

曲陽靈山煤田　分佈於曲陽縣北境靈山鎭一帶。煤系露頭不全、一部份已被剝蝕而去。地層可見者、爲黑灰黃各色頁岩及薄層砂岩、下部夾有煤層。亦有薄層灰岩。厚約不及一公尺、或卽爲含腕足類化石之灰岩層、屬於煤系中部者。

阜平炭灰舖煤田　分佈於阜平縣北境炭灰舖一帶、面積頗小。煤系上部、大抵已經蝕去、暴露地層、以棕黑色頁岩及黑色灰色砂岩爲主、而含煤層。

井陘煤田　煤田之在本區域者、僅東邊一小部份、地層率被掩於黃土。就各方面觀察、大抵可分爲三部、下部以硬質頁岩白色砂岩爲主、中部爲軟質砂岩、薄層灰岩、夾有煤層、上部多黃色及棕色砂岩。詳見地質彙報第六號朱君庭祜報告。

臨城煤田　分佈於臨城縣西北、沿白雲山東麓向東北延長、一部伸入高邑屬境。地層掩於黃土、露頭絕少。就溝渠中及礦井內所得、下部則有頁岩及白色硬砂岩交互爲層、夾有礫岩及含腕足類化石灰岩、重要煤層悉出其中。上部爲紅紫色泥質頁岩砂岩、與山東所見本系地層上部殊爲近似。詳見地質彙報第六號趙田二君報告。

沙河密坡村章村一帶煤田　分佈於沙河縣之西、逼近河南武安縣境。地層多被正長岩侵入、隔爲數區、構造複雜。煤系露頭頗不完全、觀察所及含煤部份有黑色灰色頁岩白色黃色砂岩一部與正長岩接觸、變爲黑色硬質岩石。其上乃不含煤層部份、爲彩色泥質頁岩及淺黃綠色砂岩、卽通常所見之煤系上部也。

磁縣武安煤田　分佈於直隸磁縣西境及河南武安縣南部。地層可見者、濟南灰岩之上爲赤色含鐵粘土及白色粘土、上爲黃色黑色頁岩、黃色白色灰色砂岩、中夾深黑色燧石灰岩紡錘虫灰岩、並含重要煤層、當爲煤系之中部、再上爲紫紅色深灰色頁岩及黃色白赤色砂岩、大致屬煤系上部。

武安沙河煤田　分佈於河南武安縣北境東境、一部延長至直隸沙河屬境。煤系地層與磁縣沙河及武安南部所見無甚軒輊、惟有時盛產黃鐵礦、可用以製硫。所夾煤層重經變質、往往一部已變爲石墨、但仍多含雜質。

安陽六河溝煤田　分佈于河南安陽縣西境、南北延長頗遠。六河溝居煤田北端、因開採甚著故名。濟南灰岩之上有粘土及頁岩、中含鐵質扁核、大致當煤系下部。上爲含煤地層、中夾燧石灰岩四層、含紡錘虫及腕足類化石、斯爲中部。再上粗砂岩與赤色頁岩交互成層、或卽煤系之上部也。

七　二疊三疊紀

地層　整合於石炭二疊紀煤系之上者、爲二疊三疊紀或三疊紀之砂岩層。從岩石性質、可分爲二部。在下者爲石英砂岩層、中多石英粗粒、質頗堅實、可用爲磨具、故亦以磨石名。色白或淡紅或淡黃、厚有七八十至三百餘公尺不等。在上者爲紅色砂岩層、以深紅色砂岩爲主、質鬆粒細、夾有薄層粘土泥灰岩及淺綠色砂岩。其下部間呈十字層、厚有達六七百公尺者。此上即爲侏羅紀地層矣。

分佈　本系隨古生界煤系爲出沒。與陶紀灰岩之大山蜿蜒於煤田之後、而本系之小山起伏於煤田之前、此本幅內地質與地形不易之關係也。故如山東淄博章煤田中覺山大奎山黑山危山皆爲石英砂岩層顯露之地、而紅色砂岩層則地勢較低、居於孝婦河之兩岸。長山南麓則因安山岩侵入、層次錯亂、且變質成石英岩焉。臨城磁縣武安煤田之東、皆有本系小山、且往往上下二部均爲紅色、非若山東石英砂岩與紅色砂岩之易於分劃。開平煤田中紅色砂岩全層甚厚、惟下部石質較堅、殆已與石英砂岩相當。北京西山則爲葉良輔君所稱之紅崗嶺砂岩、亦與磨石層爲近。

八　侏羅紀

地層　侏羅紀地層以砂岩頁岩爲主。其下部有時夾煤、頗重要、故稱爲中生界煤系、以別於古生界之煤系。其上部以紅綠砂岩爲主、兼有頁岩礫岩。煤系內多植物化石、紅綠砂岩內則未之見。本紀地層與其下地層形似整合、但恐仍有間斷、故通常與二疊三疊紀相接、而亦有逕覆於較古地層之上者、卽二疊三疊紀地層亦各處厚薄完缺、不甚一律。

地層厚度變化極大、煤系厚自六十以至六七百公尺、紅綠砂岩亦自數百以至八百公尺以上。

分佈　本幅內侏羅紀地層、以北京西山爲最發達、而其性質頗爲特殊、其詳具見葉良輔君之西山地質誌。中生界煤系積於二疊三疊紀之粗砂岩以上、在門頭溝齋堂安子長溝峪諸區、皆成爲重要煤田、煤系厚自五百至七百公尺、在山西地質誌中名爲之門頭溝系。中含植物化石極多、如Podozamites, Pterophyllum, Asplenium等。其上之九龍山系、卽與他處之紅綠砂岩相當。在北京山西、則以紫色頁岩及綠色砂岩爲主、夾以礫岩、故亦名之爲紫綠岩系、厚在六百至八百五十公尺之間。因受變質、質頗堅實、故大抵組成高山、而煤系則蝕爲溝壑。山西直隸間蔚縣陽原廣靈一帶、(詳見地質彙報第一號丁張二君報告)亦爲重要侏羅紀煤田。但煤系直覆於奧陶紀石灰岩以上、煤系之上、則漸變爲紅綠砂岩、質鬆易碎、無北京西山之變質。靈邱煤田中本系不甚發育、且近斷層、構造亦頗複雜。山東省內、惟濰縣坊子煤田侏羅紀煤系發育較優、產有植物化石、而露頭極少。下以斷層逼近片麻岩、與凝灰礫岩層成不整合之接觸、層內似有火成岩侵入。地層可見者、有白色粘土灰色頁岩、絕未見有紅色砂岩之顯露。淄川博山一帶、二疊紀紅色砂岩之上、亦有與中生界煤系相當之層、但以砂岩爲主、不常夾煤、厚百餘公尺。其上則爲紅色砂岩礫岩、夾以黃綠紫棕灰各色砂岩、分佈於荊山崑崙山、延長及於長山一帶。以上砂岩因受火成岩侵入之影響、皆一部份變爲石英岩、質頗純、可用作玻璃。紅綠砂岩之厚度、因上部已受侵蝕、不能全計、但就剩留部份言之、亦不下五六百公尺。

九　白堊紀

地層　本紀地層下部、(卽蒙陰系)以砂岩頁岩及凝灰礫岩或角礫岩等爲主、並夾火山岩流及火成岩侵入體。厚度不一、自數百公尺至千餘公尺。上部(卽王氏系)以紅色粘土及砂礫岩爲主、偶含輝綠岩侵入體、厚約

二千公尺。二者層次頗若整合、但上部礫岩內含下部火山岩之礫石、故知二者實不整合也。全系含化石極多、如魚類昆虫類葉鰓類爬行類以及各類植物化石、據本所古生物專家研究、大致均屬白堊紀。

分佈　本紀岩質龐雜、隨處而異、尤以下部爲最、故因其岩質之不同、而另以專名名之。在萊蕪境內、本紀下部之露出者、厚約三百六十公尺、茲名之曰蒙陰系。此爲灰綠或淺棕色之頁狀砂岩、有時盡爲凝灰岩角礫岩及火山岩流所成、而不見砂岩、但二者均含火成岩侵入體。本系含化石頗多、動物植物俱備。在膠縣諸城境內、不整合而覆於五台系之上者、有萊陽含魚層。此爲淺綠淺棕及黃色硬砂岩、中夾泥質頁岩及礫岩、厚約九百公尺。除魚類化石早經發現外、作者又採得昆虫類叶鰓類及植物化石極多、據葛利普氏研究、大致均屬白堊紀。在本區域東南西北二隅、本紀下部之岩質、與上述二者又稍有異、種類龐雜、以此爲最。大致言之、則爲凝灰岩礫岩及火山岩流、而更夾頁岩砂岩及少許不規則之煤層。以作者在萊陽青山於本系內首發現爬行類及葉鰓類化石、故名之曰青山層。在北京西山及蔚縣煤田、本層係不整合而位於紅綠砂岩之上、再上爲近生代物。在山東東部、則位於中生代煤系之上紅色粘土之下。在北京西山、本層以礫岩頁岩火山岩爲主、下部夾有煤層、礫岩中多紅斑岩塊礫、於頁岩中得植物化石。其詳見葉君之西山地質誌。

本紀之上部、亦稱王氏系、分佈於膠縣諸城高密等處。大致可分爲三部、下部爲紅粘土夾灰砂岩、中部爲紅粘土夾灰綠粘土及礫岩、偶含輝綠岩板、上部爲粗礫岩夾紅色硬砂岩。在中部曾發見巨大骨化石及叶鰓類化石。

十　第三紀

地層　本紀地層可分爲上下二系、互不整合。上系以紅土爲主、屬上新統、下系以砂岩礫岩爲主、亦稱官庄系。其下部礫岩層內含閃長岩礫石、質與蒙陰系同時或較新之閃長岩侵入體酷似、故知其與蒙陰系爲不整合也。厚度不一、在萊蕪最厚者約一千六百七十公尺、薄者不過數百公尺。此中採得哺乳類腹足類爬行類及魚骨等化石、似均屬始新統。

分佈　官庄系在萊蕪境內、可分爲三部。下部爲紅色鬆砂岩及粘土、夾鬆質礫岩、其中礫石大半爲灰岩、亦有火成岩。中部爲紅色鬆砂岩、與黃灰淺綠或白灰色砂岩相間、中夾灰白色灰岩數層。上部爲礫岩、中夾紅砂岩。在直隸長辛店一帶、本系爲紅粘土與礫岩、其礫石多爲火成岩所成、粘土內有石灰質結核。在直豫交界磁縣武安煤田、則有本系上部之礫岩、其塊礫多爲奧陶紀灰岩、體大形圓。在山西靈邱南部所見亦然。在曲陽煤田者、威利斯名之爲靈山層、大致與本系上部相當。

紅土層在黃土之下、與之成不整合、中夾礫岩數層、凡山坡溝岸屢見及之、在山東淄川博山章邱益都等處、紅土位於濟南灰岩及古生代煤系之上、下部夾礫岩厚約一公尺、上部爲礫岩與紅土之交互層、礫岩厚在五公尺與十五公尺間、臨朐境內此項礫岩甚薄、自數寸至四五尺。在直隸東北部、本系性黏色紅、礫石絕少。曩時學者多以本系爲黃土之一部、同歸入於第四紀內、近經安特生氏詳細觀察、與黃土係不整合、且在河南於本層採得哺乳類化石數種、均屬上新統。

十一　第四紀

地層　本紀可分爲二、下爲黃土、上爲冲積層。黃土色棕黃、質軟可碎以指、有顯著直立之劈開面、含淡水產之

螺殼。其主要成分爲細鹽土、雜稜角砂粒、並有石灰質、有時含礫石、平鋪成層。上部常夾黑土一層、厚約一二尺。其與冲積層往往難於分界、蓋二者常相混雜也。茲所言者、係專指初生黃土、其歷經風水作用混雜於冲積層內者、概不與焉。厚度不一、通常自數公尺至一二十公尺、多至三十公尺。本層內除產陸生介殼及哺乳類化石外、又含鴕鳥卵與類似象類之長牙及臼齒（Elephas namadicus）。論黃土成因、李希霍芬氏謂爲風力所成、其質料謂自中亞細亞沙地而來。但內蒙高厚黃土頗少、其理似不充足。安特生氏則謂係由中國北部上新統之粘土移積而成。又據所產化石而論、鴕鳥卵與風成說固相吻合、然象類齒牙亦產日本洪積統內、而印度納巴達河之河淤內且與慣生於河中之河馬共生、最近在河南黃土內又得 Castorid、而草原齧齒類動物、則一無所獲、益覺風成之說有未可盡信者矣。

冲積層爲最新之沉積物、成分複雜、隨地而異、凡沙礫河淤及次生黃土鹽土悉屬之。

分佈　黃土在中國北部分佈最廣、原野山坡無不有之、其地點難以盡述。冲積層分佈尤廣、或堆積成層、上開田畝、或散佈河岸、成爲廢地。在京東三河薊縣境內、則有泥炭與軟泥共生、厚度頗不一致、在山地薄至數尺、就平原鑿井所得、往往深至數百尺、猶似爲本層之物、厚薄之差概可知矣。在平原曠野冲積層露出者、大致悉爲黃土鹽土、在山地邊緣或山嶺坡麓多爲礫石、雜以沙土泥質。直隸西部、往往見石英岩礫石堆積頗多、組成岡阜、位於山嶺平原之間、高出於平原數十米突、大抵爲第四紀中之最古者也。

第四章　火成岩

本區域火成岩種類不一、中國各處所常見者、殆均有之。最多者爲花崗岩閃長岩、次爲安山岩斑岩、再次爲輝

長岩輝綠岩正長岩玄武岩而粗面岩類亦偶見之。又有各種變類。花崗岩閃長岩斑岩安山岩輝長岩每成巨塊、偶爲岩脈。輝綠岩往往成岩層。正長岩爲岩脈或巨塊、而玄武岩粗面岩率爲岩流、亦偶爲岩脈。茲按其種類敘述如次。

花崗岩　附偉晶花崗岩及長英岩

就花崗岩之生成時代言、大致可分兩組。一古花崗岩、在泰山系特別發育、五台系內亦有之。二新花崗岩、大部侵入水成岩中、常在元古界矽質灰岩及寒武奧陶紀地層內、古生代煤系中微露踪跡、並有與片麻岩及斑岩接觸者。

古花崗岩　生成時代大抵甚古。泰山系花崗岩惟發育於太古界變質地層內、未見越泰山系而侵入於他系地層者。其時代或在五台系之前。岩石成分、以長石石英角閃石黑雲母等爲主。山東泰山徂徠山及大屋山所見皆是、每成高峯。五台系花崗岩當爲元古代之產、其生成時代似在舊元古代之末。每有螢石方鉛礦脈與之共生。產山東膠縣七寶山一帶。

新花崗岩　直隸北部盛發育。在本區域滦源易縣、組成五迴黃安二大嶺、延長約百里、西至浮圖峪、東抵紫荊關、廣約五六十里。與片麻岩及矽質石灰岩相接觸。大塊花崗岩之西南、猶有較小露頭、或於地下互相連續者。滦水涿鹿之花崗岩乃產灰岩中、灰岩一部變成大理岩、分佈於兩縣交界。在本區域內延長約百里、寬約三十里、西向一部入蔚縣境、東至涿縣。北京西山一帶、花崗岩尤多、悉成塊狀、露頭大小不等。岩石成分以正長石與灰曹長石爲主、石英較少、角閃石黑雲母均有、又含楣石磁鐵礦磷灰石等次要礦物。本區域內以房山羊坊二

處爲最著。分佈於周口店北嶺及上葦甸一帶、北西南三方俱與水成地層接觸、變質狀態頗著、與陶紀灰岩已變大理岩、煤質變劣、煤系地層一部爲片岩、夾有紅柱石空晶石硅線石十字石柘榴石等接觸礦物。

上述各處花崗岩、產狀不同、是否同時生成、尙難確定。惟岩石性質大致類似、產地又近、似有相互之關係。至生成確期、從接觸地層察之、當在古生代之後。但花崗岩與中生代地層均無明顯之關係、究屬中生代何期、尙係懸案。就地質構造推測、本區域至三疊紀後期、始漸隆起爲大陸、而火成岩之侵入、又每與大陸之昇降有因果之關係、則謂本區域內之新花崗岩起於三疊紀後期、亦無不可也。

偉晶花崗岩及長英岩　偉晶花崗岩在泰山系內特別發育、五台系內亦有踪跡。大致成脈、蔓延頗長、有時交錯縱橫、密如羅網。脈厚數寸至數尺。成分以正長石石英爲主、正長石或乳白、或淺紅、結晶均甚粗、常含磁鐵礦。在灤縣安各莊五台系內、偉晶花崗岩盛產電氣石、結晶往往頗巨。長英岩生於泰山系五台系及矽質灰岩內、多成岩脈、厚數尺至數十尺。成分以石英正長石爲主、質較緻密、每呈白色。在山東膠縣諸城南境侵入於五台系內、成厚約數十尺之岩脈、色白質堅。在直隸唐縣境內長英岩侵入於泰山系及矽質灰岩內、成岩脈、寬數尺、色灰白。

正長岩

正長岩在本區域不甚發育、其露出處、惟山東泰山及直隸西部偶及見之。

泰山正長岩產於泰山腰際片麻岩內、爲岩板形。主要成分爲正斜長石及角閃石之一種。正長石結晶較大、斜長石偶現帶狀組織。石英有時存在。角閃石量極多、每使岩石成黑色、結晶多不完全。其時代尙難確定、惟與泰

山系有直接之關係、其地位又距太古界花崗岩不遠、故暫擬爲太古界岩石、而以泰山正長岩名之。

涿源易縣正長岩與花崗岩共生、而常在其邊際。當以岩漿分離酸性物質分佈不均使然。在涿源浮圖峪所見、以正長石爲主要成分、結晶整齊、斜長石亦有之、角閃石頗多、晶形完整。長石間隙中偶嵌有石英、惟量甚微。黑雲母偶一見之、磁鐵礦頗夥。此類正長岩生成時代、大抵與花崗岩不相軒輊、亦當在三疊紀末季也。

邢台沙河正長岩、分佈於直隸邢台沙河西境。露頭段落不接、或在山坡、或沿溝邊大抵均成巨塊、侵入於寒武奧陶紀灰岩及古生代煤系。在邢台咽喉、正長岩主要成分爲正長石、稍含斜長石、石英有時嵌入長石間隙中、角閃石黑雲母均有。

正長岩之四周、地層均變質。在沙河西境與河南武安交界一帶頗爲顯著、奧陶紀灰岩變爲黑色結晶灰岩、煤系砂岩變爲黑色硬石英岩、烟煤變爲無烟煤。就其接觸之地層及地質構造而論、此項正長岩當爲古生代以後之物產、或屬白堊紀初期、亦未可知。

北京西山正長岩、一在齋堂之西、侵入於寒武紀地層、一在齋堂之北、見於侏羅紀煤系內。其成分均與通常正長岩稍殊、內含黑雲母頗多、可稱雲母岩。在齋堂之西、岩石內黑雲母多成片狀、有時纖細如絲。正長石頗多、晶形不甚完整、亦偶有石英及赤鐵礦。在齋堂之北、岩石成分以正長石爲最多、結晶不甚完全、黑雲母多成片狀。兩處岩石成分頗相類似、大致同時生成、其時代當後於下侏羅紀無疑。西山火成岩除花崗岩生成較早外、大抵多屬白堊紀初期、而雲母岩或亦成於此時也。

閃長岩

本區域閃長岩發育頗著、或在太古界變質地層中、或侵入於古生代中生代水成地層內。其接觸帶常生接觸礦物、而以磁鐵礦爲最著、往往積聚頗富、而成重要鐵礦。山東金嶺鎭鐵礦、河南武安鐵礦、卽其例也。生成狀態、大抵均成巨塊。生於太古界地層內者、往往不易分劃、露頭亦較狹、而在水成岩內者暴露有時頗廣、其界限亦甚明晰。

徂徠山閃長岩生於泰山系片麻岩中、成塊狀。其主要成分、以斜長石爲最多、角閃石次之、石英晶形不具而嵌入長石之間隙中、正長石極少。依此成分、亦可稱石英閃長岩、惟石英之量似過少耳。

臨朐閃長岩、在縣南境金葫蘆山嵩山等處、生於太古界片麻岩內、成塊狀、含斜長石角閃石磁鐵礦等。在嵩山一帶、閃長岩常爲斑狀、斑晶爲斜長石及角閃石、石基爲斜長石細微晶粒。

徂徠山及臨朐閃長岩之生成時代尙未確定。惟就地質構造觀察、閃長岩四周水成地層在臨朐南境傾斜狀況、具一淺平穹窿形之遺跡、而金葫蘆山嵩山凸起較高、似此穹窿形乃爲閃長岩掀起地層所致。而四周水成地層以古生代煤系爲最新、故閃長岩似當產於古生代以後也。

武安閃長岩、分佈於縣之西境北境上泉坡青嶺山紅山等處、侵入於奧陶紀灰岩內、亦與古生代煤系接觸。大抵均成塊狀、一部偶侵入地層內而爲岩脈。成分以斜長石爲主、而石英常充塡於斜長石之間、量亦不少、有時可逕名之爲石英閃長岩。上泉坡岩石成分、以斜長石爲最多、角閃石磁鐵礦亦頗常見、燐灰石及風信子石偶一見之。有時礦物結晶大小相差殊甚、顯有斑晶石基之分、故有一部又可稱爲斑狀石英閃長岩。角閃石磁鐵礦亦見之。

安陽閃長岩、在河南安陽煤田西礦礦村一帶、侵入於奧陶紀灰岩內、向南北方向延長約十里、東西不廣。岩石成分、與武安所見大致相同、亦爲石英閃長岩一種。閃長岩四周水成地層俱變質甚著。灰岩變爲大理石、色白、每帶綠色條紋。接觸礦物有柘榴石綠簾石風信子石符山石等、而磁鐵礦聚集頗多、往往成爲鐵礦、紅山礦山、其最著者也。紅山接觸帶內、磁鐵礦赤鐵礦雜柘榴石綠簾石而生、礦山接觸帶內不見柘榴石。在安陽礦礦村一帶、接觸帶附近亦常見鐵礦、作大塊狀。

鐵山閃長岩、分佈於山東桓台長山臨淄屬境、侵入於濟南灰岩及古生代煤系內、所占面積略成圓形。大抵岩漿上湧之際、水成地層被衝隆起、而爲穹窿形、嗣後上部地層被蝕失去、閃長岩露出、遂成今日分佈之形狀。岩石成分不甚均勻、在鐵山一帶、斜長石頗多、石英時見、角閃石較少。西至玉皇山北一帶、黑色礦物漸多。與閃長岩接近之灰岩一部、變爲大理岩、變質淺者成一種黑色結晶灰岩。在鳳凰山一帶、古生代煤系中之砂岩變爲石英岩、色多黑、間有呈赤綠及白色者。接觸帶內礦物頗多、如綠簾石柘榴石孔雀石黃鐵礦磁鐵礦赤鐵礦褐鐵礦均有、而磁鐵礦積聚特富、爲金嶺鎮鐵礦主要礦石。

歷城章邱閃長岩自濟南附近東迄章邱屬境、其間濟南灰岩層內、每有閃長岩巨塊。如濟南東五頂山一帶、安家庄附近、再東章邱境內高庄唐冶一帶、張庄之西、所見皆是。大抵閃長岩生成之際、濟南灰岩均被隆起、而爲穹窿形、今猶有其遺跡也。岩石成分各地大致相仿、含斜長石角閃石磁鐵礦鐠鐵礦及燐灰石等。石英亦微有之、嵌入長石空隙間。灰岩與閃長岩接觸處、每變爲大理岩、內含磁鐵礦小塊、往往與綠簾石共生。在高庄安家庄濟南附近、均有露頭。

沂水閃長岩、在沂水縣西北境金星頭一帶、侵入於蠕狀灰岩內、爲巨塊狀。露頭每在山嶺低處、或沿溝渠而生。灰岩雖被衝動、但不爲穹窿形。岩石成分、以斜長石及角閃石爲主、微露斑狀痕跡。磁鐵礦亦常見、多作正方形。

萊蕪泰安閃長岩在萊蕪縣西部泰安縣東部、分佈頗廣、各代地層均相與接觸、悉成巨塊。岩石性質、各處無大差異。在萊蕪城西北礦山一帶、岩石結構頗粗。其主要成分、以斜長石爲最多、角閃石次之、再次爲石英、每填充於長石間隙中、無結晶形。磁鐵礦頗多。此岩可稱爲石英閃長岩。其四周水成地層往往變質甚著、灰岩一部變爲大理岩、並常生接觸礦物、以磁鐵礦爲最著。萊蕪礦山泰安魯東冶土人曾試探之、惜爲量不多、不足以興礦業也。

閃長岩果屬於何時代乎。就山東鐵山閃長岩而言、其附近地層、除奧陶紀灰岩及古生代煤系外、在淄博煤田一帶尙有中生代三疊侏羅兩紀地層、雖距離稍遠、而與閃長岩生成時代頗有關係。鐵山閃長岩上昇之時、奧陶紀灰岩被掀起爲穹窿形、而淄博煤田構造亦與此有關。其北部奧陶紀灰岩突出、傾斜向南、而古生代煤系及中生代地層俱至此隨奧陶紀灰岩層而轉其傾斜方向。此可證閃長岩衝動之際、中生代地層已經生成、故影響特著。此處地層最新者爲紅綠砂岩系、大抵屬侏羅紀、故鐵山閃長岩生成時代、或在白堊紀之初期、亦卽火成岩漿活動最烈之時。山東萊蕪閃長岩直接侵入於中生代地層內者、其生成時期似與鐵山閃長岩相同。至武安安陽歷城章邱沂水等處、閃長岩附近受影響之地層、以屬於三疊紀者爲最新、故其時代尙難確定。惟就岩石性質及接觸狀況觀察、均與鐵山萊蕪兩處閃長岩頗相類似、或亦白堊紀初期之產物也。

輝長岩

輝長岩除在北京西山稍稍呈露外、於山東北部最發育。或與奧陶紀灰岩直接接觸、亦或闖入中生代地層內、大抵均成巨塊、而爲侵入岩石。惟察其生成狀況、當岩漿上昇凝固之際、距地面頗近、惟尚未噴出地表、各種礦物得從容結晶、以呈此組織耳。輝長岩除與水成地層顯著接觸外、與他火成岩如閃長岩安山岩輝綠岩等距離甚近、其生存時代自有密切關係。大抵岩漿分離、以四圍情形不同、彼此結晶自別、遂以各成其類耳。而輝長岩成分亦不一致、有時黑色礦物多爲輝石、時或紫蘇石亦占重要位置。

淄川輝長岩在淄川縣西南崑崙山三台山一帶、大部侵入於中生代煤系、與紅色砂岩層及紅綠砂岩系均互接觸。露頭大抵在山嶺高處、山嶺似顯由水成地層被輝長岩掀起而成者。岩石成巨塊、所占面積不廣、長寬均不過數里。岩石成分、斜長石與輝石並重、而輝石量似較多、俱晶形整齊。尙有紫蘇石角閃石少許、均現多色性、角閃石作淺綠色、紫蘇石有淺紅淺綠兩種色澤。亦有黑雲母、呈棕色。磁鐵礦每作正方結晶、佈散各處。在崑崙山一帶、中生代煤系內白色砂岩受輝長岩之影響、變質而爲石英岩、質頗純淨、人多採挖爲製造玻璃之原料。在三台山、紅綠砂岩系與輝長岩接觸者、亦多變爲石英岩。

歷城輝長岩、分佈於濟南附近華山金牛山藥山鵲山一帶。山多孤立、周圍盡黃土及冲積層。南與濟南灰岩逼近、距五項山閃長岩亦非遙。而與水成地層接觸者極少、惟在華山南麓有少許大理岩與之接觸。岩石成分與淄川輝長岩大致相同、但紫蘇石量加多、然視輝石猶稍遜、故未稱 Noirite、姑以紫蘇石輝長岩名之。輝長岩四周多被掩沒、與水成地層直接接觸者極少。除前述華山南麓之大理岩確爲接觸變質外、又於小清河北、有結晶灰岩變質頗顯、雖與輝長岩無接觸可尋、而北距華山不遠、想亦受輝長岩之影響也。

上述兩處輝長岩、成分組織頗相類似、大抵爲同時之產物。水成地層與之接觸者、以奧陶紀灰岩爲最古、而以侏羅紀之紅綠砂岩系爲最新、輝長岩後於侏羅紀而生、已甚顯然。當白堊紀初期、造山力一時甚盛、多數火成岩即成於此時、故輝長岩亦伴他種岩石後先乘運而起者、殆無疑也。

安山岩

安山岩在山東北部直隸西部東北部、均經目擊。地層被其侵及者範圍頗廣、大抵自泰山系以迄中生代地層、均有一部與安山岩接觸。岩石多成巨塊、亦成岩脈、或岩層。大部爲侵入類、一部爲噴出類。其侵入者凝固時大抵距地面頗近、而噴出者有時成爲岩流。在山東安山岩與輝長岩輝綠岩均甚接近、生成關係亦頗密切。北京西山一帶、安山岩與各種火成岩雜處、而與斑岩又極混淆。蓋西山凝灰礫岩層內夾有多數火山岩、安山岩斑岩及流紋岩夾雜並生、殊難分別者以此。

贊皇安山岩在贊皇縣西九龍關下、侵入於五台系、大致成岩脈。岩石呈斑狀、斑晶多斜長石、角閃石輝石等次之、石基爲斜長石、雜以角閃石之碎屑。岩石生成時代頗難確定、惟察其包圍於五台系內之狀況、似不類後代之物、或視中生代之安山岩蓋稍古者。

泰安安山岩、在泰安縣南雲亭山、侵入於太古界片麻岩、亦與寒武紀饅頭頁岩接觸。岩石爲岩板、呈斑狀。斑晶以斜長石及輝石爲主、當名爲輝石安山岩。石基多斜長石、有時呈針狀小晶形、輝石細屑亦常夾雜其間。岩石生成時代不易斷定、雖岩板包於片麻岩、而北壁與饅頭頁岩接觸、似曾受其影響、故只可假定爲奧陶紀後之產物耳。

昌黎安山岩在昌黎縣西安山一帶、四圍被冲積層掩沒、不見與他種地層接觸。岩石爲巨塊、組成小山低嶺。斑狀組織頗顯著、斑晶以斜長石及角閃石爲主、當名爲角閃安山岩。石基爲斜長石。岩石生成時代頗難斷定、惟東距斑岩巨塊頗近、關係密切。而他地層與斑岩接觸者、盡爲太古元古兩代之物、亦不足以定其時代。擴觀地質構造、昌黎盧龍灤縣境內地層、隱約爲一大穹窿形、今惟西邊一部略有其遺迹。推當時穹窿層突起之原、似爲斑岩衝動所致、而其西邊地層以二疊三疊紀紅色砂岩爲最新。據此則斑岩生成時代當在三疊紀之後、而安山岩亦當爲同時之物也。

易縣安山岩在易縣西良各庄一帶、侵入矽質灰岩內、成塊狀、岩石呈斑狀組織、石基較少、斑晶以斜長石及角閃石爲主、可名之爲角閃安山岩。石基爲斜長石、內常嵌石英晶粒、磁鐵礦亦有之。岩石生成時代、因四周接觸地層惟有矽質灰岩、尙難確定。就直隸西部火成岩而論、生成時代非在三疊紀之末季、即在白堊紀之初期。安山岩之生成亦當爲二期所限、蓋論其地位與花崗岩接近、而成分組織則又類於西山之安山岩也。

淄川章邱長山鄒平安山岩、分佈於四縣境內。在淄川西境組成小山嶺、在章邱長山鄒平交界境上、組成高山。岩石侵入於中生代地層、爲巨塊、或一部侵入於古生代煤系而爲岩層。在淄川西境亦有成岩脈者。大部爲侵入體、或一部曾破地面而出。淄川西境明山星山等處、安山侵入紅綠砂岩內、其上往往覆有砂岩一部、已變爲石英岩、長山低處亦常見石英岩。凡此皆足證明中生代地層爲安山岩侵入而隆起、尙未剝蝕殆盡。惟長山突出頗高、似安山岩上昇之際、已有一部迸出地面者。岩石呈斑狀、以斜長石及角閃石爲主、大致均爲角閃安山岩一種。角閃石一部結晶完全、石基爲斜長石。

安山岩之生成時代、當後於紅綠砂岩無疑、擴觀山東北部火成岩發育歷史、大部俱爲白堊紀初期之產物、如閃長岩輝長岩等、前已詳述之。安山岩與此等岩石距離頗近、生成亦必有關係、故似當屬白堊紀初期也。

北京西山薊縣涿鹿安山岩、分佈於西山西部齋堂煤田百花山及薊縣涿鹿交界小五台山一帶。侵入於寒武奧陶紀地層及中生代煤系內、亦與古生代煤系接觸、均成巨塊。大部爲侵入體、或一部破地而出。岩石爲斑狀、斑晶以斜長石爲主、並有角閃石黑雲母及少許石英、石基爲斜長石。

此外凝灰礫岩內亦常含有安山岩、在西山清水尖及薊縣煤田曾見之。此類岩石大抵均爲噴出岩。在清水尖一帶、岩石斑晶較少、內多斜長石角閃石及輝石。石基爲斜長石、結晶細微、排列有一定方向、而成流紋狀。輝石類礦物亦多。在薊縣鷲嶺寺一帶、安山岩斑晶以斜長石爲最多、鐵鎂礦物均已變爲鐵質而呈棕赤色。石基爲長石細微結晶。

西山薊縣等處安山岩、就其侵入之地層察之、當爲侏羅紀以後之產物。自白堊初期成陸時代、地下岩漿鼓動上昇、活動不已、齋堂百花山及小五台山等處安山岩、首先崛起而爲侵入岩石。繼而西山東北降爲窪地、似曾積淺水。此時岩漿繼續活動、噴出而爲火山、凝灰礫岩因以造成。其岩漿一部、噴出凝結而成安山岩、雜灰渣而夾於凝灰礫岩中。故西山薊縣安山岩生成時代先後不同、其一較先、在甫經成陸之時、餘乃較後、殆與凝灰礫岩同時生成也。

斑岩

本篇所謂斑岩、專指富於矽酸而斑狀結構極爲顯著者而言。又本區域凝灰礫岩層內所夾噴出岩、如粗面岩

類、與礫岩凝灰岩劃分匪易、以其與斑岩相近、故附述於此、

昌黎撫寧斑岩、在昌黎北境撫寧西境與北境。侵入於太古界片麻岩內、亦與元古界地層接觸、組成高山大嶺、而斑岩常居其頂。觀岩石生成狀況、大致爲侵入體而成巨塊。龍山一帶半穹窿層似與此岩石有關。在昌黎撫寧之交碣石山一帶、斑岩發育特著、純爲酸性岩石。惟在侵入巨塊邊緣、岩石有時變爲基性、蓋岩漿分離之結果也。岩石斑晶爲正斜長石石英及少許之角閃石、石英晶形不甚完全。石基以正長石及石英爲主、兼有斜長石。地層與斑岩接觸者變質現像不易窺見、斑岩生成時代亦難確說。前叙述昌黎安山岩、曾就地質構造、推定斑岩生成之期、當在舊三疊紀之後。惟是否在三疊紀末與花崗岩同時、抑或在白堊紀初期與閃長岩輝綠岩等同時歟、此誠不易解決之問題也。

西山蔚縣凝灰礫岩層中之斑岩及粗面岩、可彙述之。產西山安家莊附近者爲一種石英斑岩。斑晶以石英爲最多、次爲正斜長石、角閃石輝石亦有之。石基爲石英及正斜長石、有時呈細小之球狀結構。斑晶有一定排列方向、呈所謂流紋狀石理。蔚縣橋澗之西平坨一帶、有粗面岩。斑晶絕少、石基爲正斜長石、但雜以角閃石細微晶粒。流紋組織頗顯著。在蔚縣北魚兒山一帶、有流紋岩。斑晶爲石英及正斜長石、稍有輝石踪跡。石基爲斜長石。流紋組織亦顯著。

輝綠岩

本區域輝綠岩、在西山一帶特別發育、山東泰山及淄川博山煤田亦有之。或生於太古界片麻岩內而爲脈狀、或夾於古生代煤系及二疊中生代地層中、而成層形。驟視之、似爲火山岩流、實則岩漿上昇、一部循層隙而進、

而成侵入岩層也。在西山一帶分佈甚廣、僅一層、頗厚。在山東淄博煤田面積較狹、有數層、均甚薄、然有時亦只有一層。石既成層、而於同地層數又有差、顯爲岩漿侵入層內而成、非由火山岩流所致也。

泰山輝綠岩、侵入於太古界片麻岩內、成板狀岩石完全結晶。斜長石頗多、晶形完好、多嵌入輝石角閃石間隙中、而呈 Ophitic 組織。輝石及角閃石結晶均不完全、黑雲母亦偶有之、磁鐵礦頗常見。輝綠岩生成時代、以僅與泰山系接觸、無由推斷、大抵爲本區域輝綠岩中之最古者也。

西山輝綠岩、常侵入於石英砂岩層與中生代煤系之間、成層形。厚由三百公尺至五百公尺。惟在門頭溝附近岩層愈厚、並侵入中生代煤系。至西山西部輝綠岩、直劃分兩代煤系、且有時侵入古生代煤系內矣。岩石完全結晶、有時呈斑狀。常見杏仁狀之細孔、孔內充以石英綠簾石方解石等礦物。斜長石爲主要成分、結晶完整。輝石及角閃石每變爲綠簾石及他次生礦物。磁鐵礦細粒亦常目覩。

輝綠岩之生成時代、當在下侏羅紀之後。然輝綠岩又每與他水成地層同受地力移動而成縐縐、則其生成又當在西山地層皺褶之前矣。就地質構造觀察、西山一帶縐縐之時、在第三紀之初、則輝綠岩又當成於白堊紀初期矣。

淄川博山輝綠岩、侵入於古生代煤系、多成層形。每在煤系上部、中部亦間有之。在鸞山一帶有六層、厚由一公尺左右至四公尺、至大奎山只有一層、厚約八公尺。岩石成分、以斜長石及輝石爲最主要、斜長石結晶大致完全、角閃石磁鐵礦亦多。至論其生成時代、當後於古生代無疑。又因其與他種火成岩如閃長岩輝長岩安山岩等均有密切關係、故知輝綠岩生成當與閃長岩等同時、而亦在白堊紀初期也。

玄武岩

本區域玄武岩多呈露於山東北部直隸西北部、常覆於中生代煤系紅綠砂岩層及凝灰礫岩層之上、質硬而脆。

荊山玄武岩、在山東長山縣南境荊山一帶、多在山頂、下有紅綠砂岩。岩石在顯微鏡下觀察、有斑晶石基之分。斑晶惟有橄欖石、結晶雖不甚整、腐蝕尚少。石基由斜長石及輝石組成、大部結晶、一部爲玻璃質。斜長石成細長針狀結晶、形甚完全、常現流紋組織、與輝石交錯並生。磁鐵礦晶粒每傍輝石而生。

蔚縣玄武岩、在蔚縣西北鍋帽山一帶、位於中生代煤系及紅綠砂岩之上、與凝灰礫岩層接近。岩石呈斑狀、成分組織與荊山玄武岩不相軒輊。晶斑爲橄欖石、石基爲斜長石及輝石、並稍雜有玻璃質。磁鐵礦晶粒散佈頗多。

昌樂玄武岩、在昌樂縣南方山一帶、平鋪於凝灰礫岩層之上。山嶺上部往往爲玄武岩、而下部即凝灰礫岩層岩石成分以橄欖石斜長石爲最多、並稍有輝石及多量之玻璃質。橄欖石多爲斑晶、一部成石基、結晶不甚完整。斜長石或爲斑晶、或爲石基、成狹長晶形。輝石多成石基。石基中玻璃質量頗多、呈棕赤色。磁鐵鑛晶粒觸處皆是。

第五章　地質構造

一　地殼變動之時代

地殼變動之時代、可於地層間相互之關係定之。五台系前已經過許多變動、使太古界地層一致變質、然其詳

已不易攷。五台系上中下各部互不整合、當亦已有若干次之滄桑變遷。自五台系末大變動後、地殼頗爲平靜五台紀造山作用所成之山地漸次夷平、南口系於焉沉澱。寒武奧陶紀時代、海水頗廣、除山東東部外、其餘各地未被淹沒者殆鮮。至奧陶紀末又起造陸作用、故志留泥盆二紀毫無代表之地層。石炭二疊紀地層乃直接整覆於奧陶系之上。當石炭二疊紀、本幅區域大致爲濱海低原、植物茂盛、而海水亦時一進犯。迨二疊紀終、全區成陸、海水不復侵入、氣候轉乾、砂岩漸盛。同時地層褶曲亦漸開始、然進行極緩、故二疊三疊紀之紅砂岩猶常與古生代煤系相整合、但其間已不盡連續。侏羅紀之始、各地頗被侵蝕、深淺不等、故侏羅系下之三疊紀砂岩各處頗不一律。侏羅紀時代、淡水湖澤分佈頗廣、植物滋殖、又成煤田。嗣以氣候轉乾、又繼以紅綠砂岩。侏羅紀末期褶曲漸盛、岩漿亦隨之活動、成爲種種火成岩體。白堊紀初、本幅區域已多隆起成山、頗少沉澱、惟東南一隅尚多湖澤。火山噴發甚盛。白堊紀末火山已熄、地勢較高、殆無沉澱。以上所述自二疊紀至白堊紀、地殼實頗多變動、但皆係局部昇降、並無甚劇烈之褶曲。至第三紀初始新世、復多淺澤、故成砂岩礫岩。第三紀中季變動又起、在太行山恆山北京西山燕山一帶、頗有褶曲、雖不甚烈、大致方向要自顯然。在山東則褶曲不甚顯明、重要變動以斷層爲多、現在沖積平原之陷落殆亦發生於此時。故第三紀中季、實爲本區域地殼變動最劇烈之時期、遂以造成今日所見之重要構造。

二　褶曲

本區域三面環山、中爲平原、由邊緣而中央、地層時代逐漸而新、而傾斜每向平原略示輻輳之勢。概言之、地層在南部者大致傾斜向北、在西傾斜向東、在北又轉向南。雖中部平原、地層悉被掩沒、不可探究、然環視四周情

形、本區域全部、實爲一大盆地。惟組織稍複雜、內尙包內外斜層及穹窿層小盆地種種局部變態。茲惟就平原四周之山地構造分區言之。

一、太行山東部

太行山外斜層　太行山分隔直晉二省、而成一大外斜層。西翼多在山西境、地層傾斜大致西向、東翼在本區域西部、占據河南安陽武安兩縣及直隸磁縣沙河邢台內邱臨城賛皇元氏井陘獲鹿九縣屬境。層脊大致與山脊相合、略成南北方向、有時稍偏向東北西南。至元氏井陘之交、層脊乃東北向、入獲鹿境、遂沒不見。擴觀之、東翼地層大致向正東東南東北三方傾斜、有時因受斷層及侵入岩之影響、間傾向正西西南或西北。外斜層隆起時、大抵緩平、而兩翼左右擴張、故傾斜角度均不甚大、通常約在十度三十度之間。其遠過四十度或不及五度者、爲局部變化、概不多覩。

彭城和村盆地　在直隸磁縣河南武安兩縣之交、因地層斷折、傾斜有時不與大外斜層一致、而獨作成一盆地。外繞寒武奧陶紀地層、內有古生代煤系、向南北兩方延長。四周地層大抵均向中央傾斜、在東部者傾向西北正西西南三方、在西部者反向東南正東東北傾斜。角度大致較小、由十度至三十五度、而地層緩平者亦有之。

靈山盆地　在曲陽縣西北靈山鎭一帶、四周爲寒武奧陶紀地層、中有古生代煤系。地層傾斜往往對向、作成一內斜層、軸爲東北西南方向。而煤系以阻於他系地層。不甚延長、惟中央一部顯露、自成一盆地。地層在南者傾向北或偏西、斜角由二十五度至三十五度、在北者傾向南、或偏西或偏東、斜角大致爲二十度。

狼牙山內斜層　由易縣之西直至阜平東邊、中經滿城完縣唐縣曲陽屬境、矽質灰岩及寒武奧陶紀地層、作成一大內斜層、軸向東北西南延長、高處以狼牙山爲最著。左翼地層除局部變更外、傾斜方向大致爲西北或正北或正西、右翼地層大致傾向東南或偏南。兩翼地層傾斜均頗平緩、斜角約在二三十度之間、實一淺平內斜層也。

二、北京西山

花木嶺外斜層　在宛平縣西境房山縣北境、西山之中部也。地層分向四周傾斜、中央突出甚高、實爲一穹窿層而失去其上部者。惟有時受斷層之影響、而變易原形、中部地層往往水平、在邊緣者傾斜角度不一、大致由二十度至四十度。

廟安嶺內斜層　在宛平縣之西境。南翼即花木嶺外斜層之一部、軸向西南東北延長、正與廟安嶺清水尖二山山脊相合。內斜層中凡新元古界以迄中生界侏羅紀之地層層層俱備、而黑色頁岩層及寒武紀地層、以抵抗力弱、稍受褶皺。

北嶺內斜層　在房山縣北境。北翼與花木嶺外斜層相連、略成西南東北方向。在長溝峪一帶、地層頗褶皺、至周口店附近褶成小內外斜層。北翼地層大致傾斜向南、或偏東南與西南、南翼則適相反。斜角大抵頗大、至中部有達七十度以上者。

九龍山內斜層　在宛平縣境。山脊與層軸相合、成東北西南方向。南翼地層傾斜東北或偏北、斜角在二十度五十度之間、北翼地層傾向東南或西南、斜角自三十度至八十度不等、並受擠壓較重、不甚擴展、南翼皺褶頗

著。本內斜層西與廟安嶺內斜層以王平村外斜層互相聯絡。

三、燕山

燕山褶曲　由玉田經豐潤抵遷安南境灤縣北部、悉爲矽質灰岩、而層勢極彎曲褶皺之態、傾斜毫無規則。小內外斜層雖屢經目擊、大致均不完全。在玉田一帶地層傾向東北及西南、略成外斜層之形、而傾斜向北或西南者又每錯綜其間。斜角通常一二十度、過四十度者蓋寡。豐潤一帶地層多向東北西南東西四方傾斜、外斜層亦不完整、斜角通常二三十度。至遷安南境灤縣北端、地層雖任向四方傾斜、而常呈內斜層之觀、兩翼略成西南東北對向、但亦不易究其端委也。

龍山半穹窿層　遷安南部盧龍西部及灤縣昌黎之交、石英岩層及矽質灰岩大抵傾向西北西西南三方、層向所示、略成半圓弧形。惟地層中經折斷、眞跡幾泯。推察當時概況、昌黎盧龍撫寧屬境、似爲一大穹窿層、嗣經剝蝕失去大部、今龍山一帶、僅其西方殘留之一部耳。在遷安南境、地層傾斜西北、傾角約一二十度、至盧龍西部灤縣東境昌黎西境、大致傾向西或西南、斜角約在三十度左右、當亦低平之穹窿層也。

開平盆地　在直隸灤縣豐潤交界之區、爲燕山山脈南來之餘委、隱約與龍山半穹窿層有關係者。推察當時龍山穹窿層之狀態、體甚擴大、燕山山脈似亦爲其西方之一部。惟折疊交錯、各自成形、在北者爲燕山褶皺、在南者成開平盆地。盆地東北西三面皆全、而南方微缺。外繞寒武奧陶紀地層、中爲古生代煤系及二疊三疊紀地層。傾斜由四方趨向中央、在邊緣斜角頗大、通常四五十度、間有直立者、中部大抵平緩幾成水平、斜角大者亦不過十數度耳。

四、山東北部

山東大穹窿層　山東一域、當近生代初期、造山力日益強大、而地下岩漿又乘機上昇、致地層被衝動隆起、大致成一廣大之穹窿層。惟時地層弱處、不勝壓迫、因而斷折、遂呈破碎不完之狀態。本幅內僅山東北部邊際、猶見地層彎曲、略成半圓弧狀、西自東阿平陰、東迄益都臨朐等處。傾斜方向雖因斷層及侵入岩之影響、局部常有變改、但大致斜向西北、北東北三方、斜角頗小、有時幾成水平、蓋一低平穹窿層之北緣地也。穹窿層破碎後、地層斷折、其俯側沉落者亦大致向東北、北西北三方傾斜、而大部地層向南傾倚者、在山東境內實不多覩。

淄博盆地　在山東淄川博山兩縣屬境、因斷層關係、趨向與穹窿層稍異、而自成一盆地、向南北兩方延長。北東南三方均爲奧陶紀灰岩、中有古生代煤系及二疊中生代地層。在北者斜向南或西南、在東者傾向西或西北、在南者傾斜北或西北或東北、略成輻輳之勢。惟西方爲斷層所阻、盆地遂微缺。

鐵山穹窿層　在益都桓台長山之交、與淄博盆地相接近處、奧陶紀灰岩與古生代煤系爲閃長岩掀起而爲穹窿層。後經剝蝕出其上部、閃長岩露去、遂成今日之觀。地層分佈約略猶呈圓狀、中爲閃長岩、周邊圍以奧陶紀灰岩及古生代煤系、大致均向四方傾斜。其南邊一部、卽當淄博盆地北緣。地層傾斜不甚平緩、蓋一突高之穹窿層也。

嵩山穹窿層　在山東臨朐南境、嵩山居其中、故名。中爲太古界片麻岩層、含閃長岩侵入體、周圍環以寒武奧陶紀地層、分向東北西三方傾斜、角度不大、爲一低平之穹窿層。推其生成之由、殆以閃長岩侵入片麻岩內、寒武奧陶紀地層遂以隆起、久而侵削剝蝕、以成今日之觀。

高庄穹窿層　在歷城章邱兩縣交界境上、高庄居其中。四圍爲奧陶紀灰岩、中爲閃長岩侵入體。歷城章邱境內閃長岩露出數處、惟高庄一帶灰岩層隆起而爲穹窿層、傾斜分向四方、角度頗大。此殆閃長岩侵入時、地層掀起頗高、而中部破碎愈甚、剝蝕侵削尤易爲力、惟四周灰岩抵抗稍強、遺爲山嶺、遂成此不規則之圓形凹陷。

三　斷層

本區域斷層、除少數生成時代尙有疑義外、大抵均與褶曲有聯帶關係。蓋自白堊紀以後、地殼波動日烈、褶曲繁興、而地層抵抗力弱者因以斷折。雖成就之期先後有差、就事實推測、約當在近生代第三紀之中期。其重要斷層、在本區域南境較爲發育。大抵山東大穹窿層生成以後、活動猶未息、穹窿層致遭破裂、斷層遂錯綜而生。太行山東翼西山一帶燕山山脈南部、亦常見多數斷層、每與煤田構造有關。山東東部有數斷層、似本掩埋於凝灰礫岩層之下、後經剝蝕作用重行露出者。凝灰礫岩層大抵爲白堊紀之物、而侏羅紀煤系亦嘗受斷層之影響、故斷層生成之時代、或在白堊紀之初時也。

地斷層折、一昇一降、錯動斯生、而錯動之緩急、與外力壓迫之大小有關。本幅內斷層在山東者、大抵錯動較烈、地層斷距有達數千公尺者。而太行山西山燕山一帶斷層錯動較小、俯仰兩側地層時代相差每不甚遙。綜觀斷層面傾斜所趨、多向俯側、而傾斜緩急有差、均不失爲正斷層。茲將重大斷層關係顯要者縷細述之、其局部地層錯亂無涉大體者悉略焉。

泰山斷層　泰山拔出海面約一千五百餘公尺、其南麓爲一大斷層、而泰山乃在其仰側。斷層大抵成西北東南方向、西北入片麻岩區域、東南至閃長岩侵入體、爲正斷層。延長約五六十里、仰側在東北爲太古界片麻岩

層、俯側有寒武紀地層。斷距雖不甚劇烈、約亦近二千公尺。斷層全部被河淤掩沒、但其踪跡可由兩側地層露頭揣測而推定之。

泰安肥城交界斷層　與泰山斷層接近、方向一致、而延長乃不逮、可踪跡者總計不及二十里、爲正斷層。斷層面斜向西南、仰側在東北、爲泰山系地層、俯側爲寒武奧陶紀地層。錯動不劇、似合泰山斷層而爲階級斷層、蓋泰山斷層之俯側、似卽此斷層之仰側也。

萊蕪斷層　萊蕪縣屬境、地層極錯亂、斷層頗多、而關係重要者、大抵有七。一大屋山斷層、在縣北境、起於大屋山北麓、初成東南西北方向、西北延長漸迤邐而西、入泰安境而盡、長約六十里、爲正斷層。斷層面傾斜向南或西南、仰側在東北、卽泰山東向之脈、爲太古界地層、俯側有寒武紀地層、錯動不甚大。二煤田北緣斷層、亦成東南西北方向、稍有彎曲之狀。延長約六十里、一端埋沒不見、一端阻於他斷層、爲正斷層。斷層面向西南傾斜、仰側爲泰山系、俯側爲中生代而兼有近生代地層。錯動頗劇、斷距大約在三千公尺以上。其仰側之泰山系直位於大屋山斷層俯側寒武紀地層之下。此斷層似與大屋山斷層一部、合爲階級斷層。三煤田東緣斷層、其踪跡所趨成半圓弧形、而向西北凸出。長約七十里、一端入太古界地層區域、一端觸他斷層而盡、大抵斷層之成、垂直動力之外、尙受水平推移之力、故地層一面上下移動、一面前後變位。推想當時地位、草埠萊蕪及張家庄等煤田、本相連續、復以動力侵入、地層乃折斷。錯動頗劇、仰側在其北方、同時平推動力適至、地層位置遂向南北移動、而成今日錯綜之狀態。四煤田中部斷層、分劃萊蕪煤田爲東西二部、略成南北方向、長約四十里、純爲平推斷層。水平斷距不大、不及十里。南與張家庄煤田斷層相交、再南入蒙陰境北端、沒於河淤。五張

家庄煤田斷層、略成東西方向、西部轉向南、盡於泰山系區域內、東與萊蕪煤田東緣斷層相觸、爲正斷層。斷層面大致向南、仰側爲太古界及寒武紀地層、俯側爲寒武奧陶紀地層及古生代煤系、更有中生代地層。錯動不甚劇烈。　六萊蕪煤田西端斷層、略成東西方向、阻斷煤田、長約十數里、爲正斷層。斷層面傾向西南、仰側爲濟南灰岩、俯側爲古生代煤系、錯動不大。　七萊蕪西部斷層、成東南西北方向、延長約四十里。北入泰安境、阻於閃長岩侵入體而盡、南入新泰境、與他斷層相遇、爲平推斷層。水平斷距不遠、約不及十里。

章邱煤田斷層　在章邱南部、縱斷煤田爲東西兩部、成南北方向、延長約七十里、北端沒於黃土、南入萊蕪境、盡於太古界地層區域內、爲平推斷層。南北錯動之水平斷距約二十里。

淄博煤田斷層　一煤田西邊斷層、分劃淄川博山煤田及章邱淄川煤田、成南北方向、大致與章邱煤田斷層平行、長約八十里。北掩於黃土、南入萊蕪縣境、止於泰山系地層區域內、亦爲平推斷層。南北錯動之水平斷距約三十里。　二西河煤田斷層、劃分淄博本部煤田及西河煤田、成東北西南方向、蹤跡屈曲、延長三十里、兩端均入奧陶紀灰岩分佈區域內、爲正斷層。斷層面傾斜東南、仰側爲奧陶紀灰岩、俯側爲古生代煤系、錯動不大。　三黑山煤田斷層、在黑山煤田東緣一部份、劃西河黑山兩煤田、成西北東南方向、延長約二十里。北端阻於西河煤田斷層、南端沒於奧陶紀灰岩區域內、爲正斷層。斷層面傾向西南、仰側多灰岩、俯側爲煤系、錯動微小。　四淄博本部煤田北端斷層、成東南西北方向、延長約十餘里、北端沒於黃土、南端止於灰岩區域內、爲平推斷層。錯動不劇、約只數里而已。

博山南部斷層　一黃家庄煤田斷層、在煤田北緣成東西方向、延長不過十里、兩端沒於奧陶紀灰岩內、爲正

斷層。斷層面傾斜南向、仰側爲灰岩、俯側爲煤系、錯動微小。　二下庄斷層、在博山南境、大致成東西方向、延長約二十里、爲正斷層。斷層面傾斜北向、仰側爲太古界片麻岩、俯側爲寒武紀蠕狀灰岩、中間矽質灰岩饅頭頁岩緜狀灰岩沉沒不見。

沂水蒙陰北部斷層　一自沂河北岸起、蜿蜒西北、至魯山東南麓、遞向西南、繼又轉南、止於太古界片麻岩區域內。踪跡大致成半圓狀、延長將近百里、爲正斷層。仰側多太古界片麻岩、俯側爲寒武奧陶紀地層、兼有凝灰礫岩層。錯動不甚劇烈。　二九頂連環山斷層、略成東西方向、延長約六十里、兩端均爲前斷層所限、爲正斷層。斷層面傾斜南向、仰側多饅頭頁岩、俯側爲蠕狀灰岩、斷距微小。　三東里店斷層、方向略成東西、與前斷層平行、延長約三十里、爲正斷層。斷層面傾斜向南、仰側爲饅頭頁岩、俯側爲蠕狀灰岩、錯動微小。其仰側地層實即九頂連環山斷層之俯側地層、故二斷層又可合稱階級斷層。

臨朐南部斷層　縣境南部地層錯亂、斷層頗多、其顯著足述者有三。　一北自五井煤田起、迤邐西南、被阻於南北一小斷層、延長約三十里、爲正斷層。斷層面傾斜東南、仰側爲蠕狀灰岩、俯側爲濟南灰岩、兼有古生代煤系、斷距頗微。　二南自魯山起、東北入臨朐境、延長約四十里、爲南北小斷層隔絕、不與前斷層相連、爲正斷層。斷層面傾斜東南、仰側爲太古界片麻岩、俯側爲寒武奧陶紀地層、斷距較大。　三嵩山斷層、與前兩斷層平行、略成東北西南方向、延長不及二十里、爲正斷層。斷層面斜向西北、仰側爲泰山系、俯側地層與前兩斷層俯側一部爲同一濟南灰岩、故三斷層可合稱槽狀斷層。

安邱臨朐斷層　在兩縣交界境上、略成南北方向、延長統計約五十里、而踪跡常被凝灰礫岩層掩沒、常若不

連續者。露出部分仰側爲太古界片麻岩、俯側爲蠕狀灰岩、而在高鎭煤田一帶、蠕狀灰岩作爲仰側、中生代煤系爲其俯側。斷層生成時代、頗有疑義、據觀察所得、凝灰礫岩層常覆於片麻岩層及蠕狀灰岩之上、並有時遮掩斷層之跡、斷層似古於凝灰礫岩層、惟中生代煤系與蠕狀灰岩爲斷層之接觸、顯受斷折之影響、故其生成之期、又當後於中生代煤系也。

濰縣昌樂斷層　一坊子煤田斷層、沿煤田南緣、爲東西方向、可踪跡者延長十餘里、兩端似均埋沒於凝灰礫岩層之下、爲正斷層。仰側爲片麻岩、俯側爲中生代煤系、斷距甚大。生成時代或亦在凝灰礫岩層之前、中生代煤系之後。二荊山窪煤田斷層、煤田爲地層斷折陷落而成、介在兩斷層中間。北斷層之仰側、爲濟南灰岩、南斷層之仰側、爲太古界片麻岩、而兩斷層共一俯側、爲古生代煤系分佈區域、可聯稱爲槽狀斷層。兩斷層相交後、又向東南延長、遙遙東北、沒於凝灰礫岩層之下。仰側爲太古界片麻岩、俯側爲寒武奧陶紀、其時代似亦在凝灰礫岩生成之前、而與坊子煤田斷層殆屬同時者也。又北斷層仰側之寒武奧陶紀地層、直位於坊子煤田斷層仰側片麻岩之上、而山勢隆起、故又可合稱爲凸起斷層。此外小斷層頗多、或延長不遠、或斷距甚微、不勝枚舉。

磁縣武安斷層　一煤田東緣斷層、沿鼓山西麓略成南北方向、延長約六十里。兩端大致均沒於黃土、爲正斷層。斷層面傾斜西向、仰側爲寒武奧陶紀地層、俯側爲濟南灰岩古生代煤系及中生代地層、而更兼有礫岩、斷距不大。二煤田中部斷層、方向與前斷層平行、長不過十里、爲正斷層。斷層面傾斜向西、仰側爲濟南灰岩、俯側爲古生代煤系、斷距微小。三紫山斷層、在武安東境、沿紫山西麓略成東北西南方向、延長約六十里、爲正

斷層。斷層面向西傾斜、仰側爲濟南灰岩古生代煤系、俯側河淤掩佈、而隱約可見者有石英砂岩層、斷距不大。

邢台沙河斷層　兩縣境內斷層頗多、大抵均不重要、而錯動頗微、圖中不易繪出。惟兩縣交界有南北斷層、蹤跡可見者、長約十餘里、爲正斷層、面向東傾斜、仰側爲石英岩層及饅頭頁岩、俯側爲蠕狀灰岩、錯動不大。邢台西北境黃寺北、有一小斷層、略成東西方向、蹤跡可見者不及十里。太古界片麻岩與寒武奧陶紀地層及石英岩藉斷層爲分界、斷層北爲片麻岩暴露區域、正當其仰側、南卽寒武奧陶紀地層及石英岩、當其俯側。斷距甚小。

臨城斷層　一臨城煤田斷層、沿煤田東緣、略成南北方向、長約二十里。在煤田南部、地層由古生代煤系而石英砂岩而赤色砂岩、次序秩然、概無缺失、而北部古生代煤系之上、直接赤色砂岩層、中間顯介有一層向正斷層。斷層面大致向東傾斜、煤系爲其仰側、砂岩爲其俯側、斷距較大。二白雲山斷層、沿山西麓略成東南西北方向、延長約四十里、北端抵他斷層而止、南端沒於黃土、爲正斷層。斷層面傾斜向東北、仰側多太古界片麻岩、俯側爲石英岩及寒武奧陶紀地層。北部錯動頗微、南部斷距較大。三泜河斷層、大致沿泜河而成東南西北方向、長約十餘里、爲正斷層。面傾斜東北。仰側爲濟南灰岩、俯側爲古生代煤系及石英砂岩。北部斷距甚微、南部較大。

井陘斷層　境內斷層頗多、而南部太行山脊尤夥、蹤跡可見者、不下十數、延長由數里至數十里不等。大致多縱列、略成南北或東北西南方向、但亦有東西橫列者、特少數耳。縱者每成正斷層、仰側多元古界地層、俯側多寒武奧陶紀地層、斷層面傾斜向東或東南、斷距俱不大。橫者或成正斷層、或爲平推斷層、斷距均頗小。北部

斷層較大者、爲井陘平山交界斷層、方向大致成東西、而踪跡蜿蜒、長約四十里、東端沒於黃土、而西猶未竟其端、爲正斷層。斷層面傾斜向南、仰側爲五台系地層、俯側爲寒武紀地層、斷距不甚大。

曲陽靈山斷層　曲陽靈山煤田小斷層頗多、最著者爲夾煤田之二大斷層、方向大致爲東北西南、而略相平行。北斷層延長約五十里、南斷層約四十里、大致均爲正斷層。斷層面傾斜對向、惟南斷層之一部、因兼受水平動力、仰側地層往往覆於俯側地層之上、而成逆掩斷層。兩斷層仰側爲太古界片麻岩及元古界矽質灰岩、而共有一俯側爲濟南灰岩及古生代煤系、故兩斷層又可合稱爲槽狀斷層。煤田乃因地層斷折而陷落者。

靈邱煤田斷層　阻絕靈邱煤田、有兩大斷層、方向略成東北西南、狀頗屈曲、有時一部轉向東南西北延長、均約七十里、爲正斷層。斷層面傾斜對向、仰側均爲元古界地層、而兩斷層共有一俯側、地層爲寒武奧陶紀地層及煤系、故又可合稱爲槽狀斷層。煤田亦因地層斷折陷落而成者也。

蔚縣煤田斷層　煤田斷層頗多、不可勝記、最重要者厥爲襄山斷層。方向大致成東西、沿山之南麓、狀頗屈曲、局部方向常有變改。襄山一帶北多寒武奧陶紀灰岩、南爲中生代地層、每以斷層相接觸。大致爲正斷層、斷層面傾斜向南、仰側爲寒武奧陶紀灰岩、俯側有中生代煤系紅綠砂岩凝灰礫岩等層。

房山西部斷層　滾水溪縣交界境上、地層依次暴露、寒武紀地層緊接元古界地層、東入房山境、寒武紀地層不見、元古界矽質灰岩及黑色頁岩直與奧陶紀灰岩接觸、中間顯然介有斷層。大致成東南西北方向、一部略趨東西、爲正斷層。斷層面向東北傾斜、仰側爲元古界地層、俯側爲奧陶紀灰岩、斷距不大。

西山斷層　西山地層彎褶既多、而斷層亦夥、其顯而大者有六。一花木嶺斷層、初沿嶺南坡城東西方向、繼

由東折而南、略走南北、逾龍泉河上游而盡、總長約二十里。大致爲正斷層、而斷層面傾斜甚陡、仰側爲濟南灰岩、俯側爲古生代煤系、斷距甚微。二清水河斷層、齊堂煤田構造複雜、小斷層頗多、勢難詳述。其關係顯要者、爲近清水河岸斷層、略成東西方向、均不甚延長、爲正斷層。斷層面大致傾斜向北、中生代煤系爲其仰側、紫綠岩系墜落爲其俯側、斷距甚小。三紅煤廠西北斷層、成東西方向、延長約二十里、爲正斷層、斷層面傾斜大致南向、仰側爲奧陶紀灰岩、俯側爲古生代煤系、錯動不劇、惟沿斷層之灰岩常夾劣質石棉礦、蓋灰岩變質而生者也。此斷層與花木嶺斷層北部平行、其仰側之灰岩直位於花木嶺斷層俯側煤系之下、故兩斷層又可合稱爲階級斷層。四花安山東端斷層、大致成南北方向、斷層接觸明晰、長約十里、似亦爲正斷層、惟動力複雜、究難確定。斷層仰側爲古生中生兩代煤系及灰岩石英砂岩、俯側只石英砂岩層而已。五大灰廠斷層、大致成東北西南方向、有時轉南北方向、延長約二十里、爲正斷層。斷層面傾斜東南、仰側爲古生中生兩代地層、而兼有矽質灰岩、俯側爲凝灰礫岩層。惟斷層至東部又歧爲二支、中生代煤系與矽質灰岩相接觸、斷距頗大。六九龍山北麓斷層、成東西方向、延長不及十里、爲正斷層。仰側之古生代煤系、初與俯側之中生代煤系接觸、繼與紫綠岩系接觸、錯動不甚一致。

灤縣青龍山斷層　沿青龍山北麓成東西方向、延長約二十里、兩端掩沒、爲正斷層。斷層面傾斜北向、仰側爲元古界片麻岩及石英岩、俯側爲矽質灰岩、斷距甚微。此外灤縣境內斷層頗多、然皆爲局部變動、如唐山一帶地層極形錯亂、有非地面所能窺悉者。灤縣一帶地層亦多斷折、惟斷距微小、延長不遠、故略弗述。

昌黎盧龍斷層　在兩縣之交、大致成東南西北方向。矽質灰岩層本甚厚、而此處獨不見、石英岩層直與寒武

紀地層相接、此斷層南部之情形也。北部歧爲二支、共抵灤河而盡、延長約二十里、斷距不甚一致。

第六章　礦產及礦業

本區域內礦產、以煤鐵爲最重要、他若鉛銅石棉滑石等、亦一二踪跡及之。

一　煤田

本區域內煤田分佈頗廣、開採亦甚盛、如直隸之開平臨城磁縣井陘、河南之安陽、山東之淄川博山灘縣、均有大公司經營。餘如山東之章邱萊蕪、直隸之蔚縣曲陽西山等處、土法小礦亦甚發達。就煤之性質言、可分爲煙煤無煙煤及泥炭之類。就其生成之時代論、則有古生代中生代及新生代之別。古生代煤田以煙煤爲主、而煉焦性質之適宜與否、各處殊不一律。中生代煤田無煙煤居最多數、煙煤除西山齋堂外、率不宜於煉焦。泥炭產三河薊縣、屬新生代、量不甚多。茲按時代分述如左。

古生代煤

開平煤田　在直隸東北部、占灤縣豐潤兩縣境、延長五十里、寬約十里。京奉鐵路經過煤田南部、交通便利。煤層甚多、通常以數可紀者有十四層、而堪採之煤、其層位厚薄至不一、最厚至六十五尺、最薄時僅一二尺。煤質概爲烟煤、適於煉焦、但各層質亦不同、大概可分爲三種、其成分如左。

	水分	揮發分	固定炭素	灰分	硫	比重	發熱量
第一種	〇・六四	二二・二七	七一・五五	五・五四	〇・九八	一・二八五	未詳

第二種	○·六八	二一·○三	六七·七八	一○·五二	○·九六	一·三一○	未詳
第三種	○·六一	一九·八三	六四·六三	一五·二三	○·九五	一·三一○	七○四○

倘以深度六百公尺計、全煤田煤量約爲四萬萬噸、然實際所得、恐不及半。現有中外合辦之開灤礦務局從事開採、資本二百萬磅、在唐山馬家溝趙各莊林西四處開採。歷年產額日漸增加、民國四年、日產煤約七千餘噸、近則增至一萬五千噸。由京奉路運銷各地、在秦皇島登輪、可遠銷南洋羣島日本及美國西部等地。

臨城煤田　在直隸西部占臨城縣屬境其北端已入高邑縣、南北延長約二十五里、寬約五里。京漢路築有支路、直達煤田。煤層有九、厚自二尺至八尺、除第八層外均可開採。煤質有烟、可煉焦。其所採塊煤成分分析結果、謂含炭質百分之五四·八○、揮發分三一·五五、灰分一○·四○。假定可採深度爲六百公尺、約可得煤一萬萬噸。煤田內僅有臨城礦務局一處開採、中外合辦、資本六百萬法郎。礦井在雙井村、每日產額自五百噸至二千噸、由京漢路轉運各處。

磁縣煤田　在直隸西南部、大部在磁縣境、其北端已入河南武安縣境。煤田可分爲二區。一在磁縣彭城鎭及武安和村一帶、南北長約二十五里、寬約六七里、可稱彭城煤田。一在磁縣西佐村及武安淑村一帶、南北長十六里、寬二三里、可稱西佐煤田。由煤田至京漢路之磁縣車站、陸路約五十里。煤田東之滏陽河可行小船。煤層已知者有九、第一層最薄、無開採價值、餘自二尺許至二十尺。煤有烟、可煉焦、惟第八層之一部有時不能煉焦。分析結果如左表。

煤之種類	水分	揮發分	灰分	炭質	灰色	煤性	發熱量
第三層	〇・八九	二〇・〇一	一九・一二	五九・九九	——	——	六四三一
第七層	一・〇三	二一・六五	一一・九九	六五・三四	紅灰色	可煉焦	七二〇〇
彭城西北王看村煤	〇・二二	二一・三四	六・二八	七二・一七	棕色	可煉焦	七一六〇
紅山南十五里胡村煤	一・〇六	二七・一七	二一・五三	五〇・三五	棕色	可煉焦	五五〇〇
紅山鐵鑛西南三里煤	〇・八二	一五・六三	二一・〇八	六二・四七	黑灰色	可煉焦	六八二〇

就煤田面積及煤層厚度、并假定堪採深度爲六百公尺、則磁縣煤田約有煤量二萬三千萬噸、內彭城煤田約一萬四千萬噸、西佐煤田約九千萬噸。煤田內煤礦較大者、在西佐爲怡立公司中和公司、均商辦、及淑村官礦局。在彭城爲北洋官礦局、餘均土窰、計不下三十處。每年產額約十餘萬噸、中以怡立公司產額爲最巨。運輸或由滏陽河運銷下游各地、或由京漢路轉運各處。

安陽煤田　在河南北部安陽縣西境南北延長約六十里、東西寬約六七里。東距京漢鐵路約四十里、由煤田北部六河溝煤礦至豐樂鎭車站築有鐵路一道交通便利。煤層已知者有九、第一第九二層最厚、約三四公尺、餘在一公尺左右。煤有烟、可煉焦、有時亦見無烟煤。分析結果如左。

煤層	水分	揮發分	炭質	灰分	硫	發熱量

第一層	一•二	一九•八二	六七•六三	一一•四四	〇•六五	七五〇二
第九層	〇•七〇	一五•七六	八三•五三	一四•七五	〇•六〇	六六七〇

茲就煤田盛採部份計算、礦量約爲一萬萬噸。如南部煤層與北部相埒、則全煤田礦量約有二萬萬噸。煤田內大礦爲六河溝煤礦、在北部開採、爲商辦公司、民國五六年間日產煤五百噸左右。現每日能產二千噸。由支路運至豐樂鎭、轉由京漢路運銷各地。

淄博煤田　在山東北部、居淄川博山二縣境、其東北一部達益都屬地。煤田可分爲三區。一淄博本部煤田、在淄博二縣一帶、長約八十里、寬十餘里。二黑山煤田、在博山城東、長二十六七里、寬六七里。三西河煤田、在博山城東北、長約十里、寬約四里。膠濟鐵路、由張店分支經淄博本部煤田、直達博山城、交通便利。煤層頗多、有上八層下八層之稱。通常堪採者有八、惟淄博本部煤田南部可採煤層有九、北部疊山煤礦可採者亦有九層。各層厚薄不一、約自一尺左右至六七尺。煤質以有烟煤爲主。淄博本部煤田之煤、大致均不能煉焦、惟疊山第四第九二層煤及博山城西灰石崖、有時可煉焦、西河及黑山煤田之煤、大致均可煉焦、分析結果如左。

地點	煤層	水分	揮發分	灰分	灰色	固定炭	焦性	硫	發熱量
黑山西河	小緞石炭	〇•六三	一八•一五	七•九三	淺白棕色		可煉焦	痕跡	七三六〇
	油性	〇•六九	三•一七	五•七七	棕色		可煉焦	痕跡	七三八〇

淄川矍山	第八層	〇・九八	九・三六	八・五〇	淺紅色	八一・一六	不可煉焦		六一五〇
	第九層	〇・七九	一三・九六	三・九八	白色	八〇・〇三	可煉焦	一・二四	七七〇〇

據作者民國八年測量結果、淄博本部煤田煤量約五萬八千餘萬噸、茲假定以十之三爲因採礦手續及斷層影響、不能採出、則實際所得、當在四萬一千餘萬噸左右。黑山煤田約有煤六千餘萬噸、西河煤田二千五百餘萬噸。總計淄博全煤田之礦量、約爲五萬萬噸。淄博本部煤田北部、有矍山煤礦、先由德人經營開採、資本五百七十萬馬克、青島戰役後、日人接辦。民國六年至八年、平均日出煤約一千五百噸、至多約一千七百噸。華盛頓會議後決歸中日合辦、現組爲魯大公司繼續開採。淄博本部煤田南部及黑山西河兩煤田、民國八年開採者有商辦煤礦三十餘處、資本由一千元至十五萬元。日出煤平均計約千噸、煤之大部由膠濟鐵路運往青島外銷、一部售於濟南及沿膠濟路一帶。

章邱煤田　在山東北部章邱縣南境、其東部已入淄川縣境、西端已入歷城縣境、東西延長約百餘里、南北最寬處約十里。膠濟鐵路經過煤田北部、交通便利。煤層尚多、而可採者頗少。在煤田東部已知者有六、最厚不過四尺、在西部確知者有十一層、最厚約四尺二寸、名爲大炭。據土人云、大炭之下、尚有煤二層、一厚約六尺、一厚約四尺。煤均爲有烟煤、有可煉焦不可煉焦之分。茲將各處煤質分析結果列表如左。

產地	水分	揮發分	炭質	灰分	灰色	硫	煤性	發熱量
人和公司	〇・八六	七・九〇	九一・二四	二九・一三	灰色		不能煉焦	五三九〇

泰豐公司	○·四五	一四·一四	八五·六〇	一九·五四	肉紅色	○·四三	可煉焦	七〇四〇
天源公司	○·四四	一三·五〇	八六·〇六	一三·六九	灰色	○·三四	可煉焦	六四九〇

就煤田面積觀察、東西延長頗遠、地層傾斜平緩、亦可向下深採、惟煤層可採者甚少、層亦較薄。在東西兩部可採者只一層、最厚處不過五六尺、再下是否尚有可採煤層、尚待詳探。茲僅按一層煤、下採六百公尺計算、全煤田煤量約爲八千餘萬噸、如確有三層可採、則全煤田煤量當在二萬萬噸以上。

煤田內小礦、在民國八年以前、計約十處、小窰共六十餘處、均爲商辦。總計章邱煤田大小窰礦平均日可產煤約五百噸。煤由膠濟鐵路運往濟南、一部銷售於煤田附近各地。

萊蕪煤田　在山東中部萊蕪縣中境、東南西北延長約五十餘里、最廣處約六七里。由縣城西至津浦鐵路泰安車站、計約百里。煤田三面環山、交通不便。煤層可採者有六層、厚自二尺至十一尺（營造尺）。煤多爲有烟煤、惟東部高家嶺一帶有無烟煤、茲將分析結果表列如左。

產地	水分	揮發分	炭質	灰分	灰色	硫	煤性	發熱量
驗貨台子	○·九○	三○·七一	六八·三九	一一·七○	棕色	四·四○	煉焦	克洛利 八○四四
高家嶺	一·四二五	五·二四	九三·三三五	一三·○四五	甘草色		不能煉焦	七七八八

就可採煤層之長及已知煤層之厚、估計全煤田煤量當在一萬萬噸以上、但煤田構造較爲複雜、並受火成岩

影響、恐不能如數開採耳。煤田內採煤者、在民國九年僅二處、十二年領照者已十餘處、均爲商辦。日出煤不過三十噸、總計全煤田煤礦平均日出煤約二百噸、俱銷本地。

沙河武安煤田　在直隸南部沙河縣西南、河南北部武安縣東北、一部在永年縣境。煤田可分爲二區。一在沙河窰坡村武安邑城一帶、延長約二十餘里、寬約五六里、一在紫山一帶。煤系地層雖向兩方延長、而產煤部分因受火成岩侵入之影響、頗不連續。煤田距京漢鐵路近處約三十里、半爲山嶺、半爲平原。煤層土法採掘已知者有十一層。厚由七寸至十二尺。煤爲無烟煤、在紫山一帶、因變質較甚、往往成不純之石墨。茲就已知煤層之厚及可採煤層之長、估計兩處煤田煤量約爲一萬萬噸。煤田內開採者有小窰數處、均商辦。每日出煤最多者不過二三十噸。總計全煤田煤窰日出煤不過百噸、大部銷售本地。

曲陽煤田　在直隸西部曲陽縣西北境靈山鎮一帶、西南東北延長、約二十里、寬約七八里。東南距縣城約四十里、距京漢鐵路車站最近者約七十里。山地約二十里、平地約五十里。煤層已知者有七層、厚自一尺至九尺。煤爲無烟煤、第七層爲半有烟煤、質最佳、以第五層質次之、餘均質雜、含硫較多。倘假定六百公尺爲堪採深度、可得煤約六千萬噸。煤田內煤窰據民國八年調查、只四五處、均爲商辦。出煤最多者、平均日約二十噸、總計全煤田煤窰日出煤不過百噸、大部銷售本地。

阜平煤田　在直隸西部阜平縣東北境炭灰鋪一帶、面積狹小、不及二方里。交通不便。煤層有四、均爲無烟煤、最厚約五尺。面積既小、煤量亦少、民國八年只有三數小窰採挖、產額頗少。

北京西山煤田　西山古生代煤系不甚發育、所夾煤層既少、煤質亦劣。分佈雖廣、而產煤部分、惟楊家屯琉璃

局煤田、延長約十餘里寬約二三里、距京綏鐵路之京門支路三家店車站最近四五里。王平村木廠子煤田、延長約十餘里、寬約三四里、距京門支路門頭溝車站最近約二十里。白道子羅侯嶺煤田、延長約二十餘里寬二三里、距門頭溝車站最近十餘里煤嶺煤田面積狹小、長不過數里、距京漢支路坨里車站約十里。佛子庄橫流水煤田、延長約十餘里、寬約一二里、距坨里車站約十里。周口店柴廠煤田延長約三十餘里、寬約二三里。煤田南端近臨京漢支路周口店車站、北端東距坨里車站不及十里。煤層可採者計四層、有時併爲一層、各煤田所採煤層不同、厚薄亦異。琉璃局有大煤層一厚約四十尺（英尺）中夾頁岩厚三四尺、下有小煤層二三厚平均各約四五尺、亦有厚至十尺者。楊家屯有煤四層、厚各五六尺、有時併爲一層、厚十尺至二十尺。王平村木廠子煤田、採煤一層、合夾石層計之、厚三十尺。白道子羅侯嶺煤田、煤層開採者厚三四尺、層數未詳。煤嶺煤層厚約十尺。周口店橫流水等煤田煤有二三層、厚各四五尺。煤均爲無烟煤、不能煉焦、茲將各處煤層分析結果、列表如次。

煤層	水分	揮發分	炭質	灰分	灰色	硫	煤性	發熱量
楊家屯第一層	一•四〇	三•九八	七三•三二	三三•三二		〇•一九	不結結	
王平村安家灘煤層	〇•八三	六•八八	六六•六	二五•六	黃黑色	〇•二八	不結結	六三〇

以三百公尺爲堪採深度、則楊家屯琉璃局煤田可得煤二千五百萬噸、王平村木廠子煤田可得九千萬噸、白道子羅侯嶺煤田可得二千七百萬噸、煤嶺煤田可得一百萬噸、周口店橫流水等煤田可得三千五百萬噸楊

家屯煤田有煤礦一處、中日合辦、資本十萬元。民國七八年間、日出煤自五十噸至百八十噸、運至三家店、轉由京門支路運京。王平村煤田有小礦五六處、作輟靡常、產額無定、煤銷於本地、一部運至門頭溝。白道子羅侯嶺及煤嶺煤田、小窰頗多、產額未詳。周口店橫流水煤田、小窰頗多、聞年產約十萬噸、或由高線路及京漢路之坨里周口店兩支路外運、或由騾馬駝運。

井陘煤田　在直隸西部井陘縣境、在本區城內者只東邊一小部分、全煤田南北長約三十里、東西廣闊不一、最寬處約十里、有時僅一二里。正太鐵路橫貫南部、交通便利。煤層可採者約有五層、薄者不及二尺、厚者逾二十尺、總厚八公尺至十二公尺。全煤田煤量總計約一萬七千餘萬噸。煤爲有烟煤、可煉焦。採煤者約有五處、而具有規模者惟井陘礦務局及正豐寶豐諸煤礦而已、但均不在本幅範圍、礦業未暇詳述。井陘礦務局日出煤約一千二百噸、正豐公司民興公司日各出煤約二百噸、由正太鐵路運至石家莊、轉由京漢路運銷各處。

山東北部及中部各小煤田　此種煤田面積狹小、含煤不豐、僅有土法小窰開採、無重大價值。茲分述其地點如次。(一)昌樂荊山窪煤田、在昌樂縣東部、距膠濟路坊子車站十餘里、有煤一層厚二十尺。(二)臨朐五井煤田、距臨朐縣城約二十里、昔採今停。(三)博山黃家庄煤田、在縣南、有烟煤三層。(四)蒙陰草埠煤田、在縣北、據云有烟煤五層、最厚者約十尺、交通不便、昔採今停。(五)萊蕪張家庄煤田、居萊蕪二縣交境、交通不便、昔採今停。

中生代煤

北京西山煤田　分佈於宛平房山兩縣屬境、產煤區域頗多、可分爲五區。(一)門頭溝煤田、煤系沿九龍山剝

露、東西長約十五里、南北廣約四五里、京綏鐵路之京門支路直達煤田。(二)長溝峪安子煤田、煤系著於北領一帶、東北西南長約二十餘里、廣約六七里。東南距京漢支路之周口店車站約十里、東距京漢支路之坨里車站約七八里、並有高線路由安子直達坨里。(三)齋堂煤田、東西長約二十里、廣約七八里、僻處山叢、交通不便。(四)清水澗煤窩煤田、東西延長頗遠、計約五十里、而寬僅約二里、交通不便。(五)磨石口炭峪響峪等處煤田、均在西山東部、面積狹小、距京門支路均不甚遠。

煤層數目隨地而異、門頭溝煤田有煤十三層、現採者有六層、厚薄不一、最厚約三四公尺。門頭村東通興煤礦打鑽一次、遇煤七層、一處遇煤四層。長溝峪安子煤田、據云亦有煤十三層、惟可採者只有七層、厚由四尺至十尺。齋堂煤田、煤層數目厚度各處不同、在王城峪溝西北有煤四層、厚由四尺至十尺(英尺)、在溝東北有煤六層、厚由二三尺至十尺、在青龍澗有煤七層、厚由四尺至十尺、在雙石頭有煤七層、厚由二尺至十尺。清水澗煤窩煤田有煤十一層、厚由數公分至十三公尺。磨石口炭峪響峪等處煤田、煤層隨地而異、磨石口煤田開採者只一層、厚由數公分至五公尺、炭峪煤田有煤三層、厚由一尺至四五尺、最厚處達十二尺、響峪煤田據云只有煤一層、厚約三尺。

西山中生代煤多無烟煤、或半有烟煤、惟齋堂煤田有烟煤有時可煉焦。茲將各處煤質分析結果列表於左。

產地	煤層	水分	揮發分	炭質	灰分	硫	煤性	熱量
門頭溝通興煤礦		二、三	九、一	七五、三	一三、四	〇、三	不煉焦	一三五〇〇英熱量

門頭溝龍門村		四、九一	一、九〇	七八、二九	一四、九〇	〇、三一	全上
長溝峪順窯公	第五層	一八、五	四、〇五	七六、二一	一五、八九	〇、一四	全上
長溝峪兒口村	第十三層	三、九二	一、六七	七四、一〇	二〇、三一	〇、一六	全上
長溝峪查兒村	第十二層	一、一七	二、八三	七八、四六	一七、五四	〇、五九	全上
西安子	第十一層	四、五三	二、五八	八一、四八	一一、四一	〇、七三	全上
西安子	第九層	三、三一	二、三一	七八、七五	一五、七三	〇、五三	全上
齋堂王城峪		一、六二	一七、八六	七七、一七	三、三五	〇、四九	可煉焦
齋堂雙石頭		二、七五	二、五二	七四、〇八	二〇、六五	〇、四二	不煉焦
齋堂馬蘭村		五、一六	五、一五	八四、二五	二〇、五五	〇、一三	不煉焦
清水澗	第二層	三、二二	二、二八	七二、〇〇	二二、五一	〇、二五	不煉焦
磨石口寶祥煤礦		四、四二	三、四九	六八、八一	二三、二八	〇、四一	不煉焦

茲約略計算西山各煤田之礦量如左。

煤田　儲量　實際可以採出之數

門頭溝龍門村	全上	
長溝峪順窯公	全上	
長溝峪兒口村	全上	
長溝峪查兒村	全上	
西安子	全上	
西安子	全上	
齋堂王城峪	可煉焦	七二五〇
齋堂雙石頭	不煉焦	六〇三二
齋堂馬蘭村	不煉焦	四五一〇
清水澗	不煉焦	
磨石口寶祥煤礦	不煉焦	

門頭溝煤田　八千萬噸　三千萬噸

長溝峪安子煤田　一萬一千萬噸　七千四百萬噸

齋堂煤田　二萬二千萬噸　四千一百萬噸

清水澗煤窩　一萬二千二百萬噸

磨石口煤田　五百萬噸

炭峪煤田　八百萬噸

響峪煤田　二百萬噸

西山煤礦多土法小窯、散見各處。其用新法開採具有規模者、僅有門頭溝之通興公司及裕懋公司、均爲中英合辦。尙有齋堂之煤礦公司、於民國六年成立、官商合辦、惟迄今尙未實行開採。至論產額、門頭溝一區大小礦合計年產不下二十萬噸、長溝峪安子煤田、平均年產約五十萬噸、冬季出煤較多、磨石口煤田有煤礦四、日出煤自二十噸至五百噸。各處所產之煤、均由京漢路之周口店及坨里二支路及京綏路之京門支路運出、大部銷售於北京、一部運往天津。

灤縣坊子煤田　在山東北部灤縣南境、產煤部分東西長約十里、南北廣四五里。膠濟鐵路經煤田北緣、交通便利。

開採之煤僅一層、厚度不一、厚者三十餘尺、薄者數尺、平均爲十二尺。

煤質有烟而不甚粘結、分析結果列左。

產地	水分	揮發分	炭質	灰分	硫	煤性	發熱量
坊子西礦	一、九〇	三三、八五	六七、一〇	八、一五 淡黑色	〇、五九	有烟稍粘結	七〇四〇 克洛利
坊子東礦	一、五六	一三、六七	七六、七五	八、〇三 淡褐色	〇、五〇		七〇四〇

今就可採煤層之長及平均厚度、約計礦量爲七百餘萬噸、而地質構造複雜、可採出者恐尚不及半數也。

昔日有小窰採掘、後歸德國人經營、無甚效果。青島戰後、日人繼而採辦。民國八年有東西兩礦、西礦日出煤由二百五十噸至三百噸。

蔚縣廣靈煤田　在直隸西北部山西東北部、占直隸蔚縣山西廣靈陽原屬境。煤系分佈所及、東西延長約六十里。產煤部份可分六區、卽白草窰黃崖子五岔露骨磁窰及橋澗等煤田是也。煤層數目厚度各處不同、露骨煤田大抵有煤五層、厚由數公分至五公尺、白草窰煤田只採煤兩層、各厚一公尺餘。煤質屬無烟、其成分如左。

產地	水分	揮發分	炭質	灰分	灰色	煤性	發熱量
東溝	一〇、一〇	三六、七二	五三、一八	三、七九	褐色	有烟不粘結	六六五〇
南溝	一一、三九	二三、六六	六四、九五	九、二五	灰色	仝前	五五〇〇
西山小白溝	一一、九六	二三、四〇	六五、四六	五、九八	白色	仝前	六六〇〇
東溝磁炭	一一、五八	三一、一四	五六、八八	四、三六	白色	仝前	五〇一〇

全煤田總礦量爲四萬三千八百萬噸、其中以露骨煤田含煤最豐。煤田內小窰頗多、民國三四年間爲數百餘、平均每窰年產七百至一千噸、大部銷售於本地。

其他小煤田　（一）靈邱煤田、在山西東北部靈邱縣南境寬平村一帶、堪採者僅一層、厚三四尺、無烟、土法採掘、產額極微。（二）五圖煤田、在山東昌樂縣東境、距膠濟鐵路最近處十餘里、已知煤層有三、厚自半英尺至二尺半、有烟不能煉焦、昔採今停。（三）高鎮煤田、在昌樂縣南境、堪採者僅一層、厚五尺、有烟、不能煉焦。以上各煤田俱面積狹小、交通不便、無重大價值。

新生代煤

三河薊縣泥炭區域　京東三河薊縣有泥炭區域三處、一在三河城南七里不洸淀、一在三河城東二十里五百戶、一在薊縣西南西二十五里謨庄子。此區面積最大。泥炭層有一、有時析而爲二、厚自二十公分至二公尺餘。本地人開小坑採掘、工作者最多有七八百人、所產泥炭均銷售本地。

二　鐵礦

本區域鐵礦、就時代而言、可分爲下元古代上元古代中生代中期中生代後期及新生代之鐵礦。按礦床而論、有生於片麻岩中成變質礦床者、有夾於石英岩及矽灰岩中、或灰岩及煤系中成層形或袋狀之水成礦者、有生於灰岩及火成岩之接觸帶者、又有經剝蝕而聚集成爲次生砂鐵礦者。茲就其生成時代礦床種類分別述之。

五台系片麻岩中之鐵礦

灤縣盧龍遷安鐵礦　三縣境內產鐵地點頗多、已知者有十處。(一)司家營鐵礦、在灤縣東境、北距京奉鐵路之灤縣車站約十八里、東北距灤河約四里。礦床生於片麻岩中、成層形、向西傾斜、平均四十七度。長約一千一百公尺、厚度不等、中部最厚、約百米突以上、平均厚約五十公尺。礦石爲結晶質之赤鐵礦及石英、半呈鱗片、大部爲粒狀、團結成片層、有時稍有磁鐵礦。礦石含鐵成分頗低、由百分之二十五至三一、平均爲百分之二十九。礦量概算爲二千五百萬噸。(二)張家庄鐵礦、在灤縣北境、東南距京奉鐵路之雷庄車站約十六里、礦床生於花崗質片麻岩中、成層形、傾斜約四十度。總長約七百公尺、平均厚四十公尺。礦石與司家營同、惟結構較粗、多屬磁鐵礦質、較佳。含鐵由百分之三六・三八至四〇・一六、平均爲百分之三十八。礦量概算爲六百五十萬噸。(三)吳家庄鐵礦、在灤縣北境、東南距雷庄車站約十三里。礦床生於花崗質片麻岩內、成層形、向西傾斜約三十五度。長約二百五十公尺、平均厚二十五公尺。礦石爲磁鐵礦及赤鐵礦、含鐵約百分之三十。礦量約一百萬噸。(四)趙家溝鐵礦、在灤縣北境、與張家庄鐵礦接近、礦床與礦石均與張家庄鐵礦相似、惟礦床甚小、毫無價值。(五)石佛寺鐵礦、在遷安縣西南境、東距灤河約十七里。礦床生於花崗岩及片麻岩中、成層形。南北長約一千二百公尺、厚約四十公尺。(六)小張家庄鐵礦、在遷安西南境、東距灤河約十七里。礦床與石佛寺礦同。長約四十公尺、厚約二十三公尺。(七)西閣寺鐵礦、在遷安西南境、東北距灤河約十里、礦多爲零星碎塊、散佈於山坡之上。(八)洞山鐵礦、在盧龍縣西境、東距灤河二三里。礦床生於片麻岩內、成層形、大致向西北傾斜、層短而薄。礦石爲磁鐵礦、含鐵成分極低、毫無價值。(九)梆子山鐵礦、在盧龍縣西北境、西距灤河五六里。礦床生於片麻岩內、成層形、層短而薄、毫無價值。(十)桃園鐵礦、在盧龍縣西南境、距灤河頗近。礦床生於片麻岩中、體積小

而含鐵成分較高、爲百分之三七・〇二。

膠縣鐵礦　在山東膠縣南境七寶山東距海口紅石崖三十餘里。礦床生於片麻岩中、呈層形、傾斜向東北、斜角甚大、幾近直立。層長約百公尺、厚由半公尺至一公尺半。礦石爲磁鐵礦、與石榴石共生、含鐵百分之六〇・〇八、矽養二百分之八・一七、燐百分之〇・〇四二、硫百分之〇・一二二。茲假定可下採百公尺、則礦量約爲四萬噸。

濤沱系石英岩層內之鐵礦

井陘縣鐵礦　直隸西部石英岩層內常夾鐵礦、在井陘縣境內最多、而質較佳。已知者計有七處、多在井陘縣南境、北距正太鐵路約三四十里、在北境只一處。礦床生於石英岩內、成層形。礦石爲赤鐵礦、含鐵頗低、僅百分之二三十、含矽既殊高。層厚約一二公尺、礦量概算約有二十餘萬噸。

濤沱系矽質灰岩內之鐵礦

易縣鐵礦　在直隸易縣北、距京漢路之高碑店良各庄支路不遠。礦床大致成裝狀。剝蝕後之鐵塊每聚集於冲積層中、量頗少、實無價值。

灤縣豐潤鐵礦　在直隸灤縣豐潤兩縣交境下水路、矽質灰岩內常有赤鐵礦成袋狀、體積頗小、毫無價值。

奧陶紀灰岩及石炭紀煤系中間之鐵礦

灤縣開平煤田鐵礦　在開平煤田北部、含鐵層厚自一公尺至三公尺。礦石爲赤鐵礦及褐鐵礦、呈結核狀、散漫無定。

宛平縣鐵礦　在西山王平村、礦石爲赤鐵礦、質頗劣。在王平口礦層傾向西北、斜角約七十度、最厚處約十尺、薄者一尺。礦石爲褐鐵礦、量極微。周口店石炭紀煤系之下、亦有鐵礦層。

邯鄲縣鐵礦　在直隸西南部邯鄲縣西境、奧陶紀灰岩之上、常見有赤鐵礦塊、質頗劣。

蔚縣廣靈煤田鐵礦　在煤田西部大黑疙疸一帶、礦床生於寒武奧陶紀岩及中生代煤系之間。礦石爲赤鐵礦、含鐵百分之五五・五六、矽養二一・六六、硫〇・二六、燐〇・一三一。礦石露出地面者量不多、且層亦不規則。

中生代後期之接觸鐵礦

金嶺鎮鐵礦　在山東北部長山桓台臨淄交境、南距膠濟鐵路約八里。由金嶺鎮車站至礦築有支路、交通便利。產鐵地點爲鐵山四寶山玉皇山、惟鐵山礦最佳、四寶山玉皇山僅有踪跡而已。礦床生於奧陶紀灰岩及閃長岩之接觸帶、傾斜與岩層一致、斜角自十五度至八十度。礦石爲堅密質赤鐵礦及磁鐵礦之團結體、浮面有少量褐鐵礦、與灰岩接觸處並有菱鐵礦脈。礦石半含堅密佳礦、而大半則與綠簾石黃鐵礦等相雜。鐵山礦床總長爲一千七百三十公尺、平均寬爲十三公尺九。礦質優劣不等、在地表成分頗佳、含鐵百分之六六・五一、矽養二三・一四、而深處礦質較劣、含鐵百分之五五・二七、矽養二一〇・四六。據約略估計、地平以上之礦量爲三百七十萬噸、如下採之深度爲一百公尺、則礦量總數爲一千三百七十萬噸。先是金嶺鎮鐵礦原爲德人經營、惟未正式開採。自青島戰後、爲日人所得、積極進行、民國八年五月正式出鐵、日產礦石約五百噸、是年共出礦石約一一四・七五二噸、民國九年共出礦石爲一二二・九三五噸、現歸中日合辦魯大公司所採

歷城章邱鐵礦　在歷城縣東境章邱縣西境、閃長岩與奧陶紀灰岩接觸處常有鐵礦、惟量少質劣、不足稱礦、礦石爲磁鐵礦、與綠簾石共生。在章邱高莊礦床最長者約十公尺、最寬者不過二三公尺、在濟南附近長者不過五公尺、寬約一公尺、均無開採價值。

萊蕪泰安鐵礦　一在萊蕪縣城西北四里礦山、礦床生於奧陶紀灰岩及閃長岩之接觸帶、成塊狀、均不連續。礦石爲磁鐵礦、質不佳。一在萊蕪泰安交界魯東冶、亦爲接觸礦、成塊狀、量微質劣。以上二礦、均無價值。

武安安陽鐵礦　在武安縣西境北境、已知者爲紅山礦山小礦腦上泉坡黑石坡五處、在安陽西部者爲礦礦村。礦床均生於奧陶紀灰岩及閃長岩之接觸帶。紅山礦石爲赤鐵礦磁鐵礦、常有綠簾石石榴石共生。礦床最厚爲二十二公尺、平均爲十二公尺半。含鐵在百分之五十五以上之礦石共有七十四萬噸。礦山礦石爲赤鐵礦及磁鐵礦、綠簾石頗多、惟少石榴石。礦量僅及數百噸。小礦腦礦床長約五十公尺、寬約二十五公尺、厚度不一、呈扁豆形。上泉坡鐵礦富含石榴石、礦床長一百五十公尺寬約五十公尺。黑石坡礦石爲赤鐵礦、大部已變爲褐鐵礦。礦礦村礦石爲磁鐵礦質極純、絕少石榴石及綠簾石等礦物。

新生代之鐵砂

定興易縣間沿京漢鐵路一帶、有磁鐵砂。一、拒馬河礦砂、自吳村南一里許、向楊村延長共約三十四里。一、易水礦砂、自梁台起至鐵路橋止、共約二里。一、白澗河鐵砂、見於中高及中營河之間、鐵砂厚薄不等、自二・五公寸至六十公寸、砂中含磁鐵礦約百分之五・五。

三　鉛礦

本區域鉛礦、已知者計有五處。(一)山東安邱縣東境担山鉛礦、礦脈生於片麻岩及大理岩中、礦石爲方鉛礦、與黃鐵礦共生。民國五年有人開採、至今舊坑猶存。脈小而薄、毫無價值。(二)安邱縣西南境白石嶺鉛礦、脈生片麻岩中、脈石爲螢石重晶石、脈寬約二三寸、昔曾有人開採。(三)膠縣七寶山鉛礦、礦脈生片麻岩中、爲數甚多、長者約數十公寸、寬由一公寸至三公寸。脈石爲石英及螢石、含方鉛礦、量殊少不足採。(四)淄川縣鉛礦、在蠻山煤礦東南約五里、生於奧陶紀灰岩內、爲方鉛礦、有孔雀石共生、量微質劣。(五)西山鉛礦、在長槽村北約五里、生於奧陶紀灰岩中、爲礦脈。脈石爲石英、含方鉛礦。

四　銅礦

本區域銅礦已知者計有四處。(一)山東歷城縣南境桃科銅礦、礦脈生於片麻岩中。礦石爲黃銅礦、常與黃鐵礦共生、並偶含鎳質。民國五六年曾經開採、量小質劣、毫無價值。(二)直隸滦源縣南境鼻子嶺銅礦、礦床生於矽質灰岩及花崗岩之接觸帶。礦石爲孔雀石。係黃銅礦所變。分析結果、含銅百分之一・一九、鐵百分之五六・三七、只可謂爲含銅之磁鐵、不足以稱銅礦。(三)直隸完縣含陽坡銅礦、礦脈生於灰岩內。脈石爲方解石及石英、含斑銅礦及孔雀石。含銅百分之三八・七、含鐵百分之一・八、含矽養二百分二九・四四〇(四)西山齋堂銅礦、爲孔雀石之細脈、生於輝長岩安山岩內、毫無開採價值。

五　非金屬礦物

石棉

本區域內石棉礦已知者有四處。(一)在直隸滦源縣水泉溝、生於矽質灰岩及花崗岩之接觸帶、寬一二分至

二寸餘不等。民國八年有裕榮石棉公司開採、日出石棉多可五六百斤、少亦二三百斤、運銷天津北京。(二)在山東膠縣南境灰村一帶、石棉生於五台系大理岩內、脈寬二三公分均甚短。聞有人曾採之。(三)在西山紅煤廠西北八里、石棉生於奧陶紀灰岩斷層線附近、爲淺綠色、質極劣。(四)在獲鹿南境金珠嶺亦有石棉礦、生於五台系大理岩內、質不佳、曾有採之者。

滑石

直隸房山縣石窩村、有滑石礦生於大理岩內。分爲五層、最上層厚一・〇五公尺、最下層厚一・四公尺。石窩東北約八里黃井兒、亦有滑石礦。以上二處所採滑石、均在半壁店製成粉末、由琉璃河運往天津山東掖縣西境粉子山、滑石生於五台系滑石片岩內、土人採取、製成粉末售賣。

參考書類

本說明書僅記本幅範圍內地質鑛產之大概、其詳仍須參考其他專門報告、茲將地質調查所業已出版之報告中關係本幅者列左

丁文江張景澄直隸山西間蔚縣陽原廣靈煤田地質(地質彙報第一號)

翁文灝中國礦產區域論(地質彙報第二號)

譚錫疇山東淄川博山煤田地質(地質彙報第四號)

李捷直隸易唐蔚等縣地質(地質彙報第四號)

譚錫疇山東中生代及舊第三紀地層(地質彙報第五號第二册)

安特生山東章邱煤田地質(地質彙報第六號)

朱庭祐直隸井陘地質礦產(地質彙報第六號)

王竹泉趙亞曾田奇瑋直隸臨城煤田地質(地質彙報第六號)

趙亞曾田奇瑋磁州及六河溝煤田地質(地質彙報第六號)

葉良輔北京西山地質誌(地質專報甲種第一號)

丁格蘭中國鐵礦誌(地質專報甲種第二號)

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翁文灝中國礦產誌畧(地質專報乙種第一號)

丁文江翁文灝中國礦業紀要(地質專報丙種第一號)

葛利普中國地質史

以上僅及專論地質礦產之書誌其詳載古生物專門研究諸作限於篇幅茲不備列

各幅南濟京北
and Different Formations

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100 Km.里公

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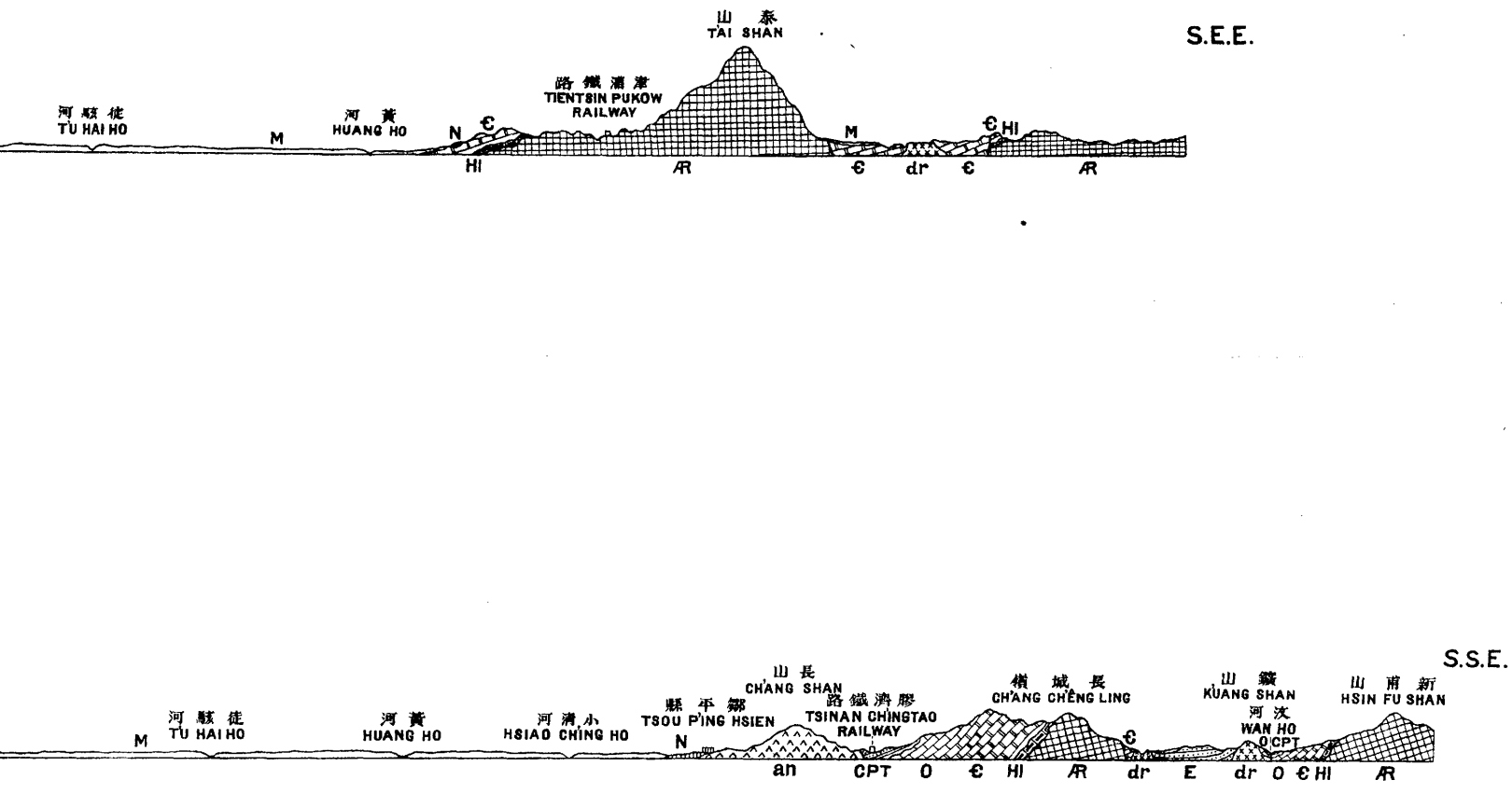

層地紀武寒　　岩灰紀陶奧　　層地紀陶奧武寒

Cambrian Formations.　　O. Ordovician Limestone.　　CO. Cambrian and Ordovician undifferentiated.

紀羅侏　　層岩礫灰凝及岩頁岩砂紀堊白及紀羅侏上

Sandstone.　　Jk. Upper Jurassic and Cretaceous Sandstone, Shale and Tuff-Conglomerate.

三第新　　層積冲　　岩崗花　　岩長閃　　岩山安

ocene Deposits.　　M. Alluvium.　　gr. Granite.　　dr. Diorite.　　an. Andesite.

北京濟南幅各地部地質構造及地層剖面圖

Sections Showing the Structural Features and Different Formations

in Peking Tsinan Sheet

一之分萬百一尺縮面平

Horizontal Scale 1: 1,000,000

0 10 20 30 40 50 100 Km.里公

一之分萬十尺縮面直

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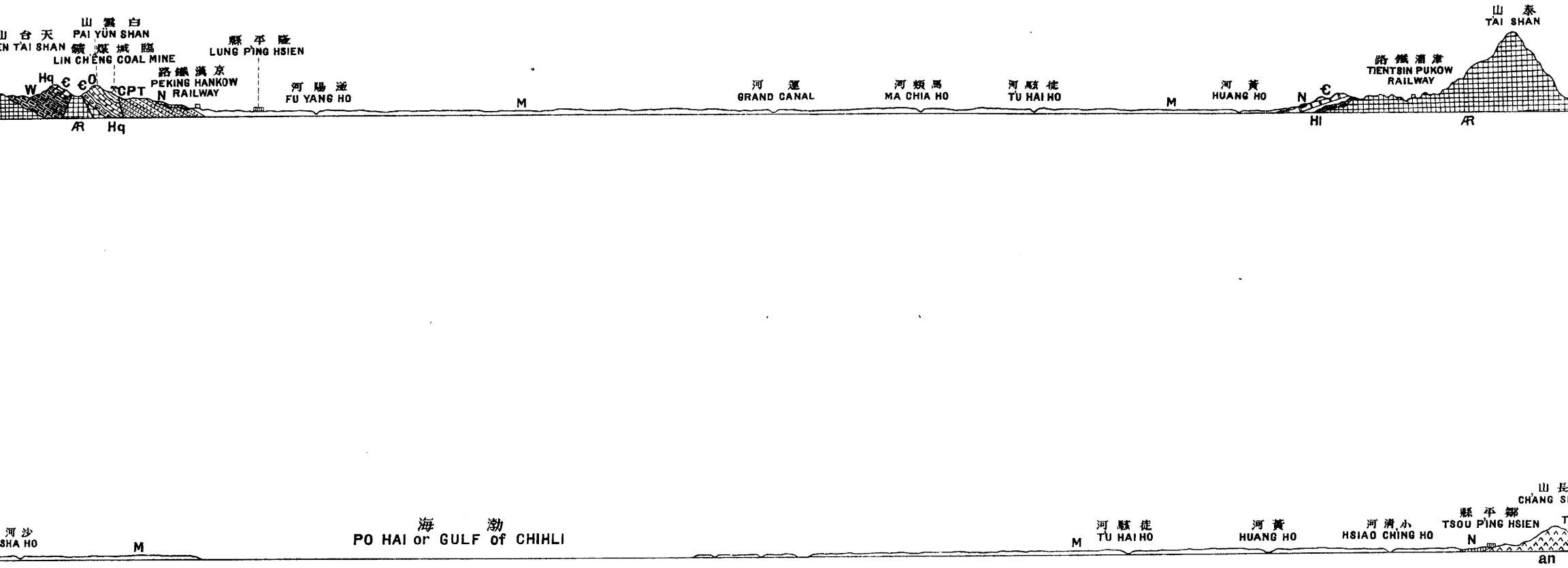

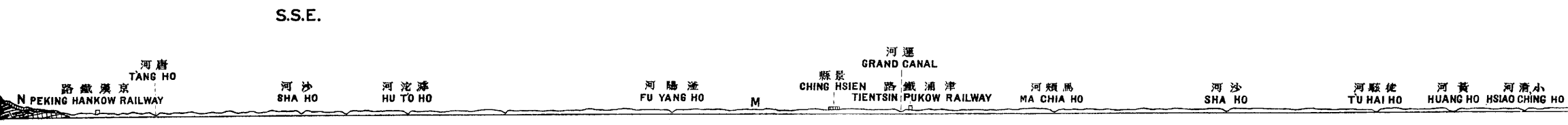

台五 層岩英石 層岩頁色黑及層岩灰質矽 層地紀武寒 岩灰紀陶奧

t'ai System. Hq. Quartzite Formation. HI. Siliceous Limestone and Black Shale. C. Cambrian Formations. O. Ordovician Limestone. CO

二疊二及系煤紀疊二炭石 層岩砂綠紅及系煤紀羅侏 層岩礫灰凝及岩頁岩砂

s Coal Series and Permo-Triassic Sandstones. J. Jurassic Coal Series and Red and Green Sandstone. Jk. Upper Jurassic and Cretaceous Sandst

岩灰及岩灰泥岩礫岩頁岩砂紀三第舊 層地統積洪及紀三第新 層積冲 岩崗花 岩長閃

Tertiary Sandstone, Shale, Conglomerate, Marl and Limestone. N. Young Tertiary and Pleistocene Deposits. M. Alluvium. gr. Granite. dr. Diorit

圖面剖層地及
Sections Showing the Stru

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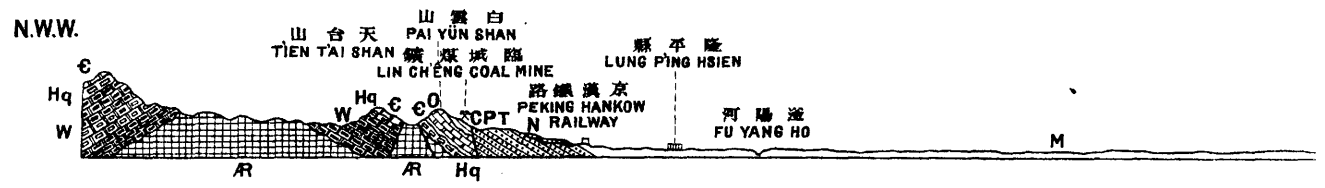
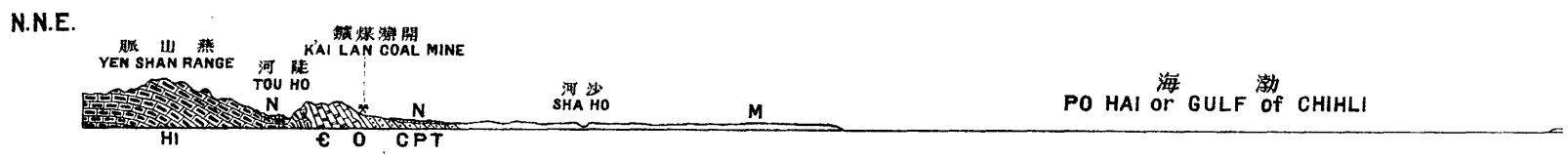
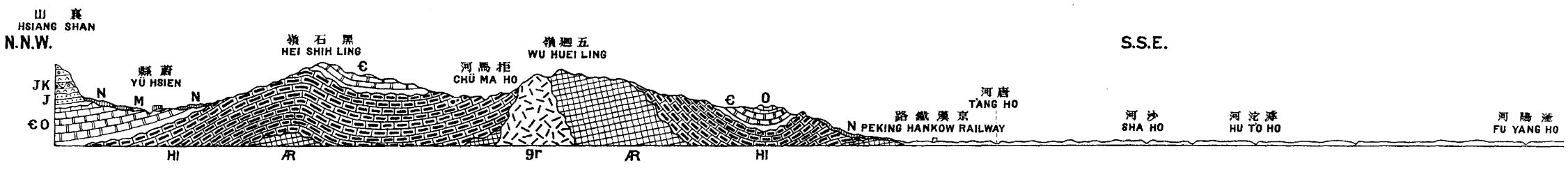






系山泰　　系台五　　層岩英石　　層岩頁色黑及層

AR. T'aishan Complex.　　W. Wut'ai System.　　Hq. Quartzite Formation.　　HI. Siliceous Limestone

岩砂紀叠三叠二及系煤紀叠二石炭　　層岩砂

CPT. Permo-Carboniferous Coal Series and Permo-Triassic Sandstones.　　J. Jurassic Coal S

岩灰及岩灰泥岩礫岩頁岩砂紀三第舊

E. Old Tertiary Sandstone, Shale, Conglomerate, Marl and Limestone.　　N.

剖 狀 柱

SECTIONS

面剖層地部西東山
Generalized Section of the Formations of western Shantung

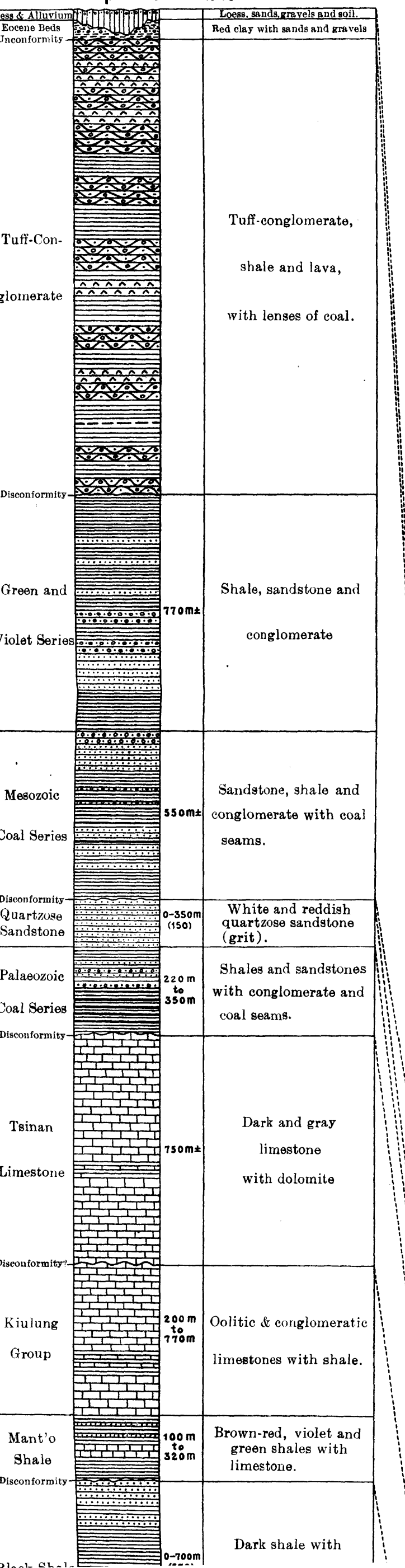
Quaternary	Loess & Alluvium			Loess, sands, gravels and soil.
Pliocene	Red Clay			Red clay with gravel.
	Unconformity			
Eocene	Kuanchuang Series		200m to 1670m (900)	Conglomerate with red sands. Red sands with yellow, gray, greenish and white-gray sandstone, and beds of grayish-white limestone. Red sands and clay with loose conglomerate beds.
	Disconformity			
Cretaceous	Mêngyin Series		360m to 800m (500)	Gray and green shaly sandstones, tuff-conglomerate, breccia, tuff and lava.
	Disconformity			
Jurassic	Red and Green Sandstone		500m±	Red, green, yellow, violet, brown and gray sondstones with red conglomeratic sandstone.
	Mesozoic Coal Series		160m±	Sandstones and shales with conglomerate.
	Disconformity			
Triassic?	Red Sandstone		680m±	Red sandstone with greenish sandstone and clay.
Permian?	Quartzose Sandstone		290m±	White quartzose sandstone (grit).
Permo-Carboniferous	Palaeozoic Coal Series		280m	Sandstone and shale with clay, limestone, coal seams and diabase sheets.
	Disconformity			
	Disconformity			
Ordovician	Tsinan		850m	Gray limestone with

面剖層地部東及部中東山
Generalized Section of the Formations of central Shantung and part of eastern Shantung.

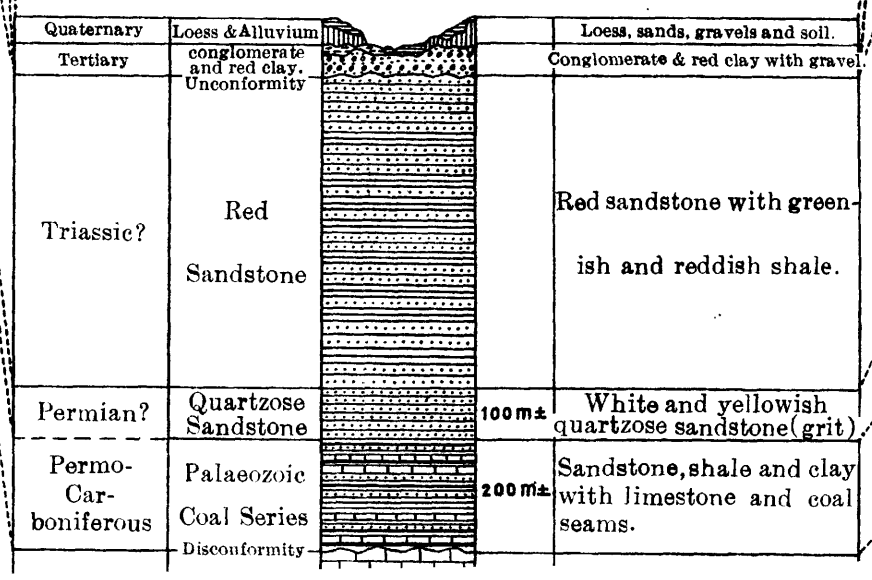
Quaternary	Loess & Alluvium			Loess, sands, gravel & soil.
Tertiary	Red Clay			Red clay with gravel.
	Unconformity			
	Wangshih Series or Red Clay		2000m±	Coarse conglomerate with brown-red coarse and hard sandstone. Red clay with green and gray clay and conglomerate. Red clay with red and gray sandstone.
	Disconformity			
Cretaceous	Ch'ingshan Formation or Tuff-Conglomerate		1200m±	Tuff-conglomerate, tuff and lavas with brown-red sandstone.
	Laiyang Formation		900m±	Yellow, greenish and brownish hard sandstone with gray, green and brownish clayey shale, conglomerate and quartzite.
	Disconformity			
Jurassic	Fangtzŭ Series			Shale and sandstone with clay, and coal seams.
Permo-Triassic	not represented			
Permo-Carboniferous	Palaeozoic Coal Series			Shale and sandstone with clay, limestone and coal seams.
	Disconformity			
Ordovician	Tsinan Limestone		850m	Deep-gray limestone

圖 面 剖 狀 柱
COLUMNAR SECTIONS

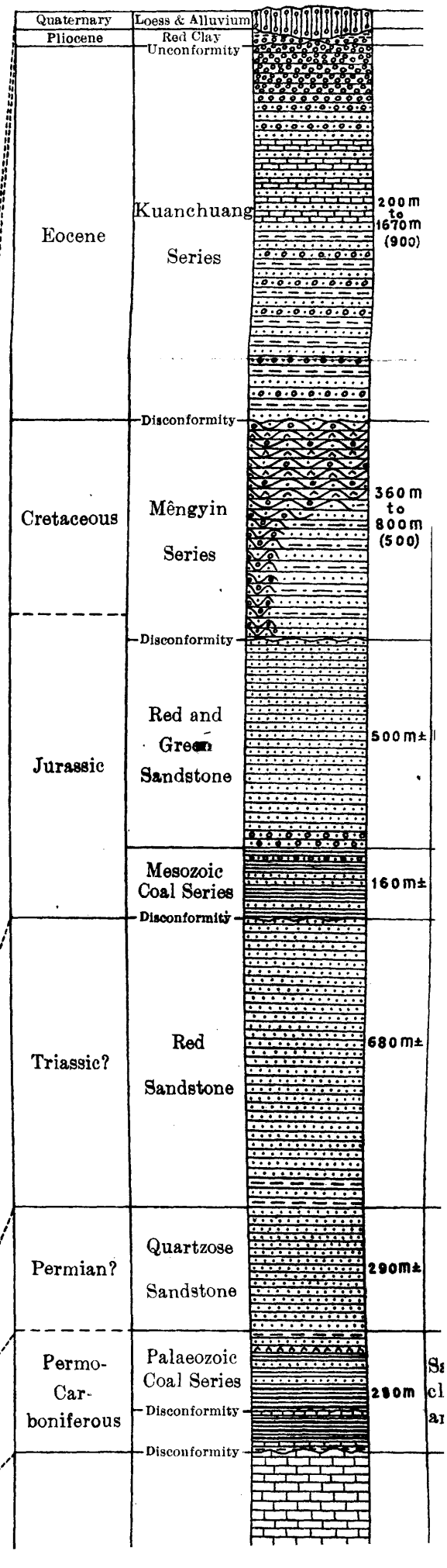
剖面層地部北西隸直
Generalized Section of the Formations of northwestern Chihli and part of Shansi



面剖層地部南西隸直
Generalized Section of the Formations of southwestern Chihli and part of Honan.

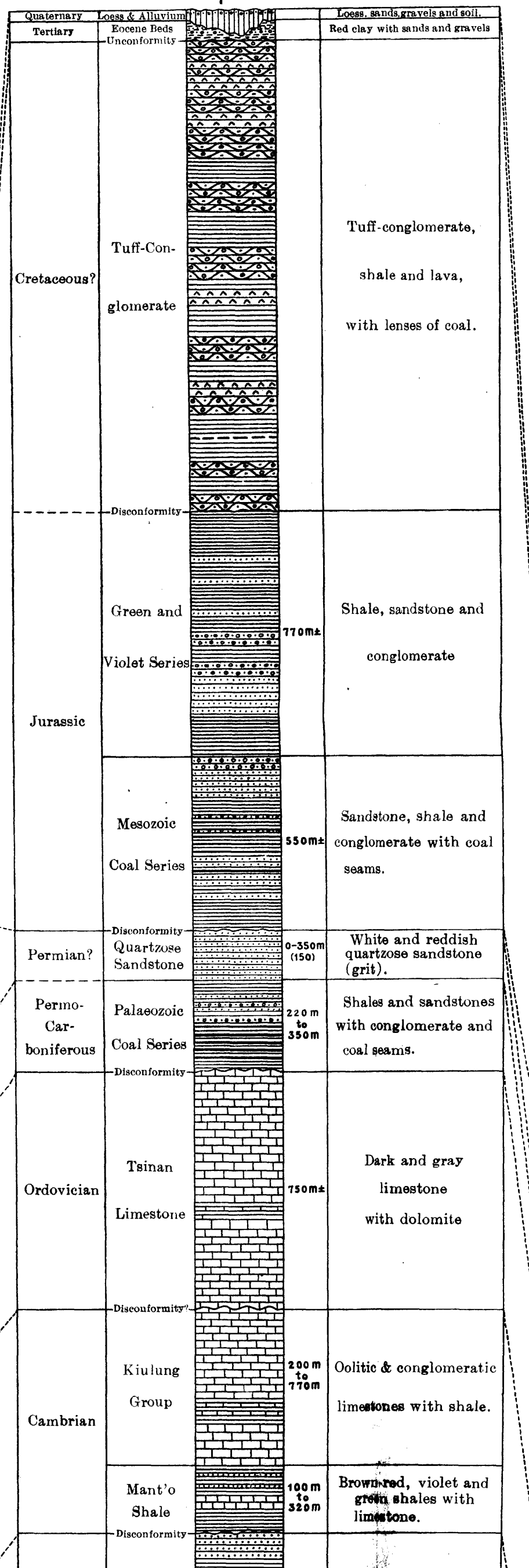


面剖層地部四
Generalized Section of th of western Shan



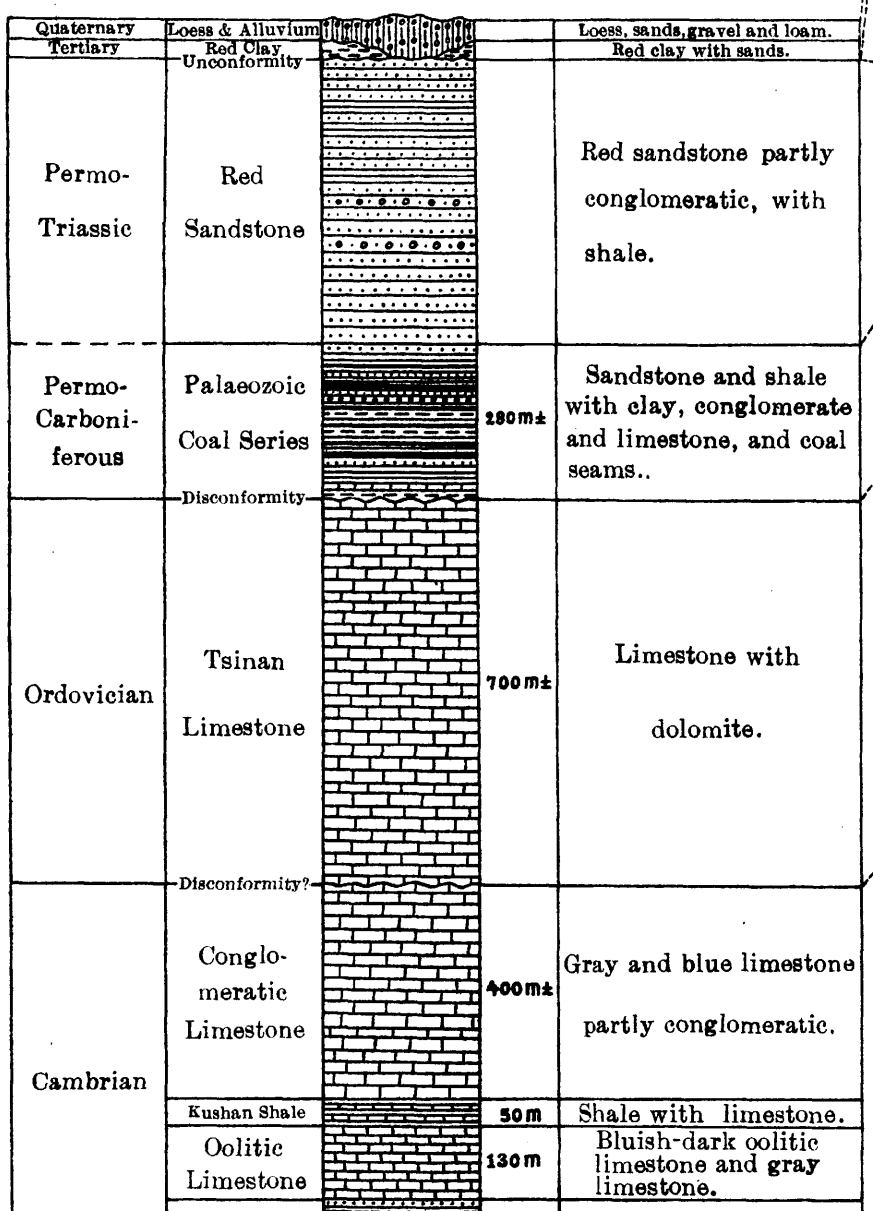
面剖層地部北西隸直

Generalized Section of the Formations of northwestern Chihli and part of Shansi



面剖層地部北東隸直

Generalized Section of the Formations of northeastern Chihli



Pliocene	Red Clay Unconformity			Red clay with gravel.							
Eocene	Kuanchuang Series		200m to 1670m (900)	Conglomerate with red sands. Red sands with yellow, gray, greenish and white-gray sandstone, and beds of grayish-white limestone. Red sands and clay with loose conglomerate beds.	Cretaceous	Ch'ingshan Formation or Tuff-Conglomerate	1200m±	Red clay with red and gray sandstone. Tuff-conglomerate, tuff and lavas with brown-red sandstone.			
	Disconformity					Disconformity					
Cretaceous	Mêngyin Series		360m to 800m (500)	Gray and green shaly sandstones, tuff-conglomerate, breccia, tuff and lava.							
	Disconformity										
Jurassic	Red and Green Sandstone		500m±	Red, green, yellow, violet, brown and gray sondstones with red conglomeratic sandstone.							
	Mesozoic Coal Series		160m±	Sandstones and shales with conglomerate.							
	Disconformity										
Triassic?	Red Sandstone		680m±	Red sandstone with greenish sandstone and clay.		Laiyang Formation	900m±	Yellow, greenish and brownish hard sandstone with gray, green and brownish clayey shale, conglomerate and quartzite.			
						Disconformity					
Permian?	Quartzose Sandstone		290m±	White quartzose sandstone (grit).	Jurassic	Fangtzŭ Series		Shale and sandstone with clay, and coal seams.			
					Permo-Triassic	not represented					
Permo-Carboniferous	Palaeozoic Coal Series		280m	Sandstone and shale with clay, limestone, coal seams and diabase sheets.	Permo-Carboniferous	Palaeozoic Coal Series		Shale and sandstone with clay, limestone and coal seams.			
	Disconformity					Disconformity					
	Disconformity										
Ordovician	Tsinan Limestone		850m	Gray limestone with dolomite.	Ordovician	Tsinan Limestone	850m	Deep-gray limestone			
	Disconformity?					Disconformity?					
Cambrian	Conglomeratic Limestone		400m±	Gray and blue conglomeratic limestone with shale.	Cambrian	Conglomeratic Limestone	400m±	Gray and blue conglomeratic limestone with shale.			
	Kushan Shale		50m	Shale with thin-bedded limestone.		Kushan Shale	50m	Shale with thin-bedded limestone.			
	Oolitic Limestone		130m	Dark and gray oolitic limestone.		Oolitic	130m	Gray and dark oolitic limestone.			
	Mant'o Shale		80m to 130m	Brown and red shale with thin-bedded limestone and sandstone.		Mant'o Shale	80m to 100m	Brown-red shale with thin-bedded limestone.			
	Disconformity					Disconformity					
Neo-Proterozoic	Siliceous Limestone		10-30m	Siliceous limestone.	Neo-Proterozoic	Siliceous Limestone	100m±	Siliceous limestone with shale and sandstone.			
						Disconformity					
						Quartzite Formation	50m to 200m (150)	Quartzite sandstone and shale with conglomerate, slate and limestone.			
	Unconformity					Unconformity					
Archean	T'aishan Complex			Gneisses with granite.	Eo-Proterozoic	Wut'ai System		Schists and gneisses with marble.			
						Unconformity					
					Archean	T'aishan Complex		Gneisses with granite.			

面剖層地部南西隸直

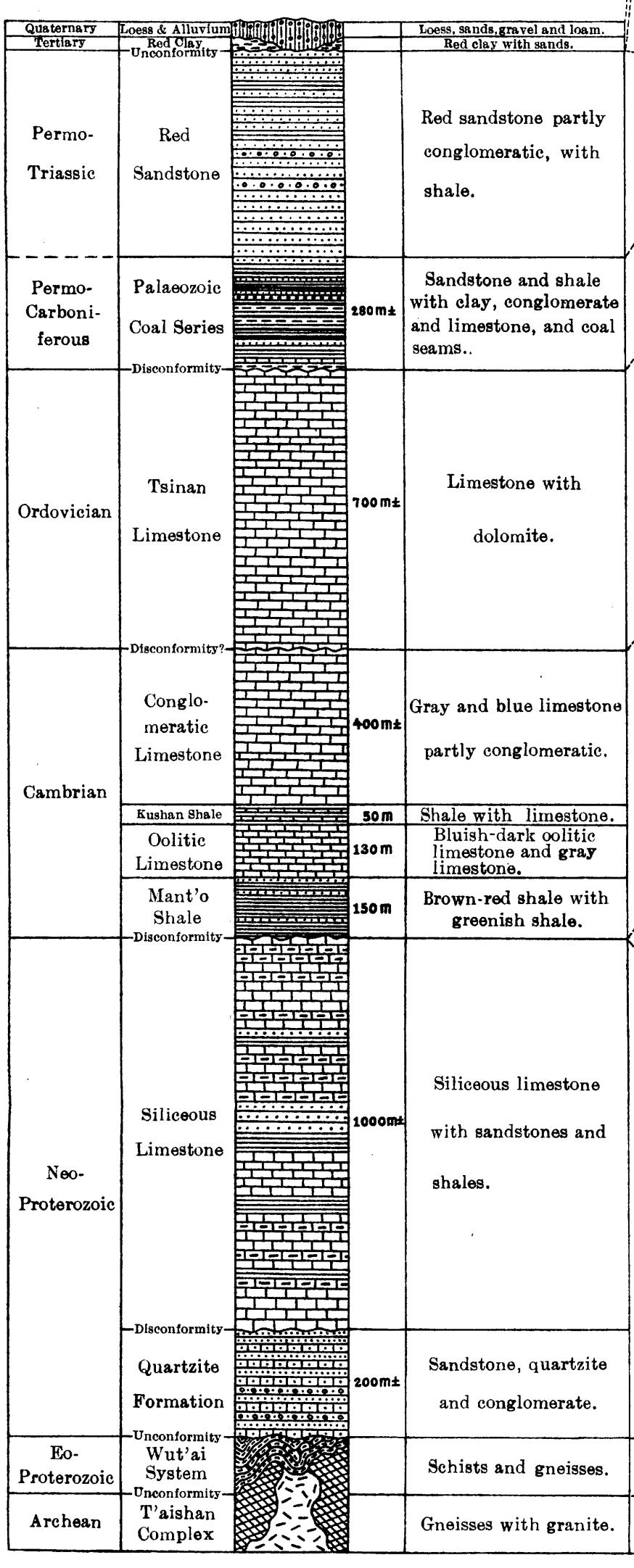
Generalized Section of the Formations of southwestern Chihli and part of Honan.

Quaternary	Loess & Alluvium			Loess, sands, gravels and soil.
Tertiary	conglomerate and red clay. Unconformity			Conglomerate & red clay with gravel.
Triassic?	Red Sandstone			Red sandstone with greenish and reddish shale.
Permian?	Quartzose Sandstone		100m±	White and yellowish quartzose sandstone (grit)
Permo-Carboniferous	Palaeozoic Coal Series	Disconformity	200m±	Sandstone, shale and clay with limestone and coal seams.
Ordovician	Tsinan Limestone		600m±	Gray and dark limestone.
		Disconformity?		
Cambrian	Kiulung Group		400m±	Oolitic and conglomeratic Limestones with shale.
	Mant'o Shale		90m±	Brown-red shale with limestone.
Neo-Proterozoic	Siliceous Limestone	Disconformity	0-60m	Siliceous limestone
	Quartzite Formation		0-200m	White and red quartzite and sandstone with black shale and beds of poor hematite.
Eo-Proterozoic	Wut'ai System	Unconformity		Schists and gneisses with marble and quartzite.
Archean	T'aishan Complex	Unconformity		Gneisses with granite.

Quaternary	Loess & Alluvium			Loess & Alluvium
Pliocene	Red Clay			Red Clay
		Unconformity		
Eocene	Kuanchuang Series			
		Disconformity		
Cretaceous	Mêngyin Series			
		Disconformity		
Jurassic	Red and Green Sandstone			
	Mesozoic Coal Series			
		Disconformity		
Triassic?	Red Sandstone			
Permian?	Quartzose Sandstone			
Permo-Carboniferous	Palaeozoic Coal Series			
		Disconformity		
		Disconformity		
Ordovician	Tsinan Limestone			
		Disconformity?		
Cambrian	Conglomeratic Limestone			
	Kushan Shale			
	Oolitic Limestone			
	Mant'o Shale			
		Disconformity		
Neo-Proterozoic	Siliceous Limestone			
		Unconformity		
Archean	T'aishan Complex			

Jurassic	Green and Violet Series		770m±	Shale, sandstone and conglomerate
		Disconformity		
	Mesozoic Coal Series		550m±	Sandstone, shale and conglomerate with coal seams.
		Disconformity		
Permian?	Quartzose Sandstone		0-350m (150)	White and reddish quartzose sandstone (grit).
Permo-Carboniferous	Palaeozoic Coal Series		220m to 350m	Shales and sandstones with conglomerate and coal seams.
		Disconformity		
Ordovician	Tsinan Limestone		750m±	Dark and gray limestone with dolomite
		Disconformity?		
Cambrian	Kiulung Group		200m to 770m	Oolitic & conglomeratic limestones with shale.
	Mant'o Shale		100m to 320m	Brown-red, violet and green shales with limestone.
		Disconformity		
Neo-Proterozoic	Black Shale		0-700m (570)	Dark shale with sandstone and slate.
	Siliceous Limestone		60m to 1000m	Siliceous limestone with shale, sandstone and quartzite.
		Unconformity		
Eo-Proterozoic	Wut'ai System			Schists and gneisses.
		Unconformity		
Archean	T'aishan Complex			Gneisses with granite.

面剖層地部北東隸直
Generalized Section of the Formations of northeastern Chihli



中華民國十四年八月初版

▣(中國地質圖說明書一冊)

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顧琅先生實地調查之傑作

中國十大礦廠調查記

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富國要政。開礦爲先。我國礦產之著有成績者。首推漢陽、大冶、萍鄉、六河溝、臨城、井陘、開灤、峯縣、本溪湖、撫順、等處。顧琅先生不辭勞瘁。實地調查。撰成此書。詳明博實。凡辦理礦政及經營礦業諸君。備置一編。則各礦之歷史現狀。及辦礦之得失利弊。無不了然。不特各學校地理商業教授得一良參考書已也。

商務印書館發行

Explanation to the 1:1,000,000 Geological Map of China

PEKING–TSINAN SHEET

CONTENTS OF ENGLISH SUMMARY

THE GEOLOGICAL MAP OF CHINA

on the scale of 1 in 1,000,000

GENERAL EXPLANATION

1. This map is issued in sheets. The division of sheets is made according to the rules governing the Map of the World on the scale of 1 in 1,000,000 as adopted by the International Conference, each sheet covering an area 4 degrees in latitude by 6 degrees in longitude.

2. Each sheet bears, besides the lettering corresponding to the geographical Map of the World, the name of two principal cities contained in the sheet.

3. The geology shown in this map is essentially the work of the Geological Survey, and reduced from more detailed field maps mostly on the scale of 1 in 200,000. Materials of other workers are however also largely utilized whenever available.

4. Each sheet is accompanied by an explanation giving outlines of the geology and mineral resources of the area.

5. The present issue is to be considered as a provisional one.

EXPLANATION TO THE 1:1,000,000 GEOLOGICAL MAP ON CHINA. PEKING-TSINAN SHEET

By

H. C. T'AN

Geologist to the Geological Survey of China

INTRODUCTION

This sheet occupies the area within 36°-40° of north latitude and 114°-120° (from Greenwich) of east longitude, including the northern part of Shantung, the greater part of Chihli, the smaller part of Honan and Shansi and a corner of Fêngtien.

The almost whole province of Shantung was surveyed by the writer in 1917-1920 and parts of Chihli by Mr. C. Li and the writer in the autumn of 1920. The geology of Shansi was surveyed by Mr. C. C. Wang except some small parts by Dr. J. G. Andersson and Mr. E. T. Nyström.

The topographical map was compiled from the map of Chihli and Shantung on scale 1:200,000 by the German General Staff and the more detailed map of Shantung on scale 1:200,000 by the Military Survey Office of Shantung province. Besides these two general maps, more than 40 special maps mostly unpublished both topographical and geological have been utilized for the special regions. The sea level at Ta Ku K'ou is used as the datum of the heights expressed in meters.

STRATIGRAPHY

ARCHEAN

T'aishan Complex

This is the basal member among the formations and consists of gneiss, schists, granite and other igneous intrusions, with pegmatite dykes, fluorite and baryte veins. Such dykes or veins often contain metallic ores, such as lead, copper, iron and occasionally trace of molybdenite.

The complex is widespread in Shantung and forms the high mountains, such as T'ai Shan, Lu Shan, Yi Shan, Tsu Lai Shan, Hsin Fu

Shan, Ta Wu Shan, Sung Shan and Huang Shan, etc. It also occurs in Lin Yü, Fu Ning and Lu Lung districts in northeastern Chihli, in Fu P'ing, P'ing Shan, Tsan Huang, Lin Ch'êng and Nei Ch'iu districts in western Chihli, in Suei Chung district, Fengtien, and in Ta T'ung district Shansi.

EO-PROTEROZOIC

WUT'AI SYSTEM. W.

This system is well developed in Wu T'ai Shan of Shansi and unconformable with the T'aishan Complex. It may be subdivided into several groups which seem to be disconformable with each other. The rocks included in this system are chiefly schists and gneisses interbedded with marble, crystalline limestone and quartzite. Among the schists the mica schist and hornblend schist are predominant, while Chlorite, semi-crystalline and talc schists are also found. The schistosity of the gneisses is finer and clearer than that of the Archean gneisses. The quartzite is white, compact and fine, without visible quartz-grains as in the case in later quartzite formations. The marble is white and occasionally greenish in colour, it is often rich in magnesia. This system also comprises intrusive rocks, such as granite, aplite and andesite, and some metallic and useful minerals, such as galena, magnetite, asbestus, talc, fluorite and garnet.

In Shantung this system only occurs in Chiao Hsien, Yeh Hsien and An Ch'iu districts, and contains galena, magnetite, garnet, fluorite and talc. In Lai Yüan, Ch'ü Yang, Hsing T'ang, Ling Shou and P'ing Shan districts, northwestern Chihli, and in Ling Ch'iu district, Shansi, the mica and hornblende schists and fine-grained gneiss are predominant; in Huai Lu, Tsan Huang, Yüan Shih, Lin Ch'êng, Nei Ch'iu and Hsing T'ai districts, southwestern Chihli, the prevailing rocks are gneisses and schists, with quartzite and marble, the chlorite schist frequently contains garnet and the marble asbestus; in Lu Lung and Lan Hsien districts, northeastern Chihli, the mica schist and fine granitic gneiss are developed, with magnetite ore and pegmatite veins from which tourmaline crystals were found in the vicinity of An Ko Chuang.

NEO-PROTEROZOIC

Hut'o System (or Sinian System). Hq. Hl.

This system consists of two groups of strata, namely quartzite formation (Hq) and siliceous limestone with shale (Hl). The former (Hq) is composed of white, red or gray-green and compact quartzite, white, reddish, greenish and yellow sandstone, white and red conglomerate, with black, gray and green shale and slate; the quartzite and sandstone sometimes have ripple marks on the bedding plane and contain sometimes poor hematite beds. The latter (Hl) comprises grayish, deep gray siliceous limestone, green and violet, argillaceous or calcareous shale, white, yellow, green and red sandstone, and black shale, slate and sandstone; the siliceous limestone sometimes contains hematite and igneous intrusions.

This system is in angular unconformity with the underlying Wu-t'ai system and disconformable or in parallel unconformity with the overlying Cambrian strata. Besides he lower and upper parts (Hq & Hl) of the system seem to be disconformable between themselves. The Hut'o system is also called Nank'ou system. Recently it is proposed to specially apply to it the term Sinian system.

This system is well developed in the northern part of this sheet. In northwestern Chihli the siliceous limestone is about 1,000 meters thick and rests either upon the T'aishan complex or upon the Wut'ai system with or without the quartzite formation between them; the black shale which may be the uppermost part of the siliceous limestone, is 50-700 meters thick. In southwestern Chihli the quartzite formation overlies the Wut'ai system, is from 100 to 200 meters thick, and contains poor oölitic hematite beds in its upper part; the siliceous limestone diminishes in thickness, is only 3-4 meters thick at Ch'i Ssŭ in Ching Hsing district, and is totally absent south of Ching Hsing district. In northeastern Chihli the quartzite rests upon the Wut'ai system and is about 200 meters thick, the siliceous limestone contains poor hematite nodules and syenite intrusion. In Shantung the quartzite formation overlies the T'aishan complex and is 50-200 meters thick, the siliceous limestone exists between the T'aishan complex and the Cambrian strata but is only a very few to 90 meters thick.

PALÆOZOIC

CAMBRIAN. €.

The Cambrian strata are divided into two groups, namely, Manto shale and Kiulung limestone, the former consisting of dark and red-brown shales, greenish calcareous shale, dark-brown sandstone and thin-bedded limestone, the latter comprising Oölitic limestone or Changhsia limestone, green shale or Kushan shale and conglomeratic limestone (Wurmkalk) or Tsaomitien limestone. They are disconformable with the Hut'o system and contain an abundance of trilobites and brachiopods.

In Shantung the Manto shale is 80-130 meters thick, and in Chihli and Shansi it is 70-150-300 meters thick; in Shantung it includes Redlichia sp., Ptychoparia sp., Hyolithes sp. and Stenotheca sp. Upon the Manto shale conformably rests the Kiulung group, the thickness of which amounts to more than 500 meters in Shantung and in southwestern and northeastern Chihli, and about 200 meters in northwestern Chihli and Shansi; the Changhsia limestone containing Anomocare sp., Drepanura sp., Ptychoparia sp., Dorpyge sp., Menocephalus sp., Solenopleura sp., Stenotheca sp. and Orthis sp.; the Kushan shale comprising Teinistion sp., Crepicephalus sp., Dorypyge sp. and Lingula sp.; the Tsaomitien limestone including Ptychospis sp., Illænurus sp. and Orthis sp.

ORDOVICIAN. O.

According to fossil-content the Ordovician limestone is disconformable with the Cambrian limestone, it is also called Tsinan limestone or Actinoceras limestone. It consists chiefly of pure gray or dark limestone interbedded with dolomite and has a considerable thickness varying from 600 meters to 850 meters. In this limestone the most prevailing fauna is represented by Actinoceras.

The members of the Cambro-Ordovician strata occur in constant association and are well developed in this sheet. In northwestern Chihli the Manto shale somewhere contains thick seam of limestone in the middle part and the Ordovician limestone in contact with the granite is partly converted into white marble. In southwestern Chihli the Manto shale sometimes comprises poor hematite beds and rests either upon the siliceous limestone or

upon the quartzite formation. In northeastern Chihli the Manto shale seems to exclude the thin-bedded limestone and the Ordovician limestone is extensively used for lime burning and cement works. In Shantung the Manto shale can be divided into three parts and the Kushan shale is apparently separated from the Changhsia limestone and the Tsaomitien limestone.

Carbon-Permian. C.P.

The strata belonging to the Carboniferous and Permian are coal-bearing, so that they are grouped under the name, the Palæozoic coal series. This series disconformably overlies the Ordovician limestone, without the interposition of the Silurian and Devonian strata between them. On the basis of petrographical character most conspicuous in the field, this series except some few coal fields where the strata show local variation, is generally divided into three parts; the lower part consisting chiefly of clay, clay shale and marine limestone, in some places with poor hematite ore; the middle part essentially of shales and sandstones, with workable coal seams and a thin limestone; the upper part largely of variegated clayey shales and sandstones, in some places with green hard clay, but without coal seams.

This coal series contains, in middle part, an abundance of plant fossils, such as Annularia, Calamites, Lepidodendron, Sigillaria, and Neuropteris etc. According to Dr. A. W. Grabau's examination of the marine fauna from the limestones, the lower part of this coal series and the lower portion of the middle part belong to the late lower Carboniferous, and the Upper part and the upper portion of the middle part to Permo-Carboniferous, i.e. the Upper Carboniferous and the Permian, there exists then a great hiatus between them and the middle Carboniferous would be a period of complete emergence from marine water.

It is difficult to calculate the exact thickness of the strata, not only the strata are mostly covered by superficial deposits but also the faults and folds often render them interrupted and undulated, so that the estimate can not be accurate. The thickness here mentioned is based on the measures actually taken from the exposed strata. In Tzŭ-Ch'uen—Po-Shan coal field in Shantung the thickness of the coal series is 232.5 meters at Hung Shan, 284 meters at Ta Kuei Shan and 203 at Hei Shan; in Kaiping

coal field in N. E. Chihli it is 208 meters thick at a locality east of Chao Ko Chuang and 280 meters at a locality west of the same village; in Tzŭ Hsien and Liu Ho Kou coal fields only one portion of the part which contains coal seams is about 160 meters and 130 meters respectively, the thickness of the whole series may be much more than 200 meters; in Hsi Shan, west of Peking, the thickness is also variable, from 250 to 350 meters and even to 400 meters.

This coal series which occurs in different coal fields in this sheet will be briefly described as follows:

Tzŭ-Ch'uan—Po-Shan coal field:—The coal series at Hung Shan comprises the following members—

UPPER PART	Greenish-yellow clayey shale	13	meters thick
	Diabase sheet	.8	,, ,,
	Greenish-yellow loose sandstone	3	,, ,,
	White-gray compact sandstone	.5	,, ,,
	Diabase sheet	3	,, ,,
	Yellow sandstone	11	,, ,,
	Brown, violet and gray clayey shale	14	,, ,,
	Greenish-yellow sandstone with red colour in lower part	10.5	,, ,,
	Yellow loose sandstone	3.5	,, ,,
	Brown, violet and gray clayey shale	5	,, ,,
	Diabase sheet	2	,, ,,
	Brown, violet and gray clayey shale	5	,, ,,
	Diabase sheet (it being named basalt flow by Bailey Willis)	2	,, ,,
	Brown, violet and gray clayey shale	2.5	,, ,,
	Yellow and brown micaceous sandstone	.8	,, ,,
	Brown, violet and gray clayey shale	7	,, ,,
	Yellow hard sandstone interbedded with brown, violet and gray clayey shale	5	,, ,,
	Yellowish and whitish coarse sandstone with violet and gray clayey shale in lower part	7	,, ,,
	Yellow loose and coarse sandstone containing small pebbles	6	,, ,,

MIDDLE PART	Yellow loose sandstone interbedded with greenish, dark and violet clayey shale (containing coal seam)	14	meters	thick
	Yellow sandstone interbedded with ferruginous hard sandstone	14	,,	,,
	Yellow loose sandstone with violet clayey sandstone in lower part.	21.5	,,	,,
	Gray loose thin sandstone interbedded with yellow compact sandstone	5	,,	,,
	Dark-gray thin shale interbedded with yellow sandstone (containing coal seam)	7	,,	,,
	Productus limestone	1.5	,,	,,
	Variegated (gray, red, violet, brown and yellowish) loose thin clayey sandstone	5.5	,,	,,
	Greenish black thin shale (containing coal seam)	7	,,	,,
	Diabase sheet	4	,,	,,
	Dark and green thin shale (possibly containing coal seam)	3	,,	,,
	Diabase sheet (it being named basalt flow by Bailey Willis	1	,,	,,
	Greenish and dark thin shale interbedded with greenish sandstone (possibly containing coal seam)	6	,,	,,
	Greenish-gray hard sandstone	1.2	,,	,,
	Black shale partly turned into inkstone (containing coal seam)	12	,,	,,
LOWER PART	Fusulina limestone	4.2	,,	,,
	Greenish and grayish clay interbedded with yellow and reddish sandstone and dark clayey shale in upper part	6	,,	,,
	Brown and yellowish clay	.5	,,	,,
	Impure calcareous rock	.5	,,	,,
	Red and yellowish clay	.5	,,	,,
	Heavy rock resembling tuff and variegated clay	10	,,	,,
	Yellow and whi ish clay with red colour	2	,,	,,
	Brown red clay	4.5	,,	,,

Chang-Ch'iu—Tzŭ-ch'uan coal field:—The coal series contains all the characteristic members, such as Fusulina limestone of the lower part, Productus limestone of the middle part and variegated clayey shale and sandstone of the upper part. The coal field is close to the andesitic intrusion of Ch'ang Shan, and also comprises numerous intrusive sheets.

Lai Wu coal field:—Upon the Ordovician limestone rests the clayey shale followed by Fusulina limestone. The middle part of the coal series is represented by Productus limestone and yellow sandstone, the upper part is composed of red-violet clayey shale and yellowish-green sandstone. The important coal seams are certainly contained in the middle part.

Coal fields in the southern part of Po Shan, northern part of Mêng Yin and at the boundary between Mêng Yin and Lai-Wu:— In the coal field in the southern part of Po Shan the coal series is represented by lower and middle parts; in the northern part of Mêng Yin the Productus limestone and yellowish-green sandstone are exposed.

Ch'ang Lo coal field:—The strata exposed are ferruginous beds, limestone similar to Fusulina limestone, brown and green shale interbedded with yellow-green clayey shale likely belonging to the middle part of the coal series, and the white hard sandstone also occurs and is in fault contact with the Archean gneiss.

Lin Chü coal field:—The coal series is in fault contact with the Ordovician limestone and represented by gray clayey shale and black shale.

Lin Tzŭ coal field:—The stratification is obscure, the rocks contained in the coal series are metamorphosed into black hard rock, and the white sandstone exposed seems to belong to the lower portion of the middle part.

Kaiping coal field:—The coal series at Chao Ko Chuang consists chiefly of gray and black shale, with ferruginous sandstone, fire-clay and calcareous shale in lower part. At Linsi it is represented by gray-violet clayey shale, white and red-violet clay, black calcareous shale, black thin-bedded shale, yellowish sandstone and yellow, white and reddish coarse sandstone. At T'angshan, above the Ordovician limestone there are

ferruginous shale, tuff, fire-clay, yellow, gray and green sandstone and Fusulina limestone, next to the Fusulina limestone is the important part of the coal series, which contains yellow, white, gray, green, brown and violet clay interbedded with white and red sandstone, black shale, conglomerate, and valuable coal seams, further upward there exists white coarse sandstone which is the uppermost member of the exposed part of the coal series.

Hsi Shan (Western Hills of Peking) coal fields:—The Palæozoic coal series may be grouped into two parts; the lower part consisting largely of black, dark-gray and gray-green shale, slate and schist with coal seams and some contact minerals, such as pyrite, garnet, andalusite and chiastolite; the upper part chiefly of conglomerate, shale and sandstone, and quartzite.

Ch'ü Yang coal field:—The exposed members of the coal series are black, yellow and gray shale and thin-bedded sandstone, with coal seams in lower part. There also occurs a soft limestone which is less than one meter thick and may correspond to the Productus limestone in the middle part of the coal series.

Fu P'ing coal field:—The upper part of the coal series has been eroded away, the part left consists chiefly of brown-black shale, dark and gray sandstone with coal seams.

Ching Hsing coal field:—Only the eastern part of the coal field is contained in this sheet. The coal series may be divided into three parts; the lower part consisting chiefly of hard shale and white sandstone; the middle part of the soft sandstone and thin limestone with coal seams; the upper part of the yellow and brown sandstone.

Lin Ch'êng coal field:—The strata are mostly covered by loess, the lower part of the remaining portion found along the ravines and known from the shafts is composed largely of shale interbedded with white hard sandstone, conglomerate, Productus limestone and several coal seams; the upper part comprises red-violet clayey shale and sandstone and resembles the upper part of the coal series occurring in Shantung.

Sha Ho coal field:—By the syenite intrusion the field is divided into several divisions. The exposed part of the coal series is composed largely

of black and gray shale, white and yellow sandstone, black hard quartzitic rock, variegated clayey shale and yellowish-green sandstone, with coal seams in lower part.

T'zŭ-Hsien—Wu-An coal field:—The exposed strata are red ferruginous clay, white clay, yellow, black shale, white, yellow and gray sandstone, black flint limestone, Fusulina limestone and coal seams, they belong to the middle part of the coal series. There also occur violet, red and dark-gray shale, yellow, white and red sandstone, which may belong to the upper part of the coal series.

Wu-An—Sha-Ho coal field:—The strata resemble those occurring in T'su-Hsien—Wu-An and Sha Ho coal fields, but they contain an abundance of pyrites which may be utilized for preparing sulphur, and the coal contained was remetamorphosed partly to convert into impure and unutilisable graphite.

An Yang coal field:—Upon the Ordovician limestone rest clay and shale with iron nodules; they form the lower part of the coal series. Succeeding to them there are strata which contain four seams of flint limestone with Fusulina and Brachiopods, and several coal seams, and which constitute the middle part of the coal series; further upward there occur the coarse sandstone and red shale, which represent the upper part of the coal series.

Permo-Triassic. P. T.

Upon the Palæozoic coal series conformably rest the Permo-Triassic strata which may be subdivided into two formations, namely, the quartzose sandstone and the red sandstone. The former comprises white, reddish or yellowish compact and coarse quartzose sandstone, and is also called millstone and from 70 to more than 300 meters thick. The latter consists essentially of deep-red soft and fine sandstone, with clay, clayey shale and greenish thin-bedded sandstone, and is cross-bedded in the lower part and about 700 meters thick.

The two sandstones occur in association with the Palæozoic coal series. In Tzŭ-Ch'uan—Po-Shan and Chang-Ch'iu—Tzŭ-Ch'uan coal fields the quartzose sandstone constitutes the upper part of Hung Shan, Ta K'uei Shan, Hei Shan and Wei Shan, and the red sandstone occurring along the southern foot

of Ch'ang Shan is partly converted into quartzite. In the eastern part of Lin Ch'êng and T'zŭ-Hsien—Wu-An coal fields the sandstones form low hills and are all red in colour. In Kaiping coal field the lower part of the red sandstone is hard and may correspond to the quartzose sandstone. Miao An Ling sandstone of Hsi Shan (west of Peking) may also correspond to this quartzose sandstone.

Jurassic. J.

The Jurassic strata disconformably overlie the underlying formations and may be divided into two groups; the lower group is coal-bearing and often called the Mesozoic coal series consisting chiefly of sandstone and shales, with conglomerate, igneous intrusions and often workable coal seams; the upper group may be called the red and green sandstone and is essentially composed of sandstone and locally of shales, sandstones and conglomerates, with igneous rocks, such as andesite and gabbro. The lower part contains an abundance of plant fossils, the prevailing genera are Podozamites, Pterozamites, Coniopteris, Sphenopteris, Pterophyllum and Asplenium, etc. But no fossils were found in the upper part. The thickness of both parts are considerably variable, the lower one from about 60 to 700 meters, and the upper one from 50 to 850 meters.

In Hsi Shan (west of Peking) the Jurassic formations are well developed. The coal series rests disconformably upon the Permo-Triassic sandstone and constitutes important coal fields, such as Mên T'ou Kou, Chai T'ang, Ch'ang Kou Yü and An Tzŭ coal fields; it is also called Ment'ou-kou series and from 500 to 700 meters thick. The sandstone formation is called Kiulungshan series and from 600 to 850 meters thick; but it often contains violet shale and green sandstone, so that it is also called violet and green series; the rocks are partly metamorphosed and mostly form high mountains. In Yü Hsien, Kuang Ling and Yang Yüan the coal series disconformably overlies the Ordovician limestone and constitutes important coal fields, and is followed by the red and green sandstone formation, both the coal series and the sandstone are thin. In Ling Ch'iu coal field the coal series is not well developed and interrupted by faults. In Fang Tzŭ coal field of Wei Hsien, Shantung, the coal series is comparatively developed, in fault contact

with Archean gneiss below, disconformable with the tuff conglomerate above, and invaded by igneous rocks under-ground; the strata exposed are white, gray, yellow and black shale, white and yellowish-brown sandstone. In Tzŭ Ch'uan and Po Shan districts, the coal series rests disconformably upon the Permo-Triassic red sandstone and consists essentially of sandstone, without workable coal seam, the thickness is about 160 meters, and the white sandstone contained is partly converted through metamorphism by the gabbro into pure quartzite which is utilized by the glass work at Po Shan: above the coal series rests the red sandstone with variegated sandstones, which may corresponed to the red and green sandstone formation, it was partly eroded away, the real thickness can not be measured, but the remaining part only is not less than 500 to 600 meters. In Wu-T'u and Kao-Chên coal fields in Ch'ang Lo district, the coal series comprises black clayey shale, violetish and yellow sandstone in the former field, and Yellowish-green and gray-black shale in the latter.

Cretaceous. K.

The Cretaceous strata may be divided into two parts; the lower one comprising sandstones, shales and tuff-conglomerate or breccia, with volcanic lava and igneous intrusions and the upper one of red clay, sandstone and conglomerate occasionally with diabase dykes. The lower part rests either disconformably or unconformably upon the underlying formations, and these two parts are disconformable themselves with one another. They contain an abundance of land living fossils, such as fishes, insects, pelecypods, reptiles and plants.

In Lai Wu district, Shantung, the lower part disconformably overlies the Permo-Triassic red sandstone, it is often called the Mêngyin series, and is about 360 meters thick and composed of gray and green or brownish shaly sandstone with numerous dykes, but in some places it comprises only volcanic material, such as green tuff-conglomerate, tuff-breccia, tuff and lava flow, with some intrusive bodies. The Mêngyin series includes plenty of fossils, both animals and plants. In Chiao Hsien and Chu Ch'êng districts the lower part is divided into two formations, viz., Laiyang formation and Ch'ingshan formation; the former rests unconformably upon the Wut'ai system and is

about 900 meters thick, consisting chiefly of yellow, greenish and brownish hard sandstone and gray, green and brownish clayey shale and conglomerate with quartzitic sandstone in upper part, and containing some plant fossils; the latter conformably overlies the former and is about 1200 meters thick, comprising brown tuff, conglomerate and volcanic lava, sometimes with obsidian. In Chiao Hsien, Chu Ch'êng and Kao Mi districts the upper part is called Wangshih series, and lies disconformably upon the Ch'ingshan formation or tuff-conglomerate and is not less than 2000 meters thick, containing red green and gray clay, red, gray and brown-red sandstone and conglomerates, occasionally with diabase dykes, and including reptiles and pelecypods. In other parts of Shantung the tuff-conglomerate either unconformably or disconformably overlies widely various formations, from the Archean gneiss to the Jurassic coal series, and consists chiefly of brown, violet and green tuff and conglomerate with volcanic lava and red sandstone. In Hsi Shan (Western Hills of Peking) the tuff-conglomerate rests disconformably upon the red and green sandstone, is also called Tiaochishan formation and composed largely of conglomerate, shale and volcanic rocks with coal seam and plant fossils in lower part, the thickness is estimated at about 1500 meters; in Yü Hsien coal field it also disconformably overlies the red and green sandstone, comprises mostly red porphyry and is about 400 meters thick.

CENOZOIC.

TERTIARY. E. N.

The Tertiary strata may be divided into two formations, namely, Kuanchuang series (E) and red clay (N); the former consists chiefly of red sands, clay and conglomerate and belongs to the Eocene; the latter comprises red clay and conglomerate and belongs to the Pliocene.

In Lai Wu district, Shantung, the Kuanchuang series disconformably overlies the Mêngyin series and may be divided into three parts: the lower part consisting chiefly of red sands and clay with loose conglomerate; the middle part chiefly of red sands interbedded with yellow-gray, greenish and white-gray sandstone and grayish-white limestone; the upper part chiefly of conglomerate with red sands. It contains mammals, gastropods, reptiles

and fish-bone; and its thickness is from several hundred meters to about 1670 meters. At Ch'ang Hsin Tien, Chihli, this series comprises loose conglomerate interbedded with red and variegated clays and calcareous concretions. In T'zŭ-Hsien—Wu-An and Ch'ü Yang coal fields and the southen part of Ling Ch'iu district there occurs a conglomerate which may correspond to the upper part of this series.

The red clay disconformably underlies the loess and often occurs along ravines, on low hills and slopes of mountains. In Tzŭ Ch'uan, Po Shan, Chang Ch'iu and Yi Tu districts, Shantung, this formation rests upon the Ordovician limestone and the Palæozoic coal series and contains, in lower part, the conglomerate with limestone pebbles and about one meter thick, and red clay interbedded with conglomerate or gravels in upper part, varying from 5 to 10 meters in thickness. In Lin Ch'ü district it comprises numerous thin beds of conglomerate, varying from several inches to 4-5 ft., the total thickness is variable, in some places more than 10 meters. In northeastern part of Chihli it consists of sands without gravels.

Quaternary. N. M.

The Quaternary strata may also be divided into two parts, viz., the loess or Huang T'u formation (N) and the alluvium (M). The loess is well developed in northern China, brown and yellow in colour, soft in character and easily crushed by fingers, with apparent vertical cleavage, bearing land shells. The essential constituent is fine loam, often with rather angular grains of sand and a considerable amount of carbonate of lime. In some places this formation contains pebbles in beds and one seam of dark clay, 1-2 ft. thick. In this sheet the thickness of the loess is irregular, varying from several meters to about 30 meters. Among fossils found are Elephas, Rhinoceros and Ostrich eggs which belong to the Pleistocene. In regard to the origin of the loess, von Richthofen suggested the eolian theory, but in the recent years Dr. J. G. Andersson suggested that much of the loess is formed through resortment of the more or less loess-like Pliocene "clays" which underlie the loess in many parts of northern China.

The alluvium is the youngest superficial deposit and the constituents are complicate and variable in composition. The alluvium here mentioned

includes sands, gravels, river deposits, loam, secondary loess and the peat with ooze occurring in San Ho and Chi Hsien districts, Chihli. It is widespread, constituting the big plain and low lands in this sheet; the thickness is variable, only several feet in mountainous region, but in the plain according to the result of deep boring it still exists at a depth of several hundred feet and may continue to more than 1000 feet below the surface. The secondary loess and loam are often spread in the plain, the gravels with sands and clay are invariably exposed along the slope and foot of the mountains and hills. In western Chihli the quartzite gravel is abundantly accumulated, often forming low-hills of several tens of meters in height between the mountainous region and the plains, and may be the oldest one among the members of the alluvium.

IGNEOUS PETROGRAPHY

In the area contained in this sheet there are different groups of igneous rocks, namely, Granite, Syenite, Diorite, Gabbro, Andesite, Diabase, Basalt and Trachyte and many varieties of them. The former four groups constitute batholiths or laccoliths and occasionally dykes, the diabase mostly forms sills or intrusive sheets, and the basalt and trachyte mostly form flows and occasionally small dykes.

GRANITE. gr. (including Pegmatite and Aplite)

It may be divided into two classes; one comprising the older granites and the other the younger ones. The older granites are especially developed in T'aishan complex and also found in Wut'ai system. Those contained in T'aishan complex often constitute the high peaks such as T'ai Shan and Tsu Lai Shan; the granite forms batholiths and contains all the essential minerals, such as orthoclase, quartz, plagioclase, hornblende and biotite, at Ta Wu Shan the granite comprises largely orthoclase, quartz and biotite and occasionally plagioclase but the hornblende is rare. The granite included in Wut'ai system forms laccoliths or batholiths and occurs in the vicinity of Ch'i Pao Shan in Chiao Hsien, Shantung, in association with them frequently occur fluorite veins containing galena; among its essential constitutents the biotite is less abundant. In regard to the age of the older

granites it seems that the granits in T'aishan complex was formed not beyong the close of the Archean time and that in Wut'ai system during the later period of the Proterozoic time.

The younger granites are well developed in the northern part of Chihli. In Lai Yüan and Yi Hsien districts the granite constitutes two big mountains, Wu Huei Ling and Huang An Ling, and consists of orthoclase, quartz, plagioclase and hornblende, but the biotite does not play an important rôle; siliceous limestone in contact with the granite is in part converted through metamorphism into marble, with which in some places the asbestus is associated. In Lai Shui and Cho Lu districts the granite forms batholiths and comprises all the essential minerals, the limestone in contact with it is converted into either white marble or dark crystalline limestone. In Hsi Shan, West of Peking, two granitic laccoliths occur at Yang Fang and Chou K'ou Tien, their essential composition consists of orthoclase, plagioclase, hornblende and biotite; quartz is rare; titanite, apatite and magnetite are common. The sedimentary rocks in contact with the granite are partly metamorphosed, the Ordovician limestone into marble, the coal into graphitic anthracite and the shale into schist containing andalusite and chiastolite. The youngest one among the formations in contact with the granites is the Permian quartzose sandstone; the age of these younger intrusions is therefore post-Palæozoic. It is probably later Triassic.

The pegmatite veins are well developed in T'aishan complex and also found in Wut'ai system. At An Ko Chuang of Lan Hsien veins in Wut'ai system contain elongated crystals of tourmaline. The aplite dykes occur often as intrusion in T'aishan complex, Wut'ai system and siliceous limestone, especially conspicuous in the southern part of Chiao Hsien and Chu Ch'êng districts, Shantung, and in the part of T'ang Hsien, Chihli.

SYENITE. sn.

The syenite occurs at T'ai Shan of Shantung and in the western part of Chihli. At T'ai Shan it forms dykes in the Archean gneiss and comprises orthoclase and hornblende as the essential minerals with small amount of plagioclase and quartz; the intrusion is probably contemporaneous with Archæon granite. In Lai Yüan and Yi Hsien districts, Chihli, syenite occurs

in association with the younger granite and often along its margin; its essential constituents are orthoclase and hornblende, plagioclase is also found, quartz is exceptional and biotite is very rare. This syenite may be contemporaneous with the younger granite. In Hsing T'ai and Sha Ho districts, Chihli, the syenite forms laccoliths or stocks intruded in the Cambro-Ordovician limestone and the Palæozoic coal series and essentially consists of orthoclase and hornblende and biotite with very little quartz and plagioclase. Its age is certainly post-Palæozoic and may be of early Cretaceous. In Hsi Shan the syenite intruded into the Cambrian strata as well as in the Jurassic coal series in the vicinity of Chai T'ang, by the increasing amount of biotite it approaches minette. It may also be assumed to be early Cretaceous.

DIORITE. dr.

In the area within this sheet the diorite is well developed either in Archean strata or in contact with the Palæozoic and Mesozoic sedimentary rocks. In the latter case the contact metamorphism often results in the production of new minerals as garnet, epidote magnetite etc. The magnetite and hematite are sometimes in such a large amount that important iron ore deposits are thus formed, such as Chin Ling Chên in Shantung and Wu An in Honan. At Tsu Lai Shan in Shantung the diorite forms large body in T'ai-shan complex. By the presence of quartz as one of its constituents this diorite may be named quartz-diorite. At Sung Shan and Chin Hu Lu Shan in Lin Ch'ü, Shantung, diorite occurs in Archean gneiss, at Sung Shan it is in part porphyritic. According the structure the age of the diorite may be provisionally assumed to be post-Palæozoic. In Wu An district, Honan, the diorite intruded in the Ordovician limestone and the Palæozoic coal series, mostly forming laccoliths and occasionally dykes; it sometimes contains a good deal of quartz, so that the name quartz-diorite may be applied, and in some places the diorite apparently exhibits the porphyritic texture, and may also be named dacite. In An Yang coal field, Honan, diorite laccolith occurs in the Ordovician limestone, and is of similar type than that of Wu An. The strata surrounding the diorite are in part metamorphosed, especially the limestone into marble. Along the contact zone often occur garnet, epidote, zircon and vesuvianite, and also magnetite distributed here and there to form

iron ore deposits. In Huan T'ai, Ch'ang Shan and Lin Tzŭ, Shantung, diorite occurs in contact with the Ordovician limestone and the Palæozoic coal series. The sedimentary strata were uplifted by the intrusion of the diorite magma to form a dome, the upper part of which was there-after denuded to the present appearance. The composition of the diorite is variable; at T'ieh Shan plagioclase is abundant, quartz is often present and hornblende is less abundant; at Yü Huang Shan the black minerals increase in quantity. The Ordovician limestone is in part converted through metamorphism by the diorite into marble and the sandstone of the Palæozoic coal series into quartzite. Along the contact zone occur epidote, garnet, malachite, pyrite, magnetite, hematite, limonite and siderite. The iron ore deposit of Chin Ling Chên will be discribed later in the section of mineral resources. In Chang Ch'iu and Li Ch'êng districts, dioritic bodies occur also in the Ordovician limestone. Their composition is nearly constant, with much plagioclase and hornblende, little quartz and small amount of accessory minerals, such as magnetite, titante and apatite, minor iron ore deposits are also found in the contact zone. In Yi Shui district, Shantung, a diorite body in the Cambrian limestone, contains plagioclase and hornblende as essential minerals and occasionally exhibits porphyritic texture. In Lai Wu and T'ai An districts diorite is found in contact with different formations, among its constituents the plagioclase is most abundant, hornblende and quartz are present, it is a quartz-diorite; the limestone in contact with the diorite is partly converted into marble; among the contact minerals the magnetite is predominant, though the deposit is not large enough to be workable.

According to the mode of occurrence the diorite occurring in the vicinity of T'ieh Shan and in Lai Wu is considered to be of early Cretaceous age. The same is true for the diorite of Wu An, An Yang, Li Ch'êng, Chang Ch'iu and Yi Shui.

GABBRO. gb.

Gabbro intrusion is quite frequent in the northern part of Shantung, either in the Ordovician limestone or in the Mesozoic strata, forming laccoliths or stocks. At K'un Lun Shan and San T'ai Shan in Tzŭ Ch'uan district, the gabbro laccoliths intruded into the Mesozoic coal series and also in contact

with the red sandstone and the red and green sandstone, plagioclase and augite are the essential constituents, hypersthene, hornblende and biotite are also present. At K'un Lun Shan the white sandstone of the Mesozoic coal series is converted by the metamorphic action of gabbro contact into quartzite and it is also partly the case for the red and green sandstone of San T'ai Shan. At Hua Shan, Chin Niu Shan, Yao Shan and Ch'iao Shan in the neighbourhood of Tsinan, gabbro is also found in association with the diorite of Wu Ting Shan. The contact of these gabbro bodies with the sedimentary strata are however little exposed, only at the southern foot of Hua Shan the contact between the gabbro and the marble can be seen. The composition is different from that of the gabbro of Tzŭ Ch'uan by the greater quantity of hypersthene. Therefore the Tsinan gabbro should be better called hypersthene-gabbro or "hyperite".

Gabbro bodies of the above mentioned localities are probably all contemporaneous. Among the sedimentary formations invaded by the gabbro, the youngest one is the red and green sandstone of Jurassic age. Thus the age of the gabbro may be assumed to be early Cretaceous.

ANDESITE. an.

Andesite intrusions occur in the northern part of Shantung and the western and northeastern parts of Chihli, and intruded into nearly all the formations from Archean to Mesozoic, constituting dykes or sills. There are also some occurrences related with volcanic action. In Tsan Huang district, Chihli, andesite occurs in Wut'ai system, the phenocrysts are plagioclase, hornblende and augite, and the groundmass consists of plagioclase with hornblende. The age of this andesite is probably palæozoic if not pre-Palæozoic. At Yün T'ing Shan in T'ai An district the Archean gneiss contains some andesitic dykes which are also in contact with Cambrian Manto shale, the rock is an augite andesite as augite plays an important rôle both among the phenocrysts and in the groundmass. In the latter microlitic plagioclase is predominant. The age of these dykes are provisionally assumed to be post-Ordovician. At An Shan in Ch'ang Li district, Chihli, andesite has been found to contain as phenocrysts chiefly plagioclase, hornblende, and biotite. According to its relation with the adjacent sedimentary strata, the

age of this andesite proably post-Triassic. In the vicinity of Liang Ko Chuang in Yi Hsien, Chihli, the andesite forms laccolith-like body in the siliceous limestone; the phenocrysts are chiefly plagioclase and hornblende; the groundmass comprises plagioclase with small crystals of quartz; in western Chihli the igneous rocks are either later Triassic or early Cretaceous, but it is yet questionable whether this andesite belongs to the former period or to the latter. In Tzŭ Ch'uan, Chang Ch'iu, Ch'ang Shan and Chou P'ing, Shantung, the andesite forms hills of various heights and intruded mostly into the Mesozoic strata and sometimes in the Palæozoic coal series. It is however not impossible that part of this rock is of extrusive origin. The intrusive origin of the main part is proved by the contact metamorphism on surrounding sandstones which are in part converted into quartzites, the intrusion took place probably in early Cretaceous time. In the vicinities of Pai Hua Shan, Chai T'ang coal field, Hsiao Wu T'ai Shan, northwestern Chihli, a large andesite mass intruded into Cambro-Ordivician limestone, Palæozoic and Mesozoic coal series. There is however also andesite of extrusive orgin. The rock contains phenocrysts of plagioclase, hornblende and biotite and occasionally quartz, the groundmass is holocrystalline and composed chiefly of plagioclase. Besides the above mentioned andesite, the tuff-conglomerate which was referred to Cretaceous also contains andesite lava of volcanic origin; at Ch'ing Shui Chien, West of Peking, it contains plagioclase, hornblende and crystals of augite. In Yü Hsien coal field, andesite occurs also in conditions similar to those of Hsi Shan, west of Peking. From the mode of occurrence in Hsi Shan and Yü Hsien we may conclude that andesitic intrusion took place at post-Jurassic time probably beginning with Cretaceous and continuing during the time of formation of the tuff-conglomerate with which layers of andesitic lava are interbedded.

PORPHYRY. pr.

In this paper the name porphyry is applied to the rocks which are rich in silica and consists of both phenocrysts and groundmass. The tuff-conglomerate often contains extrusive rocks belonging to the trachyte group; and as they can hardly be separated from the quartz porphyry with which they are associated, they are for convenience in the porphyry group. In

Ch'ang Li and Fu Ning districts, Chihli, large masses of porphyry are found in Archean gneiss and Proterozoic strata; at Chieh Shih Shan outcrop is well developed, the phenocrysts are feldspar, quartz and hornblende, the groundmass is holocrystalline and consists of orthoclase, quartz and plagioclase, the age of this porphyry is at least posterior to the early Triassic. At An Chia Chuang in Western Hills of Peking occurs a quartz porphyry which contains quartz, feldspar, hornblende and augite as phenocrysts, the groundmass is holocrystalline and consists of quartz and feldspar. In Yü Hsien coal field occur both trachyte and rhyolite; the former comprises very rare phenocrysts and feldspar and hornblende forming holocrystalline groundmass; the latter consists of quartz, feldspar and augite as phenocrysts and orthoclase and plagioclase constituting holocrystalline groundmass.

DIABASE. db.

Diabasic rocks are found in various formations ranging from Archean to Cretaceous in age. At T'ai Shan diabase dykes occur in the Archean gneiss, the rock is holocrystalline and exhibiting ophitic texture, plagioclase and augite are essential minerals, and hornblende and biotite are also present. In Hsi Shan or Western Hills of Peking diabase sills occur over an extensive area and are interbedded between the Permo-Triassic quartzite-sandstone and the Mesozoic coal series. The sill is from 300 to 500 meters thick, but in the vicinity of Men T'ou Kou it increases in thickness and invades the Mesozoic coal series. The rock is holocrystalline and sometimes porphyritic, plagioclase and augite form ophitic texture but the augite is mostly altered to epidote and other secondary minerals. As to the age of intrusion, the lower limit is lower Juassirc as the Men-tou-kou coal series is invaded by diabase, while the upper limit is afforded by the Pre-Cretaceous folding which has equally affected Jurassic strata and the diabase. Therefore the diabase must have been formed during later Jurassic or earliest Cretaceous. In Tzŭ-Ch'uan—Po-Shan coal field the diabase sill is found mostly in the upper part and occasionally in the middle part of the Palæozoic coal series; at Hung Shan there are six sheets, thin sheet being about one meter and the thickest one about 4 meters; at Ta K'uei Shan there occurs only one sheet about 8 meters thick; the diabase consists chiefly of plagioclase and augite, though hornblende is also present; in regard

to the age of this diabase, it is unquestionable that it is post-Palæozoic, but the diabase is also in association and probably contemporaneous with diorite, gabbro and andesite in northern Shantung, which are of early Cretaceous age.

BASALT. bs.

The basalt is mostly found over the northern part of Shantung and the northwestern part of Chihli, either covering the Mesozoic coal series and the red and green sandstone or the tuff-conglomerate. At Ching Shan in Ch'ang Shan, Shantung, basalt lava covers the top of the hill of the red and green sandstone. Under microscope the phenocrysts of olivine can be seen in a groundmass of plagioclase and augite. At Kuo Mao Shan in Yü Hsien coal field the basalt covers the Mesozoic coal series and the red and green sandstone. In the vicinity of Fang Shan in Ch'ang Lo, Shantung, the basalt rests upon the tuff-conglomerate. It consists of olivine and plagioclase as phenocrysts and a groundmass composed of microlites of plagioclase, small fragmentary olivine, decomposed augite and glass.

STRUCTURAL GEOLOGY

FOLDING

In the area within the present sheet, the northern, western and southern parts occupied by mountains and hills while the central part is covered by an extensive plain. Very broadly speaking, the geological formations of the bordering hills as a rule dip down to the plain. Thus the strata south of the plain dip to the north, those west of it to the east and those north of it to the south. Therefore this alluvial plain of Chihli, structurally speaking, forms a large basin, though the nature of the strata within the basin under thick alluvial covering can not be easily inferred. This large basin clear in broad lines is however incomplete and complicate; it includes many smaller synclines, anticlines, domes and basins. Brief description only will be given here for the mountains and hills surrounding the plain.

ALONG THE T'AI HANG SHAN RANGE

T'ai Hang Shan Anticline: T'ai Hang Shan is the massive range dividing the two provinces, Chihli and Shansi. Structurally it forms a broad anticline. The western limb dips gently westward to form the plateau of Shansi, while the eastern limb dipping more steeply and aided by younger warping and faulting descends abruptly to the east, northeast and southeast. Although it appears as a mountain range rugged and abrupt when looked at from the plain, the T'ai Hang Shan anticline is but flat and broad, so that the inclination of the strata as a rule is gentle, with dipping angles between 10° and 30°.

P'êng Ch'êng and Ho Ts'un Basin: This basin occurs near the border between the districts T'sŭ Hsien, Chihli, and Wu An, Honan, and extends in northsouth direction. It consists of the Palæozoic coal series and is surrounded by the Cambro-Ordovician formations. The strata composing the eastern border of the basin dip to the west, northwest and southwest, whereas those of the western part to the east, northeast and southeast, the dipping angles are generally from 10° to 35°, and in some places the strata are nearly horizontal. Several strike or oblique faults have been observed, causing repetition of limestone outcrops.

Ling Shan Basin: It is situated in the vicinity of Ling Shan Chên in Ch'ü Yang district, Chihli, surrounded by the Cambro-Ordovician strata and composed of the Palæozoic coal series. The syncline has a northeast to southwest direction, the strata on the southern border of the basin dip to the north or to N. N. W. with the angles of 25°-35°, while those on the north dip to the south, or to S. S. E. and S. S. W. with the angles of about 20°.

Lang Ya Shan Syncline: In the district of Yi Hsien, Man Ch'êng, Wan Hsien, T'ang Hsien, Ch'ü Yang and Fu P'ing, Chihli province, the Sinian (Nankou) limestone and the Cambro-Ordovician strata form a broad syncline, the axis of which lies in northeast to southwest direction. The strata of the left limb generally dip north-northwest or westward and those of the right limb to the southeast or S. S. E., the dipping angles are from 20 tc 30 degrees.

The Western Hills of Peking

Hua Mu Ling Anticline: It occupies the central part of Hsi Shan or the Western Hills of Peking and in some places exhibits an appearance of a dome. The dome shape is imperfect by being affected by the faults. The strata in the central part are nearly horizontal, and the dipping angles of those on the margins are generally from 20° to 40°.

Miao An Ling Syncline: It lies on the north of the Hua Mu Ling anticline with which it joins by its southern limb. The synclinal axis extends in northeast to southwest direction. This syncline consists of all the formations from Neo-Proterozoic to the Jurassic.

Pei Ling Syncline: It occurs in the northern part of Fang Shan district and is connected by its northern limb with the Hua Mu Ling Anticline. The coal-bearing formations of the Ch'ang Kou Yü coal field form small syncline and anticline and are sometimes overthrusted. The strata building up the northern limb of the syncline generally dip southward or southeast and southwestward, while those of the southern limb dip to opposite directions, the dipping angles are, in some places, more than 70°.

Kiu Lung Shan Syncline: It is partly situated in Wan P'ing district, and its axis coincides with the ridge of Kiu Lung Shan, extending from northeast to southwest. This syncline and Miao An Ling syncline are connected by Wang P'ing Ts'un anticline. The strata of the northern limb dip to southeast or southwest with the dipping angles varying from 30° to 80° those of the southern limb dip to northeast or N. N. E. at angles ranging from 20° to 50°.

Along the Yên Shan range

Yen Shan Folds: In the range N. E. of Peking constituting N. border of the great plain and lying in Yü T'ien, Fêng Yün, Ch'ien An and Lan Hsien districts, the Siliceous limestone is folded to form many small anticlines and synclines. In Yü T'ien district the strata dip to northeast and southwest to form an anticline with dip angles generally between 10° and 20° and seldom more than 40°. The anticline is continued eastward in Fêng Yün district where the strata mostly dip to northeast, southwest, east and west

at angles varying from 20° to 30°. In Ch'ien An and Lan Hsien districts prevails however an incomplete syncline extending in northwest and southeast direction.

Lung Shan incomplete Dome: In Ch'ien An, Lu Lung, Lan Hsien and Ch'ang Li, the quartzite formation and siliceous limestone of Nankou system constitute one part of a big dome, most part of which was however eroded away. The Lung Shan incomplete dome is only one part of the western margin of that dome. In Ch'ien An district the strata dip to northwest at angles ranging from 10° to 20°, in Lu Lung, Ch'ang Li and Lan Hsien districts the strata generally dip to the west or southwest at angles of about 30°.

Kai P'ing Basin: It occupies the regions near the border between Lan Hsien and Fêng Yün districts, and constitute the southern margin of the Yên Shan range. It may be related to the Lung Shan dome. The basin is occupied by the Carboniferous, Permian and Triassic strata and is surrounded by the Cambro-Ordovician formations. The strata dip at angles varying from 40° to 50° and in some places become almost vertical. The dip angle decreases however from the periphery to the center of the basin to be nearly horizontal in the central part where is developed the Permo-Triassic sandstone.

The Shantung plateau

The Shantung Dome: During the early or Middle Cenozoic time Shantung was affected by epeirogenic movement accompanied by the invasion of magma, so that the strata were uplifted to form a broad dome which was immediately broken by faultings. Within the present sheet the northern margin of the broad dome can only be seen in northern Shantuug. The strata appear to form an arch commencing from the regions in Tung O and P'ing Yin districts and terminating in regions of Lin Ch'ü and Yi Tu districts. The inclination of the strata is generally, though locally variable, to the north, northwest and northeast, at rather gentle angles.

The Tzŭ-Ch'uan—Po-Shan Basin: The basin occurs in Tzŭ Ch'uan and Po Shan districts and extends in a north-south direction. It is composed of the Palæozoic coal series and Mesozoic sandstone and shale and surrounded by the Ordovician limestone on the northern, eastern and southern sides. The strata of the northern side dip to the south or southwest, while those on the east to

the west or northwest and those on the south to the north, northwest or northeast; on the western side the basin is interrupted by a fault.

The T'ieh Shan Dome: It occurs in Yi Tu, Huan T'ai and Ch'ang Shan districts and is connected with the Tzŭ-Ch'uan—Po-Shan basin on the southern side. It is composed of diorite in the central part and surrounded by the Ordovician limestone and Palæozoic coal series on the periphery. The strata dip away from the center to all sides at steep angles. The formation of this dome is probably due to the dioritic intrusion as a laccolith.

The Sung Shan Dome: It is situated in the southern part of Lin Ch'ü district and composed of the Archean gneiss with diorite body. It is surrounded by the Cambro-Ordovician formations. The strata gently dip to the east, north and west.

The Kao Chuang Dome: It occupies the regions near the border between Li Ch'êng and Chang Ch'iu districts, and consists of diorite in the central part and is surrounded by the Ordovician limestone which dip away from the center at steep angles.

FAULTING

The main faultings took place at post Eocene time. The faults date generally from the middle Tertiary, although they may not be exactly contemporaneous between them. Some of them are developed in the southern part of the area represented in this sheet and were formed on the breaking of the Shantung dome. In the eastern part of T'ai Hang Shan, in Hsi Shan and the southern part of the Yên Shan range also occur many faults both in strike and dip direction especially affecting the structure of coal fields. In the eastern part of Shantung there are several faults which seem to have been covered by the tuff-conglomerate of Cretaceous age and to have affected the Jurassic coal series, so that they might have been formed at the post-Jurassic or pre-Cretaceous period.

The T'ai Shan Fault: This fault lies along the southern foot of T'ai Shan in southeast and northwest direction. It is a normal fault and about 30 km. long. The upthrow side is composed of the Archean gneiss and the downthrow side of the Cambrian strata; the throw is estimated at about 2000 meters.

The Fault on the border between T'ai An and Fei Ch'êng districts: This fault is nearly parallel to the T'ai Shan fault, the part which may be traced amounts to less than 11 km. It is also a normal fault, the fault plane slightly inclines toward southwest. The T'aishan complex composes the upthrow side and the Cambrian and Ordovician strata the downthrow side. The downthrow side of the T'ai Shan fault is the upthrow side of this fault, so that they can be considered as step faults.

The Faults of Lai Wu coal fields: In Lai Wu district there are seven important faults. 1. The fault of Ta Wu Shan extends northwestward and westward about 34 km. and is a normal fault; the fault plane dips to the south and southwest with the upthrow side made of the Archean gneiss and the downthrow side of the Cambrian strata. 2. The fault along the northern margin of the Lai Wu coal field lies in northwest and southeast direction at a length of about 34 km. and is also a normal fault; the upthrow side consists of the T'aishan complex and the downthrow side of the Mesozoic and Cenozoic strata; the throw is estimated at more than 3000 meters; the T'aishan complex which composes its upthrow side is overlain by the Cambrian strata which build up the downthrow side of the Ta Wu Shan fault, so that the two faults can be considered as step faults. 3. The fault along the eastern margin of the coal field forms an arch toward the northwest and is about 40 km. long; this fault was formed not only by the vertical movement but also by the horizontal displacement. 4. The fault separating the Lai Wu coal field into two parts lies in north-south direction and is about 23 km. long; it is a horizontal displacement; the distance of the horizontal offset is not much less than 6 km. 5. The fault in the Chang Chia Chuang coal field lies in eastwest direction and is a normal fault; the upthrow side is composed of the Archean gneiss and the Cambrian strata and the downthrow side of the Cambro-Ordovician formations, the Palæozoic coal series and the Mesozoic strata. 6. The fault at the western end of the Lai Wu coal field lies in eastwest direction and is a normal fault; it is more than 6 km. long; the upthrow side is the Ordovician limestone and the downthrow side the Palæozoic coal series. 7. The fault in the western part of Lai Wu district lies in southeast and northwest direction at a length of about 23 km.

and is a horizontal displacement; the distance of the horizontal shift is not much less than 6 km.

The Chang Ch'iu Fault: This fault separates the coal field into two parts and lies in northsouth direction. It is a horizontal fault and the distance of the shift is about 11 km.

The Faults of the Tzŭ-Ch'uan--Po-Shan coal field: There are four prominent faults which divide the coal field into different parts. 1. That separating the Tzŭ-Ch'uan—Po-Shan coal field from the Chang Ch'iu coal field is a horizontal displacement, running southnorthward, being parallel to the fault of the Chang Ch'iu coal field and about 45 km. long. 2. That separating the Tzŭ-Ch'uan—Po-Shan coal field from the Hei Shan and Hsi Ho coal fields is a normal fault, running from southwest to northeast, with the Ordovician limestone forming the upthrow side and the Palæozoic coal series the downthrow side. 3. That dividing the Hei Shan and Hsi Ho coal fields is a normal fault, running from northwest to southeast. 4. That which is developed at the northern end of the Tzŭ-Ch'uan—Po-Shan coal field is also a small horizontal fault, causing a discontinuity in the coal series.

The Faults in the southern part of Po Shan district: 1. That occurring along the northern margin of the Huang Chia Chuang coal field is a normal fault, running from east to west, with the Ordovician limestone forming the upthrow side and Palæozoic coal series the downthrow side. 2 That occurring in the vicinity of Hsia Chuang is also a normal fault, running from east to west, with the Archean gneiss forming the upthrow side and the Cambrian conglomeratic limestone the downthrow side.

The Faults in the northern part of Yi Shui and Mêng Yin districts: 1. That running along the southern foot of Lu Shan is a normal fault, with the upthrow side of the Cambro-Ordovician formations and downthrow side of the tuff-conglomerate. 2 That at Chiu Ting Lien Huan Shan is a normal fault, running from east to west, with the Manto shale on the upthrow side and the conglomeratic limestone on the downthrow side. 3. That at Tung Li Tien is a normal fault, running from east to west, the upthrow side being made of the Manto shale and the downthrow side of the conglomeratic limestone, both of Cambrian age.

The Faults in the southern part of Lin Ch'ü: There are three prominent faults. 1. That running from the Wu Ching coal field southwestward

to another small fault, is a normal fault with the upthrow side consisting of the Cambrian conglomeratic limestone and the downthrow side of the Ordovician limestone and Palæozoic coal series. 2. That occurring at Lu Shan is a normal fault with the T'aishan complex on the upthrow side and the Cambro-Ordovician formations on the downthrow side. 3. That occurring at Sung Shan is a normal fault, its upthrow side being made of the T'aishan complex and its downthrow side of the Ordovician limestone.

The Fault of An Ch'iu and Lin Ch'ü districts: It occurs along the border between these two districts, running from south to north. In some places the Archean gneiss forms the upthrow side and the Cambrian conglomeratic limestone the downthrow side, but at Kao Chên the conglomeratic limestone builds up the upthrow side and the Mesozoic coal series the downthrow side. This fault is partly covered by the Cretaceous tuff-conglomerate and separates the Jurassic coal series from other formations, so that it must be formed at post-Jurassic or pre-Cretaceous periods.

The Faults of Wei Hsien and Ch'ang Lo districts: 1. That occurring along the southern margin of the Fang Tzŭ coal field is a normal fault, running from west to east and being covered by the tuff-conglomerate, the Archean gneiss forming the upthrow side and the Mesozoic coal series the dowthrow side, it might be formed at the beginning of the Cretaceous. 2. Those interrupting the Ching Shan Wa coal field are trough faults, the upthrow side of the northern fault is constituted by the Archean gneiss, the Palæozoic coal series forming the downthrow side in both cases. These two faults further meet to form one fault and may be contemporaneous with that of the Fang Tzu coal field.

The Faults of T'zŭ Hsien and Wu An districts: 1. That occurring along the eastern margin of the Tzŭ Hsien Wu An coal field is a normal fault, running from south to north, the upthrow side consisting of the Cambrian and Ordovician strata and the downthrow side of the Ordovician limestone, Palæozoic coal series, Mesozoic strata and Tertiary conglomerate. 2. That cutting the strata in the middle part of the coal field is a normal fault, running from south to north, the Ordovician limestone forming the upthrow side and the Palæozoic coal series the downthrow side. 3. That occurring along the western foot of Tzu Shan in the eastern part of Wu An

district is a normal fault, running from southwest to northeast, the upthrow side being made of the Ordovician limestone and Palæozoic coal series and the downthrow side partly made of the quartzose sandstone.

The Faults of Hsing T'ai and Sha Ho districts: There are two prominent faults. One running from south to north is a normal fault, the upthrow side consisting of the quartzite formation and Manto shale and the downthrow side of the conglomeratic limestone. Another running from east to west is also a normal fault, the upthrow side being composed of the Archean gneiss and the downthrow side of the quartzite formation and Cambro-Ordovician strata.

The Faults of Lin Ch'êng district: 1. That occurring along the eastern margin of the Lin Ch'êng coal field is a normal strike fault, running from south to north; the upthrow side consists of the Palæozoic coal series and downthrow side of the quartzose sandstone and red sandstone. 2. That occurring along the western foot of Pai Yün Shan is also a normal fault, running from northwest to southeast, the upthrow side is mostly made of the Archean gneiss and the downthrow side of the quartzite formation and Cambro-Ordovician formations. 3. That occurring along the river Ch'ih Ho is a normal fault, running from northwest to southeast; the upthrow side is formed of the Ordovician limestone and the downthrow side of the Palæozoic coal series and the quartzose sandstone.

The Fault of Ching Hsing district: There are more than ten faults in the southern part of this district. Those running longitudinally are normal faults, the upthrow side being mostly composed of the Proterozoic formations and the downthrow side of the Cambrian and Ordovician strata; those running transversally are either normal faults or horizontal displacements. That occurring along the border between Ching Hsing and P'ing Shan districts is a normal fault, running from east to west, the Wut'ai system forming the upthrow side and the Cambro-Ordovician strata the downthrow side.

The Faults of Ling Shan in Ch'ü Yang district: In the Ling Shan coal field there are many faults, among them the most important are those two which interrupt the coal field. They run from northeast to southwest and are normal faults. One part of the southern fault forms however an

overthrust. The upthrow sides of the two faults consist of the Archean gneiss and the siliceous limestone, and they have the same downthrow side which is made of the Ordovician limestone and the Palæozoic coal series.

The Faults of the Ling Ch'iu coal field: There are two big normal faults which interrupt the coal field and run from northeast to southwest and partly from southeast to northwest. The upthrow sides of the two faults are composed of the Proterozoic formations and they have the same downthrow side which consists of the Cambro-Ordovician strata and the Mesozoic coal series.

The Faults of the Yü Hsien coal field: There are many faults, of which the most important is the Hsiang Shan fault running from east to west. It is a normal fault, the upthrow side being made of the Cambro-Ordovician limestone and the downthrow side of the Mesozoic coal series, red and green sandstone and tuff-conglomerate.

The Fault in the western part of Fang Shan district: It is a normal fault, running from northwest to southeast; the Proterozoic formations form the upthrow side and the Ordovician limestone the downthrow side.

The Faults of Hsi Shan: 1. That occurring along the southern slope of Hua Mu Ling is a normal fault, running from west to east, the Ordovician limestone forming the upthrow side and the Palæozoic coal series the downthrow side. 2. Those occurring along Ch'ing Shui Ho in Chai T'ang coal field are normal faults, running from west to east, the upthrow sides consisting of the Mesozoic coal series and the downthrow side of the violet and green series. 3. That occurring on the west of Hung Mei Ch'ang is a normal fault, running from east to west, the Ordovician limestone composing the upthrow side and the Palæozoic coal series the downthrow side. 4. That occurring on the east of Hua An Shan seems to be a normal fault, running from north to south, the upthrow side being composed of the Ordovician limestone, Palæozoic and Mesozoic coal series and quartzose sandstone and the downthrow side of the quartzose sandstone. 5. That occurring on the north of Ta Huei Ch'ang is a normal fault, running generally from northeast to southwest, the upthrow side comprising the Palæozoic and Mesozoic strata and the siliceous limestone and the downthrow side the tuff-conglomerate. 6. That occurring along the northern foot of

Kiu Lung Shan is a normal fault, running from east to west, the Palæozoic coal series composing the upthrow side and the Mesozoic coal series and violet and green series the downthrow side.

The fault of Ch'ing Lung Shan in Lan Hsien district: The fault occurring along the northern foot of Ching Lung Shan is a normal fault, running from east to west, the upthrow side being made of the Wut'ai system and the quartzite formation and the downthrow side of the siliceous limestone.

The Fault of Chang Li and Lu Lung districts: It occurs on the border between these districts and runs from southeast to northwest. The quartzite formation forms the upthrow side and the Cambrian strata build up the downthrow side.

MINERAL RESOURCES AND MINING INDUSTRY

COAL FIELDS

Among the mineral resources the coal is of the first importance. Within the area of this map the Kai P'ing, Lin Ch'êng, T'sŭ Hsien, Ching Hsing, An Yang, Tzŭ-Ch'uan—Po-Shun and Wei Hsien coal fields are the largest ones and are already being worked in an extensive scale, while in Chang Ch'iu, Tai Wu, Yü Hsien, Ch'ü Yang and Hsi Shan coal fields numerous smaller mines are being operated. The coal is either bituminous or anthracite.

The coal of Carboniferous age is essentially bituminous and usually coking, becoming anthracite only by local metamorphism. On the contrary the Mesozoic coal happens to be mostly anthracite in the area in question; the Jurassic bituminous coal of importance only occurs in part of the Chai T'ang coal field This rule of distribution of different qualities of coal in the area included in this sheet makes the Carboniferous coal fields in this area to have the greatest importance for the industrious fuel, whereas the rule is by no means always true every where else. Peat occurs in San Ho and adjoining districts.

PALÆOZOIC COAL

Kai P'ing coal field: It is situated in Lan Hsien and Fêng Yün district; the Peking Mukden railway passes through its southern part. There are numerous coal seams, 14 of which are usually recognized, but different seams are worked in different shafts. The thickness of the coal seams is variable from about 1 ft. up to a maximun of 65 ft.; the coal is bituminous and coking, the analyses of different classes of coal are given as follows:

Coal	Moisture	Volatile matter	Carbon	Ash	Sulphur	Specific gravity	Caloric power
1st. class	0.64	22.27	71.55	5.54	0.98	1.285	
2nd ,,	0.68	21.03	67.78	10.52	0.96	1.320	
3rd ,,	0.61	19.82	64.62	15.23	0.95	1.320	7040

The coal reserve in this field is estimated at about 400 million tons. The whole field is now under the control of the K'ai Lan Mining Administration, with four mining centres at T'ang Shan, Lin Si, Chao Ko Chuang, Ma Chia Kou. In 1923 the total daily output was about 15000 tons, the coal is partly transported by the Peking Mukden railway to different interior markets and partly from the Ch'ing Huang Tao port by steamers to Phillipine and other over-sea ports.

Lin Ch'êng coal field: It is situated in Lin Ch'êng and Kao Yi districts and is connected by a branch line to Ya Ko Ying station of the Peking-Hankow railway; there are 9 coal seams, the thickness of the seams is from about 2 ft. to about 8 ft.; the coal is bituminous and coking and contains 52.05% of Carbon, 31.55% of volatile matter and 16.40% of ash; the coal reserve in this field is estimated at 100 million tons. This field is worked by the Ling Ch'êng coal Mining Administration, the daily production is from 500 to 2000 tons, the coal is transported by the Peking-Hankow railway to various markets.

T'zŭ Hsien coal field: It is situated in Tsŭ Hsien, Chihli, and Wu An, Honan, and is about 28 km. distant from the T'zŭ Hsien station of the Peking-Hankow railway. The river Fu Yang Ho near this field is navigable. Nine coal seams are known, the thickness of workable seams is from 2.5 ft. to about 20 ft.; the coal is mostly bituminous and coking, the result of the analyses of the coal is as follows:

Coal	Moisture	Volatile matter	Ash	Carbon	Colour of ash	Nature of coal	Caloric power
3rd seam	0.89	20.01	19.11	59.99			6431
7th ,,	1.02	21.65	11.99	65.34	red-gray	coking	7206
coal at Wang K'an T'sun	0.21	21.34	6.28	72.17	brown	coking	7160

The coal reserve in the whole field is estimated at about 230 million tons. Besides the native pits, the coal field is exploited by two mining companies bearing the name of Yi-Li and Chung-Ho, and two government mining bureaus at Shu Ts'un and Pei Yang. The annual output is more than 100,000 tons; the coal is either transported throughout Fu Yang Ho or by the Peking Hankow railway.

An Yang coal field: It is situated in the western part of An Yang district, Honan and about 23 km. distant from the Peking-Hankow railway and connected to it by branch line, between Liu Ho Kou coal mine and the Fêng Lo Chên station. Nine coal seams are known, the thickness of which varies from 1 to about 4 meters; the coal is mostly bituminous and coking, the analyses are given in the following table.

Coal	Moisture	Volatile matter	Carbon	Ash	Sulphur	Caloric power
1st seam	1.11	19.82	67.63	11.44	0.65	7502
9th ,,	0.70	15.76	83 52	14.75	0.60	6670

The coal reserve in the whole field is estimated at about 200 million tons; the Liu Ho Kou coal mine works in the northern part of this field, the daily output is about 500 tons, the coal is transported by the Peking-Hankow railway.

Tzŭ-Ch'uan—Po-Shan coal field: It is situated in Tzŭ Ch'uan, Po-Shan and Yi Tu districts; the Tsinan-Tsingtao railway passes by the northern end of the field and has a branch line from Chang Tien running into it; there are 13 coal seams, 9 workable, varying from about 1 ft. to about 7 ft. in thickness; the coal is bituminous and either coking or non-coking, the analyses are given in the following table:

Seams	Moisture	Volatile matter	Ash	Colour of ash	Nature of coal	Sulphur	Caloric power
Hsiao-tuan-shih-t'an	0.63	18.15	7.92	whitish-brown	coking	brace	7260
Yiu-hsing	0.69	12.17	5.77	brown	,,	,,	7380
8th seam	0.98	9.36	8.50	pink	non-coking		6150
9th ,,	0.79	13.96	3.98	white	coking	1.24	7700

The coal reserve in the whole field is estimated at 496,969,200 tons. The Tzŭ Ch'uan coal field is worked by the Lu Ta Company producing about 2000 tons per diem, while in the Po Shan fields exist a great number of smaller collieries, whole output totals at about the same amount of 2000 per day. Most of the coal is transported to Tsingtao, the remainder chiefly to Tsinan.

Chang Ch'iu coal field: It covers the southern part of Chang Ch'iu district and one part of Tzŭ Ch'uan and Li Ch'êng districts; the Tsinan Tsingtao railway passes through the northern part of the field; the coal seams are numerous but the thickest one is about 4 ft.; the coal is bituminous and either coking or non-coking, the analyses of the coal are given as follows:

Localities	Moisture	Volatile matter	Carbon	Ash	Colour of ash	Sulphur	Nature of coal	Caloric power
coal at Jin Ho & Co.	0.86	7.90	91.24	29.13	gray		Non-coking	5390
coal at T'ai Fêng & Co.	0.45	14.14	85.60	19.54	flesh	0.43	coking	7040
coal at T'ien Yüan & Co.	0.44	13.50	86.06	13.69	gray	0.344	coking	6490

The coal reserve in the whole field may be more than 200 million tons; a number of small collieries are in operation, the total daily output is about 500 tons, the coal is transported by the Tsinan Tsingtao railway to Tsinan.

Lai Wu coal field: It is situated in the middle part of Lai Wu district and about 50 km. distant from the T'ai An station of the Tientsin-Pukow railway; 6 coal seams are workable, the thickness is from about 2 ft. to about 11 ft., the coal is mostly bituminous but partly anthracite, the analyses are given as follows:

Localities	Moisture	Volatile matter	Carbon	Ash	Colour of ash	Sulphur	Nature of coal	Caloric power
coal at Yên Huo Tai Tzŭ	0.90	30.71	68.39	11.70	brown	4.40	coking	8044
Coal at Kao Chia Ling	1.425	5.24	93.335	13.045	yellowish		non-coking	7788

The coal reserve is estimated at about 100 million tons; small coal mines are in operation, the daily production is about 200 tons.

Sha-Ho—Wu-An coal field: It occupies the parts of Sha Ho, Wu An and Yung Nien districts and is about 17 km. distant from the Peking-Hankow railway; 11 coal seams are known, the thickest one is about 12 ft.; the coal is anthracite; the coal reserve is estimated at about 100 million tons, only native pits work there, the total daily output is about 100 tons.

Ch'ü Yang coal field: It is situated in the vicinity of Ling Shan Chên in Ch'u Yang district, Chihli, and about 40 km. distant from the Peking-Hankow railway; there are 7 coal seams, the thickness is from about 1 ft. to about 9 ft.; the coal is mostly anthracite; the coal reserve is estimated at about 60 million tons, only native pits work there, the total daily output is abeut 100 tons.

Fu P'ing coal field: It is situated in the vicinity of T'an Huei P'u in the northeastern part of Fu P'ing district, Chihli, there are 4 coal seams, the thickest one is about 5 ft.; the reserve is not rich and the output is very little.

Hsi Shan coal fields: There are 6 Palæozoic coal fields, namely, Yang Chia T'un and Liu Li Chü field, Wang P'ing Ts'un and Mu Ch'ang Tzu field, Pai Tao Tzu and Lo Hou Ling field, Mei Ling field, Fuo Tzu Chuang and Hêng Lin Shui field and Chou K'ou Tien and Ch'ai Ch'ang field, some coal fields are not far from the Men T'ou Kou station of the Peking and Men-t'ou-kou branch line, and the T'o Li and Chou K'ou Tien stations of the branch lines of the Peking-Hankow railway; there are 4 workable coal seams, the thickest is about 40 ft. and the thin seams are 3-4 ft. thick; the coal is anthracite, the analyses are given in the following table:

Seams	Moisture	Volatile matter	Carbon	Ash	Colour of ash	Sulphur	Nature of coal	Caloric power
1st seam of Yang-chia-t'un	1.40	3.98	72.31	22.31		0.19	non-coking	
coal of Wang-P'ing-t'sun	0.93	6.88	66.6	25.6	yellow-dark	0.28	,,	6220

The total coal reserve in the 6 coal fields is estimated at 178 million tons; both native pits and coal mines work there, the total annual output is more than 100,000 tons, the coal is transported to Peking.

Ching Hsing Coal field: It occupies the regions belonging to Ching Hsing district, the Chêngting-T'aiyüan railway passes through the southern part of the field; there are 5 workable coal seams varying from 2 ft. to more than 20 ft. in thickness; the coal is bituminous and coking; the coal reserve in this field is estimated at about 170 million tons; the Ching Hsing coal mine and other mines work there, the total daily output is about 1600 tons, the coal is transported via Shih Chia Chuang by the Peking-Hankow railway.

Ching Shan Wa Coal field: It is situated in the eastern part of Ch'ang Lo district, Shantung, and about 6 Km. distant from the Fang Tzŭ station of the Tsinan-Tsingtao railway; the workable seam is about 20 ft. thick; the coal is bituminous but non-coking; the coal reserve is estimated at about one million tons; in 1919 some small mines worked there with total daily output of about 14 tons.

Wu Ching coal field: It is located in the middle part of Lin Ch'ü district, Shantung; the area is small, there are no active pits.

Ts'ao Pu coal field: It is situated in the northern part of Mêng Yin district, Shantung; there are 5 coal seams, the thickest one amounts to about 10 ft.; the coal is mostly bituminous.

Chang Chia Chuang coal field: It occupies the regions near the border between Lai Wu and Mêng Yin districts; the area is small and no native pits work there.

Huang Chia Chuang coal field: It is situated in southern part of Po Shan district; there are 3 coal seams, the thickest one is 3 ft.; the coal is bituminous; in 1918-1919 several small mines worked there, the daily output of the biggest one was not more than 30 tons.

MESOZOIC COAL

Hsi Shan coal fields: There are 5 groups of the Mesozoic coal fields viz., Men T'ou Kou field, Ch'ang Kou Yü and An Tzŭ field, Chai T'ang field, Ch'ing Shui Chien and Mei Wo field and Mo Shih K'ou, T'an Yü and Hsiang Yü fields most of them are not far from the branch lines of the Peking-Hankow railway, the coal of An-tzŭ field is transported by a rope way from T'o Li to An Tzŭ. The coal seams are variable in thickness and number in the different coal fields. In the Men T'ou Kou coal field there are 6 workable seams varying from about 1 meter to 3-4 meters in thickness,

in the Ch'ang Kou Yü Coal field 7 workable seams varying from 4 ft. to 10 ft. in thickness, in the Chai T'ang coal field 7 workable seams varying from 2-3 ft. to 10 ft. in thickness, in the Ch'ing Shui Chien and Mei Wo coal field 11 seams varying from .30 meters to 13 meters, and in the Mo Shih Kou, T'an Yü and Hsiang Yü coal fields 1 or 3 workable seams varying from several centimeters to 5 meters. The coal is mostly anthracite and in some places semi-bituminous or bituminous, the analyses of the coal are given in the following table:

Localities	Moisture	Volatile matter	Carbon	Ash	Sulphur	Nature of coal	Heating power
Coal at Tung Hsing coal mine (Men-t'ou-kou)	2.30	9.10	75.20	13.40	0.20	non-coking	13500 B.T.U.
Coal at Kung Shun Yao.	18.50	4.05	76.21	15.89	0.14	non-coking	
Coal at Wang Ch'éng Yü (Chai-t'ang)	1.62	17.86	77.17	3.35	0.49	coking	7250 calories
Coal at Ch'ing Shui Chien	3.21	2.28	72.00	22.51	0.25	non-coking	
Coal at T'ien Hsing coal mine (Mo Shih K'ou)	4.61	3.78	64.90	26.71	0.32	non-coking	

The coal reserve is estimated at about 80 million tons in the Men T'ou Kou coal field; at about 110 million tons in the Ch'ang Kou Yü and An Tzŭ coal field; at about 220 million tons in the Chai T'ang coal field; at about 122 million tons in the Ch'ing Shui Chien and Mei Wo coal field; and at about 15 million tons in the Mo Shih K'ou, T'an Yü and Hsiang Yü coal fields. There are many native pits and several new mines, the total annual output is not less than 500,000 tons, the coal is transported to Peking and partly to Tientsin.

Fang Tzŭ coal field: It is situated in the southern part of Wei Hsien district; the Tsinan-Tsingtao railway passes through the northern part of this field; only one coal seam is workable and the thickness is variable. At the west mine the thickest part of the seam amounts to 20 ft. and the average thickness is 12 ft., at the east mine the seam is more than 30 ft. thick; the coal is bituminous but non-coking, the analyses are given in the following table:

Localities	Moisture	Volatile matter	Carbon	Ash	Sulphur	Nature of coal	Caloric power
Coal at west mine	1.99	22.85	67.10	8.15 blackish	0.59	semi-coking	7040
Coal at east mine	1.56	13.67	76.75	8.02 limonitic brownish	0.50		7040

The coal reserve is estimated at about 7 million tons; in 1919 the daily output of the west mine was from 250 to 300 tons.

Yü Hsien coal field: It covers the regions belonging to Yü Hsien district, Chihli, and Kuang Ling and Yang Yüan districts, Shansi; the workable coal seams are 7 or 5 in number, the thickness is from .30 meters to about 5 meters; the coal is rich in volatile matter but non-coking, the analyses of the coal are given in the following table:

Localities	Moisture	Volatile matter	Carbon	Ash	Colour of coal	Nature of coal	Caloric power
Coal at Tung Kou	10.10	36.72	53.18	3.77	limonitic brown	non-coking with flame	6650
Coal at Nan Kou	11.39	23.66	64.95	9.25	gray	,,	5500
Coal at Hsi Shan Hsiao Pai Kou	11.96	22.40	65.46	5.98	white	,,	6600
Tung Kou T'sŭ T'an (coal)	11.58	31.14	56.88	4.36	white	,,	5010

The total coal reserve in the whole field amounts to about 438 million tons; there are many native pits, in 1914-1915 the annual output is about 100,000 tons.

Ling Ch'iu coal field: It is situated in the southern part of Ling Ch'iu district, Shansi; there is only one workable coal seam and the thickness is 3-4 ft., the coal is anthracite.

Wu T'u and Kao Chên coal fields: The Wu T'u coal field is situated in the eastern part of Ch'ang Lo district, Shantung, and about 6 km. distant from the Tsinan-Tsingtao railway; 3 coal seams are known, the thickness is from .5 ft. to 2.5 ft.; the coal is bituminous but non-coking. The Kao Chên coal field is situated in the southern part of Ch'ang Lo, only one seam is workable and about 5 ft. thick; the coal is bituminous but non-coking.

CENOZOIC COAL

Peat Bogs in San Ho and Chi Hsien: In San Ho and Chi Hsien districts, Chihli, there are 3 regions where peat bogs occur; the 1st. is named Pu Lao Tien, about 4 km. s. from the San Ho city and it extends to a length of about 500 meters. The peat seam is 2.25 meters thick. In 1922 there were 12 pits worked by more than 100 men. The 2nd region is about 12 km. E. from the San Ho city and adjacent to Wu Pai An, the area is smaller, the seam is in some places one in number about .60 meters thick; in some places there are two seams, each being .20 meters thick with .30 meters of ooze between them. In 1922 only 20 men were working. The 3rd is named Mo Chuang Tzŭ and about 24 km. S. W. S. from the Chi Hsien city and about 24 km. E. from the San Ho city, the area is about 1.15 km. × 1.5 km., the seam is from .30 meters to .70 meters thick. In 1922 there were about 100 pits and were worked by 700-800 men. The peat is used as fuel by poorer class in the surrounding regions.

IRON ORE DEPOSITS

Among the iron ore deposits in this area only the Chin Ling Chên iron ore in Shantung has an industrial importance. The Lan Hsien ore is large in quantity and too poor in percentage to be easily workable. Minor deposits are found in the gneiss, Proterozoic quartzite and siliceous limestone, between the Ordovician limestone and the coal series, and in the contact zone between the limestone and grano-dioritic intrusion. The Chin Ling Chên deposit is of the latter orgin.

IRON ORE DEPOSITS IN WUT'AI SYSTEM

Ore deposits in Lan Hsien, Lu Lung and Ch'ien An districts: 1. The Ssŭ Chia Ying deposit is situated in the eastern part of Lan Hsien district, Chihli, about 10 km. S. from the Lan Hsien station of the Peking Mukden railway and about 2.5 km. W. of the river Lan Ho; the ore is contained in the gneiss, about 1100 m. long and about 50 m. thick in average; the ore is composed of hematite and quartz with magnetite; the iron content ranges from 25% to 31%, the average being about 29%; the quantity is

estimated at about 25 million ton. 2 The Chang Chia Chuang deposit is situated in the northern part of Lan Hsien district, about 9 km. N. W. of the Lei Chuang station of the Peking-Mukden railway; the ore deposit is enclosed in the granitic gneiss, about 700 m. long and 40 m. thick; the ore is the same as that of Ssŭ Chia Ying; the iron averages nearly 38%; the reserve is estimated at about 6.5 million tons. 3. The Wu Chia Chuang deposit is situated in the northern part of Lan Hsien and about 7 km. N. W. of the Lei Chuang station; the ore deposit is contained in the granitic gneiss, about 250 m. long and 25 m. thick; the ore is composed of magnetite and hematite; the iron is nearly 30%, and quantity is estimated at about 1,072,000 tons. 4. The Chao Chia Kou deposit is too small to be of any economic importance. 5. The Shih Fo Ssŭ deposit is situated in the southwestern part of Ch'ien An district and about 10 km. W. of the river Lan Ho; ore deposit is contained in the granite and gneiss, about 1200 m. long and about 40 m. thick. 6. The Hsiao Chang Chia Chuang deposit is situated in the southwestern part of Ch'ien An and about 10 km W. of the river Lan Ho; the ore deposit is about 40 m. long and 23 m. thick. 7. The Hsi Ko Ssŭ deposit is situated in the south-western part of Ch'ien An and about 6 km. W. of the river Lan Ho; only blocks were found. 8. The Tung Shan deposit is situated in the western part of Lu Lung district and about 1.5 km. W. of the river Lan Ho; the ore deposit is contained in the gneiss and composed of magnetite and quartz. 9. The Pang Tzŭ Shan deposit is situated in the northwestern part of Lu Lung and about 3 km. E. of the river Lan Ho; the ore deposit occurs in the gneiss. 10. The T'ao Yüan deposit is situated in the south-western part of Lu Lung and near the river Lan Ho; the ore deposit is contained in the gneiss and the ore contains 37.02% of iron.

Chiao Hsien iron ore deposit: It is located at Ch'i Pao Shan in Chiao Hsien, Shantung, and about 18 km. from the port Hung Shih Yai; the ore deposit is contained in the gneiss, about 100 m. long and .5-1.5 m. thick; ore is composed of magnetite with garnet and contains 60.080% of iron, 8.17% of SiO_2, 0.042% of P. and 0.122% of S.; the reserve is estimated at about 40,000 tons.

IRON ORE DEPOSITS IN THE QUARTZITE FORMATION

Ching Hsing iron ore deposits: In western Chihli the quartzite formation often contains iron ores, 7 localities are known in Ching Hsing district; the ore is composed of hematite and contains 20-30% of iron; the ore seam is about 1-2 meters thick; the total reserve is estimated at about 20 million tons.

IRON ORE DEPOSITS IN THE SILICEOUS LIMTSTONE

Yi Hsien iron ore deposit: This deposit is situated on the north of the Yi-Hsien city and forms pockets contained in the siliceous limestone, pebbles derived from these pockets are accumulated in alluvial deposits.

Lan Hsien and Fêng Yün iron ore deposit: At Hsia Shui Lu near the border between Lan Hsien and Fêng Yün, the siliceous limestone contains irregular masses of hematite which have however no economic importance.

IRON ORE DEPOSITS BETWEEN THE ORDOVICIAN LIMESTONE AND THE CARBONIFEROUS COAL SERIES

Iron ore deposit in Kai P'ing coal field: In the northern part of this field occurs ore deposit ranging from 1 m. to 3 m. in thickness, the ore is composed of hematite and limonite forming nodules.

Iron ore deposit in Wan P'ing district: At Wang P'ing Ts'un in Hsi shan the ore is hematite; at Wang P'ing K'ou the ore deposit is from 1 ft. to 10 ft. thick, the ore is limonite, in the vicinity of Chou K'ou Tien also occurs the hematite ore.

Iron ore deposit in Han Tan district; In the western part of Han Tan, above the Ordovician limestone some hematite blocks were found.

Iron ore deposit in Yü Hsien coal field: In the vicinity of Ta Hei Ko Ta the ore deposit exists between the Cambro-Ordovician limestone and the Mesozoic coal series, the ore is hematite and contains 55.56% of iron, 1.66% of SiO_2, 0.26% of S. and 0.131% of P.

CONTACT METAMORPHIC DEPOSITS

Chin Ling Chên iron ore deposits: The deposits are situated between Ch'ang Shan, Huan T'ai and Lin Tzŭ districts, Shantung, and about 4.5 km.

distant from the Tsinan-Tsingtao railway. Between the Chin Ling Chên station and the mine lies a branch line. The principal localities are T'ieh Shan, Ssŭ Pao Shan and Yü Huang Shan. The ore deposits exist within the contact zone between the Ordovician limestone and the diorite; the ore is mainly composed of hematite, and magnetite with minor quantity of limonite and siderite; at T'ieh Shan the average width of the whole deposit is 13.9 m. and the aggregate length is 1730 m.; the surface ore contains 66.51% of iron, 3.14% of SiO_2, but the ore at deeper levels contains 55.27% of iron and 10.46% of SiO_2; the quantity of the ore existing above zero level is estimated at about 3.7 million tons, and if the workable depth of the ore body is 100 m., the total reserve of the T'ieh Shan deposit is estimated at about 13.7 million tons.

Iron ore deposits in Li Chêng and Chang Ch'iu districts: In the eastern part of Li Ch'êng and the western part of Chang Ch'iu the iron ore deposits often occur within the contact zone between the Ordovician limestone and the diorite; the ore is composed of magnetite, at Kao Chuang the biggest ore body is about 10 m. long and not more than 3 m. wide; in the vicinity of Tsinan the maximum length of ore body is about 5 m. and the width about 1 m.

Iron ore deposits in Lai Wu and T'ai An districts: At K'uang Shan about 2 km. N. W. from the Lai Wu city the ore deposit exists within the contact zone between the Ordovician limestone and the diorite and comprises disconnected bodies of magnetite; at Lu Tung Yeh on the border between Lai Wu and T'ai An the deposit also occurs in contact zone and contains blocks of magnetite.

Iron ore deposits in Wu An and An Yang districts: In the western and northern parts of Wu An the localities are Hung Shan, Kung Shan, Hsiao Kung Nao, Shang Ch'üan P'o and Hei Shih P'o; in the western part of An Yang the deposit occurs at Kung K'uang Ts'un; the ore deposits exist within the contact zone between the Ordovician limestone and the diorite; the ore is composed of magnetite and hematite either with or without garnet and epidote; at Hung Shan the resources of high grade ore are estimated at the minimum figure of 740,000 tons.

CENOZOIC MAGNETITE SAND

Depotits of magnetite sand have been reported to occur in Ting Hsing and Yi Hsien between the Peking Paotingfu section and the Kao Pei Tien-Liang Ko Chuang branch line of the Peking Hankow railway. The deposit in Chü Ma Ho extends from about one li S. of Wu Ts'un to Yang Ts'un; the deposit of Yi Shui extends from near Liang T'ai to the vicinity of of the railway bridge. In Pai Chien Ho the magnetite sand is found between Chung Kao and Chung Ying Ho. The thickness of the bed of magnetite sand is said to vary from 2.5 cm. to 0.60 m. with an average of 0.15 m. The magnetite content of the sand is stated to be about 5.5%.

LEAD ORES

In this arsa there are 5 localities. At Tan Shan in the eastern part of An Ch'iu district, Shantung, the lead ore is composed of galena aud pyrite and forms veins contained in the gneiss and marble. At Pai Shih Ling in the southwestern part of An Ch'iu, in gneiss occur many fluorite and baryte veins which contain galena and are 2-3 inches wide. At Ch'i Pao Shan in the southern part of Chiao Hsien, in gneiss are contained many fluorite and quartz veins which contain a small amount of galena. In the neighbourhood of the Hung Shan coal mine in Tzŭ Ch'uan district, lead ore occurs in the Ordovician limestone and is composed of galena and malachite. In vicinity of Ch'ang Ts'ao in Hsi Shan in the Ordovician limestone occur the quartz veins which contain small amount of galena. None of these deposits can have industrial importance.

COPPER ORES

In this area there are 4 known localities: At T'ao K'o in the southern part of Li Ch'eng district in gneiss occur many veins which contain chalcopyrite and pyrite with trace of nickel. At Pi Tzŭ Ling in the southern part of Lai Yüan district, Chihli, the ore deposit occurs within the contact zone between the siliceous limestone and the granite, the ore is malachite and contains 1.17% of copper and 56.37% of iron. At Han Yang P'o in Wan Hsien, Chihli, in limestone occur many calcite and quartz veins which

contain some copper minerals; the ore contains 38.7% of copper, 1.8% of iron and 29.24% of SiO_2. At Chai T'ang in Hsi Shan small malachite veins occur in gabbro and andesite. None of these deposit can be profitably worked.

ASBESTUS

In this area the abestus is known to occur at 4 localities: At Shui Ch'üan Kou in Lai Yüan, Chihli, asbestus exists within the contact zone between the siliceous limestone and the granite; the veins are from less than one half cm. to about 4-5 cm. wide; in 1919 the Yü Yung company had a daily output from 200-600 catties. At Huei Ts'un in the southern part of Chiao Hsien the asbestus is contained in the marble, a member of the Wu T'ai system. At a locality about 8 li N. W. of Hung Mei Ch'ang in Hsi Shan the asbestus occurs near the fault running in the Ordovician limestone and is greenish in colonr. At Chin Chu Ling in the southern part of Huai Lu district asbestus is contained in the marble of the Wu T'ai system.

TALC

At Shih Wo Ts'un in Fang Shan, Chihli, talc is found in the marble, there are 5 seams, the uppermost seam amounts to 1.05 m. in thickness and the lowest seam is 1.4 m. thick. At Huang Ching Erh about 8 li N. E. of Shih Wo Ts'un talc also occurs. At Fên Tzŭ Shan in the western part of Yeh Hsien district, Shantung, talc is contained in the talc schist, a member of the Wu T'ai system and worked out by natives to make talc powder.

LITERATURE

The following other publications already issued by the Geological Survey of China are to be consulted for fuller understanding of the geology and mineral resources of the present sheet:

V. K. Ting & C. T. Chang: The Coal Fields of Yu Hsien, Yang Yuan and Kuang Ling, Chihli (Bulletin No. 1.).

W. H. Wong: Les Provinces métallogéniques de Chine (Bulletin No. 2.).

H. C. T'an: The Coal Fields of Tzu Chuan and Po Shan, Shantung (Bulletin No. 4.).

C. Li: The Geology of Yi, T'ang and Yu districts in north-western Chihli (Bulletin No 4.).

H. C. T'an: New Research on The Mesozoic and Early Tertiary Geology in Shantung (Bulletin No. 5, Pt. 2.).

J. G. Andersson: Geology of the Chang-Chiu Coal Field, Shantung Province (Bulletin No. 6.).

T. O. Chu: Geology of the Ching-Hsing Coal Field, Chihli Province (Bulletin No. 6.).

C. C. Wang, Y. T. Chao & C. C. Tien: Stratigraphy of Lin-Cheng Coa Field, Chihli Province (Bulletin No. 6.).

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J. G. Andersson: Essays on the Cenozoic of North China (Memoirs Series A. No. 3.).

W. H. Wong: The Mineral Resources of China—Metals and non-Metals except coal (Memoirs Series B No. 1.).

V. K. Ting & W. H. Wong: General Statement of the Mining Industry (Special Reports No. 1.).

A. W. Grabau: Stratigraphy of China (Special Publications).

The palæontological studies, which are not given in the list above, are referred to the "Palæontologia Sinica" published by the Geological Survey of China.

EXPLANATION TO THE GEOLOGICAL MAP OF CHINA

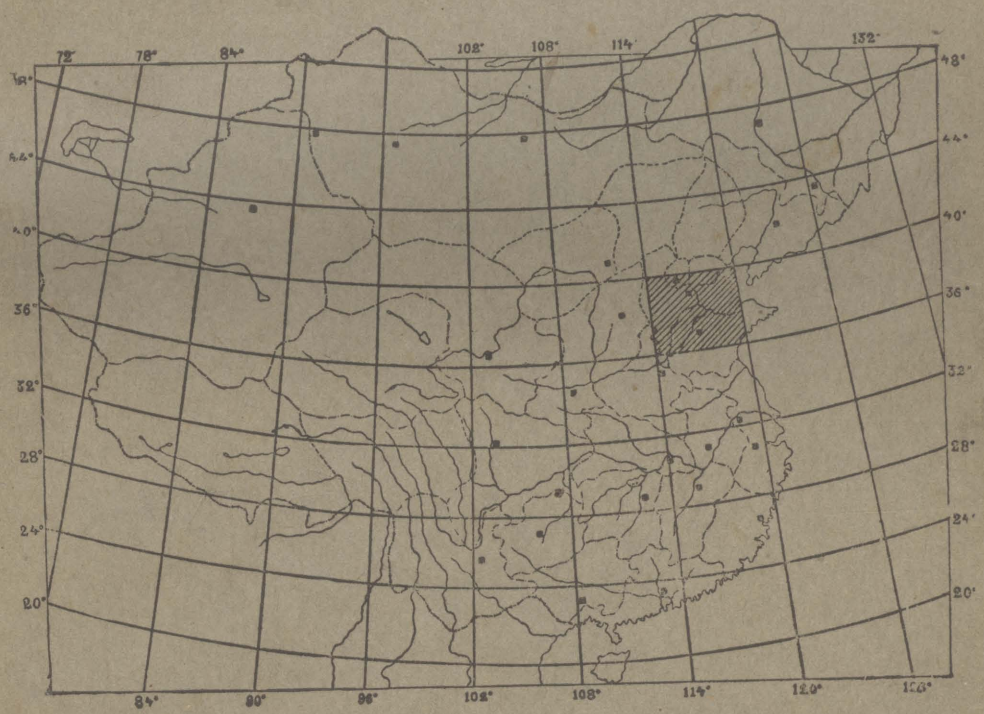
Scale 1 : 1,000,000.

Peking=Tsinan Sheet

BY

H. C. T'AN

GEOLOGIST TO THE GEOLOGICAL SURVEY OF CHINA



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