



弁 言

吾浙初不以產鑛聞於世，至地質之狀況真相尤莫能舉其概。向所號稱東南文物之繁榮，特不過墨守絲茶魚鹽之舊貫而已。於全省自然界天府無量數之寶藏，咸熟視若無所覩悉，未克革厥故而新自謀，自棄大利於地，而轉仰給於人，可慨也。民十七省府當軸秉遺教，闢建設，始組所調查而以余承其乏。縣歷五稔，溥及兩浙，綜計勘獲鑛藏殆不下百餘區，鑛石標本都數千種。賴先後共事諸同志跋涉蒐討之努力，僅迺得此淺淺之微果，差為浙鑛發大凡而明先例，俾異日從事斯業者參證焉。其本所報最之書曩昔類皆分案專具，獨燕技師是編以考察甌江流域并連烏灶煤田，包舉幽遐，範圍較廣，適用彙報。後有查述，亦均將按斯體以輯錄，而即以此為第一號，取便省覽。夫調查測量，化驗鑛探縱至精，稿翔瞻，亦止升人職之初步耳。我曹服勞不為不久，願終猶無以促開採之實現，更奚繇執報告之驗徵。先哲明訓，行易知難，蓋淺嘗輒止，小試罔成，幸前徵未遠，來軫方適，則此篇雖簡，倘亦足為求知之一助云。

民國二十一年五月浙江省鑛產調查所所長蔣尊簋識



~~1618061~~

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浙江省武義宣平麗水雲和青田永嘉 六縣地質鑛產調查報告

燕 春 臺

緒 言

民國二十年春，臺奉命調查武義、宣平、麗水、雲和、青田、永嘉六縣地質鑛產。四月初旬由杭出發，經諸暨、東陽、義烏、金華等縣而至武義。即以該縣為查勘起點。再由此而下楊市，而宣平，而洩嶺脚，而麗水，而青田，而雲和，而達永嘉。七月中旬回杭。途中計費一百又三日，野外工作約九十日。調查所及，殆遍武義、麗水全境，及宣平、雲和、青田、永嘉之大部。所探鑛產達七十八處。所採岩石及鑛石標本計三百餘件。茲將調查所得，編造圖說，綜述於后。

本編鑛石為劉君新所化驗，土壤（附說明）為錢君樹霖所化驗。爰誌於此，以表謝忱。

第一章 地文

第一節 山脈

浙江南部山脈綿亘，約佔全區十份之九以上。均爲浙東仙霞嶺之南支。有二脈。北脈在甌江之北岸，爲甌江與錢塘江及椒江之分水嶺。最著者爲麗水、青田、縉雲、仙居間之括蒼山，及永嘉、樂清間之北雁蕩山。南脈在甌江之南，爲閩浙二省交界之分水嶺。最著者爲平陽縣之南雁蕩山。

在調查範圍之內，所見山嶺，均爲南北二脈之分支。在武義有馬鞍山、燕窩尖、八素山、稽甸山、雲霧山等。在宣平有烏湫山、太阿山、迴龍山、大萊山、大萊鐵礦、在焉、龔坑山、龔坑銀鑛在焉。在麗水爲括蒼山之南支，有小括蒼山、大梁山、古樓山、十八尖等。在青田分南北二條，均括蒼之分支。北條自縉雲入境，有銀坑尖、銀洞窟銀礦在焉，烏牛尖、大草山等。南條自麗水入境，在海口市東有石門山，爲劉基讀書處，在山口村有圖書山等，爲印章石出產最旺區域。境南諸山，皆遙接南雁蕩山脈。在永嘉縣，北接括蒼山脈，東接北雁蕩山脈，有陳山、秦石山、勝美尖、桃嶺、楓樹山、大元山等。境南諸山，均接南雁蕩山脈，有雪尖山、金剛尖、吹台山、哦崗山、石鼓山、橫塘山等。在雲和縣有靈溧山、白鶴山、鹿角尖、葉山、霧溪嶺、大雄峯等。

諸縣之山，類皆重巒疊嶂，峻壁懸崖。最高山峯高出海面一千公尺，高出當地地平約八百公尺。其餘高出海面率在一百公尺至八百公尺之間。從以上諸點推測，諸山之地文時期尙在幼年。

山嶺均爲流紋岩系、凝灰礫岩系及侵入岩所構成。成於流紋岩系者類多峻險、嵯峨。成於侵入岩者率皆鈍圓雄偉。成於凝灰礫岩系者，亦多鈍圓雄偉，惟因組織不勻，經風化後，其較堅部份時成懸岩，較弱部份，常成山洞。

第二節 河流

調查範圍之內，爲甌江及武義江灌注區域。甌江獨流入海，武義江則爲錢塘江之支流。茲分述於后：

(A) 甌江：一一甌江爲浙南巨川分二支，曰大溪，曰小溪。大溪在龍泉縣境，匯秦溪、漿溪、錦川、安仁川諸水，東流入雲和境。在局村併浮雲溪，東北入麗水境。在保定舖，與遂昌大溪合。自此至白前村，又稱郭溪。在白前村，安麗溪自北來會。自此至麗水城，又稱迴溪。在麗水城東，好溪自縉雲來會。東入青田縣境。在船寮市，有腦溪自北來注。在石溪，小溪自景甯來會。

小溪在景甯東南匯北洋澗、南洋溪、英川、豐源水，東北經外卸市蜿蜒入青田縣境而與大溪合。

大溪小溪既合，始稱甌江，東經永嘉縣城，會桐溪之水而入於海。

大溪之水，自青田至麗水一段，水小之時，民船可載二十担（每担一百斤），水大可載五十担。麗水以上，水大二十担可至龍泉縣城，十五担可達龍泉之小梅。水小十五担可至龍泉，十担可達小梅。遂昌大溪終年二十担可達松陽縣城。松陽至遂昌，水大可乘船，水小用竹筏。雲和縣浮雲溪，河身甚淺，惟自雲和至局村，長年可通竹筏，載七八担。局村至碧湖，河面平均寬八十公尺，平均深一公尺，急流（rapids）甚多。碧湖至石溪，急流較少，河面較寬，在麗水城，寬約百公尺。

小溪之內，水大二十担可達景甯城，或該縣之沙灣，水小載重約十担。小溪河面較大溪狹，在青田白巖市一帶，河面平均寬八十公尺，平均深一公尺。兩岸較大溪更爲險峻，急流亦較多。

二溪之水，速度頗大，舟行每鐘約九公里。逆流而上，每鐘僅二公里。水大則逆流不能行。民船載重，亦有上水下水之別，上水載重，僅及下水半數。

甌江正流，水量較大，河面較寬，全部無急流。可分三段。石溪至永嘉之溫溪，無潮水，不通小輪。溫溪至永嘉，有潮水，終年可通小輪。永嘉以下，可通海輪。

石溪至溫溪，水大民船載重八十担，水小載重三十担，速度與大溪小溪相若。自溫溪至永嘉，因有潮水，民船長年可載二百担，無水大水小之分。在溫溪，潮漲之時，河面寬約一百五十公尺，潮落約一百二十公尺。在永嘉縣城，潮漲寬約六百公尺，潮落五百八十公尺。潮面較普通水面約高八公寸。潮水每日二次。上午四鐘到永嘉，十鐘到溫溪(五十公里)。下午六鐘到永嘉，十二鐘到溫溪。每月之內舊歷二十九、三十、初一及十四、十五、十六等日，均發大潮，可達青田之高光(溫溪西六公里)。餘日為小潮，僅達溫溪。

楠溪河身頗寬，在峙口寬約八十公尺(潮落及水量中等時)，無急流，水頗深。潮漲時小輪可達陽岙(峙口北七公里)，大潮時可達沙頭(峙口北十公里)。民船終年可達楓林(峙口北二十公里)及碧蓮(峙口西北二十五公里)。

甌江水系，兩岸相逼，節節皆險。河水澄清，礫多沙少。碧水青山，兩相掩映。是以風光之美，世所著稱。惟水流太急，交通殊多缺憾。然急流既多，如從事工程設施，可產巨量水電。就其急流及河身等狀態觀之，此河在地文史上，實在幼年期中。

甌江自岩門村以東，河身特寬，作漏斗狀。河口以東，海內島嶼星佈。據諸種狀態觀之，是地必曾下降，河谷及低地均被海水淹沒，遂成海峽及漏斗狀之河口。甌江水流湍急，河底斜度峻陡，一部份諒種因於此。在淹沒之時，河口必較現時更寬，河岸必凸凹不齊。嗣經海潮河水之沖積，沿岸始成一片沖積地。河身因此改狹，沿岸亦較完整。惟較之曩日河身，尚更寬闊也。

(B) 武義江：—武義江在武義縣境內，有二源。西南為熟溪，自宣平邊境來會。東南為永康河，自永康來注。

熟溪舊名武陽川，溪有水則歲熟，故改今名。自宣平東北流入武義西南境。河面平均寬十三公尺。水甚淺，秋冬不通竹筏。春夏半時可通，惟性若山溪，天雨則三四日內可通竹筏，過此又不通行。水流頗急，河底多沙礫，隨處沙灘起伏。兩岸多沖積地。

熟溪與永康河在武義城東會合，即稱武義江。河身較寬狹處三公尺，寬

處百公尺,終年通舟楫,叶長埠以南,兩岸有冲積地,爲武義產米之鄉,叶長埠以北,兩岸則峻壁聳立。由以上種種觀之,武義河水系,在地文史上,似在幼年末期。

第二章 地質

第一節 地層

在調查區域之內,侵入岩(intrusive rocks)之上,有流紋岩系(rhyolite series)。其上爲凝灰礫岩系(tuff-conglomerate series)。此外爲沖積層,散見於沿河諸區。流紋岩系面積最廣,約佔全區面積百分之七十五,侵入岩及凝灰礫岩系面積次之,各佔百分之十。沖積層面積最小,約佔百分之五。茲分述於后:

(A) 侵入岩:一本區之內,侵入岩零星出露者有十九處,計花崗岩十八處,閃長岩一處,形狀不一,或爲正圓形,或作橢圓形。面積大小不一,成份亦不一致。其組織或細緻或粗糙,大底中部粗糙,邊部細緻,邊部或竟具玻璃基底,內具細微晶體,甚似普通流紋岩及安山岩(andesite),蓋卽所謂岩基(batholith)及岩株(stock)是也。邊部凝結較速,故晶體不全。中部失熱較緩,故晶結遲慢,而晶體發育完整。岩內有具磁鐵者,亦以中部爲多。其造成原因,與巨晶花崗相同。此岩侵入時期,在流紋岩系及凝灰礫岩系之後。二系爲上白堊紀(見十及十六頁),侵入岩侵入時期,似在上白堊紀之末期,或竟爲第三紀。茲分述於后:

(1) 雲和濃頭花崗岩:一本區中部具磁鐵,產鐵範圍如以濃頭爲基點,則北約三公里半,南約五公里,東約二公里,西約五公里。是以南北長約八公里半,東西寬約七公里,磁鐵晶體微小,僅一公厘。

巨晶花崗之範圍,北約四公里半,南約六公里,東約三公里,西約六公里。是以南北長約十公里半,東西寬約九公里。岩石組織粗糙,全晶質。鑛物爲長石,石英,黑雲母,角閃石及磁鐵(僅中部具磁鐵),長石色白,大部份透明,晶體巨者爲四公厘(mm.)約佔全體百份之四十。石英或爲淺紫,或爲白色,晶體巨者爲半公分(cm.),約佔全體百份之三十。黑雲母晶體細微,約佔全體百份之

十三。角閃石晶體亦細，僅二公厘，約合全體百份之十。磁鐵晶體甚微，不及半公分，約合全體百份之七（浮土內磁鐵成份據化驗雖為百份之9.7，然長石風化時，鉀鈣多溶解而去，角閃石亦失去一部份。故浮土體量較花崗岩為輕，磁鐵成份亦因之提高）。

花崗岩邊部除東部外，晶體均細，具玻璃基底，似普通流紋岩。是項細晶花崗，北部寬約一公里半，西南二部各一公里。是以花崗岩區域全部面積為南北長十三公里，東西寬十公里。

(2) 雲和雲壇街花崗岩：一本區作狹長形。東起孫村及沈莊，北達雲壇之北二公里，西迄雲和之東三公里。南部止於何處，未及調查。自東徂西，狹處三公里，寬處五公里。西北部晶體微細，似普通流紋岩，其餘均為巨晶，具長石，石英，及角閃石，無磁鐵。長石合百份之六十，石英合百份之三十，角閃石合百份之十，晶體均巨，長石及石英更巨，大者半公分 (cm.)。

(3) 雲和緊水灘花崗岩：一本區花崗岩東起石富村西三百公尺，及北溪坑西四公里，北達泉溪西南一公里半，南迄河坑村西北四公里。西部未及查。內具長石，石英，及黑雲母，無磁鐵。長石合百份之五十，石英百份之四十，黑雲母百份之十，全部晶體均巨，無邊部中部之分，晶體巨者約四公厘。

(4) 麗水西坑花崗岩：一本區範圍如以西坑為基點，北約一公里，南約三公里，東西各約一公里，是以南北長約四公里，東西寬約二公里。邊部晶體微細，具玻璃基底，似普通流紋岩，中部晶體較巨，大者三公厘，為長石，石英，角閃石及黑雲母，無磁鐵。長石約合全體百份之五十，石英百份之四十，角閃石及黑雲母百份之十。巨晶花崗之範圍頗小，如以西坑為基點，東西北三部均約百公尺，南部則達二公里。

(5) 麗水滴水岩閃長岩：一岩內角閃石色暗綠，作塊狀，約合百份之五十五。長石色白，半透明，似為斜長石，約合百份之三十三。磁鐵礦約合百份之十。黃鐵礦約合百份之二。岩石晶體以滴水岩之東一公里發育最為完全，尤以角閃石為最大者約半公分。磁鐵亦以此地為最多。自此向南北西三方面

遞進(東部未及查)晶體漸小,磁鐵亦漸少。至一公里半之處,磁鐵即絕跡,閃長岩晶體亦愈微,即成安山岩。更進半公里,緊接流紋岩。

(6) 麗水却金觀花崗岩:一却金觀之西一公里,有稱銀山者,具花崗岩。範圍甚小,直徑約一公里。岩石具長石,石英,角閃石及黃鐵礦,長石色肉紅,半透明,合百份之七十。石英色灰白,半透明,合百分之二十五。角閃石合百份之三。黃鐵合百份之二。晶體以長石發育最爲完整,巨者達半公分。

(7) 宣平大萊村花崗岩:一本區爲正圓形,以大萊村爲中心,直徑約六公里。中部晶體發育完整,具長石,石英,角閃石及黃鐵磁鐵等,長石色白,合百份之二十。石英色肉紅,合百份之六十。角閃石合百份之十。黃鐵合百份之二。磁鐵合百份之八。磁鐵晶體在六縣之中,最爲巨大,有達一公分者。本區邊部半公里,晶體甚小,惟晶體完整,無基底。

(8) 宣平大橋頭西之花崗岩:一大橋頭西二公里有花崗岩,範圍頗小,直徑約半公里,具長石,石英,及角閃石,無磁鐵,長石發育不完整,作塊狀,色肉紅,半透明,約合百份之八十。石英及角閃石,晶體完全,各合百份之十。晶體巨者約四公厘。

(9) 武義麻田花崗岩:一麻田北一公里有花崗岩,範圍頗小,直徑約一公里,具長石,石英及角閃石,無磁鐵,晶體發育均甚完整,直徑約二公厘,長石色肉紅,不透明,合百份之四十五。石英亦合百份之四十五,有二種,其一灰色,不透明,其一灰白色,半透明。角閃石合百份之十。

(10) 青田舒橋花崗岩:一本區範圍北起池嶺之南一公里,南達西園,東迄舒橋之西三公里,西抵銀坑尖,略作橢圓形,東西長約十公里,南北寬約八公里。僅西部晶體微細,其面積寬約一公里半,餘均爲巨品,晶體爲長石,石英,黑雲母及磁鐵。長石色肉紅,半透明,合百份之四十。石英有深白及灰白二種,深白不透明,灰白半透明,合百份之三十七。黑雲母合百份之十三。磁鐵合百份之十。晶體巨者約六公分(石英),間有作斑岩狀者(舒橋附近),斑晶約一公分(石英),磁鐵亦以是地爲最多。銀坑尖附近之凝灰岩緊接花崗岩者,

業已變態及摺曲，作片岩狀。此均為花崗岩侵入作用所致。

(11) 青田縣城附近花崗岩：—此區範圍頗大。南至外旦之南半公里，西達北岸西三百公尺，東至魁虎市附近，東西長約七公里。北部因匪氛太熾，未及調查。岩石具長石，石英，黑雲母及角閃石，無磁鐵。長石色肉紅，不透明，晶體大者三公厘，約合全體百份之六十。石英合百份之三十。角閃石及黑雲母合百份之十。

(12) 青田嶼前花崗岩：—此區北起嶼前之北一公里，西迄吳岸之南半公里，東部至上莊西七百公尺，南部未及查。東西長約十四公里。此岩具長石，石英，黑雲母及磁鐵（磁鐵在本區西南部）。長石合百份之四十，石英百份之四十五，黑雲母百份之十，磁鐵百份之五。此區北部，在嶼前晶體頗大。嶼前南二公里山頂上，晶體甚小，具玻璃基底。更南晶體又巨。西部晶體細微。（中央地質研究所葉君左之據鏡下研究，鑑定此岩為石英二長岩，見該所叢刊第一號。）

(13) 青田下隴村龍舟崗花崗岩：—此區在青田西北十一公里，石溪南三公里，下隴村東一公里。範圍甚小，橫直不及半公里。具基底，似為侵入時冷結太速所致。長石合百分之三十，石英百份之二十，角閃石百份之十，基底百份之四十。此岩為下隴殿後鉛鋅銅接觸鑛床之母岩。

(14) 青田小嶺附近花崗岩：—此區在青田西南二十公里，居小嶺之西。範圍甚小。

(15) 青田坑口附近花崗岩：—此區在青田西南二十八公里，居坑口之西南。此岩夾於流紋岩之間，範圍甚小，長約百公尺，厚十餘公尺。岩石作斑狀，具氣孔。

(16) 青田吳岸附近花崗岩：—此區在青田西南十六公里，吳岸西北四公里。範圍極小，僅見露頭一小塊。（以上四區因範圍太小，圖內未載。）

(17) 永嘉山前村花崗岩：—此區範圍頗小，作圓形，直徑約三公里。邊部晶體小，似普通流紋岩。中部晶體大，約二公厘。具長石，石英及角閃石，無磁

鐵。長石色肉紅，半透明，合全體百份之四十。石英合百份五十。角閃石合百份之十。

(18) 永嘉樓橋附近之花崗岩：—此區西起樓橋之東二公里，北達新橋之南一公里半（上岙），東迄白象街之西七公里。南部未及調查。東西狹處三公里，寬處五公里。具長石，石英及角閃石，無磁鐵。晶體發育均不完整，中部較佳，以長石為最，約一公厘半，色肉紅，不透明，合全體百份之七十，石英合百份之二十五，角閃石合百份之五。

(19) 永嘉寺前附近花崗岩：—此區東起寺前街之西二公里，西達黃岙之東二百公尺，北迄寺前至黃岙之南路。南部未及查。東西寬約五公里。岩石具長石，石英及黑雲母，無磁鐵。長石色肉紅，不透明，晶體巨者半公分，約合全體百份之七十。石英合百份之二十五。角閃石合百份之五。

(B) 流紋岩系：—統紋岩系面積甚廣，各處組織不同。有具流紋岩，凝灰岩 (tuff)，凝灰礫岩 (tuff-conglomerate)，紅色頁岩及玄武岩者 (basalt)。有僅具流紋岩及凝灰岩者。全系在各處厚度不一，系中各岩層厚薄不齊，各層或整合或不整合。惟均為火成岩。此系既無化石可考，造成時期，殊難斷定。惟就浙西地質推測之，經多數學者之探求，已定為上白堊紀。

流紋岩為火山或裂縫中之岩液噴流凝結所成，均具少量晶體，多為長石及石英，亦有具黑雲母及角閃石者。晶體大小不一，有不及一公厘者（例如武義西南四公里草馬胡），而在流紋斑岩內，有大至二公分者（例如麗水東北三十二公里傅村）。晶體多少不一，或僅具零星數點（例如武義西北正村南二公里），或大部為晶體（例如武義西北郭頭）。晶體之外為基底 (ground-mass)，或為玻璃質，或為石質。其色或肉紅（例如武義西南三公里新涼亭），或紫紅（例如宣平北十六公里陶村附近），或灰色（例如麗水西二十四公里黃嶺），或淺綠（例如麗水東北三十二公里傅村），作肉紅色者居多數。基底之一部，有時成條紋，色較深，是為流紋，蓋即岩石凝結以前流動時所成之構造也。流紋不常見。見之則或模糊不清（例如麗水西二十四公里黃嶺），或緻密清

晰，有若片理（例如武義東南廿塘西北三公里）。流紋之間，晶體或依次排列；或竟作扁豆狀，與流紋並行之方向較長（例如麗水西二十四公里黃嶺）。凡此現象，均為流動作用所致流紋岩經劇烈之熱力及壓力，有作片岩狀者（例如宣平東大嶺頭），如與中級溫度及富於鋁養之溶液起變化，即成印章石（青田山口一帶）。

凝灰岩為火山灰(volcanic ash)及火山塵(volcanic dust)所組成。有全為火山塵所構成而質地緻密者（例如青田西南三十公里季山一帶）。有大部由火山灰小部由火山塵所構成，其粉基底之中夾有豆狀物體者（例如武義東南麻田北二百公尺）。有粉質基底之中具正長石晶體者（例如永嘉西六公里平水王殿後）。有粉質基底之中具方解石晶體者（例如宣平城北二公里）。有粉質基底之中具雲母晶體者（例如永嘉東北二十八公里沙頭）。其色或為肉紅（例如永嘉東北沙頭）或淺綠（例如武義東南麻田北二百公尺），或淺黃（例如永嘉西平水王殿後），或灰白（例如宣平東南二十六公里龍巖山），或深灰（例如永嘉西十公里岩門村）。此岩質地疎鬆而體輕。惟一經熱力之變質作用，則質地緻密而體重（例如武義東南楊村南一公里）。若與中級溫度及富於鋁養之溶液起變化，即成細膩之印章石（如青田季山一帶）。若經熱力及壓力之變質作用，即作片岩狀（例如武義東南麻田北二公里）。

流紋岩系中之凝灰礫岩組織頗複雜。礫塊大半為流紋岩塊。此外有少量之黑曜岩塊，松脂岩塊，及火山彈(lapilli，如武義東南楊村北一公里)。礫塊或為角形，或稍具圓形，具圓形者居多數。礫塊之大，有僅及小豆者（例如武義東南楊村南半公里），有大至一公尺者（例如武義東南端明村東一公里）。礫塊之量不一，或佔全體之大部，或佔全體之小部。礫塊之外為膠質。膠質為火山塵及火成岩侵蝕之產物所組合而成。多作紫紅色（例如武義東南楊村南半公里），或作肉紅色（例如武義西南仙景村附近），或作綠色（例如宣平城北四公里），或作灰白色（例如武義東南楊村南一公里），或作黃色（例如宣平東南三十二公里丁公附近）。由以上種種觀察，此岩之構成，一部份由火山

噴發物之堆積,大部份由火成岩剝蝕之產物由局部之水堆積沉澱而成。

流紋岩系之內有紅色頁岩(例如武義仙景村附近)。質細緻,成薄層,層理頗清晰。顯然為火成岩剝蝕產物經局部之水冲積所成。

流紋岩系內之玄武岩亦為火山及裂縫噴流之產物。質細緻,成塊狀。其色或暗綠(武義西南大公山),或灰黑(宣平東北大萊村附近)或具微小晶體(武義大公山),或無晶體(宣平大萊村附近)。

流紋岩系在各地,岩層種類各異,層數不同,岩層厚度亦不一致,茲特表列於后:

武義東南麻田至武義西(五公里)五葉塘

地名	岩層	層厚(公尺)
武義附近	流紋岩	200
	凝灰礫岩	20
	流紋岩	100
	凝灰礫岩	10
	凝灰岩	10
	堅結凝灰岩	200
	凝灰礫岩(具火山彈)	20
	片岩狀凝灰岩	30

麻田 花崗岩

宣平大橋頭西經宣平至溪口市北四公里

地名	岩層	層厚(公尺)
溪口市一帶	流紋岩	150
	紅頁岩	3
	凝灰礫岩	10
	紅頁岩	3
	凝灰礫岩	5

	紅頁岩	3
	凝灰礫岩	15
	流紋岩	200
	凝灰礫岩	5
	紅頁岩	3
	凝灰礫岩	5
	紅頁岩	3
	凝灰礫岩	10
	玄武岩	5
	流紋岩	15
	凝灰礫岩	100
	流紋岩	150
大橋頭西	花崗岩	
	自雲和之北溪坑,經泉溪,石橋豆, 麗水之蒼坑,碧湖,而至松坑口。	
地 名	岩 層	層 厚(公尺)
碧湖一帶	流紋岩	50
	凝灰岩	50
	流紋岩	30
	凝灰岩	20
	流紋岩	20
	凝灰礫岩	30
	流紋岩	30
	凝灰岩	30
	流紋岩	20
	凝灰岩	20

流紋岩.....30
 凝灰岩.....30
 流紋岩.....50
 凝灰岩.....30

北溪坑西 花崗岩

自青田之北岸經石溪,仁宮,道坳,石蓋埠,
 芝溪頭,海口至禎埠,

名 地	岩 層	層 厚(公尺)
禎 埠.....	流紋岩.....	20
	凝灰岩.....	10
	流紋岩.....	30
	凝灰岩.....	20
	流紋岩.....	200
	凝灰岩.....	20
	流紋岩.....	200
	凝灰岩.....	50
	流紋岩.....	50
	凝灰岩.....	50
	流紋岩.....	30
	凝灰岩.....	30
	流紋岩.....	20
	凝灰岩.....	20
	流紋岩.....	30
	凝灰岩.....	20
	流紋岩.....	150
	凝灰岩.....	10

	流紋岩	30
	凝灰岩	50
	流紋岩	20
	凝灰岩	10
	紅頁岩	1
	流紋岩	100
	凝灰巖	100
北 岸	花崗岩	
	永嘉下溪村經橋下街梅香村, 岩門村,至永嘉縣城	
地 名	岩 層	層 厚(公尺)
永嘉縣城	凝灰岩	200
	流紋岩	30
	白凝灰岩	100
	玄武岩	10
	流紋岩	100
	堅結凝灰岩	100
	玄武岩	10
下 溪	花崗岩	
	自青田魁虎市經峙香,澤雅,源口,饅頭駐, 岩門村至永嘉城	
地 名	岩 層	層 厚(公尺)
永嘉縣城	凝灰岩	200
	凝灰礫岩	10
	凝灰岩	10
	流紋岩	400

魁虎市……………花崗岩

(C) 凝灰礫岩系：——在調查範圍之內，凝灰礫岩系有四區。為武義杏渠區，宣平赤岩山區（在洩嶺腳東北），麗水界牌村區及麗水縣城區。所具岩層有凝灰礫岩，凝灰岩，紅頁岩，紅砂岩，白砂岩等。各區岩層種類各異，層數不同，厚薄亦不一。大概以凝灰礫岩為最普通，且岩層亦最厚，凝灰岩次之。本系在浙西壽昌曾見魚類化石，惟在本區未曾發見，就該項化石攷之，本系之構成當在上白堊紀。此系與流紋岩不同之點有二，(1)其中凝灰礫岩較厚，(2)無流紋岩及玄武岩，即有之亦甚薄（如浙東沿海）。

系內凝灰礫岩組織複雜，或礫塊甚少，不及百份之一（例如麗水南大坑口附近）。或礫塊甚多，佔百份之四十（例如宣平東南赤岩山）。或礫塊甚小，不及一公分（例如武義西北十二公里青龍頭慶大山）。或礫塊甚大，在半公尺以上（例如宣平東南赤岩山）。岩塊形狀不一，或作圓形，或作橢圓形，或作稜角形，前二者居多數。岩塊多為流紋岩，此外有少量之黑曜岩，松脂岩，間或具燧石，花崗岩，及凝灰岩。膠質為火山塵及火成岩侵蝕產物所組成。多為紫紅色（例如武義西北十五公里岩山），或作紫綠色（例如武義西北青龍頭慶大山），或作黃色（例如麗水西南十七公里沙溪）。或組織緻密（例如武義西三角店），或組織粗糙（例如武義西北岩山）。岩質大致疎鬆，然亦有堅結者（例如麗水西二公里），岩內有具層面者（bedding plane），層面風化較甚，往往成深槽（麗水西六公里）。此岩之構成，與流紋岩系凝灰礫岩之成因相同。

此系之凝灰岩不及流紋岩系內凝灰岩重要。武義杏渠區西部僅有凝灰岩一薄層，厚一公尺，色淺綠。杏渠區中部無凝灰岩。宣平赤岩山區在丁公見凝灰岩一層，厚三十公尺，色綠。麗水界牌村區在巨弄西見凝灰岩一薄層，厚十公尺，色淺綠。麗水縣城區亦僅凝灰岩一層，頗厚，達一百公尺，自松坑口至大梁山一帶，面積展佈甚廣，其色分紫，肉紅，深紅，淺綠數種。

在宣平赤岩山區見紅頁岩一層，厚十公尺。其質及造成原因與流紋岩系紅頁岩同。

除武義赤岩山區外,餘三區均具紅砂岩。質較紅頁岩更為粗糙。層理甚清,顯為水成岩。其構成原因與紅頁岩同。

在武義沓渠區內,西白殿附近及陳崗山,有白砂岩一層,厚五公尺。大部份為石英,外為綠黑物質。全部質粗糙。層理甚清,為水成岩無疑。似為花崗岩剝蝕之遺物由局部之水沖積而成者。

茲將各區凝灰礫岩系岩層表列於后:

武義沓渠區中部(五葉塘至黃金亭)

地 名	岩 層	層 厚(公尺)
黃金亭	凝灰礫岩	80
	紅砂岩	10
	凝灰礫岩	20
	白砂岩	5
五葉塘	凝灰礫岩	10

武義沓渠區西部(俞源北至溪口市北)

地 名	岩 層	層 厚(公尺)
溪口市北	紅砂岩	10
	凝灰礫岩	3
	紅砂岩	7
	堅結凝灰岩	1
	紅砂岩	15
	凝灰礫岩	2
	紅砂岩	3
	凝灰礫岩	5
	紅砂岩	$\frac{1}{2}$
	凝灰礫岩	3
	紅砂岩	3

	凝灰礫岩	1
	紅砂岩	1
	凝灰礫岩	2
	紅砂岩	1
俞源北	凝灰礫岩	150

宣平東南赤岩山區

地名	岩層	層厚(公尺)
三岩寺	凝灰礫岩	200
	紅頁岩	10
丁公	凝灰岩	30

麗水界牌村區

地名	岩層	層厚(公尺)
界牌村	凝灰礫岩	150
	紅砂岩	30
巨弄	凝灰岩	10

麗水縣城區

地名	岩層	層厚(公尺)
麗水城	凝灰礫岩	200
	紅砂岩	20

松坑口及大梁山一帶	凝灰岩	100
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(D) 冲積層:—在調查範圍之內,冲積層計有三區,即武義縣城一帶,麗水碧湖一帶及永嘉縣城一帶是也。武義縣城為永康河,熟溪及武義江之冲積地。碧湖區為大溪之冲積地。永嘉縣城區為甌江及海潮之冲積地。此冲積層構成之時期當為第四紀(quarternary)。茲將三區土壤分析表列后:

成 份	(1) 武義縣城區	(2) 麗水碧湖區	(3) 永嘉縣城區
	重量百份率	重量百份率	重量百份率
水份(百份率乾土)	1.907	0.809	2.058
灼熱時之消失物	5.123	3.244	6.811
腐植質	1.340	0.900	1.780
全氮	0.114	0.126	0.449
鹽酸不溶解物	84.313	91.365	86.069
鹽酸不溶解之鑛物質	82.655	90.116	82.780
溶解於鹽酸之矽酸	0.315	0.238	0.193
溶解於碳酸鈉之矽酸	14.767	8.695	12.721
氯化鋁, Al_2O_3	1.197	1.326	3.675
氯化鐵, Fe_2O_3	7.450	4.440	3.835
氯化錳, Mn_3O_4	0.330	0.212	0.177
氯化鈣, CaO	1.117	0.868	0.990
氯化鎂, MgO	0.366	0.360	0.366
氯化鉀, K_2O	0.583	0.509	0.355
氯化鈉, Na_2O	0.045	0.005	0.108
磷酸, P_2O_5	0.373	0.214	0.299
硫酸, SO_3	0.097	0.090	0.075
氯, Cl	0.031	0.009	0.016

根據上項分析表,因得以下之結論:

- (1) 腐植質含量均不多。
- (2) 氮質均不缺乏,永嘉縣城區尤多。
- (3) 強鹽酸中能溶解之物質均不多。

(4) 氯化鐵尚不缺乏,惟氯化鋁含量均少,因而吸收肥料要素之作用,不免薄弱。

(5) 氯化鈣(石灰)含量均不多,永嘉麗水二區尤少又氯化鎂(苦土)含量均較少於氯化鈣,而其石灰率約在二至三之中,尚屬良好。

(6) 氯化鉀含量均不少。

(7) 磷酸含量均屬適中。

(8) 氮質含量均微,無害於植物之生育。

(9) 三區土壤對於石蕊試紙之反應,永嘉武義二區呈中性,麗水區呈弱酸性。

綜觀以上諸點,對於該土壤施肥上應注意之要點,可列舉梗概如次:

(1) 腐植質含量均缺,宜酌加有機肥料或塘泥以資補救。

(2) 氮磷鉀三要素均不缺乏,施肥時不必用徧質肥料,以三要素配合適宜然後施用為佳,但鉀肥不宜過多。

(3) 永嘉武義兩區土壤均係中性,故所施肥料應用中性者,或酸性肥料及鹼性肥料適宜攙用亦可,麗水區土壤係弱酸性,故肥料以施用中性或稍呈鹼性者為佳。

(4) 比較三區腐植質,氮質,及鹽酸不溶解物之多寡,可知三種土壤,以永嘉區為最肥沃,以麗水區為最差。

第二節 構造

(A) 褶曲:—流紋岩系及凝灰礫岩系褶曲雖多,然斜角均微,普通為五度至十五度,最高者為三十五度,且褶曲頗凌亂,無系統,足徵是地未曾經過劇烈之變動。

(1) 流紋岩系褶曲:—武義西北叶長舖附近,流紋岩系有一向斜層(Syncline),兩翼走向均為東西,北翼傾斜南二十度,南翼傾斜北二十度,該縣西北四公里有一背斜層(anticline),兩翼走向約為北六十度西,北翼傾斜

爲東北五度，南翼傾斜西南十五度。內白鎮東北有一向斜層，北翼走向北六十度東，傾斜東南五度，南翼走向東西，傾斜爲北五度。童盧東北至泉溪西南爲一背斜層，北翼走向約北六十度東，傾斜西北五度。武義西南五公里，有半弧形單斜層(monocline)，北部傾斜東北十五度，南部傾斜東南二十度。破竹園西北有一弧形背斜層，東翼走向南北，傾斜東五度，西翼走向北四十五度西，傾斜西南五度。此翼西南行，在東陽門東北，又向東北傾斜，走向同前，斜角十度，成一向斜層。過東陽門，又向東南傾斜，成一背斜層，斜角五度，走向北六十度西。破竹園至下埕坑，有一向斜層，北翼走向北七十度西，傾斜西南二度，南翼走向北七十度東，傾斜西北五度。

在宣平陶村，流紋岩有一弧形背斜層，北翼走向北四十五度西，傾斜東北五度，南翼走向北四十度東，傾斜東南五度。溪口市至孟章源，有一向斜層。北翼走向東西，傾斜南五度，南翼走向北四十度東，傾斜西北五度。更南又傾斜南五度，走向東西，成背斜層。更南至大橋頭，又傾斜向西北，成向斜層，傾角十度，走向北七十度東。西行過大橋頭，又傾向東南，成向斜層，傾角十度，走向北三十度東。過宣平又傾斜向西北，成背斜層，傾角五度，走向北四十度東。

麗水東北大路邊之北，流紋岩成一向斜層，兩翼走向均爲北七十度東，傾斜均十度。胡陳至太平汎，有一弧形向斜層，北翼走向北三十度東，傾斜東南十度，南翼走向東西，傾斜北五度。本縣西南部，流紋岩及凝灰岩均爲單斜層，傾向東北，斜角自五度至三十度不等。

雲和西北，北溪坑附近，凝灰岩成一背斜層，北翼走向北三十度西，傾斜東北五度，南翼走向北六十度西，傾斜西南五度。河坑村北，流紋岩有一向斜層，東翼走向北二十度東，傾斜西北五度，西翼走向南北，傾斜東十度。雲和附近，凝灰礫岩成一向斜層，北翼走向北七十度西，傾斜西南五度，南翼走向北四十度西，傾斜東北五度。梅灣東北，凝灰岩成一向斜層，東翼傾斜西北二十度，西翼傾斜東南五度，走向均爲北二十度東。

青田西部，流紋岩均爲單斜層，大致傾向西南。在海口東南，流紋岩成一

向斜層，北翼走向北六十度西，傾斜西南五度，南翼走向東西，傾斜北五度。本縣東部，船寮一帶，凝灰岩及流紋岩均為單斜層，大致傾向東北。南部白岩市及莒浦一帶，流紋岩及凝灰岩均為單斜層，大致傾向南。仁村東南，凝灰岩成一背斜層，兩翼走向均為北七十度西，北翼傾斜東北五度，南翼傾斜西南五度。朱坑附近，流紋岩成一向斜層，兩翼走向均為北二十度西，東翼傾斜西南十度，西翼傾斜東北二十度。吳岸西北，流紋岩為單斜層，走向南北，傾斜西五度。山口東南，流紋岩為單斜層，走向北三十度東，傾斜東南十五度。峙岙西南，流紋岩為單斜層，走向北五十度西，傾斜東北十五度。

永嘉西北，下貴附近，流紋岩成一背斜層，北翼走向北五十度西，傾斜東北十度，南翼走向北四十度西，傾斜西南二十五度。饒頭駐附近，凝灰岩成一向斜層，北翼走向東西，傾斜南五度，南翼走向北四十五度西，傾斜東北二十度。此外西部及東北部之流紋岩均成單斜層，西部大致傾向東北，東北部大致傾向西南，成遼闊之向斜層。

(2) 凝灰礫岩系褶曲：——在武義沓渠區，履垣東北及西北，均為單斜層，走向東北，傾斜西北五度至十度。青塘東南，有一向斜層，兩翼走向均為北六十度東，北翼傾向東南，南翼傾向西北，均五度。沓渠東北至東南，有一背斜層，北翼走向北四十五度東，傾斜西北十五度，南翼走向北六十度西，傾斜西南五度。自此以南，為單斜層，一傾向西北，一傾向東南。

在宣平赤岩山區，東北部有一向斜層，北翼走向北六十度西，傾斜西南二十五度，南翼走向東西，傾斜北五度。

麗水界牌村區，僅有單斜層，傾向西南，僅二度。

麗水縣城區，北部有單斜層二，一在西北，傾斜西北十度，一在東北，傾斜東南十度，走向均為北七十度東。吳弄口東西有一向斜層，兩翼走向均為北三十度東，西翼傾斜東南十度，東翼傾斜西北十度。松坑口東北，有一背斜層，西翼走向北四十度東，傾斜西北十度，東翼走向北五十度東，傾斜東南十度。

(B) 斷層：——流紋岩系及凝灰礫岩系層序不及水成岩清晰，而尤以

流紋岩系爲最，故斷層較難發現。全區之內僅發現斷層一處，在宣平東北俞源南三公里涼亭附近。岩層爲凝灰礫岩系。爲正斷層(normal fault)，走向成東北西南之方向。此斷層之構成，似爲大萊村花崗岩侵入所致。

第三章 鑛 產

調查區域之內均爲火成岩,是以其中鑛床均爲火成鑛床。計有弗石,印章石,輝銀,鉛鋅銅,鉛鋅,黃鉄,磁鉄及赤鉄數種。此數種鑛床可類別爲岩液分泌鑛床 (deposits formed by magmatic segregation), 接觸鑛床 (contact-metamorphic deposits), 及脈形鑛床 (fissure deposits)。本區之內,侵入岩分佈甚廣,侵入岩似爲供給脈形鑛床岩漿水 (magmatic water) 之母岩。是岩爲前二類鑛床之母岩,更不待言。侵入岩侵入時期爲上白堊紀末期,故鑛床之構成亦在該紀末期。就圍岩之時代,鑛物之種類及露頭之狀態推測之,是類鑛床實爲初生鑛床(primary deposits),而非次生鑛床(secondary deposits)。就鑛物之種類,鑛床之狀態推測之,脈形鑛床似爲熱液淺造鑛床 (deposits formed at shallow depths by hot solutions)。

此次發現鑛床雖多,然良好鑛床不多觀。在弗石一類中,僅蔣萬洞新屋裏山,仙景村屋基山,及五尾龍三處較爲佳良。其餘或爲中平,或爲下乘。銀鑛中,宣平龔坑範圍頗大,普愛銀質甚豐,均有希望。惜本所試金設備尙未辦齊,鑛樣無法分析,遂致鑛質及儲量均無從得悉,殊爲遺憾。鉛鋅銅鑛以青田之下隴殿後,永嘉之坦頭垵銀坑山,山根寮後山,孫坑前山等處比較上稍有價值。以上僅以鑛床本身而言,交通未曾計及。然上述鑛床亦有交通較便者。其餘則非俟交通便利,不能開採。

所採鑛樣均力求中平。惟在露頭及坑洞中採取鑛樣,雖力求中平,亦不能代表鑛床全體。至於鑛床大小,亦多藉估計。是以此篇所載鑛質及儲量,不能視爲精確數目。俟本所鑽探機得暇,即擬擇地鑽探。庶幾鑛質及儲量均能得精確之數。

第一節 弗 石

性質:——弗石一名螢石,土人以其多作綠色,故又呼之爲綠石頭。英名

爲 fluorite 或 fluorspar。化學名稱爲弗化鈣或鈣氟₂(Calcium fluoride, CaF₂)。含氟百份之 48.9, 鈣 51.1。硬度爲 4。平均比重爲 3.13。色有白, 黃, 綠, 紫, 四種, 以淺綠者爲最佳, 或透明或半透明, 以透明者爲佳。夜中將弗石在岩石上磨擦之, 或置火內燒之, 即發螢光。螢石之名, 乃由是而起。除鈣氟₂外, 弗石常含雜質。雜質大部份爲矽氟₂(SiO₂)及少量之鐵₂氟₃(Fe₂O₃)與氟₂鋁₃(Al₂O₃)亦有具硫酸鋇(BaSO₄)硫酸鈣(CaSO₄)及氟化鎂者(MgO)。弗石內鈣氟₂成份不一, 普通自百份之五十至九十五以上不等。在百份之九十五以上者爲上選。八十以下者爲下乘。弗石熔點甚低, 普通爐火可以鎔化。矽氟₂太高者則否。

成因:—弗石本爲成鑛劑(mineralizer), 惟本區弗石鑛脈不具金屬鑛物, 僅具少許石英。下掘至三十公尺亦無若何發現。聞常山西鄉七都有一鑛脈, 上部爲弗石, 下部爲方鉛鑛。該地且有“弗石把門”之成語。諒是種鑛床不只一處。惟在著者調查範圍之內, 弗石脈下部未發現任何金屬。有時僅發現巨量石英(例如石龍崗南部)。有時弗石脈完全生於巨大石英脈之中(如四百壩, 金華山等處)。弗石鑛脈之構成, 諒爲具弗石及石英之岩液沿裂縫上昇時, 因壓力減小, 溫度降低, 石英及弗石乃相繼凝結。石英凝點高, 首先凝結, 弗石凝點低, 繼續上昇而後凝結。因成是項鑛床。弗石脈下部有金屬鑛床者, 成因諒與石英相同。弗石脈生於巨大石英脈內者, 似因石英先凝結時集於兩壁, 弗石繼之凝結, 乃集於遺留之縫道中。

用途:—弗石重要用途爲作製鋼及鍊鉄之熔劑(flux)。弗石可以減除鉄內之硫質及磷質, 因此比較用石灰石爲熔劑時, 可多得百份之三至百份之五之鉄, 並可增加鋼鐵之漲力(tensile strength)。此外亦可爲鉛銅銀冶鍊之熔劑。他如鎂鉛之電冶, 鑄鐵(spiegeleisen), 瓏瑯磁釉, 避火物, 儀器內之透鏡(lens), 假寶石, 不透明玻璃, 弗酸, 人造冰晶石(cryolite)之製造, 均利賴之。爲銅鉄熔劑者, 弗化鈣成份最低須達百份之八十。供化學工業之用者, 最低須達百份之九十五。

分佈:—浙省弗石在吾國居重要位置, 約佔百份之 99.6。分佈面積甚廣,

計金華,義烏,武義,臨安,吳興,永康,浦江,常山,江山,龍游,諸暨,新昌,嵊縣,甯波,象山,青田,麗水,遂昌十八縣均有發現。

產量:——浙省弗石,於民國陸年始從事開採。最初每年產五百英噸左右。八九兩年曾一度停頓。民國十年至十四年共產一萬二千英噸。十五年至十九年,每年平均約八千英噸,以十七年為最旺,產一萬二千英噸。

銷路:——浙省弗石什九售之日人,美法德亦購買少許,此外無問津者。據倫敦帝國國產局鑛務統計,美國出產弗石最多,且覺供不應求,每年由英國供給五萬英噸。歐洲各國亦多仰給於英國。英國弗石多為採礦之副產品(即脈石之一種),品質頗差,只可供化冶工業之用。至雕琢業及儀器業所用之弗石,多仰給於貝加爾地方。據此觀察,浙省弗石如能向歐美推廣銷路,不難獲得良好市場也。

售價:——據上海浙江弗石同業公會之報告,民國十年至十九年,弗石平均售價如下:

年 份	每英噸售價(銀元)
十年.....	15.775
十一年.....	15.477
十二年.....	14.635
十三年.....	14.359
十四年.....	14.305
十五年.....	14.857
十六年.....	15.774
十七年.....	16.774
十八年.....	16.885
十九年.....	15.708

去歲以還,凡弗石到申,顧客每提取色淺綠而透明者,另行給價,每英噸自二十元至三十元不等,餘照普通價目收買。凡品體巨大完全透明,而色帶

淺綠，可作儀器內透鏡及製造假寶石之用者，每英噸值百元以上(美金二十五元，係照現在金價計算，如異日金價賤則售價不及此矣。)

弗石售價全由日人操縱，因彼輩有聯絡，而吾國商人無團體故也。民國十七年，全浙產弗石一萬二千英噸，供過於求，價大跌，虧蝕不資。十八年，諸商乃組織同益公會，以維持售價，終以資本不充，不能堅持到底，遂有減價出售者。該會因此無形解散。

據業中人云，全浙弗石產量，每年在八千英噸以內，則價值高。過此則供過於求，價值必跌。

在調查區域之內，僅武義、麗水、青田三縣產弗石。茲分述於后：

(A) 武義縣弗石

武義採取弗石，始於民國十年。民國十七年為極盛時期，產六七千英噸。十八年產五千英噸，十九年產三千英噸。今年景況愈下，僅璋華公司在石龍崗開採，久華公司在陳範山及蝴蝶夾開採，趙子和在金鈞山開採，餘均停頓，產量預計約一千三百英噸。

武義弗石質不佳，色不純，具紫綠白數種。多數在坑內色尚佳，曝於日中即轉淡，雨後又轉濃。

武義弗石均用船筏沿武義江、松溪、梅溪經金華而達蘭谿。再換巨舟運杭。由杭裝火車運滬。自武義(城東南石水牛頭附近)至蘭谿(七十公里，一百二十華里)，去歲因米運暢旺，運費昂貴，每担(一百斤，每斤十八兩，包括途中損失，每英噸亦須以一千六百八十斤計算)須洋二角六分，今年一角二分至一角五分不等。自武義至金華，素來不運，預計每担須洋一角三分(四十六公里，八十華里)。蘭谿至杭州，每担運費，去歲約八分，今年須一角至一角二分。杭州至上海每英噸須洋一元三角二分。出井費每英噸自一元至三元不等。公司開支每英噸約一元。全部至申成本，每英噸約十三元。售價自十二元至十六元不等。略有贏餘。惟出產太多，則售價低，難免虧蝕之患。

現在杭江鐵路業已通行，武義弗石本可在金華裝車運杭。惟火車運費

過高，弗石商人尙無問津者。因金華經蘭溪至杭，水運每英噸只須二元左右。火車最近所訂運費，金華至杭州，六等貨（弗石爲六等貨）運費每公噸（每公噸 = 1.0014 英噸（長噸））合三元一角。比較水運，約超過一元一角。外加杭州過河費，每噸約五角。再加金華上車搬力，每噸估計一角。共計超過一元七角。火車運貨，固然快捷，但運輸弗石，無須迅速，故以照舊水運爲宜。

武義弗石每年只國曆四、五、六、九四個月可以運出。七八兩月雖水大可運，惟米運暢旺，運費太昂，餘時均以水小，運費昂貴，不能運輸。弗石大塊用竹筏裝載，小塊用船裝載，價相若。

武義可供井內支柱之木料，每担值洋五角（對徑二公寸，每根四元）。米每担五元五角。工價自二角五分至四角不等，主人供膳自備伙食，則須四角五分至六角不等。採弗石均用包工制，由工頭承包，每英噸自一元至三元不等，視鑛脈寬狹及鑛量多寡而定。掘脈面浮泥，素用點工制。

(1) 石龍崗及周嶺（周姓）弗鑛

位置：——鑛山在武義東南三公里（五華里），北頭爲石龍崗，南頭爲周嶺（山主周姓），均小邱。與此同爲一鑛脈者，南部有陳範山及周嶺（山主湯姓），北部有指山及金鈞山。周嶺（周姓）南部現正開採，北部未採。石龍崗北部因圍岩倒塌，南部因弗石含石英太多，均未採。

鑛床：——鑛脈走向北四十度東，傾斜東南七十度。脈長三百五十五公尺，已探部份一百九十五公尺。石龍崗脈寬一公尺三寸至二公尺四寸不等。周嶺脈寬一公尺二寸至三公尺不等。石龍崗坑最深處十三公尺，坑底高出山麓三十公尺。周嶺坑最深處二十八公尺，坑底較山麓水田低八公尺。下部寬度未改。惟水量大，現用人挑，秋冬每日二十担，春季四五十担，雨大則挑不乾。圍岩爲流紋岩，頗堅。

鑛質：——鑛石色帶綠白，質中平，化驗結果如下：

$$\text{鈣 氟}_2(\text{CaF}_2) = 82.00 (\text{百份數})$$

$$\text{矽 氟}_2(\text{SiO}_2) = 14.78$$

鐵₂氧₃及鋁₂氧₃(Fe₂O₃, Al₂O₃) = 0.84

燃燒損失 = 0.92

儲量:——本鑛弗石儲量根據長度三百五十五公尺, 平均寬度二公尺, 平均比重3.13, 假定可採深度為四十公尺(弗石脈深度頗淺, 下部多為石英, 故深度不能以他種鑛脈為例), 鑛脈中百分之六十為弗石(餘為石英, 圍岩碎塊及泥土等), 計得53,335公噸(355×40×2×3.13×0.6=53,335)。

運費, 工價及售價:——距最近水口石水牛頭二公里(三華里)每担挑力五分。每英噸出井包工價一元六角。去歲產一千英噸, 在申售價每英噸十六元。

沿革:——民國十三年由物華公司范乃蕃領照開採。一年後, 因虧蝕轉售璋華公司。售價以弗石儲量五千英噸, 每噸值洋八角計算, 合計四千元。璋華已採二年, 亦未獲利。

山主:——石龍崗山主為本縣溪南湯姓, 周嶺山主為武義城周姓。石龍崗每年租金三十元, 周嶺四十元。

(2) 陳範山弗鑛

位置:——鑛山在武義城東南三公里(五華里), 與石龍崗及周嶺同為一脈。北接周姓周嶺, 南接湯姓周嶺。鑛脈南部曾開採, 現因圍岩倒塌, 業已停頓。中部未採。北部現正開採, 與璋華公司周嶺鑛坑為緊鄰, 二坑中間所留石柱不及十公尺。

鑛床:——鑛脈南部走向北六十度東, 傾斜東南六十五度。北部走向北四十度東, 傾斜東南七十度。南部脈寬一公尺五寸, 北部脈寬一公尺五寸至二公尺五寸。鑛脈全長二百〇五公尺, 已採部份長一百十五公尺。北部坑深二十四公尺, 坑底較山麓水田低四公尺, 下部寬度未改, 水頗大, 現用人挑, 水量與周嶺南部相同。南部坑深八公尺, 比山麓水田高三公尺。圍岩流為紋岩, 北部頗堅, 南部甚鬆, 已傾圮。

鑛質:——石色與石龍崗周嶺相若, 質略差, 據化驗結果, 其成份如下:

$$\text{鈣}_{2} = 78.02$$

$$\text{矽}_{2} = 20.04$$

$$\text{燃燒損失} = 0.84$$

儲量：——本鑛儲量根據鑛脈長度二百〇五公尺，平均寬度一公尺七寸，並假定可採深度四十公尺，鑛脈百分之八十為弗石，計得34,906公噸($205 \times 1.7 \times 40 \times 3.13 \times 0.8 = 34,906$)。

工價，運費及售價：——每英噸出井包工價為一元八角。運至水口皇司灘(二公里)，每担挑力六分五厘。在申售價十六元。

沿革：——民國十七年由久華公司樓寶豐領探。十七十八兩年虧蝕。十九年稍有贏餘，年產四百噸。用地已由久華公司收買。

(3) 指山弗鑛

位置：——鑛山在武義東南三里(五華里)，石龍崗北約二百公尺。同為一脈。

鑛床：——鑛脈南部走向北三十度東，傾斜東南八十度。北部走向北二十度東，傾斜同。南部脈寬一公尺，中部一公尺五寸，北部二公尺五寸。鑛脈全長一百四十公尺。北部露頭高出山麓平均十五公尺。中部露頭高出山麓三十公尺。南部坑深十二公尺，坑底高出山麓廿二公尺。圍岩為流紋岩，質頗堅。

鑛質：——弗石色綠白，質中平。化驗結果如下：

$$\text{鈣}_{2} = 79.40$$

$$\text{矽}_{2} = 17.60$$

$$\text{鐵}_{2} \text{及鉛}_{2} = 0.88$$

$$\text{燃燒損失} = 0.92$$

儲量：——本鑛儲量根據鑛脈長度一百四十公尺，平均寬度一公尺六寸，假定可採深度五十公尺，鑛脈百分之八十為弗石，計得28,045公噸($140 \times 50 \times 1.6 \times 3.13 \times 0.8 = 28,045$)。

交通：——水口為石水牛頭，距此半公里強(一華里)，每担挑力三分五。

沿革：——鑛脈南部於民國十四年曾由南華公司開採，一年停工。

山主：——鑛脈南部山主為武義城何姓，每噸租金四角五分。北部中部尚未開採。北部山主為武義城章姓，由璋華公司租用，每英噸租金一元五角。中部山主為武義城趙子和，亦由璋華租用，每英噸一元。

(4) 金鈞山弗鑛

位置：——鑛山在武義東南三公里(五華里)，指山北二百公尺，同為一脈。

鑛床：——鑛脈在小邱之麓，南部走向北三十度東，寬八公尺。北部分二支，西支走向北三十度東，寬一公尺。東支走向北六十度東，寬一公尺八寸。已探長度三十公尺。南部寬度變狹，恐將湮沒。北部寬度未改，但伸入水田之下。坑最深處八公尺，掘六公尺始見弗石。坑底較水田低三公尺，須挑水，每日二三十担。圍岩為流紋岩。

鑛質：——弗石色紫綠，帶鐵銹，質中平。化驗結果如下：

$$\text{鈣}_{2} = 84.80$$

$$\text{矽}_{2} = 7.24$$

$$\text{鐵}_{2}\text{矽}_{3}\text{及鉛}_{2}\text{矽}_{3} = 2.02$$

$$\text{燃燒損失} = 1.88$$

儲量：——本鑛儲量根據平均寬度一公尺一寸，假定可探長度五十公尺，深度三十公尺，鑛脈百分之八十為弗石，計得4,132公噸($50 \times 30 \times 1.1 \times 3.13 \times 0.8 = 4,132$)。

運費及工價：——距水口石水牛頭三百公尺(半華里)，每担挑力一分七。每英噸開採包工價一元七角。每日產量一噸半。現由武義趙子和開採。山已購買。

(5) 周嶺(湯姓)弗鑛

位置：——鑛山在武義東南三公里(五華里)。與陳範山為緊鄰，在其南。同為一脈。

鑛床：——本山為小邱，露頭在邱頂。露頭北部走向為北八十度東，南部

爲北六十七度東。寬一公尺四寸，長一百公尺。露頭之頂高出山麓十五公尺。圍岩爲流紋岩，質不堅。

鑛質：——弗石色綠白，質中平。化驗結果如下：

$$\text{鈣 氟}_2 = 80.7$$

$$\text{矽 氟}_2 = 17.2$$

$$\text{鐵}_2 \text{ 氟}_3 \text{ 及 鋁}_2 \text{ 氟}_3 = 0.85$$

$$\text{燃燒損失} = 0.60$$

儲量：——本鑛儲量根據寬度一公尺四寸，假定可採長度一百二十公尺，深度五十公尺，鑛脈百分之八十爲弗石，計得 21,035 公噸 ($120 \times 50 \times 1.4 \times 3.13 \times 0.8 = 21,034$)。

交通：——鑛山至水口石水牛頭約二公里半（四華里），每担挑力約八分。

山主：——山主爲武義城湯姓。已由璋華公司租定，每英噸四角三分，已給定金一百五十元，尙未開採。

(6) 五尾龍弗鑛

位置：——鑛山在武義東南四公里（六華里），石龍崗東南半里強（一華里）。

礦床：——鑛脈在小邱之上，走向北三十度東，傾斜東南八十度。北端復分一小支，走向爲北六十度東，正脈寬六公尺，露頭長一百四十五公尺，已採部份三十五公尺。支脈寬一公尺五寸，露頭長四公尺，未採坑最深處十公尺。坑底高出山麓十公尺，山頂露頭高出山麓三十五公尺。圍岩爲流紋岩，頗堅。

鑛質：——弗石近露頭處（向下十公尺），表皮帶泥土銹，售價較純石色帶白，化驗結果如下：

$$\text{鈣 氟}_2 = 82.38$$

$$\text{矽 氟}_2 = 10.94$$

$$\text{鐵}_2 \text{ 氟}_3 \text{ 及 鋁}_2 \text{ 氟}_3 = 1.72$$

燃燒損失 = 1.74

鑛量：——本鑛儲量根據正脈寬度六公尺，(支脈露頭太短不必計算)並假定可採長度一百八十公尺，可採深度五十公尺，鑛脈百份之八十為弗石，計得135,216公噸($180 \times 50 \times 6 \times 3.13 \times 0.8 = 135,216$)。

工價及運價：——距水口石水牛頭約一公里強(二華里)，每担挑力三分。開採包工價為一元一二角。

沿革：——由璋華公司何紹韓領採。今年因弗石色差，銷路滯，已停。去歲產一千噸。用地已購買，價值二千元。

(7) 鵝頭頸弗鑛

位置：——鑛山在武義東十一公里(十九華里)，大塘口北一公里。

鑛床：——鑛脈在小邱之頂，走向北四十度東，傾斜東南八十度。已採長度六十五公尺，北端尚未盡，南端將就湮沒。鑛脈寬度一公尺至一公尺五寸。坑最深處十五公尺，坑底高出山麓二十公尺，下部寬度未改。圍岩為流紋岩，色深紫，質極鬆，混水有似泥土，工程進行頗因難，現已傾圮，廢石厚二公尺。

鑛質：——弗石色帶紫綠，質中平。化驗結果如下：

鈣₂ = 82.40

矽₂ = 12.10

鐵₂及鉛₂ = 1.28

燃燒損失 = 1.12

儲量：——根據鑛脈寬度一公尺二寸，假定可採長度一百公尺，深度五十公尺，鑛脈百份之八十為弗石，計得15,024公噸($100 \times 50 \times 1.2 \times 3.13 \times 0.8 = 15,024$)

運費及工價：——距水口大塘口河邊二公里(三華里)，每担挑力四分。出井包工價每噸一元四角。

沿革：——民國十七年由璋華公司開採，十九年九月停工，共採弗石約一千英噸，每年產三百餘噸，山上堆積尚多。

山主：——山主為白溪徐吳二姓，租金每噸一元。

(8) 人形山弗鑛

位置:——鑛山在武義東十二公里(二十一華里),大塘口東北四公里弱(六華里),鵝頭頸東北一公里強(二華里)。

鑛床:——鑛脈在山坡之上,走向北三十度至八十度東,傾斜東南八十度。脈寬一公尺四寸,已採長度三十公尺,西端寬度未改。坑深十公尺,坑底高出山麓四十公尺。圍岩爲流紋岩,質不堅,一部已傾圮。鑛脈西端分三支,均西走。北支經千衣山之頂,而至上四畝下四畝及龜陰山。中支經千衣山麓,長蛇山,曲坑而至龜陰山下。南支至犬形山。

鑛質:——弗石色淺綠,質較長蛇山爲佳。化驗結果如下:

$$\text{鈣}\%_2 = 90.80$$

$$\text{矽}\%_2 = 5.90$$

$$\text{鐵}\%_2\text{及}\text{鋁}\%_2 = 1.64$$

$$\text{燃燒損失} = 1.74$$

儲量:——本鑛儲量根據寬度一公尺四寸,假定可採長度五十公尺,可採深度五十公尺,鑛脈百份之八十爲弗石,計得8,764公噸($50 \times 50 \times 1.4 \times 3.13 \times 8.8 = 8,764$)。

運費及工價:——距大塘口河邊四公里弱(六華里),每担挑力一角出井包工價每英噸一元七角。

沿革:——十九年由璋華公司開採,今停。鑛山用地已購買,價值一百元。

(9) 長蛇山弗鑛

位置:——鑛山在武義東十一公里(二十華里),大塘口北三公里(五華里),人形山西半公里。

鑛床:——鑛脈在山坡之上,走向北五十度東,傾斜東南八十度。脈寬一公尺五寸至二公尺,平均一公尺八寸,已採長度三十公尺,西端變狹,東端未改。坑最深處十公尺,坑底高出山麓三十五公尺,下部寬度未改。圍岩爲流紋岩,頗鬆,惟較鵝頸略堅。

鑛質：——脈內石英頗多，往往成大塊，北壁散佈頗多。弗石多作白色，砂質甚富，質甚差。化驗結果如下：

$$\text{鈣 氮}_2 = 54.19$$

$$\text{矽 氮}_2 = 39.70$$

$$\text{鐵}_2\text{氮}_3\text{及鋁}_2\text{氮}_3 = 2.78$$

$$\text{燃燒損失} = 2.64$$

儲量：一本鑛儲量根據鑛脈寬度一公尺八寸，假定可採長度五十公尺，可採深度三十公尺，鑛脈百份之六十為弗石，計得5,070公噸($50 \times 30 \times 1.8 \times 3.13 \times 0.6 = 5,070$)。

運費及工價：——距大塘口河邊三公里(五華里)，每担挑力九分。出井包工價每英噸一元五角。

沿革：——民國十七年由璋華公司開採，十八年停。曾採二三百英噸。虧五百元。

山主：——山主為丁前村葉姓，每英噸租金九角。

(10) 干衣山弗鑛

鑛山在武義東十三公里，長蛇山東二百公尺。鑛脈在山麓。走向為北五十度東，傾斜東南八十度。脈寬約一公尺，已採長度二十公尺。坑深三公尺。圍岩為流紋岩，質疎鬆。十五年由杭州翁甚開採，一月即停。

弗石色帶綠白，質頗佳。化驗結果如下：

$$\text{鈣 氮}_2 = 90.24$$

$$\text{矽 氮}_2 = 3.14$$

$$\text{鐵}_2\text{氮}_3\text{及鋁}_2\text{氮}_3 = 1.44$$

$$\text{燃燒損失} = 2.02$$

本鑛儲量根據鑛脈寬度一公尺，假定可採長度五十公尺，可採深度五十公尺，鑛脈百份之八十為弗石，計得6,260公噸($50 \times 50 \times 1 \times 3.13 \times 0.8 = 6,260$)。

(11) 曲坑弗鑛

鑛山在長蛇山西約半公里。鑛脈在山坳之內。走向爲北七十度東，寬一公尺，露頭長十五公尺。已由璋華公司收買，價值一百元，尙未開採。圍岩爲流紋岩。本鑛弗石儲量，根據寬度一公尺，假定可採長度五十公尺，可採深度五十公尺，鑛脈百份之八十爲弗石，計得6,260公噸($50 \times 50 \times 1 \times 3.13 \times 0.8 = 6,260$)。

(12) 上四畝，下四畝及龜陰山弗礦

鑛山在曲坑西約半公里。有鑛脈二條。北脈似爲人形山上脈，走向北八十度東。露頭長約一百公尺。東端爲上四畝下四畝，寬約一公尺五寸。已由璋華公司收買，價一百元。西端爲龜陰山，寬約三公尺，已由南華公司收買，價八十元。均未開採。弗石色淺綠，質中平，化驗結果如下：

$$\text{鈣}_{2} \text{ 氟}_{2} = 80.92$$

$$\text{矽}_{2} \text{ 氟}_{2} = 13.50$$

$$\text{鐵}_{2} \text{ 氟}_{3} \text{ 及 鋁}_{2} \text{ 氟}_{3} = 1.12$$

$$\text{燃燒損失} = 0.70$$

北脈儲量根據平均寬度二公尺二寸，假定可採長度五十公尺，可採深度五十公尺，鑛脈百份之八十爲弗石，計得13,772公噸($50 \times 50 \times 2.2 \times 3.13 \times 0.8 = 13,772$)。

南脈距北脈約三十公尺。似爲人形山之中脈。鑛脈走向北六十五度東，寬三公尺，長六十公尺。大部份爲石英，無若何價值。二脈圍岩均爲流紋岩。

(13) 犬形山弗鑛

犬形山爲長蛇山東南小山。鑛脈走向北八十度東。露頭長約三十公尺，寬二公尺。未開採。圍岩爲流紋岩。本鑛儲量根據寬度二公尺，假定可採長度六十公尺，可採深度五十公尺，鑛脈百份之八十爲弗石，計得15,024公噸($60 \times 50 \times 2 \times 3.13 \times 0.8 = 15,024$)。

(14) 伏刀山弗鑛

位置：——鑛山在武義西南十二公里（二十一華里），斗山村（舊名馬昂）西北半公里。

鑛床：——有鑛脈三條，均在小邱之上。南脈走向北八十度西，寬一公尺八寸，露頭長十七公尺。中脈距南脈約十公尺，走向相若，露頭寬二公尺。北脈距中脈約一百公尺，走向北六十度西，寬約一公尺二寸，露頭長十五公尺。北中二脈已為久華公司收買，價四十元，尙未開採。三脈圍岩均為凝灰礫岩系之紅砂岩。

鑛質：——弗石色紫綠，砂質甚多，質不佳。化驗結果如下。

$$\text{鈣} \text{ 氟 }_2 = 56.76$$

$$\text{矽} \text{ 氟 }_2 = 40.08$$

$$\text{鐵}_2 \text{ 氟}_2 \text{ 及 鋁}_2 \text{ 氟}_2 = 0.12$$

$$\text{燃燒損失} = 1.04$$

儲量：——本鑛儲量根據三脈平均寬度一公尺五寸，假定三脈合計可採長度為一百公尺，可採深度四十公尺，鑛脈百份之七十為弗石，計得13,246公噸 ($100 \times 40 \times 1.5 \times 3.13 \times 0.7 = 13,246$)。

交通：——水口為斗山，挑力約三分。自斗山水運至武義城東武義河，每擔運費一角五分。

(15) 剃刀山弗鑛

鑛山在伏刀山之西約三百公尺。有鑛脈一條，為伏刀山之中脈。露頭為浮士所掩，未克詳查。弗石與圍岩均與伏刀山同。此山已為南華公司收買，尙未採開。

(16) 大指山小指山弗鑛

鑛山在伏刀山之西半公里，斗山村西北二公里。為伏刀山之中脈（經剃刀山而來）。露頭寬約二公尺，長約一百公尺，走向北六十度西。本山為小邱，露頭在山頂，高出山麓十公尺。弗石及圍岩均與伏刀山同。已由南華公司收買，價一百二十元，尙未開採。本鑛儲量根據寬度二公尺，假定可採長度一百五十公尺，可採深度四十公尺，鑛脈百份之七十為弗石，計得 26,292 公噸 ($150 \times 40 \times 2 \times 3.13 \times 0.7 = 26,292$)。

(17) 陳崗山弗鑛

位置:——鑛山在武義西南十四公里(二十五華里),斗山村西北二公里強(四華里),任村東約一公里。

鑛床:——鑛脈在山坡之上,逼近山巔,走向為北五十度西,露頭寬約一公尺三寸,長約一百二十公尺,高出山麓三十公尺。圍岩為凝灰礫岩系中之白砂岩。由璋華公司領採,山已購買,價值百餘元,尙未開採。

鑛質:——弗石色淺綠,質中平。化驗結果如下:

$$\text{鈣}\text{氟}_2 = 80.70$$

$$\text{矽}\text{氟}_2 = 14.12$$

$$\text{鐵}_2\text{氟}_3 \text{及} \text{鉛}_2\text{氟}_3 = 0.80$$

$$\text{燃燒損失} = 0.98$$

(18) 余處山弗鑛

鑛山在武義東南四公里,在武義河東岸皇司灘附近,距河一百公尺。鑛脈走向北四十度東,傾斜東南七十度。脈寬一公尺七寸。已採長度四公尺。坑深八公尺,坑底與田平。圍岩為流紋岩。十六年由南華公司開採,得弗石百餘噸,現停。弗石與石英混合,石英塊較多。弗石內石英亦多,化驗結果如下:

$$\text{鈣}\text{氟}_2 = 62.72$$

$$\text{矽}\text{氟}_2 = 33.24$$

$$\text{鐵}_2\text{氟}_3 \text{及} \text{鉛}_2\text{氟}_3 = 0.80$$

$$\text{燃燒損失} = 0.93$$

(19) 蝴蝶夾弗鑛

位置:——鑛山在武義東南六公里(十華里),為八面山之一部。

鑛床:——鑛脈在山坡之上,走向為北五十度東,傾斜東南七十度。鑛脈上部寬度一公尺,中部二公尺五寸,下部八公寸。已採長度十三公尺,全長十七公尺,兩端湮沒。坑最深處十公尺。圍岩為流紋岩。

鑛質:——弗石色綠白,帶泥土鐵銹,質中平。化驗結果如下:

$$\text{鈣}_{2} = 79.42$$

$$\text{矽}_{2} = 15.70$$

$$\text{鐵}_{2}\text{及鋁}_{2} = 0.98$$

$$\text{燃燒損失} = 1.82$$

儲量：——本鑛儲量根據長度十七公尺，下部寬度八公尺，假定可採深度十公尺，鑛脈百份之八十為弗石，計得340公噸($17 \times 10 \times 0.8 \times 3.73 \times 0.8 = 340$)。

沿革：——由久華公司樓寶豐領採。十八年開辦，產四百英噸。十九年停。二十年三月復開，營業虧蝕。

交通：——距水口皇司灘一公里半（二華里半），每担挑力五分。出井包工價每英噸三元。產量每日一噸餘，有工人六人。

(20) 余山頭（又名衣山頭）弗鑛

位置：——鑛山在武義南五公里（八華里），石龍崗南二公里（三華里）。

鑛床：——鑛山為小邱，鑛脈在山頂，鑛脈走向為北四十五度東，傾斜東南八十度。脈寬三公公尺半至十公尺半不等，寬處較多，平均八公尺。露頭長一百二十公尺，已採部份五十公尺。露頭最高處（山頂）高出坑底及山麓八公尺。坑最深處三公公尺。圍岩為流紋岩，脈內雜有流紋岩約百份之二十，分佈甚凌亂，或上部為弗石而下部為流紋岩，或上部為流紋岩而下部為弗石。

鑛質：——弗石帶鐵銹，色暗黃，惟成份頗高。化驗結果如下：

$$\text{鈣}_{2} = 88.74$$

$$\text{矽}_{2} = 3.90$$

$$\text{鐵}_{2}\text{及鋁}_{3} = 3.42$$

$$\text{硫酸鋇}(\text{Baso}_{4}) = 2.12$$

$$\text{燃燒損失} = 0.40$$

儲量：——本鑛儲量根據寬度八公尺，假定可採長度一百五十公尺，可採深度五十公尺，鑛床百份之六十為弗石，計得112,680公噸($150 \times 50 \times 8 \times 3.13 \times 0.6 = 112,680$)。

成本及售價：——距水口端明村（舊名端村）二公里強（四華里），挑力每担七分，出井包工價每英噸一元二角。到申成本十二元（十七年度），在申售價亦十二元，損失者為利息。

沿革：——本山已由趙子和收買，價值五百元。十六年租給南華公司開採，租金每英噸二角，十七年三月停辦，產弗石一千英噸。

(21) 寺山弗鑛

鑛山在武義城東北二公里（四華里），育德村（舊名程處）之北一公里。鑛脈寬二公尺半，在巨大之石英脈中。弗石內又具小石英脈多條，寬僅一公分弱。無經濟價值。

(22) 搬移崑弗鑛

鑛山在寺山之西一百公尺，同為一脈。露頭長約二十五公尺，餘與寺山同。

(23) 飯甌山弗鑛

位置：——鑛山在武義城西北六公里（十華里），三角店東北二公里（三華里）。

鑛床：——鑛脈走向北五十度東。露頭長約三十公尺，寬約一公尺八寸，高出山麓水田八公尺。圍岩為流紋岩。

鑛質：——弗石色淺黃，質頗佳。化驗結果如下：

$$\text{鈣 氟}_2 = 93.49$$

$$\text{矽 氟}_2 = 1.95$$

$$\text{鐵}_2\text{ 氟}_2 \text{ 及 鋁}_2\text{ 氟}_3 = 0.84$$

$$\text{硫酸 鋇} = 0.26$$

$$\text{燃燒 損失} = 2.50$$

儲量：——本鑛儲量根據寬度一公尺八寸，假定可採長度五十公尺，深度五十公尺，鑛脈百份之八十為弗石，計得11,268公噸（ $50 \times 50 \times 1.8 \times 3.13 \times 0.8 = 11,268$ ）。

交通:——水口爲壇頭(履坦北二公里),距此六公里(十華里)。

山主:——山主爲三角店顧姓,尙未出售,亦未開採。

(24) 四百勘弗鑛

位置:——鑛山在武義西北七公里(十二華里),三角店東北二公里(三華里)。

鑛床:——鑛脈走向北三十度西,傾斜西南八十度。南部脈寬八公寸,北部脈寬二公尺。已採長度二十公尺。坑深五公尺,坑底高出山麓水田十公尺。鑛脈在巨大石英脈中,弗石斜切其中。石英脈圍岩爲流紋岩,與寺山及搬移崑同爲一脈。

鑛質:——弗石色尙佳,帶淺綠淺紫,質中平。化驗結果如下:

$$\text{鈣 矽}_2 = 82.58$$

$$\text{矽 矽}_2 = 12.20$$

$$\text{燃燒損失} = 2.00$$

儲量:——本鑛儲量根據寬度一公尺四寸,假定可採長度三十公尺,可採深度三十公尺,鑛脈百份之七十爲弗石,計得2,760公噸($30 \times 30 \times 1.4 \times 3.13 \times 0.7 = 2,760$)。

交通:——水口爲壇頭,距此六公里,挑力每担二角。

沿革:——由久華公司樓寶豐領採,十九年開辦,四月卽停,產弗石六十噸,營業虧蝕。

(25) 郭公橋山弗鑛

位置:——鑛山在武義西北八公里(十五華里),郭頭村西南二公里(三華里)。

鑛床:——鑛脈走向北六十度西。露頭長二十五公尺,寬一公尺五寸,高出山麓八公尺。圍岩爲凝灰礫岩系之紅砂岩及凝灰礫岩。

鑛質:——弗石色淺黃及灰白,質不佳。化驗結果如下:

$$\text{鈣 矽}_2 = 74.25$$

$$\text{矽}\text{氮}_2 = 21.80$$

$$\text{鐵}_2\text{氮}_3 \text{及} \text{鋁}_2\text{氮}_3 = 7.14$$

$$\text{燃燒損失} = 1.05$$

儲量：——本鑛儲量根據寬度一公尺五寸，假定可採長度四十公尺，深度三十公尺，鑛脈百份之七十為弗石，計得3,944公噸 ($40 \times 30 \times 1.5 \times 3.13 \times 0.7 = 3,944$)。

交通：——水口為履坦，距此七公里（十二華里），每担挑力二角餘。

山主：——山主為郭公橋人，尚未出售，亦未開採。

(26) 金華山弗鑛

位置：——鑛山在武義西北九公里（十五華里），郭頭西南一公里強（二華里）。

鑛床：——鑛脈走向北六十度西，露頭長約一百公尺，寬一公尺，高出山麓約二十公尺。鑛脈在石英脈內，石英脈圍岩為凝灰礫岩系之紅砂岩及凝灰礫岩，與四百壩及郭公橋山同為一脈。

鑛質：——弗石色綠白，具石英小片，質中下。化驗結果如下：

$$\text{鈣}\text{氮}_2 = 81.10$$

$$\text{矽}\text{氮}_2 = 14.40$$

$$\text{鐵}_2\text{氮}_3 \text{及} \text{鋁}_2\text{氮}_3 = 1.74$$

$$\text{硫酸鋇} = 0.28$$

$$\text{燃燒損失} = 2.50$$

儲量：——本鑛儲量根據寬度一公尺，假定可採長度一百二十公尺，深度三十公尺，鑛脈百份之七十為弗石，計得7,838公噸 ($120 \times 30 \times 1 \times 3.13 \times 0.7 = 7,838$)。

交通：——水口為履坦，距此七公里（十三華里），每担挑力二角餘。

(27) 和尚山弗鑛

位置：——鑛山在武義西北九公里（十五華里），郭頭西南半公里。

鑛床：——鑛脈走向北四十度東，傾斜東南八十度，寬一公尺，已探長度二十五公尺。坑深二公尺，坑底高出山麓十五公尺。圍岩為凝灰礫岩系之紅砂岩及凝灰礫岩。

鑛質：——弗石色為紫黃及淺綠，質頗佳。化驗結果如下：

$$\text{鈣 氟}_2 = 90.02$$

$$\text{矽 氟}_2 = 7.10$$

$$\text{鐵}_2\text{ 氟}_3 \text{ 及 鋁}_2\text{ 氟}_3 = 0.64$$

$$\text{燃燒損失} = 0.50$$

儲量：——本鑛儲量根據寬度一公尺，假定可探長度為五十公尺，深度四十公尺，鑛脈百份之八十為弗石，計得 5,008 公噸 ($50 \times 40 \times 1 \times 3.13 \times 0.8 = 5,008$)。

交通：——水口為履垣，距此六公里（十華里），每担挑力六分。

沿革：——久華公司於十九年試探，一月即停，產十餘噸。

山主：——山主為郭龍張姓，尚未出售。

(28) 王圓山弗鑛

位置：——鑛山在武義西北八公里（十華里），居郭頭村後（西北）。和尚山在其西，同為一脈。

鑛床：——鑛脈走向北六十度東，露頭長八十公尺，寬一公尺五寸，高出山麓十公尺。圍岩為凝灰礫岩系之紅砂岩。

鑛質：——弗石色為紫黃及淺綠，質頗佳。化驗結果如下：

$$\text{鈣 氟}_2 = 89.40$$

$$\text{矽 氟}_2 = 1.20$$

$$\text{鐵}_2\text{ 氟}_3 \text{ 及 鋁}_2\text{ 氟}_3 = 2.14$$

$$\text{硫酸鋇} = 1.32$$

$$\text{燃燒損失} = 1.50$$

儲量：——本鑛儲量根據寬度一公尺五寸，假定可探長度一百公尺，深

度五十公尺，鑛脈百份之八十爲弗石，計得 18,780 公噸 ($100 \times 50 \times 1.5 \times 3.13 \times 0.8 = 18,780$)。

交通：——水口爲履坦，距此六公里（十華里），每担挑力一角五分。

山主：——此山已由武義城趙子和收買，價八十元，尙未開採。

(29) 徐家山弗鑛

鑛山在和尙山西南約一百公尺，同爲一脈。走向亦同，弗石及圍岩均同。露頭長二十公尺，寬一公尺四寸，已爲璋華公司收買，價四十元，尙未開採。

本鑛儲量根據寬度一公尺四寸，假定可採長度四十公尺，深度四十公尺，鑛脈百份之八十爲弗石，計得 5,609 公噸 ($40 \times 40 \times 1.4 \times 3.13 \times 0.8 = 5,609$)。

(30) 鄭畚寶山弗鑛

位置：——鑛山在武義西北七公里（十華里），郭頭村東二公里強（四華里）。

鑛床：——有鑛脈二條，南脈走向北四十五度東，露頭長十五公尺，寬一公尺。北脈走向北六十度東，露頭長十五公尺，寬一公尺二寸。高出山麓均二十公尺。圍岩爲流紋岩。

鑛質：——弗石色黃白，質甚佳。化驗結果如下：

$$\text{鈣}_{2} = 96.03$$

$$\text{矽}_{2} = 1.20$$

$$\text{鐵}_{2}\text{氟}_{2}\text{及鋁}_{2}\text{氟}_{3} = 0.38$$

$$\text{燃燒損失} = 0.45$$

儲量：——本鑛儲量根據南北二脈平均寬度一公尺一寸，假定可採全體長度爲五十公尺，深度四十公尺，鑛脈百份之八十爲弗石，計得 5,509 公噸 ($50 \times 40 \times 1.1 \times 3.13 \times 0.8 = 5,509$)。

交通：——水口爲履坦，距此五公里（八華里），每担挑力一角五分。

山主：——此鑛已由趙子和收買，價八十元，尙未開採。

(31) 殿後龍弗鑛

位置：——鑛山在鄭畚寶山之南約一百公尺。

鑛床：——與鄭畚寶山同脈，走向及圍岩均同。南脈露頭長三十公尺，寬一公尺五寸。北脈露頭長三十公尺，寬六公寸。均高出山麓二十五公尺。

鑛質：——弗石色綠紫，質頗佳。化驗結果如下：

$$\text{鈣}_{2} = 89.88$$

$$\text{矽}_{2} = 2.20$$

$$\text{鐵}_{2}\text{及}\text{鋁}_{2} = 2.04$$

$$\text{燃燒損失} = 2.04$$

儲量：——本鑛儲量根據南北二脈平均寬度一公尺，假定全體長度一百公尺，深度四十公尺，鑛脈百份之八十為弗石，計得 10,018 公噸 ($100 \times 40 \times 1 \times 3.13 \times 0.8 = 10,018$)。

山主：——山主為寺後林姓，尙未出售，亦未開採。

(32) 外四畝內四畝弗鑛

位置：——本鑛在殿後龍西南一百公尺。

鑛床：——鑛脈為殿後龍南脈，走向及圍岩均同。露頭長二十公尺，寬一公尺五寸，高出山麓二十公尺。

儲量：——本鑛儲量根據寬度一公尺五寸，假定可採長度四十公尺，深度四十公尺，鑛脈百份之八十為弗石，計得 6,010 公噸 ($40 \times 40 \times 1.5 \times 3.13 \times 0.8 = 6,010$)。

山主：——此山已由武義城趙子和收買，價一百元，尙未開採。

(33) 大通寺弗鑛

位置：——鑛山在武義東北九公里弱（十五華里），履坦東北二公里弱（四華里）。

鑛床：——鑛脈在東西小山之上及山間水田之中。西山鑛脈走向北七十度東，傾斜東南八十度。寬一公尺。已採長度四公尺，東西兩頭寬度均未改。坑底一部較水田低一公尺，已浸沒。東山名貓山，在牛山之麓。鑛脈走向北四

十度東，傾斜東南五十度至六十度。寬自一公尺七寸至二公尺。已探長度十五公尺，兩端寬度未改。坑深二公尺五寸，坑底高出山麓二十公尺。兩山露頭全長約一百公尺。圍岩為凝灰礫岩，極疎鬆，見水如泥，傾斜又平，工程甚感困難。

鑛質：—— 弗石色淺綠，透明，質中平。化驗結果如下：

$$\text{鈣 氟}_2 = 82.72$$

$$\text{矽 氟}_2 = 12.08$$

$$\text{鐵}_2\text{ 氟}_3 \text{ 及 } \text{鋁}_2\text{ 氟}_3 = 1.07$$

$$\text{燃燒損失} = 1.04$$

儲量：—— 本鑛儲量根據平均寬度一公尺四寸，假定全體長度一百五十公尺，深度五十公尺，脈內弗石合百份之八十，計得 26,292 公噸 ($150 \times 50 \times 1.4 \times 3.13 \times 0.8 = 26,292$)

交通：—— 水口為吳唐岸，距此一公里強（二華里），每担挑力四分。

沿革：—— 民國十一年由物華公司開採，一年停辦，產弗石二百英噸，營業虧蝕。鑛山係租用，每年租金二十元。

(34) 青龍頭慶大山弗鑛

位置：—— 鑛山在武義東北十二公里（二十華里）。

鑛床：—— 鑛脈在小山之巔，走向北六十度西。露頭長五十公尺，寬一公尺三寸，高出山麓二十五公尺。圍岩為凝灰礫岩，質頗堅。

鑛質：—— 弗石色淺綠，質中平。化驗結果如下：

$$\text{鈣 氟}_2 = 80.74$$

$$\text{矽 氟}_2 = 12.20$$

$$\text{鐵}_2\text{ 氟}_3 \text{ 及 } \text{鋁}_2\text{ 氟}_3 = 1.54$$

$$\text{燃燒損失} = 2.10$$

儲量：—— 本鑛儲量根據寬度一公尺三寸，假定可探長度八十公尺，深度五十公尺，鑛脈百份之八十為弗石，計得 13,021 公噸 ($80 \times 50 \times 1.3 \times 3.13 \times$

0.8=13,021)。

交通：——水口爲吳唐岸，距此八公里（十五華里），交通頗感不便。

沿革：——本鑛已由璋華公司何紹韓領採，山已購買，尙未開採。

(35) 蔣萬洞（又名蔣馬洞）新屋裏山弗鑛

位置：——鑛山在武義東北十七公里（三十華里），蔣萬洞東北一公里半。

鑛床：——鑛脈在山坡之上，走向爲北五十度東。露頭長約三百公尺，寬四公尺，高出山麓四十公尺。圍岩爲流紋岩。

鑛質：——弗石色白，微呈淺綠，不透明，質頗佳。化驗結果如下：

鈣	Ca_2	= 91.84
矽	Si_2	= 2.20
鐵	Fe_2	Fe_3 = 1.30
鋁	Al_2	Al_3 = 2.90
硫酸	鋇	= 0.24
鎂	Mg	Mg = 0.18
燃燒	損失	= 0.60

儲量：——本鑛儲量根據長度三百公尺，寬度四公尺，假定可採深度五十公尺，鑛脈百份之八十爲弗石，計得 150,240 公噸（ $300 \times 50 \times 4 \times 3.13 \times 0.8$ 150,240）。

交通：——最近水口爲武義縣城，每担挑力約一元，交通極不便。鑛床雖佳，非俟交通較便，不然開採。

沿革：——已由璋華公司何紹韓領採，山已購買。

(36) 仙景村（舊名溪里）屋基山弗鑛

位置：——鑛山在武義西南九公里（十五華里），仙景村東北一公里強（二華里）。

鑛床：——鑛脈在小山之頂，走向爲北七十度東，露頭長約五百公尺，

寬十四公尺五寸,高出山麓水田二十公尺。圍岩爲流紋岩。

鑛質:—— 弗石色淺綠,質中平。化驗結果如下:

$$\text{鈣 矽}_2 = 84.73$$

$$\text{矽 矽}_2 = 8.24$$

$$\text{燃燒損失} = 1.74$$

儲量:—— 本鑛儲量根據長度五百公尺,寬度十四公尺五寸,假定可採深度爲五十公尺,鑛脈百份之八十爲弗石,計得 907,700 公噸 ($500 \times 50 \times 14.5 \times 3.13 \times 0.8 = 907,700$)。

交通:—— 水口爲端明村(舊名端村),距此六十公里(十華里)。

(37) 魚鱗角弗鑛

位置:—— 鑛山在武義西南七公里(十三華里),仙景村西南三公里(五華里)。

鑛床:—— 鑛脈走向北六十度東,露頭長約七十公尺,寬一公尺八寸,高出山麓水田二公尺,西部在小邱之上,東部在水田之內。圍岩爲流紋岩系之紅頁岩。

鑛質:—— 弗石微呈綠紫,透明,質頗佳。化驗結果如下:

$$\text{鈣 矽}_2 = 92.53$$

$$\text{矽 矽}_2 = 2.12$$

$$\text{鐵}_2\text{矽}_2\text{及 鉛}_2\text{矽}_3 = 0.64$$

$$\text{燃燒損失} = 1.60$$

儲量:—— 本鑛儲量根據寬度一公尺八寸,假定可採長度一百公尺,深度四十公尺,鑛脈百份之八十爲弗石,計得 18,000 公噸 ($100 \times 40 \times 1.8 \times 3.13 \times 0.8 = 18,000$)。

交通:—— 最近水口爲小溪,距此二公里。

山主:—— 山主爲大公山陳章二姓,未出售,亦未開採。

(38) 壺山(又名壺口山)弗鑛

位置：——鑛山在武義附郭西門外。

鑛床：——鑛脈在山巔，走向為北八十度東，露頭長約二十公尺，寬一公尺三寸，高出山麓七十公尺。圍岩為流紋岩。

鑛質：——弗石色淺綠，質中平，化驗結果如下：

$$\text{鈣}_{2} = 79.24$$

$$\text{矽}_{2} = 17.00$$

$$\text{鐵}_{2}\text{氟}_{2}\text{及鉛}_{2}\text{氟}_{3} = 0.64$$

$$\text{燃燒損失} = 1.14$$

儲量：——本鑛儲量根據寬度一公尺三寸，假定可採長度四十公尺，深度四十公尺，鑛脈百份八十為弗石，計得 5,208 公噸， $(40 \times 40 \times 1.3 \times 3.13 \times 0.8 = 5,208)$ 。

交通：——水口為武義城南河干，距鑛山一公里，每担挑力八分。

沿革：——武義人視此山為武義全縣風水，禁止開採。

(39) 石柱門弗鑛

鑛山在武義西南二十三公里，山里村西南二公里。鑛脈走向北四十度西，露頭寬僅二公寸，下部寬度不知，均為泥土所掩，殊難探查。僅見露頭一處，在山頂，長度未詳。弗石色深綠，頗透明，質尚佳。

(40) 元明寺茶山弗鑛

鑛山在武義西南十九公里，在松樹下之西。有石英脈一條，走向南北，寬七公尺，長三十公尺。內有弗石少許，不及百份之一，毫無價值。弗石有作三角形格子構造者，甚美觀。

(B) 麗水縣弗石

黃泥坑弗鑛

鑛山在麗水城北三公里（五華里）。鑛脈在山坡之上。走向為北六十度東，傾斜東南四十五度。露頭長十九公尺，寬僅二公寸，毫無經濟價值。圍岩為凝灰岩。弗石色淺綠，不透明，質不佳。

(C) 青田縣弗石

十八都塔山灣大窟山弗鑛

位置:——鑛山在青田縣城西北六十九公里(一百二十華里),麗水石帆市東三公里。

床:——鑛脈在小山之腰,走向為北五十度西,傾斜東北七十度。露頭長一百三十公尺,寬六公尺,高出山麓十五公尺。圍岩為凝灰岩。

鑛質:——弗石色淺綠,透明者多,質頗佳。化驗結果如下:

$$\text{鈣 氟}_2 = 93.82$$

$$\text{矽 氟}_2 = 3.50$$

$$\text{鐵}_2 \text{ 氟}_3 \text{ 及 鋁}_2 \text{ 氟}_3 = 0.48$$

$$\text{硫酸 鋇} = 0.74$$

$$\text{燃燒 損失} = 1.30$$

儲量:——本鑛儲量根據長度一百三十公尺,寬度六公尺,假定可採深度四十公尺,鑛脈百分之八十為弗石,計得 7,812 公噸 ($130 \times 40 \times 0.6 \times 3.13 \times 0.80 = 7,812$)。

交通:——距大溪僅半公里,交通頗便。

山主:——山主為塔山灣陳姓。

第二節 印章石

青田(及永嘉沈巒)所產印章石,又名青田石,可刻圖章及陳列品。因組織之粗細,色澤之異同,計分為二種。其一石質如玉,體柔而半透明者,謂之凍石,或僅名凍,價值甚昂。現探掘殆盡,不易見及。凡未探盡者,坑口多為水淹。凍石以燈光石為上品,純潔如玉,照之燦然,價值更昂。曩日有時遇之,今已絕跡。其二為圖書岩(土人稱圖章為圖書),不透明,質細緻,甚膩滑,且脆軟,硬度在一左右,現在所採之印章石均為此類。有紅,黃,白,黑(即暗紫色,土人名曰黑石),灰及具花紋者六種,灰,白,黑三種價值較賤。

印章石產地為流紋岩及凝灰岩展佈區域。印章石即由流紋岩或細緻

凝灰岩變質而成。變質作用之媒介物爲具中級高溫 (Mesothermal) 而富於水份及鉍養之溶液。此液與是項岩石起變化時，岩內鉍養及水份即增加，餘質均減少。重要產物爲筆臘石 (Pyrophyllite, $H_2Al_2Si_4O_{12}$) 綠霞石 (pinite, $H_2KAl_3(SiO_4)_3$)，塊滑石 (Steatite, $H_2Mg_3Si_4O_{12}$)。據葉君左之精確研究 (參觀中央研究院地質研究所叢刊第一號)，青田印章石以筆臘石爲主體，綠霞石於季山區偶遇之，塊滑石未及見。筆臘石以外，印章石尙含他種雜質，故色澤組織不同，價值各異。變化不徹底者，則質粗而硬，不合鑄刻之用。高溫溶液之來源，在嶼前一帶顯然爲花崗岩。其餘諸區，未發現是項岩石，或掩藏於地下，亦未可知。

印章石在岩石內多作薄層狀，普通厚約一公尺。上下爲較硬印章石。同層之內，硬度亦不勻。工人採石，軟者則取之，硬者則棄之。亦有作脈狀者，脈路微細，縱橫極不規則，兩壁爲硬印章石，色與脈石異同不一。

印章石宋時即有採掘者，僅供鑄刻圖章之用。五十年前始運往海外，多爲陳列品，至是營業乃發達。民國十五年開始運赴美國，銷路更廣。邇來青田全縣出產鑄刻品約三千箱，每箱價值平均四十元 (重五六十斤)，共計十二萬元。百份之九十五運往海外，以美國爲最多，合百份之八十，歐洲南洋日本次之。均由華人直接經營。在產地由小販沿戶收買，運至永嘉商店出售，再裝箱經上海香港運往海外。均爲鑄刻品。未刻之鑛石，僅有少量運至青田及永嘉縣城商店鑄刻。

產地以青田東南鄉爲最著。此外爲青田北鄉之下堡及永嘉西鄉之沈巒。以東南鄉山口及嶼前所產爲最佳，產量亦最鉅。在東南鄉諸產地之中，僅山口通水運，水大通船，水小由竹筏載至油竹村裝船 (距山口六公里)。東南鄉產品泰半均由山口出口，是以市廛繁盛，人物富庶。

刻工多本地人，亦有來自外方者。男婦老幼均業此。技術特佳者，每日合三元。均獨立工作，無僱主傭工之別。所須印章石，均直接向挖工購買。挖工爲本地人。數人爲一組，擇地開採。凡開坑洞一個，每年納山租數元。挖工進款，視

石質若何而異。如岩石太硬，不能供鑿刻之用者，則終日無所得。如鑛石豐富，每人每日可採四五百斤。所採石塊，須在二三公寸以上，始可供鑿刻之用。價值視石質而異。山口一帶，每百斤值洋二元。季山一帶，佳者價相若，差者每百斤僅三四角。

(A) 青田縣印章石

(1) 二都山口岩礮（又名堯土山）印章石

鑛山在青田東南十二公里（二十華里），山口東南一公尺。母岩為流紋岩。鑛石有紅，黃，白，黑四種，紅者最多，質均佳。鑛床有脈狀層狀二種。東西綿長四百公尺。有坑洞六個，均平進，在山陰山坡之上，高出山麓約七十公尺。有工人三十名。山主為山口林姓。

(2) 二都山口圖書山印章石

鑛山在青田東南十三公里，山口西南四公里，岩礮西二公里。母岩為流紋岩。鑛石有紅，黃，白，黑四種。白者最多，質較岩礮為佳。產石處高出山麓七十公尺。有坑洞五個，二洞平進，餘斜進。有工人二十餘名。山主為山口林姓。

(3) 二都嶼前（方山區域內）白垺山印章石

鑛山在青田東南十五公里（二十七華里），嶼前西北二公里。母岩為流紋岩。鑛石有紅，黃，白，黑四種，黃者較多，每帶雜色花紋，質均佳。鑛脈為薄層狀，無脈狀者。產石處南北長約二百公尺，高出山麓百公尺。有坑洞四個，均山之東坡。有工人二三十人。山主為嶼前裘姓。

(4) 四都岩頭印章石

在青田西南二十公里，吳岸西四公里。石色白，質嫌太硬，不甚佳。前曾開採，現停。只會採浮面部份，無坑洞。出水在吳岸，僅可用竹筏。

(5) 四內都道居（又名唐古）后山印章石

鑛山在青田西南二十三公里（四十華里），吳岸西北九公里。母岩為流紋岩。鑛石有紅，黃，白三種，黃白二種較多。石質不純，且嫌太硬。鑛床為薄層，綿長四十公尺，高出山澗百公尺。坑洞已倒塌，現僅就浮土中覓取曩日遺棄

者，產量甚微。山主爲道居何姓。出水在吳岸。

(6) 三內都季山季山頭印章石

在青田西南二十九公里（五十華里），季山北一公里半。母岩爲凝灰岩。鑛石有紅、黃二種，黃者質較佳，紅者量較豐。鑛床爲薄層，厚七公寸，綿長十公尺，高出山麓八公尺。現正開始採掘，僅有淺坑一個，工人二三名。每年產量不及五箱。山主爲金竹埭嚴姓。出水在白岩市，距此十八公里。

(7) 三內都季山門前山印章石

在青田西南三十公里（五十華里），地居季山村之東。母岩爲凝灰岩。鑛石有紅色及紅色而具黃色花紋者二種，紅者較多，質均不佳。鑛床爲薄層，厚約七公寸，綿長一百二十公尺，高出山麓十公尺。有淺坑六個，工人四名，每年產量不及五箱。山主爲季山村劉姓。出水在白岩市，距此十八公里。

(8) 三內都周村龍頂尖印章石

鑛山在青田西南三十二公里（五十五華里），周村北一公里，季山村南三公里。母岩爲凝灰岩。鑛石有黃白二種，白者較多，質均佳。曩產凍石頗多，季山一帶，推此地產品爲冠軍。嗣因石質漸差，民元以還，已停止採掘。鑛床多爲小脈，均縱橫不齊，寬狹不一，脈之兩壁與脈石之色不同。大塊凝灰岩內，亦有印章石零星散佈其間。有大坑洞一個，下部已倒閉，高出山麓八十公尺。山主爲周村朱姓。出水在白岩市。

(9) 七都五源夏家地嶺頭寺院址坪印章石

鑛山在青田西南二十九公里（五十華里），嶺頭村南半公里，夏家地西南三公里。母岩爲凝灰岩。鑛石有紅、白、黃、灰四種，質頗佳，紅白二種較多。鑛床爲薄層，厚八公寸，綿長三百公尺，高出山麓二十公尺。有坑洞十餘個，或平進，或直進。有挖工五六人，刻工二三人。山主爲北山村小學校。出水在白岩，距此十四公里。

(10) 十一都下堡飯甌山印章石

鑛山在青田西北二十九公里，下堡西南三公里。母岩爲凝灰岩，鑛石色

灰白,或具紅紋,質甚佳。鑛床爲二薄層,下層厚一公尺,上層厚四公寸,二層相距四公尺。石層走向北六十度西,傾斜西北二十五度。下層高出山麓八十公尺。上下二層各有坑口一個。有工人二名。鑛石售價每百斤約六角。山主爲武溪周姓。出水在船寮市。

(B) 永嘉縣印章石

二十六都沈巖紫洞岩印章石

鑛山在永嘉西北五十一公里(九十華里),溫溪東南二公里,沈巖東南一公里。母岩爲流紋岩。鑛石色豆青,頗美麗。惟嫌太硬,且太脆,殊無經濟價值。鑛床爲薄層,厚一公尺。走向北七十度西,傾斜東北五度。有淺坑一個,現停。鑛山爲沈巖公產。出水在沈巖。

第三節 銀 鑛

(A) 宣平縣銀鑛

(1) 龔坑銀鑛

位置:——在宣平西北十二公里(二十華里),龔鑛村西南一公里。

沿革:——明朝鄉人曾開採,極一時之盛。山上井坑密如蜂巢(據鄉人云,初採不能提鍊。有潘某者來此授以提鍊之法,嗣即不見其人。鄉人以爲神,在山麓立廟祀之云。)嗣因產量不豐,鑛工無以謀生,乃轉而爲匪。當時此處爲麗水縣轄地,距縣城六十九公里(一百二十華里)。朝廷嫌其鞭長莫及,於景泰三年特設宣平縣以鎮之。

產鑛區域:——鑛脈展佈區域爲天井欄,昂良坪,馬山崗,水背,大龍坑,白頭崗,仙清坳,下田灣等處。面積長約一千三百公尺,寬約七百公尺。

鑛床:——爲脈形鑛床。脈石爲石英,色暗灰。圍岩爲流紋岩。鑛脈之數約二十。因在懸岩之上,且荆榛叢生,未及細查。大致走向南北。傾斜或西或東,傾角或急峻,或水平,甚不整齊。平均長度一千公尺,平均寬度七公寸。坑深自一公尺至數十公尺不等,深坑被水淹。坑底高出山麓平均二百公尺。鑛石爲輝

銀鑛 (Argentite), 粒甚細,大半須用放大鏡始能見之。與黃鐵鑛互生。成份似不高 (成份幾何,因本所試金設備尚未辦齊,無法分析。儲量幾何,亦無從計算)。

交通:——鑛山至薯坑村爲崎嶇山路,惟自薯坑至宣平縣城,均爲石板大道。自鑛山至宣平,每担挑力約五角。自宣平出口,不通舟楫,平時均肩挑。至武義縣之武溪,計程三十七公里 (六十五華里),每担挑力約二元。至金華八十六公里 (一百五十華里),每担挑力三元二角。宣平縣政府已建築一公路,由宣平縣城達北鄉之松和。現建設廳擬由松和築一公路經武義縣城而與金永公路幹綫啣接。如此路築成,此鑛當有啓發希望。

山主:——馬山崗,水背,白頭崗,大龍坑,仙清坳等處均薯坑陳詹二姓產業,下田灣爲何鮑二姓產業。

物價及工價:——附近木植不多,惟坑內石堅,須支柱甚少。米每担六元餘。工價約二角,主人供膳,約四角,不供膳。

(2) 普愛大銀坑銀鑛

位置:——在宣平東南三十公里 (五十二華里),普愛村東南一公里強。

沿革:——不悉何朝曾開採,有坑洞數個,深度自十餘公尺至三十公尺不等。

鑛床:——爲脈形鑛床。脈石爲石英,色灰綠。圍岩爲玄武岩。有鑛脈一條,走向北三十度西,傾斜東北三十度。脈寬七公寸,露頭長約二百五十公尺,已探深度平均二十公尺,坑底高出山麓平均四十公尺。鑛石爲輝銀鑛,成份頗高。

交通:——水口爲麗水縣太平汛,距此二十三公里 (四十華里),每担挑力五六角。太平汛至麗水城水大通小舟,水小通竹筏,每担運費一角五分。麗水至永嘉,可通巨舟,每担運費二角三分。

山主:——山主爲普愛村張姓。

物價及工價：——松木每根四角，徑二公寸。米每担六元餘。工價二角，主人供膳，約四角，不供膳。

(B) 麗水縣銀鑛

銀坑銀洞背銀鑛

位置：——在麗水東北十四公里（二十五華里），銀場西南五公里（八華里）。

沿革：——前朝已開採，究在何時，無從查考。舊坑甚淺，開所採鑛石，均運至銀場提鍊。

鑛床：——全山為浮土荆榛所蔽，殊難詳查。計查得鑛脈一條，走向北四十度西，傾斜東北五十五度。脈寬八公寸至一公尺，露頭長約二百公尺。坑底高出山澗五十公尺。脈石為石英，圍岩為凝灰岩。鑛石如何，用放大鏡不能見。

交通：——水口為麗水縣城，距此十四公里，每担挑力四角。

山主：——此山為官山。

工價及物價：——木植甚多，每担約四角。米每担六元餘。工價二角，主人供膳。

(C) 青田縣銀鑛

(1) 十二都芝溪頭后嶺銀鑛

位置：——在青田西北三十一公里（五十五華里），芝溪頭西北一公里半（二華里半）。

沿革：——遜清光緒末年，有人曾向山主租山，聲稱擬來此開採。曾付下定金三十元，並攜帶鑛樣而去。後未復還。

鑛床：——為脈形鑛床。脈石為白石英。圍岩為凝灰岩。鑛石為輝銀鑛。鑛脈走向北四十五度東，寬十五公尺，露頭長約一百五十公尺，頂部高出山麓八十公尺。鑛脈雖大，然大部份不見銀質。僅脈之北端坳馬崑地方，石英脈內含有輝銀鑛少許，粒甚微，用放大鏡始能見之。

交通：——交通甚便，距甌江僅二百公尺。

山主：——山主爲上陸村梅士選。

物價：——米每担七元。工價五角，不供膳。

(2) 十七都銀坑銀洞窟銀鑛

位置：——在青田西北六十九公里（一百二十華里），銀坑村西三百公尺。卽銀坑尖山之一部。

沿革：——宋未曾開採，有橫洞一個，沿鑛脈而進，長約半公里。

鑛床：——爲脈形鑛床。脈石爲石英。圍岩爲凝灰岩，甚堅結。有鑛脈一條，走向北二十五度東，傾斜西北六十度。脈寬九公寸，已採長度半公里，洞口高出山澗十公尺。坑內積水，僅能在洞口察看。脈石內用放大鏡不能見銀質，諒豐富部份業已採取，所留者僅貧乏部份而已。

交通：——水口爲青田之海口市，距此二十三公里（四十華里），每擔挑力七角。由海口至永嘉，通舟楫，每擔運費約四角。

山主：——鑛山爲銀坑村楊姓人產業。

第四節 鉛鋅銅鑛

(A) 永嘉縣鉛鋅銅鑛

(1) 卅都坦頭垵銀坑山鉛鋅銅鑛

位置：——鑛山在永嘉西北三十七公里（六十四華里），韓埠北十四公里（二十四華里），坦頭垵西南二公里。

沿革：——民國初年，鄉人在是地私採。民國八年，由王登墀呈請開採。結果不佳，計損失二千元。嗣由通易公司黃羣承辦，辦理半年，損失六千元，卽行停頓。

鑛床：——爲脈形鑛床。脈石爲灰色石英。圍岩爲花崗岩。有鑛脈三條，茲分述如下：

(1) 第一脈有南北二坑：

(a) 南坑爲橫洞，長約一公尺，橫穿鑛脈。復沿鑛脈南北走，長約七公

尺。鑛脈作均合帶狀 (Symmetrical banding), 中心較鬆, 其中鑛石爲方鉛鑛 (Galena) 及少量之黃銅產 (Chalcopyrite), 閃鋅鑛 (Sphalerite), 黃鐵鑛 (pyrite)。邊部較堅, 含少量方鉛, 黃銅, 黃鐵, 閃鋅等鑛。鑛脈全部寬度平均二公尺五寸。中部寬度不齊, 自六公寸至二公尺不等。鑛脈走向北十五度西, 傾斜西南七十度。坑底高出山澗三公尺。花崗圍岩亦具黃鐵鑛少許。

- (b) 北坑距南坑五十公尺, 高出南坑二十五公尺。鑛坑沿鑛脈北進, 坑高二公尺, 寬二公尺, 長十一公尺。鑛脈寬一公尺。鑛石豐富處偏東, 寬約六公寸。走向北三十度西, 傾斜西南七十度。坑底高出山澗八公尺。花崗圍岩中具黃鐵少許。脈石所具鑛石與南坑同。
- (2) 第二脈在第一脈之東, 相距五十公尺。有橫坑一個, 沿鑛脈而進。坑長三公尺, 高寬各二公尺。脈寬三公尺五寸, 走向北六十五度西, 傾斜西南七十二度。脈之東壁接近圍岩處, 全爲犬齒石英, 晶體頗短, 西壁則無有。鑛石在脈石之內分佈甚均勻, 無帶形構造。鑛石爲方鉛鑛, 閃鋅鑛, 黃銅鑛, 黃鐵鑛。花崗圍岩中不具任何鑛石。
- (3) 第三脈在第二脈之東, 相距約一百公尺。有橫坑一個, 沿鑛脈而進。坑長三公尺, 高寬各二公尺。脈寬九公寸, 鑛石爲方鉛鑛及少量黃銅鑛, 閃鋅鑛, 黃鐵鑛。中心較富, 寬僅一公寸三分, 堅度與邊部相若。花崗圍岩中具黃鐵鑛少許。鑛脈走向北二十五度西, 傾斜西南六十四度。

鑛質:——第一脈鑛石成份, 中部高而邊部低。南北二坑鑛脈中部平均寬一公尺弱。茲假定採鑛時, 內部坑洞寬度爲一公尺, 採取中部全體及邊部之一部份。所採標本亦以此爲標準。據化驗結果, 方鉛鑛成份合百份 8.52, 黃銅鑛百份之 4.10, 閃鋅鑛百份之 4.66。其原質成份如下:

$$\text{鉛 (Pb)} = 7.42$$

$$\text{鐵 (Fe)} = 7.12$$

鋅 (Zn) =	3.14
銅 (Cu) =	1.42
硫 (S) =	3.94
不溶解物 =	64.00

第二脈之內，鑛石散佈均勻。方鉛鑛合百份之2.44，黃銅鑛百份之6.35，閃鋅鑛合百份之4.81。其原質成份如下（是否含銀，因敵所試金設備不全，未克化驗。）：

鉛 =	2.12
鐵 =	1.98
鋅 =	3.24
銅 =	2.20
硫 =	4.12
不溶解物 =	85.20

第三脈之內僅有中心豐富部份標本，邊部標本已於途中損失。中部標本據化驗結果，方鉛鑛合百份之4.87，黃銅鑛合百份之5.54，閃鋅鑛合百份之1.67。其原質成份如下：

鉛 =	4.24
鐵 =	3.84
鋅 =	1.12
銅 =	1.92
硫 =	4.12
不溶解物 =	66.2

鑛量：——在第一脈之內，方鉛鑛成份為8.52，黃銅鑛4.10，閃鋅鑛4.66。方鉛比重為7.5，黃銅4.2，閃鋅4.00。茲假定可採深度為一百公尺，長度為三百尺，坑洞寬度一公尺，計得儲量如下：

$$\text{方鉛鑛} = 300 \times 100 \times 1 \times 7.5 \times 0.0852 = 19.176 \text{公噸}$$

$$\text{黃銅鑛} = 300 \times 100 \times 1 \times 4.2 \times 0.041 = 5,166 \text{公噸}$$

$$\text{閃鋅鑛} = 300 \times 100 \times 1 \times 4.0 \times 0.0466 = 5,592 \text{公噸}$$

在第二脈之內，方鉛鑛成份爲2.44，黃銅鑛6.35，閃鋅鑛4.860。茲假定坑洞寬度一公尺，可採深度一百公尺，長度二百公尺，計得儲量如次：

$$\text{方鉛鑛} = 200 \times 100 \times 1 \times 7.5 \times 0.024 = 3,600 \text{公噸}$$

$$\text{黃銅鑛} = 200 \times 100 \times 1 \times 4.2 \times 0.0535 = 5,334 \text{公噸}$$

$$\text{閃鋅鑛} = 200 \times 100 \times 1 \times 4.0 \times 0.0486 = 3,848 \text{公噸}$$

在第三脈之內，豐富部份方鉛成份爲4.87，黃銅5.54，閃鋅1.67。中心富集部份寬度爲一公寸三分，假定可採長度一百公尺，深五十公尺，計得儲量如次：

$$\text{方鉛鑛} = 100 \times 50 \times 0.13 \times 7.5 \times 0.0487 = 237 \text{公噸}$$

$$\text{黃銅鑛} = 100 \times 50 \times 0.13 \times 4.2 \times 0.0554 = 151 \text{公噸}$$

$$\text{閃鋅鑛} = 100 \times 50 \times 0.13 \times 4.0 \times 0.0167 = 43 \text{公噸}$$

交通：——鑛山距山麓小河一公里強，每担挑力一角。由此改裝竹筏至韓埠，每筏裝七擔，須洋一元，每擔計須運費一角四分。韓埠至永嘉可用小輪拖運，每擔須洋五分。共計每擔二角九分，每公噸四元八角七分。

山主——鑛山爲坦頭埠村公產，已租給王登墀，每年租金二百元。

工價及物價：——工價每日約五角，不供膳。米每擔九元三角。

(2) 三十都山根寮後山鉛鋅銅鑛

位置：——鑛山在永嘉西北二十九公里（五十華里），韓埠北六公里，山根村西一公里弱，坦頭埠南五公里。

沿革：——民國五年曾由鄉人開採。民六由永嘉王登墀領採。聘日本鑛師計劃工程。在山坡圍岩內開橫洞一個，擬橫穿鑛脈。僅及一月，洞深一公尺，未達鑛床，即因資竭停辦。

鑛床：——圍岩爲流紋岩。鑛脈爲角礫鑛脈（Breccia Vein），脈內具多量流紋岩角礫，其角頗尖銳。角礫外之空隙均爲少量之石英填滿。石英內具方

鉛礦及少量黃銅礦，閃鋅礦，黃鐵礦。方鉛有巨晶細晶二種，巨晶較多。流紋角礫之中亦具方鉛，黃銅，黃鐵，閃鋅等礦，惟為量極微，非用放大鏡不能見之。此種角礫即所謂夾石是也 (horses)。

鑛脈走向北三十度西，傾斜東北八十度，長約二十五公尺。中部較寬，兩端甚狹，寬處八公尺，狹處二公尺，平均五公尺。露頭在山坳及山坡之上，山坳最低處高出山麓水田約八十公尺。

脈內具流紋岩角礫甚多，足徵裂縫造成時，流紋圍岩曾受劇烈破碎作用，因成多量角礫。此項角礫與鑛液所載之石英及鑛質混合，遂成今日之鑛床。角礫之內又因浸染作用 (impregnation)，亦具少量鑛石。

此鑛驟視之，似為交換鑛床 (replacement deposit)。惟交換鑛床中之角礫，棱角多純圓。此鑛角礫則棱角尖銳。且流紋岩不易溶解，難成交換鑛床。

鑛質：——脈內鑛石成份高低不一。寬處較高，狹處較低。方鉛鑛與石英及流紋角礫比較，據化驗結果，為百份之 16.39，黃銅百份之 0.98，閃鋅百份之 1.25。其原質成份如下：

鉛 = 14.20

鐵 = 19.40

鋅 = 1.02

銅 = 0.34

硫 = 3.40

不溶解物 = 58.60

儲量：——本鑛儲量根據長度二十五公尺，平均寬度五公尺，方鉛成份 16.39，黃銅 0.98，閃鋅 1.52，假定可採深度一百公尺，計得儲量如次：

方鉛鑛 = $25 \times 100 \times 5 \times 7.5 \times 0.1639 = 15,365$ 公噸

黃銅鑛 = $25 \times 100 \times 5 \times 4.2 \times 0.0098 = 514$ 公噸

閃鋅鑛 = $25 \times 100 \times 5 \times 4.0 \times 0.015 = 750$ 公噸

交通：——自鑛山至山麓小河約一公里，挑力每担約一角。自此乘竹筏

至韓埠,每担約須一角二分。韓埠至永嘉可用小輪拖運,每担約須五分。共計每担二角七分,每公噸四元五角五分。

山主:——山主爲山根村鄒崇池,已出售與王登墀,再轉售通易公司黃羣(現任上海通易銀行行長)。

(3) 二十七都孫坑前山鉛鋅銅鑛

位置:——鑛山在永嘉西北七十一公里(一百二十五華里),溫溪北二十公里(三十五華里),孫坑東北三公里。

沿革:——前清光緒三十年,曾由瑞安孫詔諷組織富強公司開採,因事輟。民三又由其子延釗組織富成公司繼續開採,於民六停工。初在山坡開露天深坑一個,深約六十公尺。繼在坑底掘斜洞一個,隨脈而進,現爲水淹,深度不知。

鑛床:——爲脈形鑛床。圍岩爲流紋岩。脈石爲石英。鑛石爲方鉛鑛及少量黃銅鑛,閃鋅鑛及黃鐵鑛。方鉛鑛有巨晶細晶二種,其餘鑛石則爲游離晶體。鑛石分佈不勻,鑛脈中部較多,邊部較少。中部石英呈綠白二色,邊部爲肉紅色。鑛脈走向北六十度西,傾斜東北五十五度,寬五公尺。中部鑛石豐富處寬六公寸,距東壁一公尺,西壁三公尺。露頭已知長度二十五公尺。已採深度八十公尺。坑底高出山澗約七十公尺。

鑛質:——鑛脈寬度雖達五公尺,採取鑛樣時,僅以坑洞寬度一公尺爲標準,包含中部豐富處及邊部一小部份。據化驗結果,方鉛鑛成份合百份之14.7,黃銅鑛百份之1.29,閃鋅鑛百份3.18。其原質成份如下:

鉛 = 12.79

鐵 = 2.72

鋅 = 2.14

銅 = 0.44

硫 = 3.74

不溶解物 = 76.80

儲量：——根據方鉛成份14.7，黃銅成份1.29，閃鋅成份3.18，坑洞寬度一公尺，假定可採深度百公尺，長度百公尺，計得儲量如次：

方鉛鑛 = $100 \times 100 \times 1 \times 7.5 \times 0.147 = 11,025$ 公噸

黃銅鑛 = $100 \times 100 \times 1 \times 4.2 \times 0.0129 = 541$ 公噸

閃鑛 = $100 \times 100 \times 1 \times 4.0 \times 0.0318 = 1,272$ 公噸

交通：——水口為溫溪，每担挑力三角。溫溪至永嘉可用小輪拖運，每担約須八分。共計每擔三角八分，每公噸六元三角九分。

山主：——鑛山為孫坑村公產

(4) 廿八都黃垣坪大龍山鉛鋅銅鑛

位置：——鑛山在永嘉西北五十一公里（九十華里），溫溪東北十二公里（二十華里），黃垣坪村西南二公里，橋頭西北十一公里（十九華里）。

鑛床：——為脈形鑛床。圍岩為流紋岩。脈石為石英，色淺綠，堅度不及圍岩，故剝蝕較易，沿脈已成山澗一條，澗水隨鑛脈而行。鑛石為黃銅鑛，閃鋅鑛，方鉛鑛及黃鐵鑛。方鉛有巨晶細晶二種，巨晶較多，其他鑛石為遊離晶體。鑛石在脈內分佈頗勻，無中部邊部之分。

鑛脈走向為北十度東，傾斜東南八十五度。露頭已知長度約百公尺，南頭在山腰，北頭盡於山溪之中。南頭寬度平均一公尺四寸，北頭寬二公寸，平均八公寸。南頭高出北頭約四十公尺，故已知深度為四十公尺。

鑛質：——據化驗結果，鑛脈內方鉛鑛成份合百份之2.68，黃銅鑛百份之8.10，閃鋅鑛百份之4.05。其原質成份如下：

鉛 = 2.34

鐵 = 4.12

鋅 = 2.72

銅 = 2.80

硫 = 3.04

不溶解物 = 80.20

儲量：——根據方鉛成份2.68，黃銅8.10，閃鋅4.05，鑛脈寬度八公寸，假定可採深度百公尺，長度一百五十公尺，計得儲量如次：

$$\text{方鉛鑛} = 150 \times 100 \times 0.8 \times 7.5 \times 0.0268 = 2,412 \text{ 公噸}$$

$$\text{黃銅鑛} = 150 \times 100 \times 0.8 \times 4.2 \times 0.081 = 4,082 \text{ 公噸}$$

$$\text{閃鋅鑛} = 150 \times 100 \times 0.8 \times 4.0 \times 0.0405 = 1,944 \text{ 公噸}$$

交通：——水口為甌江上之橋頭，距此十二公里，每擔挑力二角四分。橋頭至永嘉，每擔運費一角。

山主：——山主為黃垣坪村章錫南。

(5) 廿八都鄭山半路坑鉛鋅銅鑛

位置：——鑛山在永嘉西北五十一公里（九十華里），橋頭西北十二公里（廿華里），鄭山西一公里。

鑛床：——鑛床在破裂之流紋岩內。脈石為石英，充塞於小裂縫之內。流紋岩塊甚大，為數甚夥。石英小脈甚少，僅合鑛床全部百份之一。石英及流紋岩塊均具方鉛，黃銅，黃鐵，閃鋅等鑛，石英內鑛石較富。圍岩內亦具黃鐵少許。露頭長約三公尺，寬約一公尺五寸。走向約為南北。是項鑛床，謂之鑛瘤(Stock or Stockwork)。全部在山澗之中。

鑛質：——石英脈內鑛石頗豐，然石英脈少而且小，毫無經濟價值。

(6) 廿八都黃大橫坑鉛鋅銅鑛

位置：——鑛山在永嘉西北五十一公里（九十華里），溫溪東北十二公里（廿華里），黃大村南一公里強。

鑛床：——為脈形鑛床。圍岩為流紋岩。脈石為石英，走向為北六十度東。露頭長二十五公尺，寬三公尺，在山澗之內，高出澗底八公寸。鑛石為方鉛，黃銅，黃鐵及閃鋅等鑛。分佈甚勻，晶體均微，為游離晶體。

鑛質：——據化驗結果，方鉛成份合百份之4.54，黃銅合百份之3.00，閃鋅合百份之4.28，其原質成份如下：

$$\text{鉛} = 3.94$$

鐵 = 3.02

鋅 = 2.88

銅 = 1.04

硫 = 2.84

不溶解物 = 84.00

儲量：——根據方鉛成份 4.54, 黃銅 3.00, 閃鋅 4.28, 鑛脈寬度三公尺, 假定可採深度一百公尺, 長度一百公尺, 計得儲量如次:

方鉛鑛 = $100 \times 100 \times 3 \times 7.5 \times 0.0454 = 10,215$ 公噸

黃銅鑛 = $100 \times 100 \times 3 \times 4.2 \times 0.03 = 3,780$ 公噸

閃鋅鑛 = $100 \times 100 \times 3 \times 4.0 \times 0.0428 = 5,136$ 公噸

交通：——水口為橋頭, 距此十二公里 (二十華里)。

山主：——是地為黃大村公產。

(7) 廿七都東山重柯山鉛鋅銅鑛

位置：——鑛山在永嘉西北六十九公里 (一百二十華里), 溫溪北十七公里 (卅華里), 東山村東南二公里。

鑛床：——鑛床在流紋圍岩巨大裂縫之中, 為角礫鑛脈, 與山根寮後山相若。脈內具石英及流紋岩角礫, 石英呈紅白綠等色, 角礫之角甚尖銳。鑛石為方鉛, 閃鋅, 黃銅, 及黃鐵。鑛脈走向北七十度東, 傾斜西北八十度。露頭長約二十五公尺, 寬處八公尺, 狹處二三公尺, 平均二公尺, 高出山澗約十公尺。

鑛質：——據化驗結果, 方鉛成份合百份之 1.03, 閃鋅合百份之 8.1, 黃銅合百份之 5.88。其原質成份如下:

鉛 = 0.92

鋅 = 5.44

銅 = 2.04

鐵 = 9.52

硫 = 9.02

不溶解物 = 73.04

儲量：——根據方鉛成份百份之1.03，閃鋅 8.1，黃銅 5.88，鑛脈平均寬度二公尺，假定可採深度百公尺，可採長度五十公尺，計得儲量如下：

方鉛鑛 = $50 \times 100 \times 2 \times 7.5 \times 0.0103 = 772$ 公噸

閃鋅鑛 = $50 \times 100 \times 2 \times 4.2 \times 0.081 = 3,402$ 公噸

黃銅鑛 = $50 \times 100 \times 2 \times 4.0 \times 0.0588 = 2,352$ 公噸

交通：——水口為溫溪，計程十七公里，每擔挑力三角。由溫溪至永嘉，每擔挑力八分。

山主：——鑛山為吳坑村潘姓公產。

(B) 青田縣鉛鋅銅鑛

(1) 六下都南岸下隴殿後鉛鋅銅鑛

位置：——鑛山在青田西北十二公里，石溪西南四公里。

鑛床：——似為接觸變質鑛床 (contact-metamorphic deposit)。侵入岩石為花崗岩，因凝結太速，具基底，在鑛床之東龍舟崗一帶。鑛床在流紋岩之內，在殿後一帶。接觸變質鑛床在火成岩內者，本不多觀，今乃於此地見之。鑛床長約百公尺，寬約五十公尺，走向約北六十度東。鑛石為方鉛，黃銅，黃鐵，及閃鋅，均為細晶。鑛石分佈甚不均勻，大概東南部份較豐，東北部份較差。惜鑛山為浮土所掩，不能詳查，露頭平均高出山麓約二三十公尺。

鑛質：——據化驗結果，方鉛鑛合百份之 6.82，黃銅 6.10，閃鋅 3.14。其原質成份如下：

鉛 = 5.94

鐵 = 10.02

鋅 = 2.12

銅 = 2.12

硫 = 2.98

不溶解物 = 56.00

儲量：——根據方鉛成份百份6.82，黃銅6.10，閃鋅3.14，鑛床長度百公尺，寬度五十公尺，假定可採深度百公尺，計得鑛量如下：

$$\text{方鉛鑛} = 100 \times 100 \times 50 \times 7.5 \times 0.0682 = 255,750 \text{ 公噸}$$

$$\text{黃銅鑛} = 100 \times 100 \times 50 \times 4.2 \times 0.061 = 128,100 \text{ 公噸}$$

$$\text{閃鋅鑛} = 100 \times 100 \times 50 \times 4.0 \times 0.0374 = 62,800 \text{ 公噸}$$

交通：——山麓即為甌江支流之小溪，水量頗大。自鑛山至河濱約計一公里，每担挑力一角。由此至永嘉，每担船資一角五分。共計二角五分，每公噸計須四元二角。

山主：——鑛山為上岸下隴二村葉姓公產。

(2) 六下都上岸烟燉峯鉛鋅銅鑛

位置：——鑛山在青田西北十二公里（二十華里），上岸村北一公里，與南岸下隴村隔河相望。

鑛床：——鑛石散佈於流紋岩之內。岩石色紅白，晶體甚少，頗堅結。鑛石為方鉛，黃銅，黃鐵及閃鋅，晶體均小。鑛床為長形，露頭長約百公尺，寬一公尺，走向北五十度西，高出山麓十公尺。鑛床似為接觸變質鑛床，惟侵入岩為何項岩石，因天晚忽忽，未克細查，殊多遺憾。

鑛質：——據化驗結果，方鉛成份合百份之3.58，黃銅合百份之3.8，閃鋅合百份之2.89。其原質成份如下：

$$\text{鉛} = 3.12$$

$$\text{鐵} = 8.24$$

$$\text{鋅} = 1.94$$

$$\text{銅} = 1.32$$

$$\text{硫} = 5.20$$

$$\text{不溶解物} = 74.80$$

儲量：——根據方鉛成份百份之3.58，黃銅3.8，閃鋅2.89，鑛床寬度一公尺，假定可採深度百公尺，長度一百五十公尺，計得儲量如下：

方鉛鑛 = $150 \times 100 \times 1 \times 7.5 \times 0.0358 = 4,027$ 公噸

黃銅鑛 = $150 \times 100 \times 1 \times 4.2 \times 0.038 = 2,394$ 公噸

閃鋅鑛 = $150 \times 100 \times 1 \times 4.0 \times 0.0289 = 1,734$ 公噸

交通：——鑛山距甌江之小溪僅半公里，交通甚便。

山主：——鑛山為上岸村葉姓公產。

(3) 十七都橫坑直嶺牛藏脚鉛鋅銅鑛

位置：——鑛山在青田西北六十三公里(一百一十一華里)，橫坑村東北二百公尺。

沿革：——民國十三年曾經麗水燧昌火柴公司開採，用以提取硫磺。鑛坑為露天式，今已倒塞。

鑛床：——為脈形鑛床。圍岩為花崗岩，脈石為灰色石英。因浮土倒塞，不能細查。由鄉人處取得純粹方鉛標本一塊，據化驗，始知鉛質之外有銅鋅。

鑛脈走向為南北，脈寬約二公尺。橫坑南二公里章巷坑涼亭橋溪澗之旁，亦有露頭出現，寬僅二公寸。如中部連續，則已知長度為二公里，平均寬度為一公尺一寸。

交通：——出水在甌江上之陳山埠，距此二十二公里(三十八華里)，每担挑力約六角。

山主：——山主為橫坑鄭姓。

第五節 鉛鋅鑛

(1) 永嘉廿七都孫坑上牌坑鉛鋅鑛

位置：——鑛山在永嘉西北六十九公里(一百二十華里)，溫溪北十五公里(廿六華里)，孫坑南二公里弱。

鑛床：——鑛床甚奇，有平鋪鑛脈二條。二脈走向均為北二十五度西，傾斜西南十五度。脈石為石英。鑛石為閃鋅，方鉛及黃鐵，閃鋅較多，方鉛最少。下脈厚七公寸，上脈厚一公尺。二脈距離為二公尺。下脈露頭長約十二公尺(沿

傾斜線),上脈露頭長約九公尺,西端湮沒。圍岩爲流紋岩,惟下脈之下,流紋岩爲玻璃基底,甚似黑曜岩,餘爲石基底。鑛床在山澗之旁,下脈西端沒於澗水之內。鑛脈傾斜僅十五度,諒造成裂縫之主動力亦爲十五度。

鑛質:—閃鋅成份甚高。上脈閃鋅合百份之25.7,方鉛合百份之2.89。下脈閃鋅合百份之31.4,方鉛合百份之0.67。其原質成份如下:

上 脈	下 脈
鋅 = 17.20	鋅 = 21.04
鉛 = 2.59	鉛 = 0.59
鐵 = 21.98	鐵 = 26.74
硫 = 18.94	硫 = 19.02
不溶解物 = 36.04	不溶解物 = 30.94

儲量:—上脈儲量根據閃鋅成份百份之25.7,方鉛2.98,鑛脈厚度一公尺,假定可採長度及寬度各五十公尺,計得儲量如下:

$$\text{閃鋅鑛} = 50 \times 50 \times 1 \times 4.0 \times 0.256 = 2,570 \text{ 公噸}$$

$$\text{方鉛鑛} = 50 \times 50 \times 1 \times 7.0 \times 0.0298 = 558 \text{ 公噸}$$

下脈儲量根據閃鋅成份百份之31.4,方鉛0.67,鑛脈寬度七公寸,假定可採長度及寬度各五十公尺,計得儲量如下:

$$\text{閃鋅鑛} = 50 \times 50 \times 0.7 \times 4.0 \times 0.314 = 2,198 \text{ 公噸}$$

$$\text{方鉛鑛} = 50 \times 50 \times 0.7 \times 7.5 \times 0.0067 = 88 \text{ 公噸}$$

交通:—水口爲溫溪,距此十五公里,運費與東山重柯山同。

山主:—鑛山爲孫坑公產。

(2) 二十七都孫坑水春灣及龍後鉛鋅鑛

位置:—在上牌坑之西南二百公尺。

鑛床:—二處在山澗南北兩岸,與上牌坑同爲一脈。龍後爲上牌坑上脈,走向北六十度東,傾斜西北二十度,厚一公尺二寸,露頭長十公尺,最低處高出山澗五公尺。鑛石爲閃鋅,方鉛,黃鐵三種。

水春灣鑛床與上牌坑下脈同為一脈，走向北七十度西，傾斜東北四十度，厚約一公尺三寸，露頭長四公尺，鑛脈下壁與山澗之底平。鑛石為閃鋅，黃鐵及方鉛。

鑛質：——據化驗結果，龍後閃鋅鑛合百份之20.8，方鉛2.44。水春灣閃鋅合百份之25.6，方鉛1.08。其原質成份如下：

龍 後	水 春 灣
鋅 = 13.90	鋅 = 17.14
鉛 = 2.12	鉛 = 0.94
鐵 = 17.12	鐵 = 30.04
硫 = 25.02	硫 = 19.02
不溶解物 = 40.02	不溶解物 = 13.20

儲量：——龍後儲量根據閃鋅成份百份之20.8，方鉛2.44，厚度一公尺二寸，假定可採長度及寬度各五十公尺，計得儲量如下：

$$\text{閃鋅鑛} = 50 \times 50 \times 1.2 \times 4.0 \times 0.208 = 2,496 \text{ 公噸}$$

$$\text{方鉛鑛} = 50 \times 50 \times 1.2 \times 7.5 \times 0.0244 = 549 \text{ 公噸}$$

水春灣儲量根據閃鋅成份百份之25.6，方鉛1.08，厚度一公尺三寸，假定可採長度及寬度各五十公尺，計得儲量如下：

$$\text{閃鋅鑛} = 50 \times 50 \times 1.3 \times 4.0 \times 0.256 = 3,328 \text{ 公噸}$$

$$\text{方鉛鑛} = 50 \times 50 \times 1.3 \times 7.5 \times 0.0108 = 263 \text{ 公噸}$$

山主：——龍後為孫坑村公產，水春灣為東山村公產。

(3) 二十七都孫坑五羅鋅鉛鑛

位置：——在孫坑南一公里，上牌坑西北三百公尺。

鑛床：——鑛脈上壁為石基底流紋，下壁為玻璃基底流紋，足徵為上牌坑下脈。走向為北二十度西，傾斜東北二十五度。露頭長六公尺，厚半公尺，高出水田八公寸，高出山澗三十公尺。鑛石為閃鋅，方鉛，黃鐵三種。

鑛質：——據化驗結果，閃鋅成份合百份之28.7，方鉛1.2。其原質成份如

下:

鋅 = 19.20

鉛 = 1.04

鐵 = 27.72

硫 = 23.12

不溶解物 = 27.20

鑛量:——根據閃鋅成份百份之 28.7, 方鉛 1.2, 厚度半公尺, 假定可採長度及深度各五十公尺, 計得儲量如下:

閃鋅 = $50 \times 50 \times 0.5 \times 4.0 \times 0.287 = 1,435$ 公噸

方鉛 = $50 \times 50 \times 0.5 \times 7.5 \times 0.012 = 112$ 公噸

山主:——山主為孫坑孫茂舜。

(附註:上牌坑, 五羅及龍後水春灣三處, 本為同脈, 惟未經鑽探, 不能確定是否聯續, 故儲量僅照小範圍計算。如果聯續, 厚度又勻, 則俟交通較便, 頗有開採價值。日後本所探機得暇, 當從事鑽探)。

第 六 節 黃 鐵 鑛

(A) 青田縣黃鐵鑛

(1) 六外都八源邱山白水潦黃鐵鑛

位置:——鑛山在青田西南三十四公里(六十華里), 仁宮村西北十七公里。

沿革:——前清咸豐年間, 曾經鄉人開採, 現停。

鑛床:——為脈形鑛床, 脈石為石英, 圍岩為堅結紅白凝灰岩。鑛脈走向北二十五度西, 傾斜東北八十度。脈寬平均半公尺。有平坑一個, 隨鑛脈而進, 坑最深處八公尺, 坑底與澗水平, 坑長三十公尺, 北端未盡, 南端沒於澗水之中。

鑛質:——鑛石成份高低不一, 高者達百份之八十, 低者百份之二三, 平

均成份,據化驗合百份之40.6。

鑛量:——根據脈寬半公尺,成份百份之40.6,比重五,假定可採長度六十公尺,深度百公尺,計得儲量6,090公噸($60 \times 100 \times 0.5 \times 5 \times 0.406 = 6,090$)。

交通:——出水爲小溪上之寺畚,距此十七公里,山路極崎嶇。

山主:——山主爲仁宮村夏姓。

(2) 十五都陳子須石源老鍋飯山黃鉄鑛

位置:——在青田西南六十九公里(一百二十華里),禎埠南二十公里。

沿革:——鄉人曾採以製礮,尙有淺坑留存,深一公尺。

鑛床:——圍岩爲堅結凝灰岩,曾受破碎作用,只具縱橫極不規則之小裂縫多條,裂縫狀態不一,有長圓,方諸形狀,寬度及對徑均不及一公寸。裂縫之中,均爲石英脈,石英多作犬齒狀,內具黃鉄甚富。露頭長約八公尺,寬約五公尺,高出山澗十公尺,是項鑛床,可稱爲鑛瘤(stockwork)。

鑛質:——黃鉄在石英內約合百份之七十,但採掘時,須將破碎凝灰岩同採,成份僅合百份之三十。

儲量:——根據成份百份之三十,寬度五公尺,假定可採長度二十公尺,深度五十公尺,計得7,500公噸($20 \times 50 \times 5 \times 5 \times 0.3 = 7,500$)。

交通:——水口爲大溪上之禎埠,距此十九公里,每担挑力六角。

山主:——山主爲禎埠蔣王二姓人。

(3) 十七都蔡村黃鉄鑛

在青田西北六十三公里,王垓村北三公里。爲脈形鑛床,圍岩爲花崗岩,脈石爲灰白石英,走向北十度西,傾斜西南二十度,露頭長十公尺,寬一公寸至三公寸,高出水面約七公寸。鑛石在脈石內成份爲百份之21.8,茲假定可採深度五十公尺,長度三十公尺,計得儲量327公噸($30 \times 50 \times 0.2 \times 5 \times 0.218 = 327$)。

(4) 十七都蔡村望湖崗黃鉄鑛

在青田西北六十二公里,王垓村北二公里,蔡村南一公里,爲脈形鑛床。

圍岩爲花崗岩，脈石爲灰黑石英。走向北四十度西，傾斜西南六十度。露頭長七十公尺，寬自一公尺至七公尺不等。鑛床在山澗之中，高出水面三公尺。鑛石在脈石內成份爲百份之14.28。茲假定可採長度八十公尺，深度五十公尺，計得儲量1,142公噸($80 \times 50 \times 0.4 \times 5 \times 0.1428 = 1,142$)。

(5) 十七都王垵黃鐵鑛

位置：——在青田西北六十公里(一百〇五華里)，王垵村西一百公尺。

鑛床：——爲脈形鑛床。圍岩爲花崗岩，脈石爲石英。走向爲北十五度西，傾斜西南八十度。露頭長三十公尺，寬一公尺。鑛脈橫截小河內。大水時高出水面僅六公尺。

鑛質：——據化驗結果，鑛石在脈石內成份合百份之30.3。

儲量：——根據成份百份之30.3，脈寬一公尺，假定可採長度六十公尺，深度一百公尺，計得9,090公噸($60 \times 100 \times 1 \times 5 \times 0.303 = 9,090$)。

交通：——出水在陳山埠，距此二十公里(三十五華里)。

(6) 一都峙岙古安坑黃鐵鑛

在青田西南十二公里。鑛石在流紋岩之內，散佈既不規則，且爲量極微，鑛床又在山澗之底，無一顧之價值。

(7) 十七都五源夏家地嶺頭天仙壠黃鐵鑛及赤鐵鑛

位置：——鑛山在青田西南二十九公里(五十華里)，夏家地西南三公里。

鑛床：——爲脈形鑛床，脈石爲石英，圍岩爲凝灰岩。鑛石爲黃鐵鑛及赤鐵鑛，分佈甚不規則，且不均勻。赤鐵鑛作粉狀，甚光澤。鑛脈走向爲北四十度西，寬八公尺，有舊坑一個，沿脈而進，已採長度約二公尺，坑口在山澗之旁，高出澗水面半公尺，澗內常年有水。

鑛質：——黃鐵在脈內，約合百份之二十，赤鐵約合百份之十。

儲量：——根據鑛脈寬度八公尺，黃鐵成份百份之二十，赤鐵百份之十，比重均爲5，假定鑛脈可採長度六十公尺，深度百公尺，計得儲量如下：

$$\text{黃鐵鑛} = 60 \times 100 \times 0.8 \times 5 \times 0.2 = 4,800 \text{ 公噸}$$

赤鐵鑛 = $60 \times 100 \times 0.8 \times 5 \times 0.1 = 2,400$ 公噸

交通：——出水在白巖市，距此十四公里。

山主：——山主為北山村吳姓人。

(B) 麗水縣黃鐵鑛

毛月楊對尖打石洞黃鐵鑛

鑛山在麗水北四十九公里(八十五華里)，庫豆西北八公里(十五華里)，毛月西北三公里(五華里)。

曩日鄉人在此取石，以供舖路之用，因發現石內具黃鐵，土人以為金銅，傳聞遐邇，西人來此查勘者，絡驛不絕。

楊對尖山為凝灰岩所組成。打石洞在山頂。石內含黃鐵及磁鐵，均為游離晶體。黃鐵較多，據化驗結果，合百份之7.7，無一顧之價值。

第七節 磁鐵鑛

(A) 雲和縣磁鐵鑛

(1) 三都澗頭附近磁鐵鑛

位置：——澗頭街在雲和縣城西南十二公里(二十華里)。

沿革：——遜清康熙年間，有永康縣陳某來此淘鍊鐵砂，本地土著乃相繼效尤。道光年間為最盛時期。近因舶來品價廉物美，復以鐵砂漸稀，業此者多相繼停頓。

鑛床：——

(a) 分佈：——鐵砂分佈地點為澗頭街、梅源(澗頭南一公里)，吳坪(澗頭西南三公里)，趙前(澗頭西五公里)，牆圍裏(澗頭西南六公里)，埠頭後(澗頭西南二公里半)，岩坑(澗頭西南四公里)，張花(澗頭西南五公里)，柳山頭(澗頭西南六公里)，南山(澗頭南五公里)，朱源(澗頭西北三公里)，柳塢(澗頭西北二公里)，井塢(澗頭西北二公里)，栗溪(澗頭西北三公里半)，及馬車谷(澗頭東二公里)，以埠頭後為最富。如以澗頭為基點，產鐵範圍為西北至栗

溪(三公里半),南至南山以南(五公里),西至趙前(五公里),東至馬車谷(二公里),全部面積南北長約八公里半,東西寬約七公里。

(b) 鑛物:——磁鐵在花崗岩之內,爲岩液分泌鑛床,晶體甚小,不及半公厘。岩石風化成泥土,亦具磁鐵。其中成份,據化驗結果,計合百份之9.7。鄉人從事淘洗,以取磁鐵(土名鐵砂)。

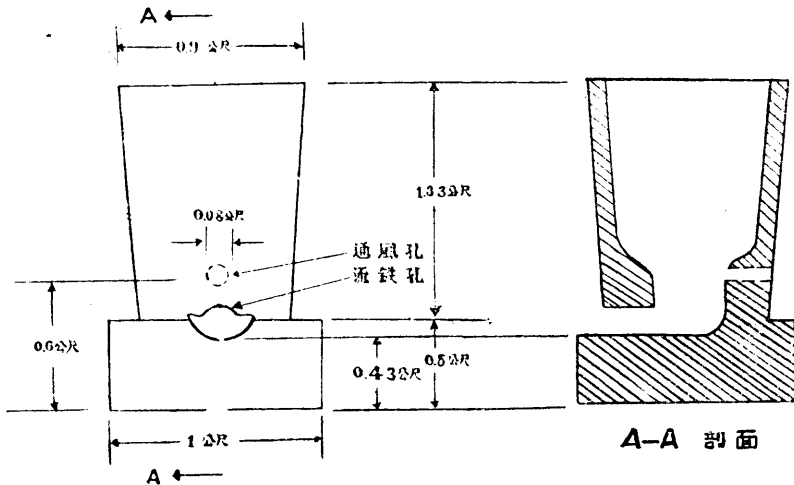
儲量:——根據產砂面積長八公里半,寬七公里,浮土平均厚度約三公尺,比重1.12,磁鐵成份0.097,計得儲量19,392,240公噸($7,000 \times 8,500 \times 3 \times 1.12 \times 0.097 = 19,392,240$)。

產砂區域大部爲農田。淘洗鐵砂,如規模較大,則非毀農田不可,鐵砂成份又低,殊不經濟,是以上項儲量,乃照學理計算之數目,非能施諸實用也。滴水岩,大萊村,舒田等處情形亦同。

淘砂:——淘砂用木槽,長三公尺,深三公寸,上端寬一公尺弱,下端寬半公尺。上端木板較兩旁之板低半公寸,板後靠泥土,高與板齊,下端無板。傾斜約一度。木槽置於山麓,將泥土用水由上端引入,以脚絞動之,鐵砂因重量關係,存留槽底,泥土較輕,被水冲去。此爲第一次淘洗,所得之砂,經第二次淘洗,始爲淨砂。淨砂據化驗結果,含鐵質百份之67.3,鉻質(Chromium)百份之0.08。每槽所用人數不等,每人每日能得淨砂,自三四十斤(每斤二十兩)至一百斤不等,平均六十五斤。

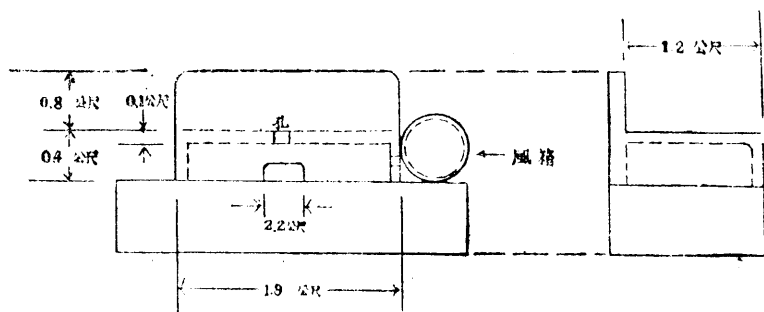
鐵砂售價:——鐵砂就地售價,較差者每百斤(每斤二十兩)約四角一分七,佳者合五角,平均四角五分八。每人每日淘砂約六十五斤,所得僅三角二分,是以淘沙者日稀。

冶鐵法:——



第一圖

冶鐵鑪為普通泥土所構成(第一圖),上部鑪壁厚0.08公尺。自通風洞以下,鑪壁厚0.22公尺。鑪座全為土築成,上部具淺溝,用以盛鐵。鑪身及鑪座之外,均用鉄片箍之,鉄片寬五公分。新建之鑪,須用柴火將鑪烘乾,然後加木炭,流鉄孔用泥塞閉,待溫度高起,即加鉄砂一層,其上再加木炭及鉄砂。如此庶續不已。鼓風用人力。風管亦用泥製成,長半公尺,外徑0.085公尺,內徑0.045公尺。每鑪每十二鐘能出生鉄二百四十斤,計須鉄砂五百斤,松炭三百五十斤(雜木炭則須四百斤),生鉄均鑄成鉄餅,長六公寸,寬四公寸半,厚一公寸。工作日夜繼續不停,鉄鑪損壞始停工修理。每鑪須工人六名,每人每日每二十四鐘得工資五角,主人供膳,外有酒資,多寡不定。工人均本地土著。



第二圖

由生鉄製成熟鉄,再須經過一度手續。先將生鉄餅打碎成一公寸長寬之小塊,放入熟鉄鑪(第二圖)內烘熱之,再加木炭炒之。鑪中養火可以減輕鉄中炭質。烘炒之後,即錘成0.13公尺×0.05公尺×0.04公尺之熟鉄塊。生鉄每百斤(每斤廿兩)可得熟鉄九十斤,如鉄鑪不佳,則僅能得八十斤。每鑪須用工人六名。製熟鉄一担(兩圈,即六十斤,每斤二十兩),給資一角二分,伙食由主人供給。如工人技術佳良,每鑪能出熟鉄十七八担。如技術不良,不獨數量減少,有時且不能製成熟鉄。

製鉄成本:——每鑪每日(十二句鐘)能產生鉄二百四十斤,計須成本十二元零五分,是以每百斤合洋五元零二分。詳數見下表:

鐵砂五百斤 = 2.5元

木炭三百五十斤 = 5.4

工資 = 1.5

伙食 = 1.2

鑪租 = 0.8

鐵砂運費 = 1.15

2.4 12.05

5.02元(每百斤)

生鐵每百斤能得熟鐵九十斤。每担熟鐵(兩圈)爲六十斤,計須成本三元九角八分四。詳數見下表:

生鐵一百斤 = 5.02

木炭三十斤 = 0.46

工資 = 0.18

伙食 = 0.12

鑪租 = 0.20

熟鐵九十斤 = 5.98元

熟鐵一百斤 = $\frac{5.98}{0.9} = 6.64$ 元

熟鐵六十斤(兩圈) = $6.64 \times 0.6 = 3.984$ 元

熟鐵售價:——熟鐵每六十斤在產地售價自三元四角至四元不等,在雲和四元二角至四元八角不等(均加運費)。與成本相比,虧折之時較多。

銷路:——曩日均由雲和運麗水之蘇埠,由客商收買。近年則一部份運景寧之大均,再轉永嘉,一部份運雲和,再轉永嘉及蘭谿。

產量:——前清光緒廿年左右,每年產熟鐵五六萬擔(每擔六十斤)至七八萬擔。民國十二年前,每年一萬擔。十四五年,六七千擔。近年僅兩千擔。

用途:——生鐵大半在產地製成熟鐵,再運他埠銷售,以製造各種用具。生鐵一小部份(約百份之一)運至雲和,鑄成鐵鍋。

運輸：一一熟鐵每担(六十斤)挑至雲和，須洋三角，由雲和乘筏至局村，須洋三分。

鑛數：一一現存鐵鑛計龍鋪二座，朱宅二座，沙舖一座，吊金坑二座，周村一座，共計八座。已停者計蔭橋坑一座，太埕一座，三排坑一座，河壩一座，靈山一座，共計五座。

(2) 五都緊水灘冲積磁鐵鑛

雲和西北十四公里，緊水灘村東一公里，大溪之南岸，有冲積磁鐵鑛床。與黃沙混合，表皮鉄砂較多，具相當堅度。面積長十公尺，寬六尺，深二公寸，高出河面一公尺。附近雖有花崗岩，然岩內無磁鉄，顯係大溪上游挾來鉄砂冲積所成，與附近花崗岩毫無關係也。據化驗結果，鉄質成份合百份之19.6，無一顧之價值。

(B) 麗水縣磁鉄鑛

滴水岩磁鉄鑛

位置：一一在麗水東北三十四公里(六十華里)。

鑛床：一一磁鉄在閃長岩之內，爲岩液分泌鑛床。與黃鉄互生，磁鉄較多。晶體細微，最大者僅三公厘，以滴水岩東一公里爲最多，自此向四方進行，鑛量淺微，展佈範圍，如以滴水岩東一公里爲中心，其東西南北一公里半，均有磁鉄。浮土之中較多，據化驗，計合百份之13.2。此爲調查範圍內磁鉄最富之區，且淘洗歷時不久，儲量尙豐。

儲量：一一根據產砂面積直徑三公里，磁鉄成份0.132，浮土比重1.12，假定浮土深度平均三公尺，計得磁鉄儲量3,133,749公噸($\frac{\pi \times 3000^2}{4} \times 3 \times 0.132 \times 1.12 = 3,133,749$)。

淘砂：一一淘砂手續與漂頭相同。惟鉄砂較多，每人每日平均可得二百斤。有木槽二，共須工人十名。一年之內有水卽洗，農忙亦然。淘剩之水，引入溝內，不入農田。計國曆一，三，四，十，十一，十二，六個月有水，餘時須供稻作之用。鉄砂售價，每百斤平均約合四角，鉄質成份爲百份之60.9。均售給滴水岩鉄鑛。

每年產量約三千担。

冶鐵：——本地有鐵鑪五個，製鐵手續與滌頭同。所製熟鐵均運麗水及縉雲出售，每担（兩捆，合六十斤）平均合五元。開利益甚厚，每鑪每年獲利約達千元左右。比較雲和滌頭，鐵砂產量較豐；離鐵鑪距離較近，是以運費較輕；熟鐵運至麗水及縉雲，運費亦較輕，故獲利較豐。是地木炭缺，供不應求，實爲此處鐵業最大困難。

運輸：——是地出水在舂溪上之雙溪，距此十七公里（三十華里），每担挑力五角。舂溪只能行竹筏，長年可通。在麗水北之西坑邊，可以裝船。

山主：——山主爲滴水岩人。

(C) 宣平縣磁鐵鑛

大萊村磁鐵鑛

位置：——在宣平東北二十九公里（五十華里）。

鑛床：——磁鑛在花崗岩之內，爲岩液分泌鑛床。與黃鐵互生，磁鐵較多。晶體頗大，有達一公分者，惟晶體細微者居多數，鑛區中部晶體較大，邊部較小。鑛區面積爲圓形，以大萊村爲中心，直徑約六公里。地面浮土均具磁鐵，據化驗結果，鐵砂合百份之9.7。

儲量：——根據鑛區面積直徑六公里，鐵砂成份 0.097，浮土比重 1.12，假定浮土深度平均三公尺，計得儲量 9,210,500 公噸（ $\frac{\pi \times 6000^2}{4} \times 3 \times 1.12 \times 0.097 = 9,210,500$ ）。

淘砂：——淘砂手續與滌頭及滴水岩相同。僅國歷一、二、三、十二、四個月可以淘洗，餘月農田須水，禁止淘砂。冬月之水，僅足供三人淘砂之用。每人每日平均約得鐵砂六十斤，全年產砂約一百擔。每担售價四角。此砂曩日均由沙山坑（西南六公里）鐵鑪收買，現鐵鑪已折，鐵砂無人過問矣。

運輸：——大萊鐵砂如欲運他埠，可由武義之細坑裝筏。細坑距大萊九公里（十五華里）。水涸則須至武溪，亦武義轄地，距大萊十四公里（二十五華里）。至細坑挑力每担四角，至武溪挑力每担六角。

山主：—— 山主爲大萊村李姓人。

(D) 青田縣磁鐵鑛

(1) 十七都舒橋一帶磁鐵鑛

位置：—— 在青田西北角舒橋，交垵，李宅，王垵，道彭，橫坑，西莊，蔡坑等處均在範圍之內。舒橋距青田五十二公里（九十華里）。

鑛床：—— 磁鐵在花崗岩之內，爲岩液分泌鑛床。晶體甚微，非藉放大鏡不能見。產鑛區域作橢圓形，東西長約十公里，南北寬約八公里。中部磁鐵較多。浮土內之磁鐵，據化驗結果，合百份之11.6。

儲量：—— 根據產砂面積長十公里，寬八公里，浮土內鐵砂成份 0.116，浮土比重 1.12，假定浮土平均深度三公尺，計得儲量 31,180,800 公噸（ $10,000 \times 8,000 \times 3 \times 1.12 \times 0.116 = 31,180,800$ ）。

沿革：—— 數十年前，鄉人曾從事淘洗。交垵及蔡坑設有鐵鑛，以供提煉。現在鐵鑛已毀，淘沙亦停。

交通：—— 出水在大溪之陳山埠，距舒橋十四公里（二十五華里）。

(2) 四內都黃垵口一帶磁鐵鑛

此區爲青田嶼前花崗岩區域，磁鐵在該區之西南部，爲岩液分泌鑛床。五源六源七源均有磁鐵，五源較豐，量甚微，尚不及大萊舒橋豐富。民國十二年以前，鄉人曾從事淘洗，黃垵口設有鐵鑛一座，提鍊此砂。及至十二年，鐵價大漲，黃垵口即增設一鑛，三溪口設二鑛，西坑，小左，八源各設一鑛，共計七鑛。現以舶來品較賤，均停辦。交通方面，吳岸長年可通竹筏，經油竹至永嘉。

第八節 赤鐵鑛

(1) 青田十七都章山黃連坑赤鐵鑛

地居青田西北六十三公里（一百一十華里），李宅西北七公里（十三華里）。是地有石英脈一條，圍岩爲花崗岩。鑛脈在澗水之內，走向北五十度西，露頭長約三十公尺，寬八公寸。中具赤鐵鑛及黃鐵鑛少許，赤鐵在鑛脈內約合

百份之二十,黃鉄百份之五,毫無經濟價值。

(2) 六下都一源湖岸烏龍坑烏岩山赤鉄鑛

在青田西北十二公里(二十華里),石溪西北三公里(五華里),在大溪西岸,鑛床爲脈狀,脈石爲石英,圍岩爲流紋岩,走向北六十度西,傾斜西南八十度,露頭長約三公尺,寬三公寸,赤鉄在脈石內,約合百份之三十,無經濟價值。

浙江義烏縣烏灶煤田地質

燕 春 臺

民國廿一年四月調查

位置：一 煤田展佈區域，爲義烏縣西北鄉之十三都。烏灶爲一小村，在義烏西北十三公里，蘇溪鎮西十六公里。大廠在義烏西北十二公里，蘇溪鎮西十六公里。

沿革：一 烏灶煤田何時發現，無從稽攷，惟知洪楊以前開採最盛，煤井之在大廠者，曾遇厚煤，獲利頗豐。他處亦曾鑿井採煤，惟結果不佳，詳細情形，業已失傳，無從探詢。遜清光緒十六年，有義烏及蘭谿人集資組織公和廠，在大廠擇地開井，擬採曩日遺留之煤柱。因井內水大，乃購機抽水。抽水機出水量每分鐘約合六十加崙，惟水大難制，井深二十公尺卽行停頓，虧蝕三千元。光緒二十七年，杭州沈徵仲開採和尚山及橋頭廠。和尚山井深五十公尺，遇夾石煤。橋頭廠井深二十公尺，遇老窰。均無結果，虧蝕三千元。民國八年，朱惠卿開採掛網形（大廠之北），井深二十公尺，遇夾石煤，虧蝕八百元。嗣後遂無問津者。

地形：一

(A) 山脈：一 烏灶煤田爲一小盆地，介於南北山脈之中。北脈爲得勝岩，稠山，龍華山，五岳山，虎山及長坑尖諸嶺。南脈爲玉峯山，鳳凰山，馬鞍山，朱家尖諸嶺。除馬鞍山外，均爲流紋岩系所組成。以得勝岩爲最高，高出海面四百二十四公尺，高出山麓約三百公尺。二系山脈中部微作弧形，盆地最寬處約二公里，向兩端進展，二脈漸接近，及至石門嶺及香山嶺，幾相啣接，是以盆地作舟形。二脈山峯亦不完全聯續，北脈在三里店，南脈在溪坦至馬交塘一帶，有二缺口，爲通浦江及義烏孔道。盆地之中，隨處小山起伏，最高山峯僅百餘公尺，均爲煤系岩層所構成。

在香山亭西南，南北山脈又復展開。北脈蜿蜒向西南進行，最著者為澤山尖，大旗山，牛角尖諸峯。南脈趨向東南，惟不及二公里即行湮沒。二者均為流紋岩系所組成。自香山亭向西二公里，亦有煤系岩層出露。自此以南，平疇百里，均為衢江紅砂岩系。石門嶺東北，二脈亦向左右伸張。自此東北行，均為流紋岩系及沖積層展布區域。

(B)水系：一 盆地之中有小溪，名曰濱水。有二源，東北起石門嶺，西南起香山嶺，在吳門市會合，經三里店，打通北系山脈，成一整齊之狹谷(water-gap)，而入浦江縣境，至黃宅市東南，與浦陽江會合，東流入諸暨境，再經蕭山縣，與錢塘江合，而入於海。

此溪為所謂暫時河流(temporary river)，一月不雨即乾涸，水大則溪身寬度自二公尺至三公尺不等。深度不齊，水大時木筏可達溪坦。

盆地四週，峻嶺聳峙，既如上述，雨水必向盆地底部流注。底部岩石又屬煤系岩層，質甚疎鬆，故多向下滲濾，因此煤層之內水量頗大。

地層：一 烏灶地層可類別為五種。一為偉晶花剛侵入岩，似屬白堊紀。二為煤系，據化石研究，屬侏羅紀。其上為流紋岩系，屬上白堊紀。其上為衢江紅砂岩系，屬第三紀。其上為沖積層，屬第四紀。茲分別論列於后：

(A)偉晶花剛侵入岩：一 此岩侵入範圍為西河，雅畝，洪巡畝，及後毛店一帶。均作岩脈狀(dike)。數甚夥，均細小，普通寬度僅二三公寸，薄者一公寸弱，亦有厚達三公寸者。岩石組織以石英為最多，均巨晶，次為白雲母。長石之量甚微，亦有不具長石者。偉晶花剛在同一範圍之內，組織素易變化，此即一例也。被侵入之岩石為煤系底部之砂岩，惟均已變質成雲母片岩及具片理之砂岩。

(B)煤系：一 煤系岩石除極小部份為砂質板岩，雲母片岩，石英岩及礫岩外，普通均為綠黃色及黃白色砂岩。各處異同不一，情形殊為複雜。茲擬柱狀圖一幅(第一圖)，聊示煤系岩層之大概而已。

雲母片岩散佈於西河，雅畝，洪巡畝一帶，均為小邱，岩層厚約五十公尺。

岩質極疎鬆，爲白雲母及石英所組成，石英之量較少。片岩之內具偉晶花剛岩脈多條，片岩之片理與岩脈之走向同一方向，足徵此項片岩之構成，由於岩脈之侵入。被侵入而變質之岩層必爲砂岩，因片岩之中具多量石英顆粒



第一圖 煤系岩層柱狀圖

FIG 1 COLUMN SECTION OF COAL SERIES

故也。後毛店之西有細緻砂岩，作片岩狀，中具絹雲母 (sericite)。其中雖有岩脈侵入，然在十萬平方公尺之內僅見小岩脈一條，因此熱力及壓力未克將砂岩完全變成片岩。與片岩處於同一地質等平線之上者 (geological horizon)，有山塘東南前山之石英岩，厚約八十公尺。其變質原因，恐與花剛岩之侵入有聯帶關係。

上項岩層之上，有中等顆粒砂岩一層。在雅畝西作灰白色，厚二百五十公尺。在山塘作黃灰色，厚五十公尺。在小金山作黃白色，且具絹雲母，厚八十公尺。

黃白砂岩之上，即為煤層，層數大致有九。煤層之上及煤層之間，有薄層頁岩。煤層之下，有薄層火泥。質均疎鬆。在小金山，煤層及頁岩等項全部厚度為七公尺。

緊接煤層之上有砂岩一層。在山塘，顆粒頗巨，色淺紫，厚六十公尺。在和尙山，為中等顆粒，色淺黃，厚六十公尺。在小金山，為中等顆粒，色淺紅，厚八十公尺。在上金，緊蓋煤層之上者，為暗綠色細緻砂岩，厚約三十公尺。

上項砂岩之上，在小金山北，均塘西及裏門塘，有砂質板岩，質細緻，成薄片，厚度約十公尺。普通為黃色，在裏門塘為淺紅色。

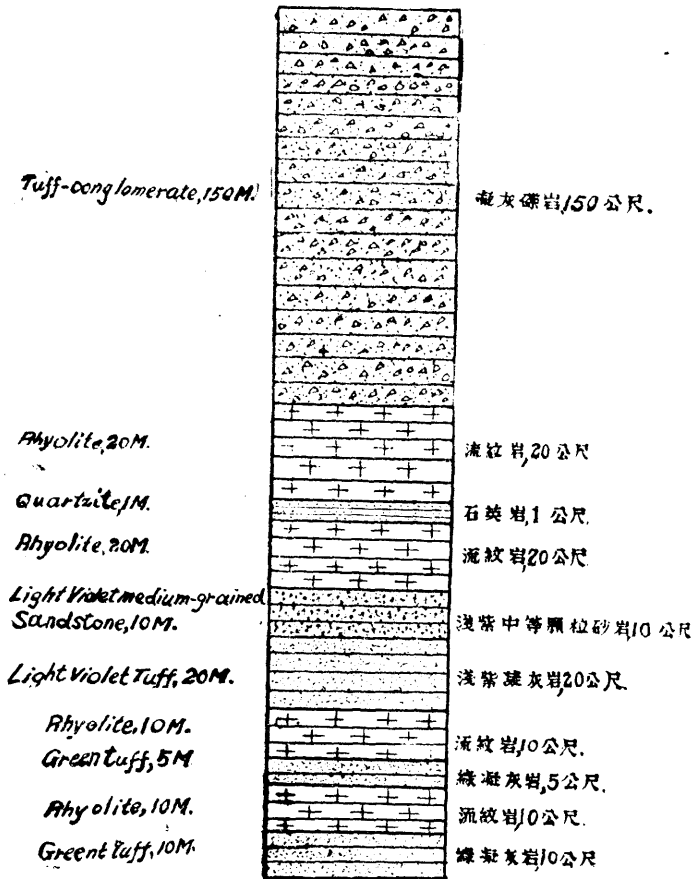
板岩之上，有黃綠色砂岩一層。中等顆粒者居多數，然亦有粗顆粒或細顆粒者。此層展佈範圍，殆遍煤田全區，可稱煤系之參攷岩層 (index or datum stratum)。平均厚度約二百公尺。

煤系岩層展佈範圍，其出露於流紋岩系及衢江紅砂岩系之外者，長約十五公里，寬約十餘公尺至二三公里不等。

(C)流紋岩系：一 煤田南北二山脈均為流紋岩系所構成，組織各有異同。南脈組織較為簡單，且頗一致。其下部為凝灰岩，色淺綠，質疎鬆，厚度為五十至八十公尺不等。凝灰岩之上為流紋岩，色紫紅，具少量斑晶，平均厚度約三百公尺。

北脈組織隨處不同，以得勝岩最為複雜。其中岩層可參觀第二圖。所足

記者,爲其頂部凝灰礫岩膠質作深紅色。其中礫塊合百份之四十,直徑半公寸至一公寸者居多數,大者合五公寸。多爲流紋岩塊,此外爲少量之磁石,凝灰岩及石英塊。多作圓形,甚似普通鵝卵石,諒此岩爲局部之水所沖積而成。



第二圖 得勝岩流紋岩系

FIG 2 RHYOLITE SERIES OF DASHIN-AN

北脈組織之最簡單者,厥爲澤山尖。自山頂至山麓,均爲凝灰岩,有綠紫白數種,全部厚度達三百公尺。

(D)衢江紅砂岩系：一 煤田內流紋岩系有二處接近衢江紅砂岩。第一區爲五峯亭，兩頭門及山面陳一帶。第二區爲演頭嶺，俞河及黃街後宅一帶。

第一區山面陳一帶，礫岩整合於紅砂岩之下。下與流紋岩系邊部相接，不整合。礫岩厚度不一致，大概東部較薄，西部較厚。在下樓村東五鳳亭附近，厚度僅十公尺。在兩頭門及山面陳之間，厚度約三十公尺。更西至石門塘一帶，則厚達二百公尺。礫塊數量不一，在兩頭門北，約合百份之三十。在樓下北，涼亭附近，僅及百份之十。多爲流紋岩塊，有時亦見凝灰岩，礫石及石英塊。膠質爲砂質，細顆粒，甚均勻，作肉紅色。間或見灰白膠質，亦爲砂質，惟範圍甚小。礫岩之內有時亦具砂岩薄層。

砂岩質地疎鬆，組織均勻，作肉紅色。多具灰白小點，亦爲砂質，作圓形，直徑普通爲一公分半。亦有不具白點者。厚度大致在二百公尺以上。

在第二區之演頭嶺，砂岩居礫岩之下，而掩蓋於流紋岩系之上，幾與之整合。在俞河及黃街後宅一帶，紅砂岩系與雲母片岩接觸。諒是地流紋系岩層業已被剝蝕而去，故衢江砂岩直接掩蓋於煤系之上。是地砂岩作肉紅色，具灰白小點，小點直徑約一二公分。與礫岩接近處組織較粗，顆粒大者達二公厘，厚度約八十公尺。

礫岩在溪坦一帶，整合於砂岩之上，厚約五十公尺。膠質色紅，礫塊頗小，巨者僅一公分。

(E)沖積層：一 煤田之內有沖積層二區。一在楓樹下一帶，爲東陽江沖積地，土質肥沃。第二區爲演水沖積地，作長帶狀，土質亦頗肥沃。

構造：一 煤田構造兩端較爲簡單，中部較爲複雜。茲特將諸剖面分別論列於後（參照烏灶煤田剖面圖）：

(1) A-A 剖面（上金北五百公尺）：一 岩層傾斜一致，約東南二十度，走向爲北八十度東。

(2) B-B 剖面（五岳山至錢庫大王廟）：一 岩層傾斜一致，約合東北三十度，走向爲北六十度西。

- (3) C-C 剖面(龍華山至馬鞍山):— 岩層傾向東北,傾角自十度至二十度不等。下田市西有石英岩及黃白砂岩,後傳亦有同類岩層,是以下田市附近必有一正斷層(normal fault),其變位(displacement)約合一百四十公尺。
- (4) D-D 剖面(經過吳門市,下吳及下樓):— 下樓以西,岩層傾向西北,傾角自二十度至四十度不等。下樓以東,岩層傾向東北,傾角自二十度至二十五度不等。驟視之,似為一背斜層。惟下樓以西,岩層為紫色粗砂岩及綠色礫岩,下樓以東,為紅色細緻砂岩及白色中等顆粒砂岩。是以二者之間,下樓附近,必有一逆斷層(reversed fault),其西壁(上盤)升起,東壁(下盤)下降。
- (5) E-E 剖面(均塘西南):— 剖面之西端為綠黃色砂岩,剖面之東端為黃色板岩及黃白色砂岩,傾向均為西北。綠黃色砂岩素居板岩之上,此處亦然。惟剖面中部有綠色礫岩及紫色砂岩伸入兩端之板岩及綠黃色砂岩之間,傾斜又復相反,故知中部之兩端必有逆斷層二,致使剖面中部與起。東部斷層之西壁岩層與下樓斷層之西壁岩層相若,二者諒為同一斷層。
- (6) F-F 剖面(自巨鉢塢至前山):— 此剖面為一向斜層,褶軸在後山。翼傾向東南,傾角自二十度至四十度不等。東翼傾向西北,傾角自二十度至六十度不等。
- (7) G-G 剖面(自烏灶北至雅畝):— 在石塘山為綠黃色砂岩,砂岩之下為煤層。在青藤山亦為綠黃色砂岩,砂岩之下為煤層。傾向均為西北。故二者之間,必有一正斷層,其變位約合一百公尺。雅畝之西,有二背斜層,範圍均小。
- (8) H-H 剖面(自虎頭山至何界):— 此剖面有二背斜層,中夾一向斜層。西端背斜層在小金山之西,西翼走向北六十度東,傾斜西北二十度。東翼走向北四十度東,傾斜東南八十度。更東又褶向西北,傾角自八十度漸變為四十度,走向約為北五十度東。更東在小金山東又褶向東南,傾角僅二十度,走向為北四十度東。
- (9) I-I 剖面(洪公塘北至東山):— 此剖面亦有二背斜層,中夾一向斜層,惟範圍較 H-H 剖面為小。西背斜層在和尙山西,西翼走向約北四十度東,

傾斜西北三十度至七十五度,東翼走向約北三十五度東,傾斜東南六十五度至七十五度。在大廠又褶向西北,傾角為六十度,走向北二十度東。更西六十公尺又褶向東南或東北,傾角為二十度。

(10) J-J 剖面(經過雷公山):— 此剖面有二向斜層及二背斜層。雷公山東端為一向斜層。東翼走向北七十度東,傾斜西北七十度,西翼走向同,傾斜東南三十度。更西褶向西北,傾角四十度,走向北六十度東。更西又傾向東南,傾角二十度,走向北七十度東。在傅宅東北又傾向西北,傾角四十度至六十度,走向為北三十度至五十度東不等。

(11) K-K 剖面(自三畏堂至下万):— 此剖面有二向斜層,中夾一背斜層,褶曲均甚平緩。三畏堂東南,岩層傾斜東北十度或東南三十度,走向為北十度西至北六十度東不等。至楊樹下東北又褶向西北,傾角自十五度至二十度不等,走向為北三十度至七十五度東不等。在下万西北又褶向東南,傾角二十度,走向北六十度東。至下万之西,又傾向西北,傾角二十度,走向北五十度東。

(12) L-L 剖面(自虎山至鳳凰山):— 此剖面有向斜層及背斜層各一。虎山之東,岩層走向北十五度東,傾斜東南三十度。至高塘西南,又傾向西北,傾角四十度,走向北七十度東。至倪村北,傾向同,傾角為三十度,走向為北五十度東。更東至倪村西,又褶向東南,走向為北四十五度至七十度東,傾角為二十度至三十五度。

(13) M-M 剖面(自長坑尖經過嶺脚):— 岩層無褶曲,均傾斜東南四十度,走向為北十度至三十度東。

(14) N-N 剖面(經過香山亭):— 岩層傾斜東北二十五度,走向北十度西,無褶曲。

(15) O-O 剖面(自香山亭至杏積塘頭):— 香山寺一帶之凝灰岩傾斜西北二十度或西南三十度。煤系岩層則傾斜東南四十度。在五峯亭,衢江礫岩傾斜東南二十五度,走向北七十度東。均無褶曲。

煤層：一 煤田岩層構造已如上述。煤層露頭多在向斜層頂部(如 F-F, H-H 及 I-I 剖面)，鄉人稱西翼煤層爲大九路，東翼煤層爲小九路。在斷層(G-G 剖面)上盤(hanging wall)之煤亦名大九路，下盤(foot wall)之煤亦名小九路。諒二處均有煤九層(鄉人名煤層爲煤路)，鄉人誤以二處之煤屬二脈，實卽爲同層之煤也。在大廠及裏門塘，東背斜層之東翼，亦曾發現煤層。上金亦有露頭。餘處是否有煤，尙待鑽探。

此地煤層，據鄉人云，薄者居多，且多具夾石(partings)。大九路僅有煤一層不具夾石，鄉人稱爲棉煤，以其灰份疎鬆如棉故也。具夾石者名爲花煤，蓋似形也。棉煤在洪公塘較厚，最厚處約三公尺，薄處三公寸，脈長僅十公尺，深僅十三公尺，此外爲閉口(pinch)，東至青籐山，厚僅七八公寸。更東至均塘，洪楊以前曾開採，厚度如何，現已失傳。

小九路沿脈，無整層棉煤。惟在和尙山南坡，曾發現棉煤一層，厚約一公尺三寸。惟脈長僅十公尺，深僅十公尺，此外爲閉口。更東均爲夾石煤。例如在小金山，露頭厚七公尺，均爲頁岩及煤骨(bone)。更東至石塘山，昔日曾開採，惟煤層如何，業已失傳。均塘亦然。

葉宅北之裏門塘及大廠爲背斜層東翼，曾發現一厚煤層，與大九路之棉煤同層，厚約十公尺，脈長僅十三公尺，東西二端均爲閉口。下掘達一百公尺，卽爲夾石煤，更下情形如何，尙待鑽探。此層之上，有一薄煤層，厚七公寸，質頗堅，鄉人名爲柴煤，可供炊爨之用，諒其灰份頗重。

上金北五百公尺，有煤層露頭，均爲煤骨(bone)，厚度不知。

聞煤層之內，水量頗大。曩日公和廠所用抽水機，排水量約爲六十加崙(所遺留之出水管內徑爲二英寸半)，尙不能制止水量。煤層蓬石頗鬆，須用巨大支柱，惟底石頗佳，見水不膩。煤內無沼氣，工作均用油燈。

煤質：一 本煤田具夾石煤(土名花煤)及良煤(土名棉煤)二種，已如上述。夾石煤內石多煤少，燃後成石塊，僅可供炊爨及燒磚瓦石灰之用。良煤質亦不純，泰半具多量石英或赤鐵，二者均呈小條紋狀，俗名白柳絲及紅柳絲，是

以煤內灰份頗重。煤中又具多量黃鉄鐵，均作塊狀，有大至一公寸者，廢石堆內散佈甚多，土人現尚拾之以供燃料。此煤頗堅結，塊體甚多，表面光澤，燃時烟甚輕。茲將棉煤分析表列後：

	1	2	3	4
	洪公塘地面所拾	青籐山地面所拾	洪公塘露頭	石塘山地面所拾
水份	2.3%	0.88%	21.2%	2.7%
揮發物	8.5%	7.62%	24.0%	19.3%
灰份	27.8%	20.8%	14.0%	35.5%
固定炭	61.4%	70.7%	40.8%	42.5%
燃率	7.2	9.8	1.7	2.2

現在所得煤樣，非拾之地面，即取之露頭，均不能代表本礦之煤。故欲據之以斷定煤之良窳及鑑定煤之種類，殊為困難。據上項四種煤樣分析表觀之，足徵成份極不一致。依照佛來則爾 (Frazer) 分類法，用揮發物除固定炭即得燃率 (fuel ratio)。一號煤樣燃率為 7.2，屬半煙煤，二號煤樣燃率為 8.9，屬半無煙煤，三號煤樣燃率為 1.7，屬煙煤，四號煤樣燃率為 2.2，亦屬煙煤。三號煤樣為露頭煤，水份特重，燃率不能兼顧水份，四號煤灰份太重，燃率亦不能兼顧灰份，故三四兩號之燃率，均不能據以鑑定煤之種類。一二兩號煤樣，水份灰份均不太重，且頗一致，故燃率頗可靠。而一為半煙煤，一為半無煙煤。三四兩號煤樣均為煙煤，故此煤比較上與煙煤接近，稱之為半煙煤可也。

煤量：一 照現在已發現煤層區域而論，除上金而外，自大廠至均塘已確定有煤。自均塘至上金，可假定煤層聯續。大廠至上金全長八公里。煤層厚度極不一致，且或隱或現，茲假定良煤（棉煤）平均厚度為一公尺。煤層深度亦不一致，此項可根據地層構造推斷，在 G-G 及 I-I 剖面煤層較深，F-F 剖面深度次之，H-H 剖面最淺，茲假定平均可採深度（沿傾斜）為二百公尺。

比重爲 1.3。採煤損失假定爲百份之三十。計得 1,456,000 公噸 ($8,000 \times 200 \times 1 \times 1.3 \times 0.7 = 1,456,000$)。

交通：一 大廠至杭江鐵路之蘇溪站約十六公里，至義烏站約十二公里，均爲坦途。蘇溪至杭州較義烏至杭州近十二公里。如他日此鑛開採，宜由蘇溪築一支線至鑛。自大廠經蘇溪至杭州全長約一百二十六公里。依照杭江鐵路最近所訂運價，一百二十六公里之運費，每公噸爲二元四角四分。

此鑛水運頗不便利。義烏城外一公里之埠頭爲東陽江，通竹筏及小舟，西經蘭谿，可達杭州。由鑛山至埠頭，每百斤（每斤十八兩）挑力約五角（每公噸約七元三角五分）。由埠頭至蘭谿，水小用竹筏（因灘多鮮用之），水大用船，平均每百斤（每斤十八兩）運費一角（每公噸一元四角六分）。蘭谿至杭州，價相若（每公噸一元四角六分）。共計每公噸十元二角七分。工價及物價：一 是地農工每日工價二角五分，農忙時每日四角。木工及泥水匠終年每日二角五分。均由主人供膳。

義烏爲產米之鄉，每百斤值洋六元二角五分。惟木植頗缺，附近諸縣僅江山武義浦江等縣產木。江山之木可由水運至蘭谿，再裝火車運鑛。武義之木可由水運至金華，再由金華裝火車運鑛。浦江之木可沿浦陽江及濱水運至鑛山。現在木植零售價目，松木每根（對徑二公寸）值洋二元五角（松木普通以斤計算，每百斤值洋約五角）。杉木每根（對徑二公寸）值洋四五元。附近松木幼林頗多，他日亦可供鑛內需要之一部也。

山主及山租：一 鑛山均爲民地。是處慣例，開一井每月須納租金三四元至五六元不等。

大廠爲川塘方文用產業。和尚山爲洪公塘村公產。小金山南面爲葉宅公產，北面爲雅畝公產，東面爲何界公產。石塘山爲義烏西門陳姓產業。後山爲均塘公產。

結論：一 本鑛煤質窳劣，良煤少而夾石煤多，且煤層頗薄，又或隱或現，兼之鑛內水多，蓬石疎鬆，誠爲鑛中之下乘也。然浙省本無良好煤田，而住戶工廠需煤孔亟，且義烏交通便利，如烏灶煤田經鑛探結果，五方公里以內，煤層平均厚度能達一公尺，未始不能作小規模之開採。

**GEOLOGY AND MINERAL DEPOSITS OF
WUYIE, SHEONPING, LIESHIEW, YINWHO, TSINTIEN
AND YINTSA DISTRICTS, CHEKIANG**

(Abstract)

By

C. T. Yen

INTRODUCTION

This work was carried out from April to July in 1931, covering the districts of Wuyie (武義), Sheonping (宣平), Lieshiew (麗水), Yinwho (雲和), Tsintien (青田), and Yintsa (永嘉). On account of unfavorable weather prevailing during the time and the disturbed condition in the field, the work was done in a hazardous manner.

The geological features of the field are simple enough, being entirely igneous formations. Mineral resources are abundant but it is rather disappointing that deposits of considerable magnitude have not been discovered.

PHYSIOGRAPHY

(A) *Mountains*: - The surveyed region is, for the major part, mountainous. The mountains belong to the southern branch of Shienhaling (仙霞嶺), the water-shed between Kiangsi and Chekiang provinces. It is further subdivided into two chains. The northern chain forms the water-shed of three rivers, with Eukiang (甌江) in the south and Tsientangkiang (錢塘江) and Tsiakiang (椒江) in the north, the most prominent ridges being Quotsonshan (括倉山) and Northern Antangshan (北雁蕩山) at its eastern terminal. The southern chain forms the divide between Fukien and Chekiang provinces, the most prominent ridge being Southern Antangshan (南雁蕩山), at Pinpyang district (平陽縣).

The mountains are still in their youthful stage of dissection, the ridges being mostly precipitous, some ranging over one kilometer above sea-level. The formations, constituting the mountains, are rhyolite and tuff-conglomerate for the major part, with spotted exposures of intrusive rocks. The outer aspect of the mountains also differs with different rock formations, being more precipitous with rhyolite and more gentle with granite and tuff-conglomerate.

(B) *Rivers*: - The waters, in the surveyed region, group themselves into two rivers. The one, named Eukiang (甌江), drains the basin between the northern and southern chains of mountains; while the other, called Wuyiekiang (武義江) drains a part of northern limb of northern chain.

Wuyiekiang, which empties to Tsientangkiang (錢塘江), is the artery of Wuyie district (武義縣). It has two branches, one, coming from southwest, is called Shutsie (熟溪), while the other, coming from Yinkong district (永康縣), is called Yinkongkiang (永康江). This river is in the early part of mature stage of development and is navigable by small junks to Yinkong city.

Eukong, second in size among the rivers of the Province, drains rather a large area. It has two main tributaries, named Datsie (大溪) and Sueotsie (小溪), which unite at Shietsie (石溪), nine kilometers northwest of Tsintien city, forming Eukong proper.

Datsie drains the districts of Lieshiew (麗水), Yinwho (雲和), Lungchun (龍泉), Shiuchang (遂昌) and Shungyang (松陽). It is navigable by small junks to the cities of Lungchun and Shungyang with an average load of 0.88 metric ton, all the year around.

Sueotsie, draining the district of Ginling (景甯) and Chingyuan (慶元), is navigable to Ginling by small junks with an average load of 0.88 met. tons, throughout the whole year.

Eukong is navigable by ocean vessels up to Yintsa city, navigable by steam-boats up to Wintsie (溫溪), the upper limit of tide-water, and navigable by junks to Shietsie (石溪) with a load of 4.7 met. tons at high water and 1.75 met. tons at low water.

In Datsie and Sueotsie, gorges and rapids are conspicuously abundant and the average speed of water is nine kilometers per hour. It is obvious that it is in its youthful stage of development. Considerable amount of water power can be developed if it is planned carefully.

The estuary of Eukiang is in the form of a bay, eastward from Yintsa city. There are small islands, scattering around outside of the bay. These facts lead one to the idea that this region had once subsided, transforming lowlands into bay and mountain ridges into islands. Subsidence of this nature might increase, partly at least, the grade of the river,

thus forming numerous rapids.

STRATIGRAPHY

The formations encountered in the mapped area are as following, ranging upwards from below chronologically:

Alluvium (tertiary)

Tuff-conglomerate series (upper cretaceous)

Rhyolite series (upper cretaceous)

Intrusive rocks (upper cretaceous)

Rhyolite series covers about three-quarters of the total area, while intrusive rocks and tuff-conglomerate occupy one-tenth respectively, and alluvium, the rest.

(A) *Granite*: - There are nineteen exposures of intrusive rocks, eighteen of which are granite while the other is diorite. Besides a few exceptions, there is one thing in common and that is the gradual degradation of crystalline development from center to the boundary, turning to felsite, in most cases. Magnetite, if there is any, is also abundant in the central part. These facts clearly indicate the intrusive character of the rocks. The exposures are briefly described as following:

(1) *Tzungtao (滬頭) Granite, Yinwho District*: - This occurs in the southwestern part of the District and is in the form of an ellipse, whose dimensions are thirteen kilometers by ten kilometers along its axes. The crystals are well-developed around the center and consist of feldspar, quartz, biotite, hornblende, and magnetite.

(2) *Yintun (雲壇) Granite, Yinwho District*: - It is in the southeastern part of the District and is longitudinal in shape, which varies from three to five km. in width. The rock is hornblende granite.

(3) *Tsingshiewtang (緊水灘) Granite, Yinwho District*: - It occurs northwest of Yinwho and is biotite granite.

(4) *Seekang (西坑) Granite, Lieshiew District*: - It is located in the extreme south-western part of the District and is in the form of an ellipse, two by four km. along its axes. The rock is hornblende-biotite granite.

(5) *Dishiew-An (滴水岩) Diorite, Lieshiew District*: - It lies thirty four km. north-east of the city. The amount of hornblende exceeds that of feldspar, which is plagioclase probably. There is also an appreciable amount

of magnetite. The area is rather small, only two km. from north to south.

(6) *Chotsinquon* (都金觀) *Granite, Lieshiew District*: - It is located twenty-nine km. north-east of Lieshiew. Its area is very small, about one km. in diameter. It is hornblende-granite, with a small amount of pyrite.

(7) *Dalia* (大萊) *Granite, Sheonping District*: - It lies twenty-eight km. north-east of Sheonping and is in the form of a circle, whose diameter is about 6 km. in length with Dalia as the center. The rock is hornblende-granite with an appreciable amount of magnetite and pyrite.

(8) *Granite West of Datsaotao* (大橋頭), *Sheonping District*: - It is about twelve km. south-east of Sheonping. The rock is hornblende-granite and is rather limited in area.

(9) *Martien* (麻田) *Granite, Wuyie District*: - It is located fourteen km. south-east of the City. The rock is hornblende-granite, occupying an area about one km. in diameter.

(10) *Shutsao* (舒橋) *Granite, Tsintien District*: - It is in the northwestern part of the District, and is biotite granite, containing a small amount of magnetite. The area is considerable, about eight by ten km. in size.

(11) *Tsintienshien* (青田縣) *Granite*: - It covers a large area around the city, about seven km. from east to west. The rock is hornblende-biotite-granite.

(12) *Yietsian* (嶼前) *Granite, Tsintien District*: - It lies fifteen km. south-east of Tsintien and occupies a large area, about fourteen km. from east to west. It is biotite granite, with a small amount of magnetite.

(13) *Lunchuokong* (龍丹崗) *Granite, Tsintien District*: - It is located eleven km. north-west of Tsintien and is limited in area. The rock is hornblende-granite.

(14) *Sueoling* (小嶺) *Granite, Tsintien District*: - It is exposed west of Sueoling, twenty km. south-west of Tsintien. The area is limited.

(15) *Kunkuo* (坑口) *Granite, Tsintien District*: - It is located southwest of Kunkuo, twenty eight km. southwest of the city. It is intercalated in rhyolite with an outcrop of ten by one hundred meters in size.

(16) *Wu-An* (吳岸) *Granite, Tsintien District*: - It lies sixteen km. south-west of Tsintien. Only a little patch of exposure was found.

(17) *Shantsian* (山前) *Granite, Yintsa District*: - It is thirty seven km.

north-west of Yintsa and is in the form of a circle about three km. in diameter. The rock is hornblende-granite.

(18) *Liaotsao*(樓橋)*Granite, Yintsa District*: - It is located eight km. south-west of Yintsa. The area covered is from three to five km. in width. The rock is hornblende-granite.

(19) *Hzetsian* (寺前) *Granite, Yintsa District*: - It is thirteen km. south-east of Yintsa and occupies an area about five km. in width from east to west. The rock is biotite-granite.

(B) *Rhyolite Series*: - The formations, constituting this series, vary rather widely. Some consist of rhyolite, tuff, tuff-conglomerate, red shale, and basalt; while others consist of rhyolite and tuff only.

Rhyolite is the product of outflow from volcanoes or fissures. It is composed of phenocrysts and groundmass. The phenocrysts are chiefly feldspar and quartz, with occasional presence of mica and hornblende. The amount of phenocrysts varies from a few specks to ninety per cent. The size of phenocrysts ranges from less than one mm. to two cm. The groundmass may be glassy or dense. Its color ranges from violet, pink, light-green to gray. The flow-structure, though quite prominent in some cases, is not always present.

Tuff is chiefly composed of volcanic dust and volcanic ash. Some are fine-textured while others are coarse. Some are incorporated with crystals of orthoclase, calcite or mica. Its color ranges from pink, light-green, light-yellow, grayish-white to deep-gray.

Tuff-conglomerate is of variable composition. The pebbles are chiefly fragments of rhyolite, while obsidian, pitchstone and lapilli are occasionally found. They range from one cm. to one meter in diameter and are either angular or rounded in shape, the latter being more prominent. The matrix, made up of volcanic dust and erosion products of igneous rocks, varies from violet, pink, green, grayish-white to yellow in color, violet being more prominent. This formation is formed partly by accumulation of eruptive products of volcanoes, while the greater part is erosion products of igneous rocks laid down by local waters.

The red shale is fine-textured. It is rather loose and well-stratified. It is distinctly the erosion products of igneous rocks laid down by local

waters.

The basalt is the result of outflow from volcanoes or fissures. It is massive, with or without phenocrysts and ranges from grayish-black to dark-green in color.

The rocks, constituting rhyolite series, differ in variety, number and thickness in different localities. They are enumerated as following:

From Martien (麻田), South-East of Wuyie to Wvyaetong (五葉塘), West of The Same City.

Localities	Rocks	Thickness(m)
Around Wuyie City	Rhyolite	200
	Tuff-conglomerate	20
	Rhyolite	100
	Tuff-conglomerate	10
	Tuff	10
	Hard tuff	200
	Tuff-conglomerate (with lapilli)	20
	Tuff(with schistose structure).....	30
Martien	Granite	

From Datsaotao (大橋頭), South-West of Sheonping to Tsiekuo (溪口), North-East of the Same.

Localities	Rocks	Thickness(m)
Tsiekuo	Rhyolite	150
	Red shale.....	3
	Tuff-conglomerate	10
	Red shale	3
	Tuff-conglomerate	5
	Red shale	3
	Tuff-conglomerate	15
	Rhyolite	200
	Tuff-conglomerate	5
	Red shale.....	3
Tuff-conglomerate	5	

Red shale.....	3
Tuff-conglomerate	10
Basalt	5
Rhyolite	15
Tuff-conglomerate	100
Rhyolite	150

West of Datsaotao..... Granite

From Paitsiekun (北溪坑), North-West of Yinwho by Way of Chontsie (泉溪), Shietsaotao (石橋豆), to Biwho (碧湖) and Shunkunkuo (松坑口), Southwest of Lieshiew.

Localities	Rocks	Thickness(m)
Around Biwho.....	Rhyolite	50
	Tuff	50
	Rhyolite	30
	Tuff	20
	Rhyolite	20
	Tuff-conglomerate	30
	Rhyolite	30
	Tuff	30
	Rhyolite	20
	Tuff	20
	Rhyolite	30
	Tuff	30
	Rhyolite	50
Tuff	30	

West of Paitsiekun.....Granite

From Pai- An (北岸), Shietsie (石溪) by Way of Ningon (仁宮), Dou-ou (道坳), Shiekeipu (石蓋埠), Giechietao (芝溪頭), Haikuo (海口), to Chinpu (禎埠) of Tsintien.

Localities	Rocks	Thickness(m)
Chinpu	Rhyolite	20
	Tuff	10
	Rhyolite	30
	Tuff	20

Rhyolite	200
Tuff	20
Rhyolite	200
Tuff	50
Rhyolite	50
Tuff	50
Rhyolite	30
Tuff	30
Rhyolite	20
Tuff	20
Rhyolite	30
Tuff	20
Rhyolite	150
Tuff	10
Rhyolite	30
Tuff	50
Rhyolite	20
Tuff	10
Red shale	1
Rhyolite	100
Tuff	100
Rhyolite	200

Pai-an..... Granite

From Shatsietsin (下溪村), North West of Yintsa by Way of Tsaohsatsai (橋下街), Mien-Autsin (梅畚村), An-Montsin (岩門村), to Yintsa city.

Localities	Rocks	Thickness(m)
Yintsa city.....	Tuff	200
	Rhyolite	30
	Tuff	100
	Basalt	10
	Rhyolite	100
	Hard Tuff	100
	Basalt	10

Hsatsietsin.....Granite

From Quiwho (魁虎), East of Tsintien, by Way of Szeyau (峙畚), Chia-Au (澤雅), Yuankuo (源口), Montaochu (驛頭駐), An-Montsin (岩門村), to Yintsa City.

Localities	Rocks	Thickness (m)
Yintsa city	Tuff.....	200
	Tuff-conglomerate	10
	Tuff.....	10
	Rhyolite	400
Quiwho.....	Granite	

(C) *Tuff-Conglomerate Series*: - Within the surveyed region, there are four tuff-conglomerate fields; namely (1) Yenchi (沓渠) field, northwest of Wuyie district, (2) Chi-An-Shan (赤岩山) field, southeast of Sheonping district, (3) Gi-Pi-Tsin (界牌村) field, northeast of Lieshiew district, (4) Lieshiew city (麗水城) field. It consists of wholly or partly of tuff-conglomerate, tuff, red shale, red sandstone and white sandstone. It differs from rhyolite series chiefly in two respects, namely (1) tuff-conglomerate is much thicker (2) there is no rhyolite or basalt present; they are insignificant, atleast, if there is any, like that in the coastal regions in eastern Chekiang.

The composition of tuff-conglomerate is rather varied. The pebbles are chiefly rhyolite, with occasional presence of obsidian, pitchstone, granite, tuff and flint. They are either angular or rounded, the latter being more numerous. They vary from one cm. to half meter in diameter and range from ten to forty percent of the whole bulk. The matrix, made up of volcanic dust and erosion products of igneous rocks, varies from violet, dark-green to yellow in color, violet being more prominent.

Tuff is rather insignificant in this series. With the exception of Lieshiew city district, which has a layer of tuff, one hundred meters thick, there is only one thin layer of tuff, ranging from one meter to thirty meters in thickness in the other fields.

Red shale has been found only in Chi-An-Shan field, with a thickness of ten meters.

With the exception of Chi-An-Shan field, red sandstone is found in all the other fields. It is well-stratified and is coarser than red shale. Ori-

gin of deposition is probably the same.

There is a layer of white sandstone near Siepaetien(西白殿)and Chinkongshan (陳崗山) in Yenchi field. It is coarse and well-stratified. It is composed of quartz sands for the major part, with occasional specks of black and green materials. It is probably the erosion product of granite.

The rocks of this series are tabulated as following:

The Middle Part of Yenehi (杏渠) Field (From Whontsinting (黃金亭) to Wuyaetong (五葉塘)):

Localities	Rocks	Thickness (m)
Whongtsingting.....	Tuff-conglomerate	80
	Red sandstone	10
	Tuff-conglomerate	20
	White sandstone	5
Wuyaetong	Tuff-conglomerate	10

The Western Part of Yenchi Field (From North of Yieyuan (俞源) to North of Tsiekuo (溪口)):

Localities	Rocks	Thickness (m)
North of Tsiekuo	Red sandstone	10
	Tuff-conglomerate	3
	Red sandstone	7
	Hard tuff	1
	Red sandstone	15
	Tuff-conglomerate	2
	Red sandstone	3
	Tuff-conglomerate	5
	Red sandstone	$\frac{1}{2}$
	Tuff-conglomerate	3
	Red sandstone	3
	Tuff-conglomerate	1
	Red sandstone	1
	Tuff-conglomerate	2
Red sandstone	1	
North of Yieyuan	Tuff-conglomerate	150

Chi-An-Shan Field

Localities	Rocks	Thickness (m)
Shan-An-Sze (三岩寺)	Tuff-conglomerate	200
	Red shale	10
Tingkou (丁公)	Tuff ..	30

Gi-Pi-Tsin Field

Localities	Rocks	Thickness (m)
Gi-Pi-Tsin (界牌村).	Tuff-conglomerate	150
	Red sandstone.....	30
Chielung (巨弄).....	Tuff.....	10

Lieshiew City Field

Localities	Rocks	Thickness (m)
Lieshiew city.....	Tuff-conglomerate	200
	Red sandstone	20
Shunkunkuo (松坑口) to Daliangshan (大梁山)	Tuff	100

(D) *Alluvium*: - There are three alluvial plains in the mapped area, namely (1) Wuyie city field, (2) Biwho (碧湖) field of Lieshiew district and (3) Yintsa city field. The first is the alluvial plain of Wuyiekiang. Its soil is of medium grade. The second field is the alluvial plain of Datsie. Its soil is a little poorer. The third is the alluvial plain of Eukiang and tide-water. The soil is colored dark gray and is quite fertile.

The analyses of the above soils are tabulated as following:

Compositions	(1) Wuyie city field	(2) Biwho field	(3) Yintsa city field
	% by wts.	% by wts.	% by wts.
moisture(of air-dried soil)	1.907	0.809	2.058
loss on ignition	5.123	3.244	6.811
decayed vegetable matters	1.340	0.900	1.780
total nitrogen	0.114	0.126	0.449
Substances insoluble in HCl	84.313	91.365	86.069
mineral matters insoluble in HCl	82.655	90.116	82.780

SiO ₂ , Soluble in HCl	0.315	0.238	0.193
SiO ₂ , Soluble in Na ₂ CO ₃	14.767	8.695	12.721
Al ₂ O ₃	1.197	1.326	3.675
Fe ₂ O ₃	7.450	4.440	3.835
Mn ₃ O ₄	0.330	0.212	0.177
CaO	1.117	0.868	0.990
MgO	0.366	0.360	0.366
K ₂ O	0.583	0.509	0.355
Na ₂ O	0.045	0.005	0.108
P ₂ O ₅	0.373	0.214	0.299
SO ₃	0.097	0.090	0.075
Cl	0.031	0.009	0.016

STRUCTURAL GEOLOGY

The geological structures of the field are simple enough. We can only find numerous undulations of structures, with dips varying from one to thirty five degrees, majority being 5°-15°. They don't follow any systematic arrangement, being local disturbances apparently. Detail features can be referred to the map.

In formations, indistinctly stratified like rhyolite and tuff-conglomerate series, it is rather difficult to locate faults. The only fault found is that three km. south of Yieyuan (俞源), northeast of Sheonping district. It is a normal fault, striking N. E..

ECONOMIC GEOLOGY

Mineral deposits are widely scattered in this field. There are fluorite, pyrophyllite, argentite, galena-sphalerite-chalcopyrite, sphalerite-galena, pyrite, magnetite and hematite. They can be classified into three groups, namely (1) deposits formed by magmatic segregation, (2) contact-metamorphic deposits and (3) fissure deposits. As intrusive rocks are widely distributed, it is quite probable that the intrusive rocks are the sources of magmatic waters for the fissure deposits. Direct relation between the intrusive rocks and the former two classes of deposits needs not be mentioned. Judging from the geologic time of the enclosing rocks, features of outcrops and nature of ore-minerals, we can well believe that these deposits are primary. Judging from the structures and minerals of the veins, I am also led to believe that the fissure deposits are deposits formed at shallow depths by hot solutions.

Although the number of deposits, found in this expedition, amounts to eighty seven, only very few are of some value. Among the fluorite deposits in Wuyie district, Chiangwantung (蔣萬洞), Chielie (溪里) and Wuwielung (五尾龍) are good prospects. Lungkun (礮坑) silver deposit of Sheonping is rather extensive in area and Pu-Ai (普愛) silver deposit of the same district is rich in value. They are both promising. Among the galena-sphalerite-chalcopyrite deposits, Hsialungtienhao (下隴殿後) of Tsintien, Tuntaoyang (坦頭坑), Sunken (山根), and Sunkun-Tsianshan (孫坑前山) of Yintsa are worthy of exploration. The sphalerite-galena deposits of Sonpeikun (上牌坑), Wuloe (五羅), Lunghao (龍後) and Shiuteowan (水春灣) of Sunkun in Yintsa district are quite rich and serve prospective grounds for future careful exploration.

Although the samples collected are of average grade, but samples, collected from the outcrops and old pits, can hardly give the average value of the deposits. The extent and depth of the deposits are mainly estimated for calculating the reserves. Thus, the value of ores and amount of reserves, given in the following text, need not be looked upon too seriously.

FLUORITE

Fluorite deposits in Chekiang rank highest in extent in China. Its distribution is rather wide, covering the districts of Kinghua (金華), Yiewu

(義烏), Wuyie (武義), Lin-An (臨安), Wuhsin (吳興), Yinkong (永康), Pukiang (浦江), Changshan (常山), Kiangshan (江山) Lungyu (龍游), Chuchi (諸暨), Hsinchang (新昌), Chenhsien (嵒縣), Linghai (寧海), Hsonshan (象山), Tsintien (青田), Lieshiew (麗水) and Shiuchang (遂昌).

In the surveyed region, there is no other mineral met with in the fluorite vein, even at a depth of thirty meters, except quartz. In Changshan (常山), galena has been found at the lower part of a fluorite vein. There is a common expression in that District that "fluorite is the door keeper of valuable minerals". But in the mapped area, only quartz has been found in accompany with fluorite. Quartz has a tendency, in some cases, to increase with depth, and sometimes the whole vein changes to quartz at depth or at a certain portion of the vein longitudinally. Sometimes, fluorite vein lies in the middle of big quartz vein. It seems that when the magmatic fluid, rising and depositing the minerals, deposits silica or valuable minerals first which have higher freezing point, and fluorite next, which has lower freezing point. Sometimes, silica deposits on the walls of the vein, while fluorite, depositing next, occupies the middle part of the opening.

Mining of fluorite began at 1917. The yearly production was about 500 tons at the beginning. There was a recess in 1919-1920. From 1921 to 1925, the total production was 12,000 tons. From 1926 to 1930, the average yearly production was 8,000 tons.

With the exception of a small amount bought by American, French and German concerns, the Japanese are almost the sole consumers of this mineral. They carry on the business along the principle of trust, dictating the prices and rejecting the product according to their whims. The Chinese operators, on account of lack of capital and cooperation, are usually forced to sell at a loss. The average price from 1921 to 1930 is about fifteen dollars Mex. per ton at Shanghai. The Japanese yearly demand is 8,000 tons. If production is kept within this limit, the chances for selling at a loss are comparatively less.

(A) *Fluorite Deposits of Wuyie (武義) District*

(1) *Shilungkan (石龍崗)* :- It lies three km, southeast of Wuyie. The vein, lying in rhyolite, strikes N. 40°E. and dips 70°S.E., It is 1.2-3 meters wide and 355 meters long. It is being operated, the pit being 28 meters

deep. The ore, colored white and green, carries 82% CaF_2 and 14% SiO_2 . The approximate reserve is 53,000 metric tons. The nearest port is Shishuiyutao (石水牛頭), 2 kilometers to the northeast. It is transported by junks and rafts to Lanchi (蘭谿), where it is loaded into barges, sailing for Hangchow; whence, it is shipped to Shanghai by rail.

(2) *Chinwheishan* (陳範山): - It is the southern elongation of Shilungkan vein. It strikes $\text{N.}40^\circ\text{E.}-\text{N.}60^\circ\text{E.}$ and dips $65^\circ-70^\circ\text{S. E.}$. Its width is 1.5-2.0 m. and length, 205 m. It is being worked, the pit being 24 m. deep. The ore is colored green and white and carries 78.02% CaF_2 and 20.2% SiO_2 . The approximate reserve amounts to 35,000 met. tons.

(3) *Tsieshan* (指山): - It is the southern elongation of Shilungkan vein. It strikes $\text{N.}21^\circ\text{E.}-\text{N.}30^\circ\text{E.}$ and dips 80°S.E. . It is 1-2.5 m. wide and 140 m. long. It had been operated, the pit being 12 m. deep. The ore is colored white and green and has a CaF_2 content of 79.4% and a SiO_2 content of 17.6%. The approximate reserve is about 28,000 met. tons.

(4) *Tsinguioshan* (金鈎山): - It lies 200 m. north of Tsieshan, being an extension of the same vein. The southern part of the vein strikes $\text{N.}30^\circ\text{E.}$ and is 0.8 m. wide. The northern part splits into two branches. The western branch strikes $\text{N.}30^\circ\text{E.}$ and is one m. wide. The eastern branch strikes $\text{N.}60^\circ\text{E.}$ and is 1.8 m. wide. The opened length is 30 m., the southern end narrowing down while the northern end remaining unchanged. It is being worked, the pit being 8 m. deep. The ore, colored violet and green, shows 84.8% CaF_2 and 7.24% SiO_2 . The approximate reserve amounts to 4,000 met. tons.

(5) *Chowling* (周嶺): - It is an extension of Chinwheishan vein. It is 1.4 m. wide and 100 m. long and strikes $\text{N.}67^\circ\text{E.}-\text{N.}80^\circ\text{E.}$. The ore, colored white and green, carries 80.7% CaF_2 and 17.2% SiO_2 . The reserve is approximately 21,000 met. tons.

(6) *Wuwielong* (五尾龍): - It occurs 4 km. southeast of Wuyie. The vein, lying in rhyolite, strikes $\text{N.}60^\circ\text{E.}$ and dips 80°S.E. . The outcrop is 145 m. long and is 6 m. wide. The ore is white and shows a rusty appearance, which seems to improve with depth. It contains 82.33% CaF_2 and 10.94% SiO_2 . The approximate reserve is about 135,000 met. tons. It had been once worked, but on account of the rusty appearance of the ore, it

has been recently shut down. Port Shishuiyutao is one km. to the N. E..

(7) *Otaotsin* (鵝頭頸):- It lies eleven km. east of Wuyie. The vein strikes N. 40°E. and dips 80° S.E.. It has a width of 1-1.5 m. and an opened length of 65 m.. The southern end is narrowing down while the northern end remains unchanged. It had been once operated, leaving a pit 15 m. deep. The ore, colored green and violet, carries a CaF_2 content of 82.4% and a SiO_2 content of 12.10%. The reserve is approximately 15,000 met. tons. The country rock is rhyolite, which turns to a plastic mass on exposure to water and air, making mining work extremely hazardous. Datongkuo(大塘口) is the nearest port, located 2 km. to the S. E..

(8) *Ninsinshan* (人形山):- It is located 12 km. east of Wuyie, about one km. northeast of Otaotsin. It strikes N.30°E. and dips 80° S.E.. It has a width of 1.4 m. and an opened length of 30 m.. There is an old pit about 10 m. deep. The ore is colored light-green and carries a CaF_2 content of 90.8% and a SiO_2 content of 5.9%. The approximate reserve is 8,700 met. tons. Port Datongkuo is 4 km. to the S.E..

The western end of the vein splits into three branches, all running westward. The northern branch passes through the top of Kuniyeshan (干衣山) and Quiyinsan (龜陰山). The middle branch passes through bottom of Kungyieshan (干衣山), Changshashan (長蛇山), Chiukun (曲坑) and bottom of Quiyinsan (龜陰山). The southern branch terminates at Chionsinshan (犬形山). The country rock is all of rhyolite.

(6) *Changshashan* (長蛇山):- It lies half km. west of Ninsinshan (人形山). The vein strikes N.50°E. and dips 80° S.E.. Its width is 1.5-2.0 m. and the opened length is 30 m.. The western end is narrowing. There is an old pit about 10 m. deep. The grade of the ore is rather low, CaF_2 content being 54.19%, while SiO_2 running as high as 39.7%, coloring the ore white. Masses of quartz are also present., especially along the northern wall. The reserve is approximately 5,000 met. tons. Port Datongkuo is 3 km. to the S.E..

(10) *Kuniyeshan* (干衣山):- It occurs 200 m. east of Changshashan (長蛇山). The vein strikes N.50°E. and dips 80°S.E.. Its width is measured one meter and the opened length is 20 m.. There is an old pit about 3 m. deep. The ore, colored white and green, has a CaF_2 content of 90.24% and

a SiO_2 content of 3.14%. The approximate reserve is 6,000 met. tons.

(11) *Chihun* (曲坑):- It lies half km. west of Changshashan (長蛇山). The vein, striking $\text{N.}75^\circ\text{E.}$, is one m. wide and 15 m. long at the outcrop. The reserve is approximately 6,200 met. tons.

(12) *Sonszemo* (上四畝), *Saszemo* (下四畝) and *Quiyinshan* (龜陰山):- It is half km. west of Chiukun (曲坑). There are two veins, 30 m. apart, being the northern and middle branches of Ninsinshan (人形山) vein. The southern vein is, for the major part, composed of quartz. The northern vein, striking $\text{N.}80^\circ\text{E.}$, is 1.5-3.0 m. wide and 100 m. long at the outcrop. Its ore is light green in color and carries 80.92% CaF_2 and 13.5% SiO_2 . Its approximate reserve is about 13,700 met. tons.

(13) *Chionsinshan* (犬形山):- It lies 300 m. S.E. of Changshashan (長蛇山). The vein, striking $\text{N. }80^\circ\text{E.}$, is 2 m. wide and 30 m. long at the outcrop. The reserve is approximately 15,000 met. tons.

(14) *Futoushan* (伏刀山):- It occurs 12 km. southwest of Wuyie. There are three veins, occurring in red sandstone of tuff-conglomerate series. The southern vein, striking $\text{N. }80^\circ\text{W.}$, is 1.8 m. wide and 8 m. long at the outcrop. The middle vein, 10 m. north of the southern vein and striking in the same direction, is 2 m. wide. The northern vein, 100 m. north of the middle vein, strikes $\text{N. }60^\circ\text{W.}$ It is 1.2 m. wide and 1.5 m. long along the outcrop. The ores are all of low grade and are green and violet in color. They carry a CaF_2 content of 56.76% and a SiO_2 content of 40.08%. Their total reserve is about 13,000 met. tons. The nearest port is Ma-On (馬昂), about half km. to the S. E..

(15) *Tietoushan* (剃刀山):- It lies 300 m. west of Futoushan (伏刀山). It is the extension of the middle vein of the latter. It is nearly entirely covered by soil.

(16) *Datsieshan* (大指山) and *Siatsieshan* (小指山):- It is half km. west of Futoushan and is the elongation of the latter's middle vein, passing through Tietoushan on its way. The vein, striking $\text{N.}60^\circ\text{W.}$, is 2 m. wide and 100 m. long at the outcrop. The reserve is approximately 26,300 met. tons.

(17) *Chinkongshan* (陳崗山):- It lies 14 km. southwest of Wuyie. The vein, striking $\text{N.}50^\circ\text{W.}$, is 1.3 m. wide and 120 m. long at the outcrop. The country rock is white sandstone of tuff-conglomerate series. The ore is light

green in color and shows 80.7% of CaF_2 and 14.12% of SiO_2 . The approximate reserve amounts to 24,400 met. tons. Ma-on (馬昂) is the nearest port, lying 2 km. to the S. E..

(18) *Yiechushan* (余處山):- It occurs 4 km. southeast of Wuyie, about 100 m. east of Wuyie river. The vein strikes $\text{N.}40^\circ\text{E.}$ and dips 70° S. E.. Its width is 1.7 m. and the opened length is 4 m.. The ore is mixed with a predominating amount of quartz, usually in masses. The purer ore carries 62.72% CaF_2 and 33.24% SiO_2 .

(19) *Futiatsa* (蝴蝶夾):- It lies 6 km. southeast of Wuyie. The vein, lying in rhyolite, strikes $\text{N.}50^\circ\text{E.}$ and dips 70° S. E.. It is lenticular in shape, narrowing down at both ends and at top and bottom. It is being worked, the width of the vein at bottom of the pit pinching down to 0.8 m.. The ore is colored white and green and shows a rusty appearance. CaF_2 and SiO_2 contents are 79.42% and 15.7% respectively. The estimated reserve amounts to 340 met. tons only.

(20) *Yieshantao* (余山頭):- It is 5 km. south of Wuyie. The vein strikes $\text{N.}45^\circ\text{E.}$ and dips 80° S. E.. Its width varies from 3.5 m. to 10.5 m., averaging about 8 m.. The length of outcrop measures 120 m.. The old pit is 3 m. deep. The vein lies in rhyolite and the ore is mixed with rhyolite masses which amounts to 20% of the whole bulk. The ore is impregnated with iron oxide, giving a dark yellowish color. It carries 88.74% CaF_2 , 3.9% SiO_2 and 3.42% Fe_2O_3 . and Al_2O_3 . The approximate reserve amounts to 112,000 met. tons. The nearest port is Donsin (端村), about 2 km. to the N. E..

(21) *Szeshan* (寺山):- It lies 2 km. northeast of Wuyie. The vein, striking $\text{N.}50^\circ\text{E.}$, is 2.5 m. wide and 40 m. long at the outcrop. The vein is located in a big quartz vein. The ore is full of quartz veinlets, making the ore practically valueless.

(22) *Panyiequeon* (搬移崐):- It occurs 100 m. west of Szeshan(寺山), being the elongation of the same vein. The outcrop is 25 m. in length. The rest are the same as szeshan.

(23) *Fentzenshan* (飯甌山):- It lies 6 km. northwest of Wuyie. The vein, occurring in rhyolite, strikes $\text{N.}50^\circ\text{E.}$. The outcrop measures 30 m. long and 1.8 m. wide. The ore, colored light-yellow, contains 93.49% CaF_2 and 1.95%

SiO₂. The approximate reserve is about 11,000 met. tons. The nearest port is Tuntao (塢頭), 6 km. to the N. E..

(24) *Szebakun* (四百壩):- It is located 7 km. northwest of Wuyie, and 2 km. northeast of Sunjuotien (三角店). The vein strikes N.30°W. and dips 80° S. E.. Its width varies from 0.8 m. to 2 m.. The opened length is 20 m.. The vein lies in a big quartz vein, the same vein from Szeshan. The ore, colored light-green and light-violet, carries 82.58% CaF₂ and 12.2% SiO₂. The approximate reserve is 2,700 met. tons. Port Tuntao (塢頭) is 6 km. to the N. E..

(25) *Quokontsaoshan* (郭公橋山):- It occurs 8 km. northwest of Wuyie and 2 km. southwest of Kuotao (郭頭). The vein, striking N.60°W., is 1.5 m. wide and 25 m. long at the outcrop. The country rock is red sandstone and tuff-conglomerate. The ore, colored light-yellow and grayish-white, shows a CaF₂ content of 74.25% and a SiO₂ content of 21.8%. The reserve is approximately 4,000 met. tons. The nearest port is Lietun (履坦), 7 km. to the N. E..

(26) *Kinghuashan* (金華山):- It lies 9 km. northwest of Wuyie and one km. southwest of Kuotao (郭頭). The vein, striking N. 60° W. is one m. wide and 100 m. long at the outcrop. It occurs in the same quartz vein from Kuckontsaoshan. The ore is colored green and white and incorporated with small quartz flakes, thus degrading the ore. The latter runs 81.1% CaF₂ and 14.4% SiO₂. The approximate reserve is about 7,900 met. tons. Port Lietun (履坦) is 7 km. to the N. E..

(27) *Hosonshan* (和尚山):- It occurs 9 km. northwest of Wuyie and half km. southwest of Kuotao. The vein strikes N.40°E and dips 80°S. E.. Its width is one m. and the opened length is 25 m.. The country rock is red sandstone and tuff-conglomerate. It had been worked, leaving a pit 2 m. deep. The ore is colored violet, yellow and light-green and is of fair grade, carrying 90.02% CaF₂ and 7.10% SiO₂. The reserve is approximately 5,000 met. tons. The nearest port is Lietun, 6 km. to the N. E..

(28) *Wangyuanshan* (王圓山):- It is located 8 km. northwest of Wuyie, just behind the village of Kuotao. The vein, striking N.60°E., is 1.5 m. wide and 80 m. long at the outcrop. It occurs in red sandstone. The ore, colored violet, yellow and light-green, carries 86.4% CaF₂ and 1.2% SiO₂.

The reserve is approximately 18,800 met. tons. Lietun is the nearest port, lying 6 km. to the N. E..

(29) *Shietsashan* (徐家山):- It is the extension of Hosonshan, lying 100 m. to the southwest. Its width is 1.4 m. and the opened length is 40 m.. The approximate reserve is about 5,600 met tons. For other features, refer to Hosonshan.

(30) *Chinsiupaushan* (鄭畚寶山):- It lies 7 km.. northwest of Wuyie and 2 km. east of Kuotao. There are two veins. The southern vein, striking N. 45°E., is one m. wide and 15 m. long at the outcrop. The northern vein, striking N.60°E., is 1.2 m. wide and 15 m. long at the outcrop. The country rock is rhyolite. The ore, colored yellowish-white, carries 96.03% CaF_2 and 1.2% SiO_2 . The approximate reserve amounts to 5,500 met. tons. Port Lietun is 5 km. to the N. E..

(31) *Tienhaolung* (殿後龍):- It occurs 100 m. south of Chinsiupaushan and the veins are the extensions of the same, with the same strike and country rock. The southern vein is 1.5 m. wide and 30 m. long at the outcrop. The northern vein is 0.6 m. wide and 30 m. long at the outcrop. The ore is colored green and violet and is of fair grade, carrying 89.88% CaF_2 . and 2.2% SiO_2 . The reserve is about 10,000 met. tons.

(32) *Wyeshemao and Nieshemao* (外四畝內四畝):- It lies 100 m. southwest of Tienshaolung. It is the extension of the southern vein of the same. It is 1.5 m. wide and 20 m. long at the outcrop. The reserve is approximately 6,000 met. tons.

(33) *Datungsze* (大通寺):- It is located 9 km. northeast of Wuyie and 2 km. northeast of lietun (履垣). The vein occurs on two opposite hills with a ravine in between. It strikes N.40°E. and dips 50°-80° S. E.. The outcrop measures 100 m. long and 1-2 m. wide. It had been worked, leaving a pit 2.5 m. deep. The country rock is tuff-conglomerate which is very loose, especially on exposure to air and moisture, making mining work extremely difficult. The ore, colored light-green and transparent, carries 32.72% CaF_2 and 12.08% SiO_2 . The approximate reserve is about 26,000 met. tons. The nearest port is Wutang-An (吳唐岸), one km. to the west.

(34) *Tsintaishan, Tsinlungtao* (青龍頭慶大山):- It lies 12 km. northeast of Wuyie. The vein, striking N.60°W., is 1.3 m. wide and 50 m. long at the out-

crop. The country rock is tuff-conglomerate, which is rather hard and tough. The ore, colored light-green, carries 80.74% CaF_2 and 12.2% SiO_2 . The reserve is approximately 13,000 met. tons. Port Wutang-An is 8 km. to the N. E..

(35) *Sinwulieshan, Chiangwantung* (蔣萬洞新屋裏山):- It occurs 17 km. northeast of Wuyie and 1.5 km. northeast of Chiangwantung. The vein, occurring in rhyolite, strikes $\text{N.}50^\circ\text{E.}$. It is 4 m. wide and 300 m. long at the outcrop. It is of high grade, carrying 91.84% CaF_2 and 2.2% SiO_2 . The approximate reserve amounts to 150,000 met. tons. The nearest port is Wuyie city, the transportation rate amounting as high as seventeen dollars mex. per met. ton on coolies' back.

(36) *Wutseishan, Chielie* (溪里屋基山):- It lies 9 km. southwest of Wuyie and one km. northeast of Chielie. The vein, striking $\text{N.}70^\circ\text{E.}$, is 14.5 m. wide and 500 m. long at the outcrop. The country rock is rhyolite. The ore, colored light green, carries 84.73% CaF_2 and 8.24% SiO_2 . The reserve amounts as high as 908,000 met. tons. The nearest port is Dontsin (端村), 6 km. to the N. E..

(37) *Yielingkuo* (魚鱗角):- It is located 7 km. southwest of Wuyie and 3 km. southwest of Chielie. The vein, occurring in red shale, strikes $\text{N.}60^\circ\text{E.}$. It is 1.8 m. wide and 70 m. long at the outcrop. The ore is transparent and is green and violet in color. It is of high grade, carrying 92.53% CaF_2 and 2.12% SiO_2 . The reserve is approximately 18,000 met. tons. The nearest port is Sueptsie (小溪), 2 km. to the N. W..

(38) *Fushan* (壺山):- It lies west of Wuyie, just outside the city-wall. The vein, striking $\text{N.}80^\circ\text{E.}$, is 1.3 m. wide and 20 m. long at the outcrop. The country rock is rhyolite. The ore is light-green in color and has a CaF_2 content of 79.24% and a SiO_2 content of 17%. The approximate reserve is 5,200 met. tons. The nearest port is the southern suburb of Wuyie.

(39) *Shieszemon* (石柱門):- It occurs 3 km. southwest of Wuyie and 2 km. southwest of Sunlie (山里). The vein, striking $\text{N.}40^\circ\text{W.}$, is only 0.2 km. wide. The outcrop is covered by soil, making detailed study difficult.

(40) *Yuanmingsze* (元明寺):- It is 19 km. southwest of Wuyie. There is a quartz vein, 7 m. wide and striking N. S.. Fluorite constitutes 1% of the vein and scatters irregularly through it.

(B) Fluorite Deposit of Lieshiew (麗水) District

Wangyiefon (黃泥坊): - It lies 3 km. north of Lieshiew. It strikes N.60°E. and dips 45° S. E.. It is 0.2 m. wide and 19 m. long at the outcrop.

(C) Fluorite Deposit of Tsintien (青田) District

Daqueoshan, Tashanwan (塔山灣大窟山): - It occurs 69 km. northwest of Tsintien and 3 km. east of Shiefan (石帆). The vein strikes N.50° W. and dips 70° N. E.. It is 0.6 m. wide and 130 m. long at the outcrop. The ore, transparent and colored light-green, carries 93.82% of CaF₂ and 35% of SiO₂. The reserve is approximately 7,800 met. tons. Datsie river lies half km. to the south.

PYROPHYLLITE (印章石)

There are pyrophyllite formations in Tsintien and Yintsa districts. According to their textures and colors they are arbitrarily divided into two classes by the natives. One is called *dungshie (凍石)*, meaning "frozen stone", which is translucent, sectile and gives a greasy feel and lustre. This variety is practically exhausted and cannot be found at present. The best grade of *dungshie* is called *denquonshie (燈光石)*, meaning "lamp light stone", which is transparent and gives a sparkling light in front of lamp light. The second class is called *tushu-an (圖書岩)*, meaning "seal stone", as it is chiefly used by the Chinese for making personal seals, at former times. It is opaque, sectile (hardness about one) and gives a greasy feel and lustre. All that are produced at present belong to this class. Its colors vary from red, yellow, white, black, gray to mixtures of these.

The country rocks are rhyolite and tuff. pyrophyllite is formed by the metamorphism of these rocks through the agency of waters, highly charged with aluminum oxide (Al₂O₃) at mesothermal temperature. Alluminum oxide and water contents of the rock are thus enriched, while other components are diminished, giving rise mainly pyrophyllite (H₂Al₂Si₄O₁₂), Pinite (H₂KAl₃(SiO₄)₃) and steatite (H₂Mg₃Si₄O₁₂). Pyrophyllite occurs in all the localities in question, while pinite is only found at Tsieshan (季山), in accompany with pyrophyllite. Steatite has not been met with.

Rocks, when not thoroughly metamorphosed, are rather hard. Pyrophyllite formation usually occurs between formations semi-metamorphosed

like this. Sometimes, it occurs as veinlets with the latter as wall rocks. It sometimes happens that one portion of the same mass of rock is pyrophyllite while the other portion is semi-metamorphosed.

Pyrophyllite was worked as early as Sung dynasty, chiefly for making seals. It was not exported to foreign countries, until fifty years ago, mainly in the form of ornaments. Exportation to the United States began as late as fifteen years ago. The annual production at present is about 3,000 boxes of finished articles, valued at \$120,000 mex., About ninety five percent of this amount is sent overseas, of which, the United States takes about eighty percent, while the rest is shipped to Japan, Europe, Philippines and elsewhere.

(A) *Pyrophyllite Formations of Tsintien District*

(1) *Anlung, Sunkuo* (山口岩礮):- It lies 12 km. southeast of Tsintien and one km. southeast of Sunkuo. The country rock is rhyolite. The pyrophyllite occurs as veinlets and thin beds. Its colors vary from red, yellow, white to black, red color predominating.

(2) *Tushushan, Sunkuo* (山口圖書山):- It is located 13 km. southeast of Tsintien and 4 km. southwest of Sunkuo. The country rock is rhyolite. The pyrophyllite is thin-bedded. Its colors vary from red, yellow, white to black, white color predominating.

(3) *Paiyanshan, Yiechien* (嶼前白坪山):- It occurs 15 km. southeast of Tsintien and 2 km. northwest of Yiechien. The country rock is rhyolite. The pyrophyllite is thin-bedded. Its colors vary from red, yellow, white to black, yellow color predominating.

(4) *Antao* (岩頭):- It lies 20 km. southwest of Tsintien and 4 km. west of Wu-An (吳岸). The pyrophyllite is white in color and is somewhat too hard.

(5) *Haoshan, Duoohie* (道居后山):- It occurs 23 km. southwest of Tsintien and 9 km. northwest of Wu-An. The country rock is rhyolite. The pyrophyllite is thin-bedded. Its colors vary from red, yellow to white, the latter predominating.

(6) *Tsieshantao, Tsieshan* (季山季山頭):- It lies 29 km. southwest of Tsintien and one and half km. north of Tsieshan. The country rock is tuff. Pyrophyllite is thin-bedded and has two varieties, namely red and yellow. The former predominates in quantity while the latter is higher in grade.

(7) *Monchienshan, Tsieshan* (季山門前山):- It is located 30 km. southwest of Tsintien just east of Chieshan. The country rock is tuff. The pyrophyllite is thin-bedded and is colored red or a mixture of red and yellow. The former predominates.

(8) *Lungtingsien, Chowtsin* (周村龍頂尖):- It lies 32 km. southwest of Tsintien and one km. north of Chowtsin. The country rock is tuff. The pyrophyllite occurs in the form of veinlets, irregularly scattering through the semi-metamorphosed tuff. Besides the veinlets, we can also find patches of pyrophyllites, incorporated in big masses of the semi-metamorphosed rock. There are two varieties, yellow and white, the latter predominating.

(9) *Lingtao, Hsiatsati* (夏家地嶺頭):- It occurs 29 km. southwest of Tsintien and half km. south of Lingtao. The country rock is tuff. The pyrophyllite is thin-bedded and varies from red, white, yellow to gray in color, the former two varieties predominating.

(10) *Fantsengshan, Hsabau* (下堡飯甌山):- It lies 29 km. northwest of Tsintien and 3 km. southwest of Hsabau. The country rock is tuff. There are two thin beds of pyrophyllite about 4 m. apart. The upper bed is one m. thick while the lower is 0.4 m. thick. The rock is colored grayish white with red bands occasionally distributing through it.

(B) *Pyrophyllite Formation of Yintsa District*

Tsiutung-An, Shin-Ou (沈畧紫洞岩):- It is located 51 km. northeast of Wintsie (溫溪). The country rock is rhyolite. pyrophyllite occurs as a thin bed about one m. in thickness. It is light-green in color and is rather brittle and hard.

SLVER DEPOSITS

(A) *Silver Deposits of Sheonping District*

(1) *Lungkun* (鶯坑):- The deposit is 12 km. northwest of Sheonping and one km. southwest of Lungkun. It had been operated in Ming dynasty, old pits amounting to hundreds, with depths varying from one to several tens of meters, deeper ones being filled with water. The veins number to twenty. Their general trend is approximately N. S., dipping west or east. The amount of dip varies from zero to over eighty degrees. The average length of the veins is about 1,000 m. and the average width, 0.7 m.. Argentite is

the ore mineral, which, according to the samples collected at the mouth of the pits, is so minute that the majority cannot be seen without a lens. The gangue mineral is quartz and country rock is rhyolite.

It is quite regretful that the assaying equipments of the Survey Laboratory are not complete enough to make a reliable assay of the ore. Thus, the grade of the ore and the reserve of the deposit are both left unknown. Nevertheless, according to its size, this deposit looks very promising and is quite worthy of careful investigation and systematic exploration at future date.

Communication is quite a problem for this deposit, There is no water transportation within 50 km. But recently, the public highway from Sheonping to Kinghua (金華), by way of Wuyie, is under construction, which, if completed, will certainly serve to raise the prospect of this deposit.

(2) *Dayinkun, Pu-Ai* (普愛大銀坑):- It lies 30 km. southeast of Sheonping and one km. southeast of Pu-Ai. The vein, striking N.30°W. and dipping 30° N.E., is 0.7 m. wide and 250 m. long at the outcrop. The argentite, occurring with quartz in a country rock of basalt, is bigger in crystals than Lungkun and is rather rich in value. It had been worked years ago, the deepest pit being about 30 m. in depth. The nearest port is Taipingfien (太平汎), 23 km. to the S.E.,

(B) *Silver Deposit of Lieshiew District*

Yintungbei, Yinkun (銀坑銀洞背):- It occurs 14 km. N. E. of Lieshiew and 5 km. southwest of Yintsong (銀場). It had been worked at times unmemorable. The vein, striking N.40°W. and dipping 55° N. E., is 0.8 m. wide and about 200 m. long at the outcrop. The gangue mineral is quartz, occurring in a country rock of tuff. The ore mineral, whatever it is, is not detectable even with a lens. Lieshiew city is the nearest port.

(C) *Silver Deposits of Tsintien District*

(1) *Haoling, Geichietao* (芝溪頭后嶺):- It lies 31 km. northwest of Tsintien and one and half km. northwest of Geichietao. The vein, striking N. 45°E., is 15 m. wide and 150 m. long at the outcrop. It is a quartz vein, occurring in tuff. Greater part of the vein is barren, except the southwestern end at Aumaquin (均馬崑), where a small amount of argentite is detectable with a lens. Communication is convenient, Eukiang being 300 m.

to the S. E..

(2) *Yintunquo, Yinkun* (銀坑銀洞窟):- It is located 69 km. northwest of Tsintien and 300 m. west of Yinkun. It had been worked in Sung dyuasty, leaving a drift about half km. long. The vein, 0.9 m. wide, strikes $N.25^{\circ}E.$ and dips $60^{\circ}N.W.$. It occurs in tuff and carries quartz as gangue. The ore mineral, according to the specimen collected at the front part of the drift, is not detectable with a lens. The inner part of the drift is partly filled with water and is not accessible. The nearest port is *Haikuo* (海口), 23 km. to the S.W..

LEAD-ZINC-COPPER DEPOSITS

(A) *Lead-Zinc-Copper Deposits of Yintsa District*

(1) *Yinkunshan, Tuntaoyang* (坦頭山, 銀坑山):- It lies 37 km. northwest of Yintsa and 2 km. southwest of Tuntaoyang. It had been worked about 20 years ago, leaving four pits, three of which are drifts while the other is a short tunnel with drift. There are three veins with quartz as gangue, lying in granite.

The first vein has two pits, 50 m. apart, from which we can find that the vein is symmetrically banded. The middle portion is looser in texture and is richer in minerals which consist of galena, sphalerite, chalcopyrite and pyrite. On both sides, the gangue rock is harder than the minerals, which, although of the same composition, are leaner in value. The vein strikes $N.15^{\circ}W.-N.30^{\circ}W.$ and dips $70^{\circ}S.W.$. Its width varies from one m. to 2.5 m., the richer portion being 0.6-2 m. wide. The known length is 50 m. with a possible length of 300 m.. The ore carries 7.42% Pb, 3.14% Zn and 1.42% Cu. The reserve is approximately 19,000 met. tons. of galena, 5,000 met. tons of chalcopyrite and 5,600 met. tons of sphalerite.

The 2nd vein is 50 m. east of the 1st vein. There is an old drift about 3 m. long. The vein, 3.5 m. wide, strikes $N. 65^{\circ}W.$ and dips $72^{\circ}S.W.$. The ore is not banded and carries 2.12% Pb, 3.24% Zn and 2.2% Cu. The estimated reserve is about 3,600 met. tons of galena, 5,300 met. tons of chalcopyrite and 3,800 met. tons of sphalerite.

The 3rd vein is 100 m. east of the 2nd vein. It strikes $N.25^{\circ}W.$ and dips $64^{\circ}S.W.$. The vein, 0.9 m. wide, is symmetrically banded. The central part, 0.15 m. wide, is richer in minerals, carrying 4.12% Pb, 1.12% Zn and

1.92% Cu. The reserve of the central part is approximately 240 met. tons of galena, 150 met. tons of chalcopyrite and 40 met. tons of sphalerite.

There is a little stream at the bottom of the hill, through which, the ore can be shipped by raft to Hanpu (韓埠), about 14 km. to the south, which is reachable by steam-boat from Yintsa.

(2) *Liaohaoshan, Sunken* (山根寮後山):- It occurs 29 km. northwest of Yintsa, one km. west of Sunken and 5 km. south of Tuntaoyang. The country rock is rhyolite. The vein is a breccia vein whose gangue consists of a small amount of quartz and a large amount of rhyolite breccias, the former filling the spaces of the latter. The ore minerals are incorporated in quartz while the breccias are impregnated with the same, which consist of galena, sphalerite, chalcopyrite and pyrite. The vein is lenticular in shape, whose width varies from 0.2 m. at its ends to 8 m. at the middle. It has a limited length of 25 m. and strikes N.30°W., with a dip of 80° to the N. E.. According to analysis, the ore carries 14.2% Pb, 1.02% Zn and 0.34% Cu. The estimated reserve is approximately 15,300 met. tons of galena, 500 met. tons of chalcopyrite and 750 met. tons of sphalerite.

The presence of breccias clearly indicates that tremendous crushing had gone through during the formation of this fissure. From the nature of the breccia rock and the angular character of the fragmental pieces, we can well believe that this vein was not formed by replacement.

The nearest port is Hanpu, 6 km. to the south, to which the ore can be transported either by raft through the small stream nearby or on the back of coolies.

(3) *Tsianshan, Sunkun* (孫坑前山):- It lies 71 km. northwest of Yintsa and 3 km. northeast of Sunkun. It had been once operated about twenty five years ago. There is an open-pit and a slope following the vein at its bottom. The country rock is rhyolite. The vein, carrying quartz as gangue and galena, sphalerite, chalcopyrite and pyrite as ore minerals, is symmetrically banded, the central part being looser and richer in minerals. The total width is 5 m., the central portion being only 0.6 m. wide. It is 25 m. long at the outcrop and strikes N. 60°W., with a dip of 55° to the N. E.. The ore carries 12.79% Pb, 2.14% Zn and 0.44% Cu. The reserve is approximately 11,000 met. tons of galena, 540 met. tons of chalcopyrite and 1,

200 met. tons of sphalerite. The nearest port is Wintsie, 20 km. to the south.

(4) *Dalungshan, Huanyuanpien* (黃坦坪大龍山):- It is located 51 km. northwest of Yintsa and 2 km. southwest of Huanyuanpien. The vein lies in rhyolite. The gangue mineral is quartz, which is weaker than the country rock. Thus, little ravine is formed along the vein, with water dripping through it all around the year. The ore minerals are galena, sphalerite, chalcopyrite and pyrite, distributing through-out the vein rather evenly. The vein strikes N. 10° E. and dips 85° S.E.. Its average width is 0.8 m. and its length is 100 m. along the outcrop. It carries 2.34% Pb, 2.72% Zn. and 2.8% Cu. The estimated reserve is 2,400 met. tons of galena, 4,000 met. tons of chalcopyrite and 2,000 met. tons of sphalerite. The nearest port is Tsaotao (橋頭), 11 km. to the southeast.

(5) *Bonlukun, Chinshan* (鄭山半路坑):- It lies 51 km. northwest of Yintsa and one km. west of Chinshan. A small block of rhyolite, about one m. by 3 m. in dimension is fractured, in the form of stockwork. The irregular fissures are filled with quartz and a certain amount of galena, sphalerite, chalcopyrite and pyrite. The fractured rhyolite fragments are also impregnated with small amounts of ore minerals.

(6) *Wenkun, Huangda* (黃大橫坑):- It is located 61 km. northwest of Yintsa and one km. south of Huangda. The vein, lying in rhyolite, carries quartz as gangue. The ore minerals consist of galena, sphalerite, chalcopyrite and pyrite. The vein, striking N.60° E., is 3 m. wide and 25 m. long along the outcrop. The ore carries 3.94% Pb, 2.88% Zn and 1.04% Cu. The reserve is approximately 10,000 met. tons of galena, 3,800 met. tons of chalcopyrite and 5,000 met. tons of sphalerite. The nearest port is Tsaotao(橋頭), 12 km. to the S.E.

(7) *Zonkoshan, Dongshan* (東山重柯山):- It is 69 km. northwest of Yintsa and 2 km. southeast of Dongshan. There is a breccia vein, lying in rhyolite. It is filled with a large amount of rhyolite breccias and the spaces between these fragments are filled with quartz. The breccias are angularshaped and are impregnated with ore minerals. They are what we call horses. The quartz, incorporated with ore minerals, is big in crystals and is colored pink, green and white. The vein, 25 m. long along the outcrop, is measu-

red 8 m. wide at the middle and 0.2 m. wide at the ends. It strikes N. 70° E. and dips 80° to the N.W.. The ore minerals consist of galena, sphalerite, chalcopyrite and pyrite. They are analyzed to carry 0.92% Pb, 5.4% Zn, and 2.04% Cu. The estimated reserve gives approximately 780 met. tons of galena, 3,400 met. tons of sphalerite and 2,300 met. tons of chalcopyrite. The nearest port is Wintsie (溫溪), 16 km. to the south.

(B) *Lead-Zinc-Copper Deposits of Tsintien District*

(1) *Hsialungtienhao, Lun-An* (南岸下隴殿後):- It lies 12 km. northwest of Tsintien and 4 km. southwest of Shietsie (石溪). The deposit seems to be of contact-metamorphic origin. The intruded rock is rhyolite while the intruding rock is granite. The ore minerals consist of galena, sphalerite, chalcopyrite and pyrite. The mineralized zone, running in a general trend of N. 60° E., is about 100 m. long and 50 m. wide. The ore is found to carry 5.94% Pb, 2.12% Zn and 2.12% Cu. The reserve is approximately 256,000 met. tons of galena, 126,000 met. tons of chalcopyrite and 62,800 met. tons of sphalerite. Communication is convenient, Sueotsie (小溪) river being at the foot of the hill.

(2) *Yenāenfon, Son-An* (上岸烟墩峯):- It is located 12 km. northwest of Tsintien and one km. north of Son-An. It is just opposite of Lun-An, across the river. The ore minerals, consisting of galena, sphalerite, chalcopyrite and pyrite, are found in rhyolite, which is pink and white in color. The mineralized zone, running in the direction of N. 50° W., is about 100 m. long and one m. wide. The deposit seems to be of contact-metamorphic origin; but what is the intruding rock, the author was unable to discover as the inspection was carried out near night-fall.

The ore is found to contain 3.12% Pb, 1.94% Zn and 1.32% Cu. The estimated reserve is approximately 4,000 met. tons of galena, 2,400 met. tons of chalcopyrite and 1,700 met. tons of sphalerite.

(3) *Neuchantso, Wenkun* (橫坑牛藏脚):- It occurs 63 km. northwest of Tsintien. It is a quartz vein, lying in granite. It had been worked for sulphur by the match factory at Lieshiew. The old pit has collapsed and outcrop cannot be found, detailed inspection of the deposit being thus made impossible.

There is an outcrop in a little creek 2 km. to the south. It is only

0.2 m. wide. If the vein perpetuates in between, the reserve will be appreciable. The nearest port is Chinshanpu (陳山埠), 22 km. to the S.W.

LEAD-ZINC DEPOSITS

Lead-Zinc Deposits of Yintsa District

(1) *Sonpeikun, Sunkun* (孫坑上牌坑):- It is located 69 km. northwest of Yintsa and 2 km. south of Sunkun. There are two veins, lying in rhyolite. They strike N. 25°W. and dip gently at 15° to the S. W. They are 2 m. apart. The upper vein is one m. thick and 9 m. long at the outcrop. The lower vein is 0.7 m. thick and 12 m. long at the outcrop. The ore minerals, lying in quartz, are chiefly sphalerite with a small amount of galena and pyrite. The upper vein is found to carry 17.2% Zn and 2.58% Pb, with a reserve of 2,600 met. tons of sphalerite and 560 met. tons of galena. The lower vein is analyzed to contain 21.04% Zn and 0.58% Pb., with a reserve of 2,200 met. tons of sphalerite and 90 met. tons of galena. The nearest port is Wintsie, 15 km. to the south.

(2) *Lunghao and Shuiteowen, Sunkun* (孫坑水春灣及龍後):- They lie about 200 m. southwest of Sonpeikun, on the opposite sides of a ravine.

Lunghao is the continuation of the upper vein of Sonpeikun. It strikes N.60°E. and dips 20°N.W.. It has a thickness of 1.2 m. and a length of 10 m. along the outcrop. The ore carries 13.9% Zn and 2.12% Pb. The reserve is estimated to contain 2,500 met. tons of sphalerite and 550 met. tons of galena.

Suiteowen is the continuation of the lower vein of Sonpeikun. It strikes N.70°W. and dips 40° N.E.. It is 1.5 m. thick and 4. m. long along the outcrop. The ore is found to carry 17.14% Zn and 0.94% Pb. The estimated reserve amounts to 3,300 met. tons of sphalerite and 260 met. tons of galena.

(3) *Wuloe, sunkun* (孫坑五羅):- It is located one km. south of Sunkun and 300 m. northwest of Sonpeikun. The vein is the continuation of the lower vein of Sonpeikun. It strikes N.20°W. and dips 25°N.E.. It is half m. thick and 6 m. long along the outcrop. The ore carries 19.2% Zn and 1.04% Pb. The reserve is approximately 1,400 met. tons of galena.

(Note:- The three locations, described above, are outcrops of the same veins. But without being proved by boring, it is safer to estimate the reserve

separately and conservatively. Judging from the data on hand, this deposit seems rather promising. Careful exploration will be done as soon as our calyx drill is spare)

PYRITE DEPOSITS

(A) *Pyrite Deposits of Tsintien District*

- (1) *Paishuitsie, Chiushan* (邱山白水滌):- It lies 34 km. S.W. of Tsintien and 17 km northwest of Ninqon (仁宮). It had been worked in Tsing dynasty, leaving a pit 8 m. deep and 30 m. long. The vein, about half m. wide, strikes N. 25°W. and dips 80° N.E.. The ore constitutes about 40% of the vein and gives a reserve approximately 6,000 met. tons. The nearest port is Sze-Au (寺番), 17 km. to the S. E..
- (2) *Lauwofenshan, Chintsiushie* (陳子須老鍋飯山):- It occurs 69 km. southwest of Tsintien. The deposit is in the form of stockwork. The country rock is tuff, which is badly fractured within an area of 5 m. by 20 m., forming numerous irregular veinlets. These veinlets are no more than 0.1 m. in width and vary from longitudinal, circular to square in shape. They are filled with pyrite and quartz, the latter usually assuming a comb-structure. The ore content, including the vein and the fractured tuff, amounts to 30 % and gives a reserve of 7,500 met. tons. The nearest port is Chinpu (禎埠), 20 km. to the N..
- (3) *Tsiatsin* (蔡村):- It is located 63 km. northwest of Tsintien and 3 km. north of Wangyau (王垓). The country rock is granite and gangue mineral is quartz. The vein, striking N. 10°W. and dipping 20° S.W., is 0.1-0.3 m. wide and 10 m. long along the outcrop. The ore content is 21.8% and the reserve is about 1,100 met. tons.
- (4) *Wangfukon, Tsaitsin* (蔡村望湖崗):- It lies 62 km. northwest of Tsintien and one km. south of Tsuitsin. Granite is the country rock and quartz is the gangue. The vein strikes N. 40°W. and dips 60° S.W.. It is 0.1-0.7 m. wide and 70 m. long along the outcrop. The ore content is 14.28%, giving a reserve approximately 1,100 met. tons.
- (5) *Wangyau* (王垓):- It occurs 60 km. northwest of Tsintien and 100 m. west of Wangyau. The country rock is granite and the gangue is quartz. The vein, striking N. 15°W. and dipping 80° S.W., is one m. wide and 30 m. long along the outcrop. The ore content is 30.3% and the reserve is

approximately 9,000 met. tons. The nearest port is Chinshanpu (陳山埠), 20 km. to the S.W..

(6) *Ku-Ankun, Szeyau* (峙畚古安坑):- It lies 12 km. southwest of Tsintien. The ore is rather scanty and scatters throughout rhyolite very irregularly.

(7) *Lingtao, Hsatsatie* (夏家地嶺地):- It is located 29 km. southwest of Tsintien and 3 km. southwest of Hsatsatie. The vein is 0.8 m. wide and strikes N.40°W.. It lies in tuff with quartz as gangue. The ore minerals are pyrite and hematite, scattering through the vein in irregular patches. Pyrite content is about 20% and gives a reserve of 4,800 met tons. Hematite content is about 10% and gives a reserve of 2,400 met. tons. The nearest port is Pai-An (白巖), 14 km. to the N. W..

(B) *Pyrite Deposits of Lieshiew District*

Yangteotsien, Mauyo (毛月楊對尖):- It lies 49 km. north of Lieshiew and 8 km. northwest of Kuto (庫豆). A little tract of tuff was found by the natives to be impregnated with pyrite and magnetite. The pyrite was mistaken as gold. The rumor was spread so widely that pilgrims after pilgrims of foreign geologists were induced to run after this fool's gold. The pyrite content is only 7.7%. Magnetite is still less.

MAGNETITE

There is no magnetite deposit in the surveyed region by the strict sense of the term. What we find is sparingly disseminated magmatic-segregation product of intrusive rocks. After being weathered into soil, the minute magnetite particles are naturally concentrated, as part of the soluble constituents of the rock are carried away by water. The content of magnetite in soil is never over fifteen percent, however. Nevertheless, the natives sometimes save the ore by washing in sluice. The concentrate is smelted into pig iron and wrought iron in native furnaces. The finished products are used to manufacture rural implements and household utensils. Ever since the European War, the imported article is getting cheaper than the native product. So, it is naturally being wiped out.

(A) *Magnetite Deposits of Yinwho District*

(1) *Tzungtao* (凜頭):- It is located southwest of Yinwho. The area covered is 7 km. by 8½ km.. The ore content of the soil is 9.7%, giving a reserve approximately 19,392,000 met. tons. The daily production of magnetite

per man is about ninety pounds. The price of the ore in spot is about five dollars and half mex. per met. ton. The cost of production of wrought iron per met. ton is about eighty eight dollars mex.. The present annual production of wrought iron is ninety met. tons. It is sent as far as Yintsa (永嘉) and Lanchi(蘭谿) districts for sale. The nearest port is Tsutsin (局村), 20 km. to the N. E..

(2) *Tsingshiewtang* (緊水灘):- About 14 km. northwest of Yinwho, there is a little patch of alluvial deposit of magnetite at the shore of Datsie (大溪) river. It is 10 m. by 6 m. in area and 0.2 m. in thickness. Although it lies in granite area but there is no magnetite in this rock. The source of the mineral is apparently somewhere up-stream. The iron content is 19.6%

(B) *Magnetite Deposit of Lieshiew district*

Dishiew-An (滴水岩):- It occurs 34 km. northeast of Lieshiew. It covers an area about 3 km. in diameter. The ore content of the soil is 13.2%, richest in the surveyed region. The reserve is approximately 3,133,000 met. tons. It is being worked, earning quite a good profit. The nearest port is Sontsie (雙溪), 17 km. to the west.

(C) *Magnetite Deposit of Sheonping District*

Dalia (大萊):- It lies 29 km. northwest of Sheonping. It covers an area 6 km. in diameter. The soil contains 9.7% of magnetite, giving a reserve of approximately 9,210,000 met. tons. It is being worked, producing only 6-7 met. tons of ore per year. The nearest port is Wutsie (武溪), 14 km. northeast of Dalia.

(D) *Magnetite Deposits of Tsintien District*

(1) *Shutsao* (舒橋):- It occurs 52 km. northwest of Tsintien. The area covered is 10 km. long by 8 km. wide. The magnetite content in the soil is 71.6%. The estimated reserve is 31,180,800 met. tons. It had been worked years ago. The nearest port is Chinshanpu (陳山埠), 22 km. to the S. W..

(2) *Wangwukuo* (玉沃口):- It is 20 km. S.W. of Tsintien. The magnetite content in the soil is even poorer than Dalia and Shutsao. It had been once worked, prospering especially in 1923.

HEMATITE

Hematite Deposits of Tsintien District

(1) *Whonglienkun. Chonshan* (章山黃連坑):- It is located 63 km. north-

west of Tsintien. The hematite lies in quartz vein in a country rock of granite. The vein, striking N.50° W., is 0.8 m. wide and 30 m. long at the outcrop. The hematite content in the vein is about 10%. There is a small amount of pyrite incorporated with it.

(2) *Wu-Anshan, Whu-An* (湖岸烏岩山):- It lies 12. km. northwest of Shietsie (石溪). There is a quartz vein containing forty percent of hematite. The vein, striking N.65°W. and dipping 80° S.W., is 0.3 m. wide and 3 m. long at the outcrop.

GEOLOGY OF WUTSAU COAL FIELD, YIEWU DISTRICT, CHEKIANG

by C. T. Yen

Location:- This field lies northwest of Yiewu. Wutsau is situated 13 km. northwest of the City, while Datson is 12 km. northwest of the same.

History:- This coal field had been discovered at times unmemorable. It had been actively worked before Taiping Revolution, especially at Datson (大廠), which had given applaudable results. Operations had revived three times thereafter, at Datson, Hosonshan (和尚山) and Quawanshin (掛網形), respectively; but they had proved failures on account of water or poor coal.

Physiography:-

(A) *Mountains*:- This coal field is in the form of a basin with two mountain chains, formed principally of rhyolite series, bordering north and south. They assume the form of two gentle loops, widening at the middle and meeting at Shimonling (石門嶺) and Shonshanling (香山嶺). There are two gaps in the two mountain chains, one at Shanliedien (三里店) in the northern chain, forming a narrow pass-way to Pukiang district (浦江縣), while the other being from Tsieten (溪坦) to Matsoutan (馬交塘), making a wide thoroughfare to Yiewu city (義烏城). The highest peak among the ridges is Dashin-An (得勝岩), ranging 424 meters above sea-level and 300 meters above its base. The hills within the basin, formed of coal series, are mainly of low ranges, the highest ridge being about 150 meters above its base.

Water:- There is a creek, named Yenshui (濱水), draining the whole basin. It is formed of two branches, one starting from Shonshanling (香山嶺) while the other starting from Shimonling (石門嶺). They unite at Wumonshie (吳門市), cut through the northern mountain chain at Shanliedien (三里店) and empty to Puyangkiang (浦陽江) at Huangtsaeshie (黃宅市). It is a temporary river, drying up if it does not rain for one month; while in rainy season, it reaches a width of 2-3 meters and a depth., suitable for raft to get to Tsieten (溪坦).

As the coal series at the bottom of the basin is loose and pervious to water and the surface water of the region is gathered into the basin

by the mountain chains, quite a good portion of the water percolates to the formations below. This explains readily why the water in the coal seams is rather heavy in amount.

Stratigraphy: - There are five kinds of formations in the field; namely (1) pegmatite dikes (cretaceous), (2) coal series (jurassic) (3) rhyolite series (upper cretaceous), (4) Chukiang red-sandstone series (tertiary), (5) alluvium (quarternary).

(A) *Pegmatite dikes*: - They cover the region of Siehoa (西河), Yafen (雅畝), Hunsinfen (洪巡畝) and Haomoudien (後毛店). The dikes are quite numerous in number but small in size, ranging from 0.1 meter to 3 meters in width, with an average of 0.2-0.3 meter. They are composed of a large amount of quartz, a moderate amount of muscovite and a small amount of feldspar, all of big crystals. Some of the dikes are devoid of feldspar. It is quite common for the composition of pegmatite to vary in the same place and we find here an example.

(B) *Coal series*: - With the exception of a limited amount of sandy slate, quartzite, mica-schist and conglomerate, the majority of the rock strata are sandstones of greenish yellow to yellowish white in color. They vary in different localities. A generalized column section (fig.1) can be referred to in the Chinese text.

The mica-schist, fifty meters in thickness, scatters around Siehoa (西河), Yafen (雅畝) and Hunsinfen (洪巡畝). It is loose in texture and consists of muscovite and a minor quantity of quartz. It is intruded by pegmatite dikes. The strike of the dikes is parallel to the schistosity of the schist. It is evident that there is a close relation between the intrusion of the dikes and the formation of schist. It is also evident that this schist is transformed from sandstone as it contains a certain amount of quartz grains. There is fine-grained sandstone, west of Haomoudien (後主店), which assumes a schistose structure and contains an appreciable amount of sericite. It is also intruded by pegmatite dikes which are fewer in number than those in mica-schist. It is quite probable that this sandstone has been transformed by the intrussion of dikes but metamorphism has not been pushed far enough to produce mica-schist. On the same geological horizon with the mica-schist, there is quartzite at Tsianshan (前山), southeast of

Shantan (山塘), It is about eighty meters in thickness.

Superimposing on the said stratum, there is a layer of sandstone of medium grain. At Yafen (雅畝), it is grayish-white in color and 250 meters thick. At Shantan (山塘), It is yellowish-gray in color and 50 meters thick. At Siujinshan (小金山), it is yellowish-white in color, 80 meters thick and contains a small amount of sericite.

Right above the said sandstone are the coal seams. There are probably nine seams with shales in between. Their total thickness amounts to seven meters at Siujinshan (小金山)

Lying above the coal seams, there is layer of sandstone. At Shantan (山塘), it is coarse-grained, light violet in color and 60 meters thick. At Hosonshan (和尚山), it is medium-grained, light-yellowish in color and 60 meters thick. At Siujinshan (小金山), it is medium-grained, colored pink and eighty meters thick. At Sonjin (上金), it is fine-grained, colored dark-green and thirty meters thick.

Situated above the said stratum at Siujinshan, Liemunshan (裏門塘) and west of Chintan (均塘), there is a layer of sandy slate. It is colored yellow to light red and is about ten meters in thickness.

Next above, we find a layer of greenish-yellow sandstone, mostly medium-grained. It practically distributes throughout the whole field and can be regarded as the datum rock of coal series. Its average thickness is about 200 meters. According to the fossil flora, found in the shales in accompaning with coal seams, the coal series seems to be formed in jurassic. The total area covered by the outcrops of coal series is about 15 km. long and 10 m. to 3 km. wide.

(C) *Rhyolite series*:- The mountain chains, superimposing the coal series north and south, are composed of rhyolite series. The southern chain is simpler in constitution, consisting of tuff at the bottom, averaging about 50-80 m. thick and rhyolite at the top, approximating at 300 m. in thickness.

The northern chain is more complex, especially at Dashin-An (得勝岩), whose column section can be referred to in fig 2 of the Chinese text. Only the tuff-conglomerate at the top deserves special mention. The matrix is red in color. The pebbles occupy forty per cent of the bulk and ran-

ge from 0.05 m to 0.5 m. in diameter. They are rhyolite pebbles with occasional presence of tuff, quartz and chert. They are principally rounded, some even assuming the form of beach pebbles. They are probably accumulated by local bodies of water for the most part.

(D) *Chukiang red sandstone series*:- There are two regions, in which, Chukiang red sandstone series superimposes on rhyolite series. One region is at Wufonting (五峯亭), Liontaomon (兩頭門) and Shanmienchen (山面陳). The second region is at Yentaoling (演頭嶺), Yiehoa (兪河) and Huanlung-haotsae (黃衝後宅).

In the first region, around Shanmienchen, the conglomerate conforms on sandstone which, in turn, rests unconformably on the side of rhyolite series. The conglomerate is of varying thickness, being thicker in the western part which amounts to 200 meters at Shiemontan (石門塘). Its pebbles, less than forty percent in the whole bulk, are principally of rhyolite. Tuff, chert and quartz fragments are sometimes found. The matrix is fine-grained, uniform in texture and mainly red in color. Sometimes it is colored grayish-white in small patches, which are circular or irregular in shape and are of the same texture as the red portions.

The sandstone is rather loose, fine and uniform in grain and pink in color. Sometimes, there are small circular patches, scattering throughout the sandstone. They are about 0.015 m. in diameter, colored grayish-white and of the same texture as the red portions. This layer is about 200 m. in thickness.

In the second region, sandstone lies under conglomerate and overlaps, nearly conformably, on rhyolite series. In Yiehoa (兪河) and Huanglung-haotsae (黃衝後宅), it lies in contact with mica-schist. It is quite probable that rhyolite series in this area had been eroded away, so red sandstone series overlaps on coal series directly. The sandstone is colored red and is spotted with grayish-white circular patches of approximately 0.015 m. in diameter. The lower part is fine-grained while that, close to conglomerate, is coarser in grain. Its total thickness is 80 m.

The conglomerate of the second region lies conformably on sandstone with a thickness of fifty meters. The matrix is fine-grained, uniform and colored red. Its pebbles are mainly rhyolite fragments which are rather

small, the largest pieces being about 0.1 m. in diameter.

(E) *Alluvium*: - There are two tracts of alluvium in the coal field. One of them is around Fonshusha (楓樹下), being a part of the alluvial plain of Dunyangkiang river (東陽江). The other is the alluvial plain of Yen-shui (濱水), assuming the form of narrow bands, along the courses of the creek and its branches.

Structures: - The structures in the middle of the field are quite complex while those at both terminals are rather simple. The cross-sections can be referred to in the figure and are described as following:

(1) *Section A-A (500 m. north of Sonjin 上金)*: - The formation dips uniformly 20 degrees to the southeast, with a strike of N. 80°E.

(2) *Section B-B (From Wuyoshan 五岳山 to Tsiankudawanmu 錢庫大王廟)*: - The formation strikes N.60°W. and dips uniformly 30° to the N.E.

(3) *Section C-C (Lunhuashan 龍華山 to Ma-Anshan 馬鞍山)*: - The formation dips 10°-20° N.E. There are quartzite and light yellow sandstones, west of Hsatienshie (下田市) and east of Haofu (後傅). It seems that there is a normal fault near Hsatienshie (下田市), with a displacement of 140 m.

(4) *Section D-D (through Wumonshie 吳門市, Hsawu 下吳 and Hsaloa 下樓)*: - The formation dips to northwest, west of Hsaloa and dips to northeast, east of Hsaloa. It seems that there is an anticline at here. But the strata are quite different on both sides, consisting of violet coarse sandstone and green conglomerate, west of Hsaloa and red fine-grained and white medium-grained sandstones, east of Hsaloa. Hence, there must be a reversed fault around Hsaloa.

(5) *Section E-E (southwest of Chintan 均塘)*: - There is greenish-yellow sandstone in the western end of the section and yellow slate and light-yellow sandstone in the eastern end, all dipping towards northwest. This is in accordance with the stratigraphical sequence of the field. But in the middle part of the section, there are green conglomerate and violet sandstone, protruding between both ends and dipping in the reversed direction. It indicates the existence of two reversed faults. The formation west of the eastern fault is the same as that west of Hsaloa fault of section D-D. It is evident that they are of the same fault.

(6) *Section F-F (From Chibowu 巨林塢 to Tsianshan 前山)*: - The sect-

ion is a syncline, with folding axis at Haoshan (後山). The western wing dips 20° - 40° to the southeast while the eastern wing dips 20° - 26° to the northwest.

(7) *Section G-G (From Wutsau 烏灶 to Yafen 雅畝)*: - The formations at Shietanshan (石塘山) and Chintenshan (青籐山) are both coal seams and greenish-yellow sandstone, dipping in the same direction to the northwest. It is evident that there is a normal fault between the two, with a displacement approximately 100 m.

(8) *Section H-H (From Hutaoshan (虎頭山) to Hotsi 何界)*: - There are two anticlines with a syncline in between. The western anticline is situated west of Siujinshan (小金山). Its western wing strikes $N.60^{\circ}E.$ and dips 20° N.W., while the eastern wing strikes $N.40^{\circ}E.$ and dips 80° S.E.. Further east, it turns towards N.W. with dips 40° - 80° . East of Siujinshan, it turns towards S.E., with an angle of 20° .

(9) *Section I-I (North of Hunquntan 洪公塘 to Dungshan 東山)*: - There are two anticlines with a syncline in between. The western anticline lies west of Hosonshan (和尚山). Its western wing strikes $N.40^{\circ}E.$ and dips 30° - 75° N.W., while the eastern wing strikes $N.35^{\circ}E.$ and dips 65° - 75° S.E.. At Datson, it turns towards N.W. with a dip of 60° , the strike being $N.20^{\circ}E.$ Sixty meters further west, it turns towards S.E. and N.E., with an angle of 20° .

(10) *Section J-J (through Liakunshan 雷公山)*: - There are two anticlines and two synclines. One of the synclines is in the eastern end of Liakunshan. Its eastern wing strikes $N.70^{\circ}E.$ and dips 70° N.W., while the western wing strikes in the same direction and dips 30° S.E.. Further west, it turns down towards N.W. with a dip of 40° and a strike of $N.60^{\circ}E.$ Still west, it turns up towards S.E. with a dip of 20° and a strike of $N.70^{\circ}E.$ Northeast of Futsae (傅宅), it dips 40° - 60° N.W. and strikes $N.30^{\circ}$ - $50^{\circ}E.$

(11) *Section K-K (From Sanwietan 三畏堂 to Hsawen 下方)*: - We find in this section two synclines with an anticline in between, all of gentle dips. Southeast of Sanwietan, the formation dips 10° N.E. with strikes $N.10^{\circ}W.$ and $N.60^{\circ}E.$, respectively. Northeast of Yanshusha (楊樹下), it turns up towards northwest with dips of 15° - 20° and strikes of $N.30^{\circ}$ - $75^{\circ}E.$ Northwest of Hsawen, it plunges down to 20° S.E. with a strike of $N.60^{\circ}E.$ West of

Hsawen, it dips 20° N.W. and strikes $N.50^{\circ}$ E.

(12) *Section L-L (From Hushan 虎山 to Funfonshan 鳳凰山):*- Here we find a syncline and an anticline. East of Hushan, the formation strikes $N.15^{\circ}$ E. and dips 30° S.E. Southwest of Koutan (高塘), it strikes $N.70^{\circ}$ E. and dips 40° N.W. Further east, it turns towards S.E., with dips of 20° - 35° and strikes of $N.45^{\circ}$ - 70° E..

(13) *Section M-M (From Chankuntsen 長坑尖 through Lintso 嶺脚):*- The formation strikes $N.10^{\circ}$ - 30° E. and dips uniformly 40° S.E., without any fluctuations.

(14) *Section N-N (Through Shonshanting 香山亭):*- The structure is also simple. The formation dips evenly 25° to the northeast with a strike of $N.10^{\circ}$ W..

(15) *Section O-O (From Shonshansze 香山寺 to Hsintsietantao 杏積塘頭):*- Around Shonshansze, the tuff dips 20° N.W. or 30° S.W.. Further east, coal series dips 40° S.E.. At Wufonting (五鳳亭), Chukiang conglomerate dips 25° S.E..

Coal Seams:- The coal seams crop out on top of the wings of synclines (sections F-F, H-H and I-I) or on top of hanging and foot-walls of fault (section G-G.). There are probably nine seams of coal, as those seams in the north-west wing of synclines or in the hanging wall of fault are called "big nine seams" by the natives, while those in the southeast wing or footwall are called "small nine seams". They assumed that they are of two different series of coal seams; but, in reality, they are of the same seams. coal has also been found at Sonjin (上金) and between Datson (大廠) and Liemuntan (裏門塘). Evidences of coal in the rest of the field are not yet known.

According to the natives, the coal seams are mainly thin and full of partings. There is only one seam, in the "big nine seams", which has no partings. It is called "cotton coal" by the natives, as its ash is as soft as cotton in contrast to the stony ash left by the coal with partings, which are accordingly called "banded coal" (花煤). In the big nine seams, the "cotton coal" is thickest at Hunquntan (洪公塘), being 0.3 m to 3 m thick; but it pinches beyond a length of 10 m. and a depth of 13 m.. Further east at Chintenshan (青藤山), it is only 0.8 m. thick.

The "cotton seam" is more insignificant in "small nine seams". In the southern flank of Hosonshan (和尚山), we find a "cotton seam" 1.3 m. thick, but it pinches out beyond a length and depth of 10 m., respectively. Further east, through Siujinshan (小金山) up to Shietanshan (石塘山), there is not a trace of "cotton coal". Shietanshan had been worked at former times, but data are not known. So is it at Chintan (均塘).

At Liemuntam (裏門塘) and Datson (大廠), the eastern wing of an anticline, a big seam of "cotton coal" had been worked. It is 10 meter thick. It pinches out at a length of 13 m. and turns to coal full of partings at a depth of 100 m., somewhere above this seam, there is a thin seam of clean coal, having a thickness of 0.7 m. It is abnormally hard and low in volatile matter. It was principally used for cooking purposes.

Five hundred meters north of Sonjin (上金), there is a spotty outcrop of coal. It is rather bony and its thickness is unknown.

It is known that the amount of water in the coal seams is too big for the native method of drainage to handle and a pump with a capacity of 60 gal. per min. had failed to overcome the water at Datson (大廠). The coal is practically devoid of gas, oil lamp being formerly used. The top rock is rather loose, but the bottom rock does not heave.

Quality of coal:- The coal is rather poor in quality. Even the so called "cotton coal" is, in many cases, incorporated with fine veinlets of silica and hematite. So the ash content is rather high. It is likewise rich in pyrite, mainly in larg lumps. The coal is rather lumpy, high in lustre and low in volatile matter. Its analyses are tabulated as following:

	1	2	3	4
	picked up from the surface at Hunquntan	picked up from the surface at Chintenshan	collected from the outcrop at Hunquntan	picked up from the surface at Shietanshan
moisture	2.3%	0.88%	21.2%	2.7%
volatile matter	8.5%	7.62%	24.0%	19.3%
ash	27.8%	20.8%	14.0%	35.5%
fixed carbon	61.4%	70.7%	40.8%	42.5%
fuel ratio	7.2	9.7	1.7	2.2

As the samples are either picked up from the dump or taken from the outcrop, they can hardly be representative in quality. According to the table, we see that its composition is rather varied. According to Frazers fuel-ratio method of classification, the coal in columns 3 and 4 are bituminous as the fuel ratios are 1.7 and 2.2 respectively. The sample in column 3 is outcrop coal, so it is high in moisture. The sample in column 4 is abnormally high in ash. As fuel ratio does not take moisture and ash into account, it is quite doubtful that this coal is really bituminous. The first sample is semi-bituminous and the second sample is semi-anthracite according to fuel ratios. As there are two samples advocating it to be bituminous, it is quite reasonable to take the mean of the two, for calling it semi-bituminous.

Coal reserve:- Besides Sonjin (上金), coal has been discovered between Datson (大廠) and Chintan (均塘). It is probable that the coal is continuous between Chintan and Sonjin. The distance between Datson and Sonjin runs about 8 km. Let us assume that the average thickness of clean coal is one meter, the average depth of workable coal is 200 m. and the amount of coal recoverable is seventy percent. With a specific gravity of 1.3, the reserve amounts to 1,456,000 metric tons ($8000 \times 200 \times 1 \times 1.3 \times 0.7 = 1,456,000$).

Communication:- The Hanchow-Kiangshan railway passes through Yiewu district. Suotsie station (蘇溪站) is 16 km. from Datson (大廠) while Yiewu station (義烏站) is 12 km. from the same, both passing through even plains on the way. The total distance to Hanchow is 12 km. shorter through Suotsie station than Yiewu. So it is advisable to build a branch railway from Datson to Suotsie, if this field is to be operated. The total distance from Datson to Hanchow, through Suotsie, is 126 km. It will cost \$2.44 mex. per metric ton of coal, according to the present freight rate of the Road for that distance.

Water communication is not convenient. Donyangkiang river (東陽江) is one km. south of Yiewu city, through which, one can get to Hanchow by way of Lanchi (蘭谿), the upper part of the course being only navigable by rafts or small boats. The total rate by water transportation from the coal field to Hanchow amounts to \$10.27 mex. per metric ton.

Labor and supplies:- Labor costs \$0.25 mex. per day in normal time, with food supplied by the employer.

Timber is scarce in this locality. But Kiangshan (江山), Wuyie (武義) and Pukiang (浦江) districts are abundant in timber. The former two are reachable partly by water and partly by rail, while the last one is reachable by water alone.

Conclusion:- According to the existing data, the value of the field is rather disappointing. most of the seams are full of partings. The clean coal is high in ash and full of pinches. On the other hand, valuable coal fields are rather scanty in Chekiang while the demand for coal is disproportionately high. In addition, communication of Wutsau is alluring. If boring work can locate one meter of coal of reasonable uniformity within a tract of five square kilometers, the property might be developed in a small scale.

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BULLETIN
OF
THE MINERAL SURVEY OF CHEKIANG

NUMBER I

MAY, 1932

GEOLOGY AND MINERAL DEPOSITS OF WUYIE, SHEONPING,
LIESHIEW, YINWHO, TSINTIEN AND YINTSA DISTRICTS,
CHEKIANG.....C. T. YEN

GEOLOGY OF WUTSAU COAL FIELD, YIEWU DISTRICT,
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HANCHOW, CHEKIANG

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售價 0.60