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Hon. W. J. ASSELSTINE, *Minister* JOHN F. WALKER, *Deputy Minister*

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Mercury Deposits of British Columbia

by

JOHN S. STEVENSON

1940

THE GOVERNMENT OF
THE PROVINCE OF BRITISH COLUMBIA

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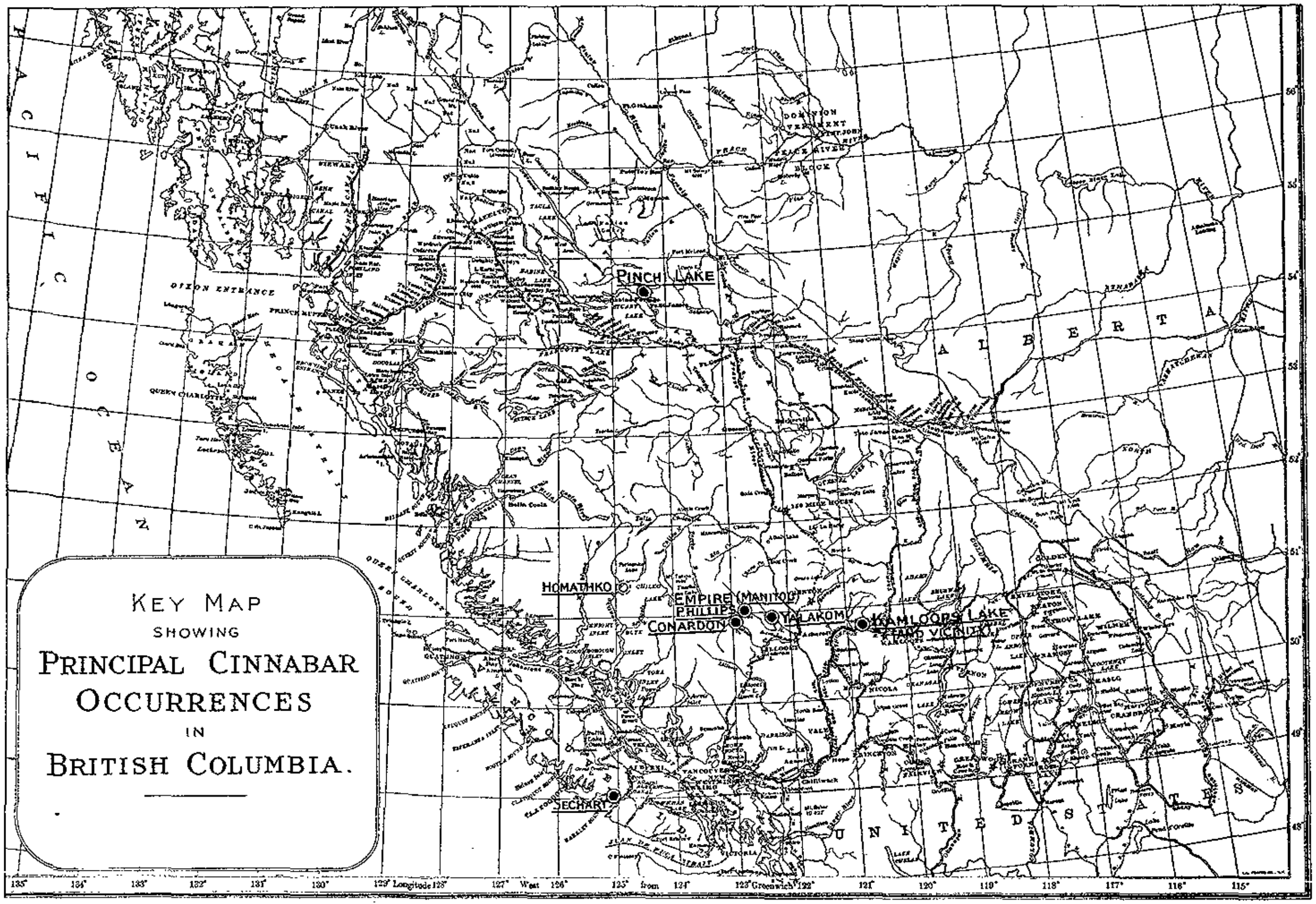
KEY MAP
SHOWING
PRINCIPAL CINNABAR
OCCURRENCES
IN
BRITISH COLUMBIA.
PINCHI LAKE
HOMATHKO
EMPIRE (MANITOU)
PHILLIPS
CONARDON
YALAKOM
KAMLOOPS LAKE
(AND VICINITY)
SECHART
PACIFIC OCEAN
ALBERTA
UNITED STATES
Longitude West from Greenwich

PREFACE.

The present report includes geological descriptions of all the known occurrences of mercury in British Columbia. With the exception of the reported occurrence on the Homathko River, all the deposits were examined by the writer during the field seasons of 1938 and 1939. For the sake of completeness an introductory chapter is included that describes the mineralogy, metallurgy and modes of occurrence and economics of mercury.

The writer wishes to acknowledge the kind assistance given by the various mine officials and prospectors associated with the properties visited. Acknowledgement is made of the hearty cooperation given by Messrs. Bronlund and Porter of the Consolidated Mining and Smelting Company, and by Messrs. Fraser and Williams of the Empire Mercury Mine. Alan R. Smith, the writer's field assistant during 1938 and 1939, greatly facilitated the field work by his capable and hearty cooperation.

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ILLUSTRATIONS.

INTRODUCTION.

In the following report the term mercury rather than the term quicksilver, will be used for the name of the metal. Where the term quicksilver appears in titles of bibliography or in quotations it will be understood to mean mercury.

Mercury Minerals

Although there are approximately twenty-five mercury minerals, only one, cinnabar, is of commercial importance. Eleven of the twelve minerals described below occur only sparingly and the remaining mercury minerals are extremely rare. The properties of these twelve minerals are listed below:

Cinnabar - Composition - mercuric sulphide, HgS = mercury, 86.2 per cent., sulphur, 13.8 per cent. Lustre adamantine. Colour scarlet-red to brownish-red. Streak, scarlet to reddish-brown. Hardness, 2 to 2.5. Fracture uneven. Tenacity, brittle to sectile. Specific gravity, 8 to 8.2.

Native Mercury - Lustre metallic, brilliant. Colour tin-white. Specific gravity, 13.6. Commonly occurs as small, liquid globules scattered through gangue or sheared wall-rock; probably reduced from cinnabar by hydrocarbons.

Amalgam - Composition - an alloy of silver and mercury of varying composition; arquerite, an amalgam containing approximately 85 per cent. silver, found in Vital Creek, Omineca District, British Columbia. Color and streak, silver-white. Opaque. Hardness 3 to 3.5. Fracture uneven. Brittle to malleable. Specific gravity 13.75 to 14.1.

Metacinnabarite - Composition - mercuric sulphide, HgS. Colour, black. Occurrence, black crystals or more frequently massive, it is a secondary sulphide deposited by descending waters.

Calomel (Horn quicksilver) - Composition - mercurous chloride, HgCl. Lustre, wax-like. Colour, white, yellowish-grey, grey, brown, translucent to sub-translucent. Streak, pale-yellowish-white. Hardness, 1 to 2. Specific gravity, 6.5. An oxidation product of cinnabar. Rare.

Montroydite - Mercuric oxide, HgO. Colour, red. An oxidation product of cinnabar. Rare.

Eglestonite and Terlinguaite - Oxychlorides of mercury. Colour, yellowish, turning to brown or green on exposure. Oxidation product of cinnabar. Uncommon, but fairly abundant at Terlingua, Texas.

Coloradoite, Tiemmanite and Onofrite - Primary; rare telluride, selenide, and sulpho-selenide of mercury, respectively.

Mercurial Tetrahedrite - A not uncommon form of tetrahedrite containing up to 17 per cent. mercury.

Geological Occurrence of Cinnabar

Cinnabar occurs in a great variety of rock-types. However, it is never of sedimentary origin, but is always associated with some manifestation of igneous activity, although the relationship may not be as evident as with other types of ore deposits. Cinnabar has been deposited under conditions of low temperature and pressure, therefore, mercury ores occur close to the surface that existed at the time of deposition.

Relatively few ore-minerals accompany cinnabar; the most common ones are pyrite, stibnite and realgar. The most common gangue-minerals include opal, chalcedony, quartz, calcite and particularly in the Kamloops Lake area of British Columbia, vein-dolomite. Carbonate-alteration, or carbonatization of the wall-rocks, is common; this type of alteration is widespread in the Kamloops Lake and Yalakom River areas of British Columbia.

Habit of Ore

In most mercury mines the ore occurs in irregularly fractured or brecciated zones, or otherwise porous rocks. In these relatively open-textured rocks the cinnabar occurs as thin, discontinuous stringers, or as scattered blebs and small grains. In the larger deposits these brecciated zones, or porous masses of rock, are capped or bounded on one side by a relatively impervious layer which may consist of either clay gouge or otherwise impervious stratum of rock, such as a lava flow.

Such structural conditions permitted the ready passage of cinnabar-bearing solutions under no great pressure, and, subsequently caused, the trapping and deposition of the sulphide from these solutions. The ore-bodies are irregular and frequently of indefinite limits; although the form may in some degree be controlled by the attitude of the enclosing rocks or faults.

The deposits are commonly associated with volcanic rocks and frequently with hot springs in regions of volcanic activity. However, the mercury-bearing solutions do not necessarily originate in the volcanic rock themselves, but rather in the same deep-seated magma-basins in which the volcanic rocks were differentiated; for that reason, cinnabar deposits may be found far from volcanic or intrusive igneous rocks.

The most favourable structure for a cinnabar deposit is one that will not only give easy access to the mineralizing solutions, but will also trap and dam them so as to localize and concentrate the cinnabar. Such open structures are afforded by sandstone, or sandy-limestone, and by brecciated and fractured zones in other rocks. The damming structure is usually supplied by overlying lava or argillaceous sediments such as shale, or by clay-gouge along a fault plane. The complete structure may not exist at the present erosion-level, but its previous existence is certainly desirable as an indication of large bodies of ore. It may be mentioned that no large bodies of ore have formed as a result of enrichment of smaller bodies by precipitation from oxidizing solutions such as has occurred in some chalcocite copper deposits.

The producing mercury mines in America are all low-tonnage operations; the largest mine, the New Almaden, treated not more than 400 tons per day when at the time of its maximum production; most of the mines in the United States mine 20 to 100 tons per day.

Because of the characteristic erratic distribution of cinnabar deposits, it is both difficult and costly to develop ore-reserves; as a result most mines never have much ore blocked out, the amount ranging from enough for one day to sufficient, at the most, for one year's operation.

The mining of cinnabar deposits differs little from that of other lode-mining, and only such features of the ore that tend to modify usual mining-practice are mentioned.

As a result of the common occurrence of cinnabar close to the present surface of erosion, open-pit and other surface-excavation types of mining are common. Owing to the brittleness of cinnabar, abundant fines are made during mining operations and special provisions should be made to save the fines, particularly in the construction of chutes.

Ventilation

Ventilation in a mercury mine should be good. At ordinary mine-temperatures there may be a volatilization of mercury from droplets of native mercury that occur in some deposits, but good ventilation will eliminate any poisonous mercury fumes. It is to be noted that the mineral cinnabar, which is the chief ore of mercury, does not give off mercury fumes at ordinary mine temperature.

Sampling

Owing to the brittleness of cinnabar and its occurrence as discontinuous veinlets and isolated blebs, which are both large and small, accurate sampling of cinnabar deposits is extremely difficult. Ordinary channel-sampling is reliable only in low-grade deposits, or in the unusual deposits in which the cinnabar occurs evenly disseminated throughout the rock. Panning of numerous samples from rock faces is common in operating mines, and when done by an experienced panner will give excellent results; checks within a limit of error of 0.1 per cent. mercury have been reported.

Metallurgy

The metallurgy of mercury ore involves the breaking down of the ore-mineral cinnabar into elemental mercury either by roasting in the presence of oxygen or retorting in the absence of oxygen. In the roasting process the mercury is driven off as mercury vapour and the sulphur is oxidized to sulphur dioxide gas, SO_2; the mercury vapour is subsequently condensed to liquid mercury in cooling condensers, and the sulphur dioxide gas escapes into the atmosphere. In the retorting process, lime is commonly added to the ore to combine with the sulphur of the sublimed mercuric sulphide to form calcium sulphide and sulphate and the mercury vapour of the dissociated sulphide is condensed in cooling condensers in the same way as in the roasting process.

Chemistry

To aid in understanding the metallurgy of mercury, some pertinent chemical data will be given. Mercury boils at 357.3 degrees C. (675.1 degrees F.) under normal atmospheric pressure. Cinnabar (mercuric sulphide) sublimes directly to mercuric sulphide vapour readily at 580 degrees C. (1076 degrees F.) at normal atmospheric pressure; the melting point of cinnabar is not known, but it lies above the subliming point. When cinnabar is roasted in contact with an excess of oxygen, it begins to oxidize at about 230 degrees C. (428 degrees F.) and at 450 degrees C. (842 degrees F.), oxidation is rapid; the oxidation takes place largely in the vapour phase. Retorting is carried out in the relative absence of oxygen and mercury is not released readily from cinnabar until near the sublimation temperature of 580 degrees C. (1076 degrees F.).

Effect of Impurities

Arsenic and antimony compounds are the only impurities which may be found in the ore that are sufficiently volatile to interfere with the extraction of the mercury. Arsenic compounds are the most serious impurities in roasting processes because the boiling point of arsenic trioxide, which is 355 degrees C. (671 degrees F.), is very close to that of mercury, which is 357 degrees C. (675 degrees F.). However, a slight modification of the treatment process is usually sufficient to overcome the contamination of the mercury by the arsenic trioxide vapour. Antimony oxides have boiling points much lower than those of mercury and a relatively simple modification of the condenser system will effect a condensation of the antimony oxides from the furnace gases at temperatures well above the condensation temperature of the mercury.

Types of Furnaces

Of the two main metallurgical processes, roasting and retorting, roasting is by far the more satisfactory and usual practice.

Several types of furnaces and kilns are used in the roasting processes; these include the coarse-ore, Scott and Armak-Spirck shaft-furnaces, and two types of mechanical roasters, namely Herreschoff furnaces and rotary-kilns. Of these types of furnaces only two are in common use in America, the Scott furnace and the rotary-kiln. The Armak-Spirck furnace, a similar type to the Scott, is used largely in Europe.

The main features of these furnaces will be briefly described.

Coarse-Ore Furnace - The typical coarse-ore furnace is a simple, internally-fired shaft-furnace that uses charcoal or coke mixed with coarse ore; the pieces of ore are preferably over 2 1/2 inches in size, fine ore cannot be treated. This type of furnace is rarely used in America.

Scott Furnace - The Scott furnace has been, until a few years ago, used almost exclusively in America. The rotary-kiln has been gradually superseding it.

The Scott furnace is a large brick structure, the outer walls of which are made of ordinary brick and the inner walls lined with fire-brick. The furnace consists of one or more pairs of narrow shafts which contain fire-clay shelves or tiers each set at 45 degrees. The ore is fed into the top of the furnace and it moves down by gravity in a zig-zag from tier to tier against the hot gases issuing from the furnace-box through ports on the side. The mercury vapour and sulphur dioxide gas pass off from the roasted ore through ports towards the top of the side of the furnace.

Scott furnaces are favoured at many mines because they have high-feed efficiency, and, because of the absence of moving parts, a low maintenance cost. However, with ores containing much pyrite, an excess of mercurial soot is formed which when absorbed by the furnace bricks creates a loss of mercury. Scott furnaces can be used for small as well as large operations, as furnaces of as low as 10-ton capacity have been satisfactorily operated.

Cermak-Spirck Furnace - The Cermak-Spirck furnace, used extensively in Europe, is a modification of the Scott. It is not used in America.

Mechanical Furnace - Of the mechanical furnaces, the Herreschoff hearth-furnace and the rotary-kiln are the two important types.

Herreschoff Furnace - In a Herreschoff furnace the ore is fed into the top of the furnace and falls on to a series of superimposed horizontal hearths. The material is stirred by rakes or rabbles set on radial arms that are revolved by a central shaft; these rakes stir the ore to the edges of each hearth and it drops to necessarily lower hearths. In this manner fresh surfaces of ore-fragments are continually exposed to the rising hot gases that pass through the ore from a fire-box on the periphery of the furnace shaft. The escaping gases, mercury vapour and sulphur dioxide, pass off through a port at the top of the furnace and into dust precipitators and condensers.

Herreschoff furnaces are not widely used because the fuel-consumption is high and a considerable amount of dust is created by rakes. This dust must be precipitated from the gas-stream before the gas enters the condensers, adding again to the operating cost.

Rotary-Kiln - The first recorded use of a rotary-kiln was in 1903 at the Socrates Mine in California, but it was not until 1918 with the installation and continued operation of a rotary-kiln at the New Idria Mine in California, that their use became established. At the present time a rotary-kiln is the more common type of furnace used on this continent.

A rotary-kiln consists of a revolving plate-steel tube set on a slope that may range from 1/2 an inch to 1 1/2 inches to the foot. The tubes range in diameter from 18 inches to 5 feet and in length from 16 feet to 75 feet; corresponding capacities of single tubes range from 8 tons to 150 tons per twenty-four hours. The daily capacity of any one furnace is also dependent on the nature of the ore, coarse ore over-roasting more quickly than soft fine ore. The capacity of a plant may, of course, be increased by increasing the number of kilns.

The ore is fed into the upper end of the tube, and as the tube revolves the ore works towards the lower end against the hot gases rising from a high-pressure oil-burner at the lower end; the speed of the tube ranges from one revolution in 1 1/2 minutes to 82 1/2 revolutions per minute. The mercury vapour and sulphur gases are drawn from the upper end of the tube through dust-precipitators and condensers.

A marked difference in operation between the Scott furnace and the rotary-kiln is, that whereas a roast requires approximately 24 hours in a Scott furnace, it takes but 30 to 50 minutes in a rotary-kiln.

Retorts - Retorting differs from roasting in that very little oxidation of the cinnabar occurs; the flames are around the ore-container and are never in direct contact with the ore as in roasting furnaces.

Retorts are cast-iron containers of either circular or D-shaped cross-section. They are commonly about one foot in diameter, 15 feet long, and are horizontally-mounted either singly or in batteries in a single furnace.

The retort-charge may consist of ore, or if the material contains much pyrite, lime is added to combine with the excess sulphur; otherwise mercuric sulphide, and not mercury, will be deposited in the condenser.

Retorts are the earliest type of furnace used, and it is reported that the Chinese operated them exclusively, but they are not in common use at present. They are largely used in the very early stages of development of a property, for the treatment of special high-grade ore, or as an accessory to a larger furnace-plant for the treatment of mercurial soot. Their disadvantages are, high construction-costs per unit-capacity and high labour- and fuel-costs.

Condensers

The mercury vapour that comes from the furnaces, kilns or retorts is first passed through dust-collectors to clean it from dust and then through condensers, first to cool the gas-stream and then to condense the mercury.

The dust-collectors are of two types, the cyclone type in which the velocity of the gas-stream is greatly reduced and the dust-particles settle by gravity, and, the Cottrel type, whereby the dust particles are electrostatically precipitated.

The gas-stream issues from the furnaces at about 300 degrees C. (572 degrees F.) and is cooled by contact with the cool wals of the condenser; it is, of course, desirable that the conductivity of the condenser-walls be as high as possible. Practically complete condensation of the mercury-vapour can be accomplished if the final temperature of the gas-stream is about 30 degrees C. (86 degrees F.). After passing through a cyclone-chamber the velocity of the gas-stream is greatly reduced from that possessed by it at the time of issuance from the furnace, so that at the cooler temperatures at the end of the condensing system, the mercury, cooled to a mist of droplets, will readily condense as liquid in the conical-shaped bottoms of the condensers.

Condensers are made from either brick, wood, glazed tile or acid-resistant metal alloys; glazed tile and alloys are in common use at present.

The mercury is tapped from the condensers into cast-iron pots and from these into 76-pound wrought-iron or pressed-steel flasks for shipment.

Mercurial soot commonly collects in the condenser-systems, and is usually collected from the condensers once a month. This soot consists of small aggregates of mercury droplets and dust, or of mercury compounds and dust. The mercury droplets and dust can be cleaned by raking or trowelling on a smooth surface; these mercury globules will coalesce and can then be collected into a pot. Dust containing mercury compounds must be retorted; this is usually done in small D-retorts accessory to the main plant.

Commonly, the mercury as collected from the condensers, will contain a small amount of base-metal amalgam. This can be collected by slightly aerating the mercury, whereby the amalgam will collect on the surface and can then be skimmed off. This is simpler than straining the full pot of mercury through a chamois cloth.

Concentration of Mercury Ores

Numerous attempts have been made to concentrate mercury ores by the same methods as are used in the concentration of the ores of gold and the base metals, but results have not been commensurate with the time and money spent. Reasonably good results can be obtained by flotation or by a combination of gravity-concentration and flotation, but the marked tendency of cinnabar to form abundant slimes makes high recoveries difficult. It must be remembered that the concentrate when obtained, must be roasted or retorted to recover the mercury from the cinnabar concentrate. At the present time, processes of concentration of mercury ores have not been so perfected as to replace the direct furnace-treatment of the ore.

Economics of Mercury

Production and Consumption

The chief mercury-producing countries are Spain, Italy and the United States; smaller producers include Mexico, China and Russia. Spain, Italy, and Russia are reported to control three-quarters of the world production (Mining and Metallurgy, May, 1939). The major consumers are the United Kingdom, United States, Germany, France and Japan; the most noticeable recent development being the increase in rate of consumption in the United Kingdom and Germany in 1938, over the high rates of 1937.

The increased consumption of mercury in 1937 over that of 1936 was accompanied by renewed activity in mercury mining. The mines in Italy and Spain are reported (as of February, 1940) to be operating at capacity. Italy responded by increasing its production in 1937 and maintained the increase in 1938 and 1939 to more than two and a half times the average for the preceding five years. Even with the cessation of the Spanish war, Italy will probably continue to supply a larger part of the world's production than she has in the past. Spanish production has continued to increase since the Civil War, reaching a record monthly production of 22,000 flasks in December, 1939. It may be noted that the Almaden district in Spain was never the scene of fighting and the mine equipment is reported to have been handed over to General Franco in perfect order. The mines in the United States were very active in the first half of 1937, but a decline in demand and decrease in the price caused a drop in the rate of production from these mines during the latter half of 1937. However, production increased from 16,508 flasks in 1937 to 17,991 flasks in 1938 and, to an estimated production of 18,343 flasks in 1939.

Germany has recently attempted to develop domestic resources, but has been unable to curtail the amount of her imports.

Normal international trade was somewhat hampered by the civil war in Spain, but ample supplies have always been available.

World Production of Mercury 1935-38, by Countries

(Compiled by R. B. Miller of the United States Bureau of Mines)

Country	1935		1936		1937		1938	
	Flasks	Metric tons	Flasks	Metric tons	Flasks	Metric tons	Flasks	Metric tons
Algeria	...	...	116	4.0	160	5.5	130	4.5
Austria	12	.4	3	.1	134.0	4.6	(1)	(1)
Bolivia(2)	422	14.5	224	7.7	18	.6	...	...
China(2)	1313	45.3	2460	84.8	1736	59.8	65	2.2
Chosen	4	.1	2	.1	2.0	.1	(1)	(1)
Czechoslovakia	2004	69.1	1876	64.7	(3)2750	(3)95	(3)2890	(3)99.6
Germany	116	4.0	1093	37.7	1741	60	(1)	(1)
Italy	28191	971.8	42732	1473.1	66719	2300.0	66719	2300.0
Japan	148	5.1	436	15.0	580	20.0	(3)580	(3)20
Mexico	6277	216.4	5307	183.0	4936	170.2	8519	293.7
New Zealand	7	.3	...	...	18	.6	(3)10	(3).3
Queensland	17	0.6	78	2.7	12	.4	(1)	(1)
Roumania	1	.1	(3)2.3	(3).1	(1)	(1)	(1)	(1)
Spain	35559	1225.8	(3)42368.4	(3)1461	(3)42342	(2)1460	40000	1378.9
Tunisia	25	.8	72	2.5	26	.9	201	6.9
Turkey	25	.9	836	28.8	484	16.9	(3)596	(3)20.5
U.S.S.R.	8700	(3)300.0	8700	300.0	8700	300	(1)	(1)
United States	17518	603.9	16569	517.2	17991	620	17991	620.2
Canada	...	...	...	...	...	...	10	.3
	100339	3459.1	122874.7	4236.48	(1)	(1)	(1)	(1)

(1) Data not yet available.
(2) Exports.
(3) Imperial Institute, London, and Metallgesellschaft.

Note: 1 metric ton = 29.008 flasks of 76 pounds.

In Canada the only production in 1938 came from the property of the Empire Mining Company in the Bridge River area; production for the year amounted to 10 flasks of mercury.

In 1937 one hundred and one mines, and in 1938, ninety-one mines in various parts of the United States produced mercury; the production by states (Minerals Yearbook, 1938, p. 602; and 1939, p. 662), is given below for both 1937 and 1938:

State	Producing Mines 1937	Flasks of 76 lbs. 1937	Value 1937	Flasks of 76 lbs. 1938
California	54	9743	$878,624.00	12,277
Oregon	14	4264	384,527.00	4,610
Arkansas, Texas and Washington	10	2266	204,348.00	768
Nevada	20	198	17,855.00	336
Arizona	3	37	3,337.00	...
	101	16508	$1,488,691.00	17,991

The Canadian consumption of mercury is indicated directly by her imports. In 1938 imports amounted to 49,584 lbs. equivalent to 652 flasks, and in 1939 to 109,232 lbs. equivalent to 1,437 flasks. The United States consumption of mercury in 1938 amounted to 19,600; and in 1939 to an estimated 19,280 flasks.

Tariffs and Cartels

At present (April, 1940) the United States maintains an import tariff of 25 cents per pound on mercury. This was imposed late in 1922 to protect domestic producers, but despite this tariff, European producers were able to get a large part of the United States market. In 1928 a European Cartel, the Mercurio Europio with Spain and Italy the most important members, was formed to control the price of mercury and to keep this at as high a level as possible. During the Spanish Civil War and for some time previous, the Cartel was inoperative, but it began to function again in May, 1939, and to handle the product from both countries, chiefly through its sales office in London. It is understood that reports concerning the moving of the sales office to Brussels, Belgium, have not as yet materialized (April, 1940). Both the Spanish and Italian producing mines are under the direct control of their respective governments.

Price of Mercury

The price of mercury has fluctuated considerably during the past few years. Because of the tariff of 25 cents per pound on mercury imported into the United States, there is a differential between the New York and London prices; this differential varies from the tariff of $19 a flask, and is dependent on the relative prices in New York and London. Between September, 1936 and October, 1937, there was a price differential in favour of selling mercury in the United States market, exceeding $19 per flask, but in November and December of that year the price differential fell below the tariff rate.

During 1939 the price of mercury has fluctuated widely. With the inception of war in September, 1939, the price rose considerably for several weeks and reached a climax toward the end of January, 1940, with the announcement that London had purchased 10,000 flasks at a price of $200 per flask f.o.b. Italy, although the Cartel posted a price of $205 per flask c.i.f. New York, duty unpaid.

Dealers in the United States fear that the various increases are due wholly to manipulation, and as a result most business in mercury in the United States is being done on a short-term basis.

Average yearly prices per flask (76 pounds) of mercury at New York and London, and excess of New York prices over London prices for period 1922 - February, 1940 (Minerals Yearbook, 1935 - 1939, E. & M.J., February, 1940, and E. & M.J. Metal and Mineral Markets, February, 1940) follow:

Year	New York	London	Excess of New York over London
1922	$ 58.95	$ 51.27	$ 7.68
1923	66.50	46.83	19.67
1924	69.76	52.93	16.83
1925	83.13	66.90	16.23
1926	91.90	76.15	15.75
1927	118.16	104.01	14.15
1928	123.51	108.54	14.97
1929	122.15	108.11	14.04
1930	115.01	105.91	9.10
1931	87.35	89.76	(Minus)2.41(London excess)
1932	57.93	48.24	9.69
1933	59.23	41.64	17.59
1934	73.87	56.15	17.72
1935	71.99	60.74	11.25
1936	79.92	64.33	15.59
1937	90.18	69.65	20.53
1938	75.47	66.92	8.55
1939	103.94 (E. and M.J., Feb. 1940)		
1940	Jan. 175.00 (E. and M.J., Feb. 1940)		
	Feb. 175.00-183 (E. and M.J. Metal and Mineral Markets for February, 1940)		

Grades of Mined Ore and Production Costs

For purposes of comparison between the three main producing countries the average grades of ore as mined over a period of years are given below: (Schuette, 1937, p. 68).

	Grade % Mercury	Period to Which Grade Figure Applies
Almaden mine (main producer in Spain)	5.00	1931 to 1934
Italy	0.79	1930 to 1934
United States	0.35	1930 to 1936

Concerning costs of production per flask, Ransome (1939) says of California costs: "This cost for present-day quicksilver mining in California varies from $30 to as much as $100 and more; the average cost of production is approximately $65 per flask."

Uses

Formerly mercury was much used for amalgamation in the treatment of gold ores, but with the increased use of cyanidation and improvements made in the recovery of mercury from amalgamation processes, the amount of new mercury used in amalgamation has decreased considerably within the past few years. By far the greatest amount of mercury is now used in electrical instruments and apparatus and in the manufacture of various drugs and chemicals. A few of its varied uses include: the manufacture of mercuric fulminate, a compound used in percussion caps and detonators; as a processing substance in the manufacture of felt; as a constituent in mercury-vapour lamps, arc rectifiers and oscillators, and, the most recent use is in the newly developed mercury (Emmet) boilers, where mercury is used instead of water.

THE USES OF QUICKSILVER
(Jenkins and Ransome, 1939)

Industries Using Quicksilver	Specific Use or Product	Form in Which Quicksilver is Used	Approx.% of Total
Drugs and Chemicals	Pharmaceuticals	Mercurial Preparations; Organic Mercurials; Metallic Quicksilver	39%
	Dental Preparations	Redistilled Quicksilver	
	Chemical Preparations	Red and Yellow Mercuric Oxide; Calomel; Corrosive Sublimate	
	Seed Disinfectant	Metallic Quicksilver and Compounds	
Explosives	Detonators	Fulminate of Mercury	19%
Industrial and Control Instruments	Gas Pressure Gages; Flow Meters; Venturi Meters; Vacuum Pumps; Heat Control Devices; Automatic Motor Switches	Metallic Quicksilver	9%
Electrical Apparatus	Mercury Vapour Lamps; Rectifier Tubes; Certain Types of Batteries	Metallic Quicksilver	7%
Paint	Vermilion	Mercuric Sulphide	7%
Hats ("Fur Cutter's" trade)	Felt	Mercuric Nitrate	5%
Chemical Industry	Caustic Soda	Metallic Quicksilver	3%
	Acetic Acid	Mercuric Salt as Catalyst	

THE USES OF QUICKSILVER (Continued)

Industries Using Quicksilver	Specific Use or Product	Form in Which Quicksilver is Used	Approx.% of Total
General Laboratory Use	Industrial Laboratories	Metallic Quicksilver	2%
	Science Labs. in Schools and Universities		
Gold Mining	Amalgamation	Metallic Quicksilver	1%
Miscellaneous Uses	Boiler Cleaning Chemicals	Quicksilver Amalgam	8%
	Manufacture of Fireworks	Sulphocyanate of Mercury	
	Marine Antifouling Paints	Red Oxide of Mercury	
	Wood Preservative	Mercuric Chloride	
	Grass Cultivation	Quicksilver Compound	
	Bearings for Lighthouse Lenses	Metallic Quicksilver	
	Refining of Lubricating Oils		
	Supersensitizing Photographic Film		
	Mercury Boiler		
	Printing Processes		

DESCRIPTION OF DEPOSITS.

Pinchi Lake

The mercury property at Pinchi Lake (Plate I A) owned by the Consolidated Mining and Smelting Company of Canada, Limited, comprises the following mineral claims: Mercury Nos. 1 to 3, Pinchi Nos. 1 to 4, Dugout Nos. 1 to 8, Chief Nos. 1 to 2 and fractions.

The discovery of cinnabar was made in the summer of 1937 by J. G. Gray of the Geological Survey of Canada, and is described by him on p. 9 of Paper 38-14, 1938. However, the original claims, the Mercury Nos. 1 to 3, were not staked until May, 1938, by A. J. Ostrem, George Nielson and A. R. Brown; these were optioned in that year by the Consolidated Mining and Smelting Company of Canada, Limited, and the remaining claims staked the same year. Since that time this company has erected a comfortable camp on the northern shore of Pinchi Lake (Plate I A).

The discovery showings are along the top of a prominent limestone ridge 700 feet above and adjacent to the northern shore of Pinchi Lake approximately 6 miles from the northwestern end of the lake.

The property may be reached from Fort St. James at the southern end of Stuart Lake, by one of two land-water routes. Of these the better and the one in common use in 1939, is via Stuart Lake for 13 miles to Pinchi Lake Indian Reserve, thence by an unimproved wagon-road on good grade for 4 1/2 miles to the southern shore of Pinchi Lake. From this point the distance by water is about 2 miles to the company's camp on the northern shore of the lake, behind a small island, beneath the showings. Alternatively, the property may be reached by a trail and poor wagon-road, 8 miles in length, branching westerly from the Fort St. James-Manson Creek road at a point about 17 miles north of Fort St. James, and connecting with a point on the northern shore of Pinchi Lake, about 7 miles distant by water from the company's camp. By far the quickest way to reach the property, however, is by airplane from Fort St. James, where planes are usually obtainable. The air-line distance is about 15 miles.

The Pinchi Lake cinnabar deposit consists of a cinnabar-bearing fracture-zone that cuts a series of dynamically metamorphosed sediments. The rocks include limestone, cherty quartzite, quartz-mica schist and a little glaucophane schist.

These rocks strike more or less uniformly north-westerly and dip north-eastward, but in the vicinity of the showings they have been warped into a structure that the writer interprets as a combined anticline and syncline that strikes northerly and plunges from 25 to 60 degrees in the same direction. The fracture-zone strikes north 60 to 70 degrees west, at times parallel to the bedding but cutting across the strike of the folds. This fracture-zone is characterized underground by extreme faulting and associated brecciation over widths ranging from 6 inches to 4 feet, and, characterized on the surface by disconnected outcrops of brecciated chert, the widths of brecciation ranging from 2 to 10 feet. The length of the fracture-zone, but not of uniform mineralization, may be summarized as follows:

(1) Length of definite fault-zone and associated brecciation as seen in the main drift of the north adit - 230 feet (as of June 11, 1939).

(2) Length of fracture-zone in the showings on Discovery Hill as indicated by fairly closely-spaced strippings and outcrops exposing brecciated rock - 750 feet.

(3) Overall distance between outcrops of brecciated rock at extremities of partly-prospected area and separated by long unprospected areas of drift - 4,000 feet.

Cinnabar occurs most abundantly in highly-brecciated fault or fracture-zone material of both the south-easterly and north-westerly workings over widths corresponding to those of the fracture-zone, and, in cherty quartzite of the north-westerly workings over widths ranging from 1 inch to 4 feet.

The showings are along the top of a limestone ridge, approximately 700 feet high that parallels the north shore of the lake. The southerly slope of the ridge begins to rise steeply a few hundred feet back from the wooded shore of the lake and rises on a slope ranging from 25 to 30 degrees to a relatively round-topped ridge at 700 feet above the lake. For the most part, the hillside consists of talus slopes and low bluffs, clothed in part by a dense covering of small timber. The showings themselves are on the highest knoll of the ridge and on the north-westerly slopes of a lower knoll approximately one-quarter of a mile north-westerly. The ground in the immediate vicinity of the discovery-showings constitutes the rounded top of the ridge, approximately 200 feet in width, and breaking off to steep talus slopes on either side.

The workings consist of 2 adits, a North and a South, of which the North adit (Plate I B) is the more important, and strippings and trenches (see Fig. 1).

In the following descriptions, when it is necessary to locate points, they can be found in one of three ways:

(1) By reference to the trench number as it appears on Fig. 1.

(2) By reference to either one of the two adits, the North adit, or the South adit.

(3) By reference to a grid system of co-ordinates with the origin near the portal of the North adit. It is to be noted that this grid has not been laid out on the ground, it is for plan reference only. (See Fig. 1.)

The hill referred to as Discovery Hill in the description trends north-westerly and the round top of it lies between the North and South adits. The discovery of cinnabar was made on this hill.

The rocks, in and adjacent to the area of the workings comprise: unaltered and altered crystalline limestone, micaceous, cherty quartzite, quartz-mica schist, glaucophane schist, serpentine and andesitic greenstone. With the exceptions of the serpentine and greenstone the rocks form a group of dynamically metamorphosed sediments that strike north-westerly and dip north-eastward, except where disturbed by minor warping in the vicinity of the ore-zone. The sequence from the lake shore north-easterly across the strike towards Discovery Hill is as follows: first, a lake-shore band of unaltered and unmineralized, crystalline limestone, approximately 300 feet in exposed width; second, a band of schist, approximately 1,000 feet in width, although this is mostly quartz-mica schist, a band of glaucophane schist of an indicated width of only 150 feet, occurs on the south-west adjacent to the limestone; third, a lens of laminated, micaceous, cherty quartzite, the scattered exposures of which indicate a width of approximately 300 feet in the widest part; fourth, a thin lens of limestone that is approximately 40 feet wide in the vicinity of a point 800 feet south and 100 feet east of the north adit (see Fig. 1), but narrows to a few lone outcrops north-westerly in the vicinity of 0 feet south and 600 feet west; fifth, a thin band of limy quartz-mica schist of variable width, but approximating 100 feet, and lastly, a band of highly-altered, mineralized limestone approximately 400

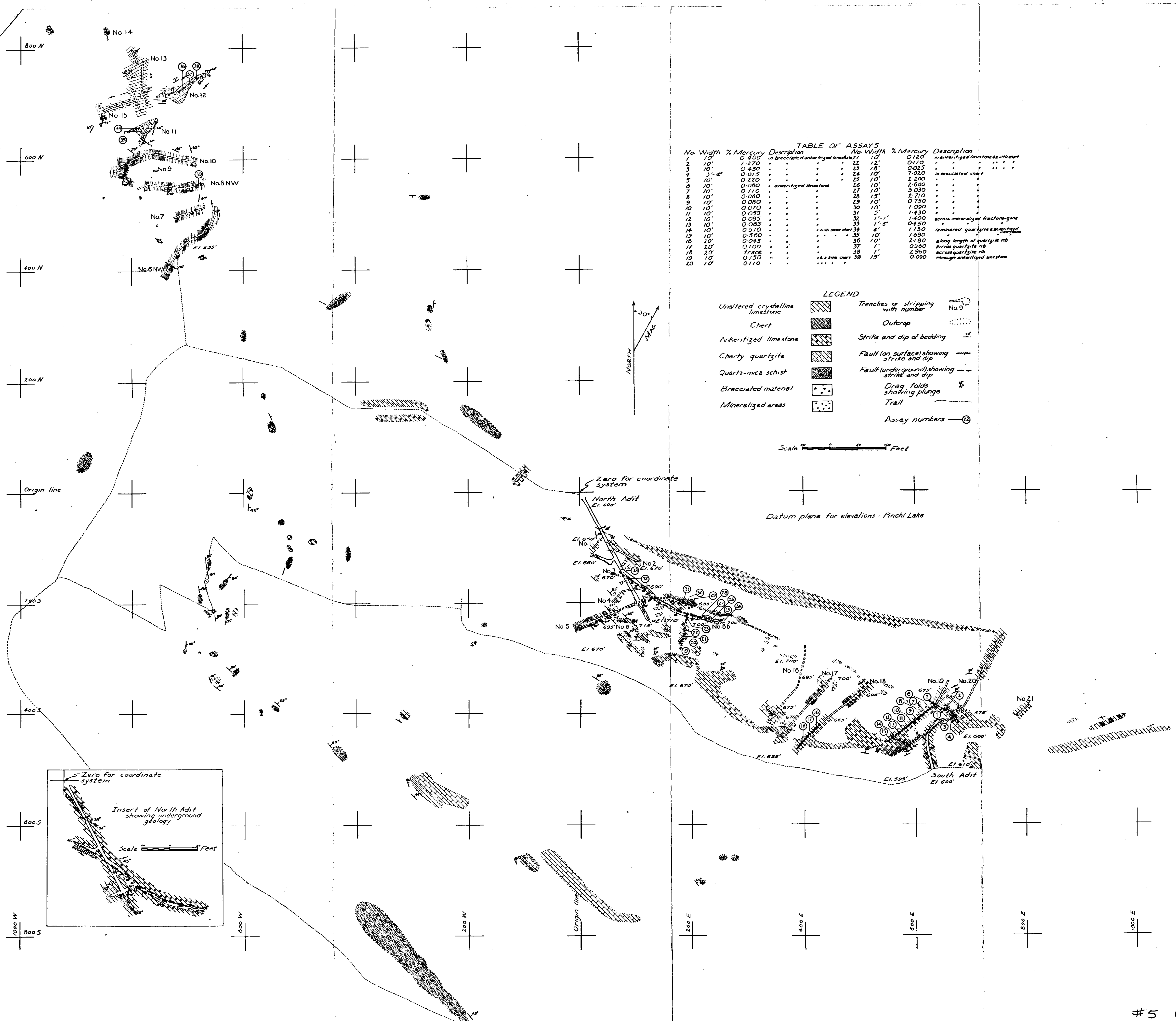


TABLE OF ASSAYS

No.	Width	% Mercury	Description
1	10'	0·400	in brecciated ankeritized limestone
2	10'	1·270	" " " "
3	10'	0·450	" " " "
4	3'-4"	0·015	" " " "
5	10'	0·220	" " " "
6	10'	0·080	" ankeritized limestone
7	10'	0·110	" " "
8	10'	0·060	" " "
9	10'	0·080	" " "
10	10'	0·070	" " "
11	10'	0·055	" " "
12	10'	0·085	" " "
13	10'	0·065	" " "
14	10'	0·510	" " " with some chert
15	10'	0·560	" " " " " "
16	20'	0·045	" " "
17	20'	0·100	" " "
18	20'	trace	" " "
19	10'	0·750	" " " & a little chert
20	10'	0·110	" " " " " "
21	10'	0·120	in ankeritized limestone & a little chert
22	12'	0·110	" " " " " "
23	18'	0·025	" " " " " "
24	10'	7·020	in brecciated chert
25	10'	2·200	" " "
26	10'	2·600	" " "
27	10'	3·030	" " "
28	15'	2·710	" " "
29	10'	0·750	" " "
30	10'	1·090	" " "
31	5'	1·430	" " "
32	1'-1"	1·400	across mineralized fracture-zone
33	1'-6"	0·450	" " "
34	4'	1·130	laminated quartzite & ankeritized limestone
35	10'	1·690	" " " "
36	10'	2·180	along length of quartzite rib
37	1'	0·560	across quartzite rib
38	1'	2·960	across quartzite rib
39	15'	0·090	through ankeritized limestone

#5 ①

Fig. 1. Workings on the Pinchi Lake cinnabar property of the Consolidated Mining and Smelting Company of Canada, Ltd.

feet in exposed width and forming the top of Discovery Hill. Serpentine forms the bulk of Pinchi Mountain, the south-westerly, slopes of which begin approximately 2 miles north-westerly from the North adit. Serpentine also occurs at a point approximately 1700 feet south and 2400 feet east of the North adit (see Fig. 1), where it forms a lone outcrop in a large drift-covered area. Andesitic greenstone occurs as the main rock of a low hill approximately 1500 feet north-easterly from the North adit.

As previously stated, there are two main bands of limestone and one small lens. A band of unaltered limestone, approximately 300 feet in exposed width, extends north-westerly along the north-easterly shore of Pinchi Lake, and a band, approximately 400 feet, in exposed width of altered mineralized limestone, forms the crest of Discovery Hill approximately 1700 feet north-easterly across the strike from the lakeshore-band. A narrow lens of relatively unaltered limestone occurs on the south-westerly slope of Discovery Hill between laminated cherty quartzite on the south-west and quartz-mica schist on the north-east. This lens is approximately 40 feet wide at a point 800 feet south and 100 feet east of the North adit (see Fig. 1), but narrows to a few outcrops, largely silicified, in the vicinity of a point 600 feet west of the portal of the North adit.

Where relatively unaltered, the limestone is white or more commonly mottled-grey and white; it is definitely crystalline and of medium-grain. The complete recrystallization of the limestone has destroyed all evidence of bedding, except where preferential chertification has given the rock a banded appearance, the colour bands corresponding to the original bedding-planes of the limestone.

Although the rock in the lakeshore-band of limestone has been relatively unaltered, on Discovery Hill it has been extensively altered by silicification and ankeritization.

Silicification has resulted in the formation of irregular areas of massive chert and areas in which chert-ribbons alternate with thin limestone bands. Massive chert occurs in three main areas, first, a very conspicuous bluff above the South adit, second, a low bluff extending from the vicinity of 200 feet south to 200 feet east, and a third area of scattered but probably connected occurrences in Nos. 6 to 10 trenches of the north-westerly group of trenches. Ribbon-chert is very sporadic in its distribution and occurs in patches indiscriminately scattered within areas of limestone; there is a tendency, however, for this type of silicification to be more prevalent in the transition-zone between the limestone band of Discovery Hill and the quartz-mica schist to the south-west.

Where well-developed, the chert is very massive and conspicuously jointed by closely-spaced fractures, so that outcrops produce an abundant talus of small angular fragments. The chert varies from white to smoky-grey in colour and in places has a definite colour-banding ranging from 1 inch to 3 inches in width, which reflects original bedding planes in the replaced limestone; folding, particularly drag-folding, is often plainly visible in such colour-banded chert. The ribbon-chert differs from the massive chert only in habit; instead of as large areas of uniformly massive material, it occurs within limestone as parallel, sinuous ribbons ranging from 1/2 an inch to 2 inches in thickness and separated by 1/2 an inch to 2-inch bands of either unaltered or ankeritized limestone.

Most of the chert lying along the strike of the main fracture-zone has been conspicuously brecciated. Outcrops of such material recognizable by their hackly surface, are formed as a result of the difference in resistance to weathering as between the broken pieces of chert. The chert fragments range from pieces barely visible to the naked eye to pieces 1 inch in maximum dimension. They are very angular and are set in a matrix of finely-pulverized material, usually consisting of angular, strained quartz grains, but often containing some sericite. Fragmental chert occurs occasionally in a limestone matrix, the carbonate grains showing conspicuous cleavage-plane slips. The brecciation of the chert is probably related to movements along the main fracture-zone which probably gave access to the solutions responsible for the silicification, or chertification, of the limestone.

The limestone in an irregular area along the strike of the main fracture-zone has been varyingly altered to masses of ankeritic carbonate. Such alteration, is marked by buff to brownish-weathering outcrops which are in distinct contrast to the white and light-grey outcrops of the unaltered limestone. Slight alteration is marked by mottled-brown and white surface, and more complete alteration by more uniformly brown surfaces. The ankeritized limestone is crystalline and massive to the same degree as the unaltered limestone, but it tends to be finer-grained. Relict areas of ribbon-chert within areas of ankeritized rock indicate that ankeritization was a later process than silicification. Its areal distribution indicates that ankeritization is related spatially to the fracture-zone, which probably served as a channel for the altering solutions.

Ankeritization as seen in the North adit, does not extend into the hanging-wall of the fracture-zone, but extends into the foot-wall for a considerable distance. The alteration is intense for 20 feet into the foot-wall, and then becomes spotty and much less intense for the remaining distance of 120 feet to the portal.

Cherty quartzite, commonly containing enough mica to impart a definitely laminated habit to its texture, occurs in scattered outcrops that suggest a lens-shaped body extending southerly and south-easterly from the north-westerly showings and narrowing from approximately 300 feet at the northerly end to a few scattered outcrops, toward the south, in the vicinity of a point 500 feet south to 300 feet west of the North adit (<u>see</u> Fig.1). Both massive and laminated quartzite occurs in the North adit in a short working that extends for 25 feet south-westerly from a point 35 feet from the face. Sandy quartzite occurs as a lenticular band ranging from 1 inch to 18 inches in thickness over a length of approximately 80 feet in No. 12 trench. The material in this band consists of light-coloured, sugary quartzite, mottled brown by rusty-weathering carbonate grains evenly scattered through the rock. The quartz grains range from medium to fine in size and all show the effects of dynamic metamorphism in either strain-shadows or granulation of the grains; all evidence of original sand grains has been destroyed. This crushed quartzite contains an abundance of evenly-disseminated cinnabar grains.

The well-laminated quartzite consists of 1/4-inch to 1/2-inch bands of cherty quartzite separated by thin layers or partings of fine, white mica. Where adjacent to limestone, 1/16 to 1/8 of an inch layers of lime frequently alternate with the quartzite.

The quartzite probably represents a purer and less argillaceous sandstone than the quartz-mica schist.

Limy phases of the schist occur along the south-westerly border of the Discovery Hill limestone band; some of these contain so much carbonate, frequently ankeritic, that they are perhaps better called lime-schists.

The main body of quartz-mica schist occurs as a band approximately 1,000 feet in width, that lies between and is conformable with the two main bands of limestone. Scattered outcrops of this schist-band extend along the strike for a minimum distance of 12,000 feet from an outcrop at a point which is 700 feet south and 1,200 feet west of the North adit (see Fig. 1) to an outcrop at a point which is 6,000 feet north and 8,500 feet west of the North adit (see Fig. 1). In this distance the strike varies from north 80 degrees west to north 45 degrees west and the dips from 45 degrees to 60 degrees northward and north-eastward. A second narrow band of schist, approximately 100 feet in width, occurs between the Discovery Hill band of limestone and the limestone-lens to the south-west; in addition to the quartzose phase, the schist of this band tends to be limy in some outcrops near the main limestone.

The quartz-mica schist is characterized by whitish-weathering outcrops of schistose rock, the schistosity of which is frequently badly contorted. The rock itself, consists of lens-shaped aggregates of quartz grains surrounded by finer grains of quartz and by weaving shreds of fine-grained white mica. The quartz-grains all show strain-shadows, are badly fractured and have been largely broken into the smaller angular grains that form the matrix for the larger grains. A small amount of material was noticed in which granulation was so advanced that the schistose texture had given way to a definitely-laminated habit.

Light-green, highly micaceous schist occurs as squeezed lenses in the limestone of the main crosscut of the North adit and towards the westerly end of No. 5 trench. In general, the material of these lenses is very micaceous and contains little quartz and carbonate; the lenses probably represent argillaceous material, that has been squeezed and has flowed into lenses during folding of the enclosing limestones.

A small amount of light-green schist containing an abundance of lime and some quartz occurs in the North adit in a short working that extends for 25 feet south-westerly from a point 35 feet from the face of the main crosscut and in the face of the west drift in the same adit; this schist has not been squeezed to the same extent as the more purely micaceous.

Outcrops of glaucophane schist were seen in the vicinity of a point 1500 feet north to 4000 feet west of the North adit and on the south-westerly side of the main quartz-mica schist band. The outcrops form part of a band approximately 150 feet in width that lies in a slight depression adjacent to and north-easterly from a prominent bluff of the lake-shore limestone band. Quartz-mica schist lies adjacent to the glaucophane schist on the north-east. The rock is dark-grey in colour, finely schistose, but badly crumpled and sheared. It consists of shreddy glaucophane wrapping around badly sheared and broken pyroxene and olivine.

A small amount of glaucophane was seen in an outcrop of grey schist in the vicinity of 800 feet south to 1200 feet west or approximately 2800 feet south-easterly along the general direction of strike from the last-mentioned occurrence. There may be a stratigraphic connection between the two occurrences, but this is not definitely shown.

Serpentine occurs as an isolated outcrop, surrounded by drift on all sides, in the vicinity of a point 1700 feet south to 2300 feet east of the North adit. The outcrop forms a south-westward-facing escarpment, approximately 40 feet high on the westerly and northerly faces; with a semi-circular length of approximately 700 feet.

The nearest outcrops, with the exception of one small chert outcrop 150 feet south-westerly from it, are those of the Discovery Hill limestone, 1500 feet north-westerly.

The outcrop consists mostly of buff-coloured, reddish-weathering serpentine that has been completely silicified and carbonatized. However, unaltered serpentine, or definitely green serpentine, occurs in small patches on the north-easterly periphery of the outcrop.

The altered serpentine is light buff-coloured and frequently spotted with light green clusters of mariposite and occasional grains of chromite; the exposed surfaces weather to a characteristic reddish-brown, hackly surface. The rock consists of lenses and streaks of shreddy carbonate grains alternating with streaks of fine to medium-sized grains of quartz. The quartz grains are clear, relatively unstrained and unbroken; the cataclastic texture common to the schist and quartzite, is lacking. This suggests that the development of quartz in the serpentine is later than the main folding of the sedimentary rocks and also later than the crushing associated with the main fracture-zone, which, combined with the occurrence of occasional 1/8 to 1/4 of an inch slabs of cinnabar, suggests the proximity of this serpentine outcrop to the fracture-zone responsible for both silica-bearing and mercury-bearing solutions.

Although greenstone does not occur in the immediate vicinity of the workings, it forms a low hill that lies approximately 1500 feet north-easterly from the North adit. This occurrence constitutes the south-westerly side of a north-westerly-trending band of greenstone.

Regionally the main structure is a belt of dynamically metamorphosed sedimentary rocks that strikes north-westerly and dips north-eastward, forming part of a limb of a major fold, the remaining parts of which do not come within the present map-area. Locally, however, in the vicinity of the ore showings, this limb has been warped into what the writer interprets as a small anticline and syncline that plunges northward diagonally down the regional dip.

A study of strikes and dips of bedding-planes, and of the relation of the axial planes of several small drag-folds to bedding, has led to the conclusions that - (1) warping has resulted in a combined anticline and syncline, the crest and trough of which are in the vicinity of No. 12 trench, and the south-westerly end of No. 20 trench (see Fig. 1), respectively; (2) these folds strike northerly and plunge in the same direction at angles ranging from 25 degrees to 60 degrees.

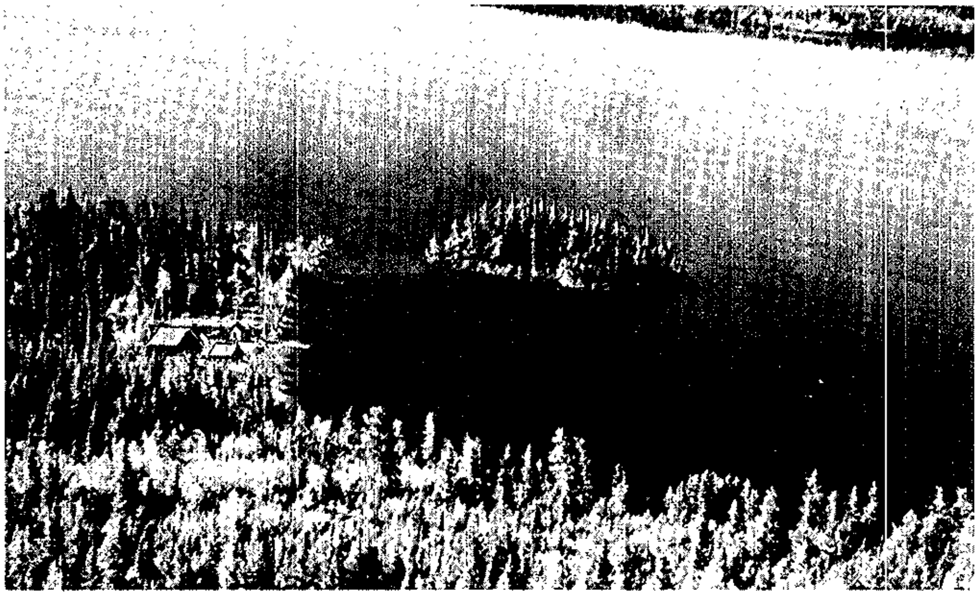
The second important structural feature is a strong cinnabar-bearing fracture-zone, marked underground by conspicuous faulting, and brecciation ranging from 6 inches to 4 feet in width, and marked on the surface by a zone and scattered outcrops of brecciated chert. The strike of the faulting underground and of the zone of brecciated outcrops on the surface, ranges from north 60 degrees west to north 70 degrees west, and dip of the faulting from 45 degrees to 65 degrees south-westward. Although the strike of this zone is nearly parallel to the bedding in some places, particularly in the drift of the North adit, it cuts the bedding elsewhere, and in general is transverse to the axial direction of the local anticline and syncline.

The zone of outcrops of brecciated chert, and in places of brecciated limestone varies from 2 to 10 feet in width. Outcrops of brecciated chert occur on the general strike of the fracture-zone from No. 14 trench south-easterly to No. 20 trench, as seen in Fig. 1; this zone very probably continues approximately 2000 feet south-easterly to an outcrop of definitely-brecciated chert that occurs 150 feet south-westerly of the cinnabar-bearing serpentine knoll mentioned in the description of the rock-types.

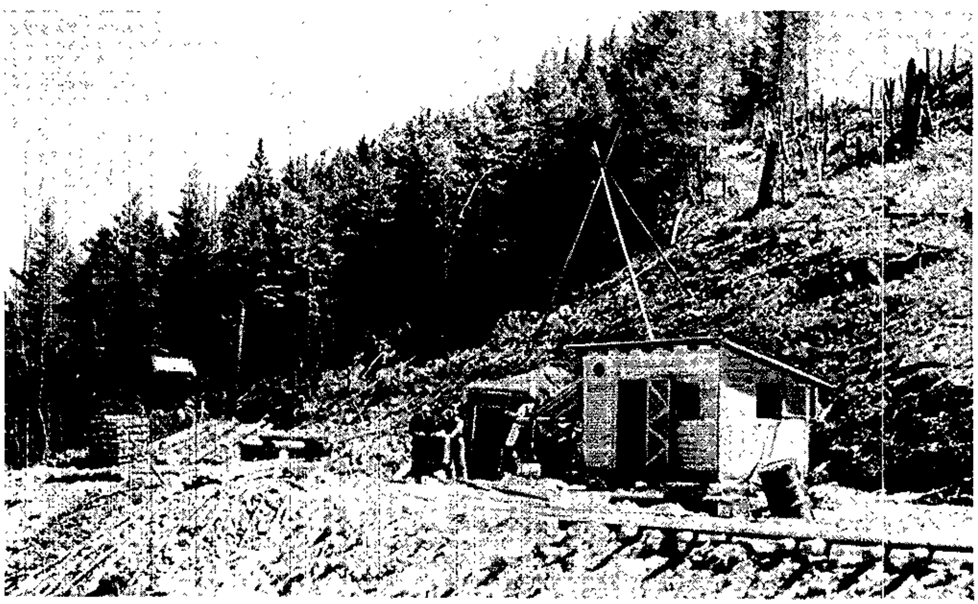
The nature of the lineal extent of the fracture-zone may be summarized as follows:

(1) Length of definite fault-zone and associated brecciation, as seen in the main drift of the North adit - 230 feet (as of June 11, 1939).

(2) Length of fracture-zone as indicated by fairly closely-spaced strippings and outcrops of brecciated rock - 750 feet.

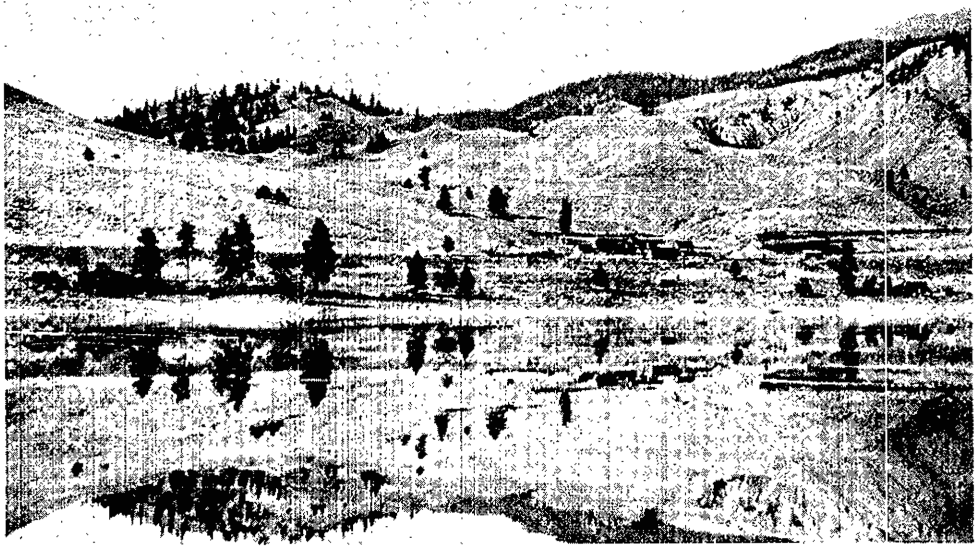


A. Camp of the Consolidated Mining and Smelting Company of Canada, Limited on Pinchi Lake.



B. Portal of North Adit, Pinchi Lake mercury property of the Consolidated Mining and Smelting Company of Canada, Limited.

PLATE II.



A. Copper Creek cinnabar property, dumps of north showings on left of picture.

B. Small D-retort at Copper Creek cinnabar property.

(3) Overall distance between outcrops of brecciated rock at extremities of partly-prospected area and separated by long, unprospected areas of drift, approximately 4000 feet.

The north-westerly extremity of prospecting done on this partly-mineralized fracture-zone, is marked by No. 14 trench, where cinnabar occurs in brecciated rock associated with a vertical shear. The south-easterly extremity is marked by an outcrop of brecciated chert, 150 feet south-westerly of occurrences of cinnabar in altered serpentine.

The distribution of cinnabar is more or less coincident with the fracture-zone. The heaviest concentrations of cinnabar occur where brecciation and shearing of the fracture-zone material appears most intense and the limestone most siliceous. This type of ore consists predominantly of scattered grains and clusters of grains, and, to a less extent, of uniform mineral sheets. The cinnabar also occurs in weaving wisps or streamers of variable width within very finely-comminuted material between larger breccia-fragments. The ore-zone breccia consists of angular fragments of chert set in a pulverized matrix of fine grains of quartz, carbonate and sometimes epidote and sericite--the texture is definitely that of a crush-or fault-breccia and as such forms a very good host for the cinnabar. Samples taken across 1-foot and 18-inch widths of breccia well charged with cinnabar have assayed: Mercury, 1.09 per cent. and 1.43 per cent.

The widths of better mineralized rock more or less correspond with those of the crush-or breccia-zone, and are usually very poorly defined. In general, the widths of good mineralization range from 6 inches to an observed maximum of 4 feet. The only place where a confining wall is evident is underground in the main drift of the North adit. Cinnabar does not occur in the foot-wall of the main fault, although it extends for irregular distances into the hanging-wall.

The concentration of cinnabar is definitely variable along the length of the shear. The main and best area of mineralization being that in the brecciated material extending from the east end of No. 8 trench westerly to the middle of No. 5 trench, a distance of 140 feet; in this distance the exposed width of mineralization ranges from 1 inch to 10 feet. Representative samples taken by the writer and considered to be more or less typical of this zone, assayed from: Mercury, 2.6 to 7.02 per cent. over 10-foot sections (for details <u>see</u> Fig. 1).

Although cinnabar occurs outside the main zone of brecciation, it is only in small quantities. Samples taken by the writer in sections adjacent to but outside the main zone of brecciation, assayed from: Mercury, a trace to a high of 0.75 per cent; they averaged, Mercury, 0.1 per cent.

The deposition of cinnabar in the westerly group of trenches is not only related to brecciated rock, but also to the occurrence of a heavy bed of more or less crushed quartzite where the best grade of ore in this group of workings has been found to date (June 10, 1939), in No. 12 trench (see Fig. 1). Two samples taken across 12-inch widths of this bed assayed: Mercury, 0.56 per cent. and 2.96 per cent.

At other places, such as in Nos. 11 and 15 trenches (see Fig. 1), cinnabar is disseminated through the ribbons of laminated quartzite.

Minute amounts of stibnite were seen in a small "outcrop" of high-grade near the discovery-post; it is not a characteristic mineral of the deposit.

In addition to cinnabar a small amount of uncrushed, hydrothermal quartz occurs, close to, but not in the fracture-zone. Narrow irregular lenses and stringers of watery quartz up to 3 inches thick occur in the vicinity of a point which is 450 feet south and 540 feet east of the North adit (see Fig. 1), and at a point on the west wall, 100 feet from the portal of the North adit.

Calcite stringers are commonly associated with the cinnabar; these are definitely later than the ankeritization of the limestone, but more or less contemporaneous with the cinnabar.

Favourable conditions for ore-deposition, as opposed to sparse occurrences of ore, appear to have been in part,

(1) The presence of highly comminuted, crushed and brecciated material related to the fracture-zone.

(2) The occasional presence of crushed quartzite, as in No. 12 trench.

(3) Possibly the occurrence of schistose and, therefore, relatively impervious phases of the sediments that seem to have acted as local barriers to rising solutions and aided in the concentration of cinnabar into ore-shoots.

The type of ground represented by (1) and (2) is relatively porous and would offer no resistance to the passage of mineralizing solutions. No rock-types or structure, other than possibly some schistose phases, definitely suitable to serve as a trap for the concentration of the ore-solutions, and, therefore, suitable for the formation of ore-shoots, were evident at the time of the writer's examination. It is possible that the relatively flat-lying Tertiary lavas, remnants of which occur north and south of Stuart Lake, served as the ultimate trap for the rising mineralizing solutions; the nearest lava remnant is the eastward-sloping cuesta that form Hunitlin Mountain, approximately 11 miles in an air-line north-easterly.

Kamloops Lake and Vicinity Occurrences

Cinnabar occurs at several places within a belt approximately 8 miles wide that extends for 11 miles northerly and for approximately the same distance southerly from the west end of Kamloops Lake (Fig. 2). The deposits consist of shear-zones and dolomite veins that contain varying amounts of cinnabar. The rocks are greenstone of the Nicola group, which, in the vicinity of the deposits, have usually been intensely altered by ankeritization. The occurrences include the following deposits: Copper Creek Cinnabar Claims; Hardie Mountain Cinnabar Deposit; Sabiston Flats; Davis Showings; Criss Creek Showings (Mercury Mining Syndicate); Charbonneau Showings near Savona Station on the Canadian Pacific Railway; showings in the vicinity of Tunkwa Lake (Fig. 2). These are described in detail in the following text.

COPPER CREEK CINNABAR CLAIMS. The most recent information concerning the cinnabar claims near the mouth of Copper Creek indicates that they were last owned by the Cinnabar Mining Company of B. C., formerly care of Davis, Marshall, MacNeil and Pugh, 626 Pender Street, Vancouver. These claims went into tax-sale in 1938, the date of redemption expiring November 7, 1939.

The property is situated on the slope of the hillside immediately to the north from Copper Creek Station, a flag-stop on the Canadian National Railway on the north shore of Kamloops Lake, approximately 5 miles easterly from the west end of the lake.

There are two means of access, one by Canadian National Railway from Savona, and one by auto-road from Kamloops. The distance is 32 miles by road from Kamloops past Tranquille, up the Tranquille River and down Carabine (Copper) Creek to

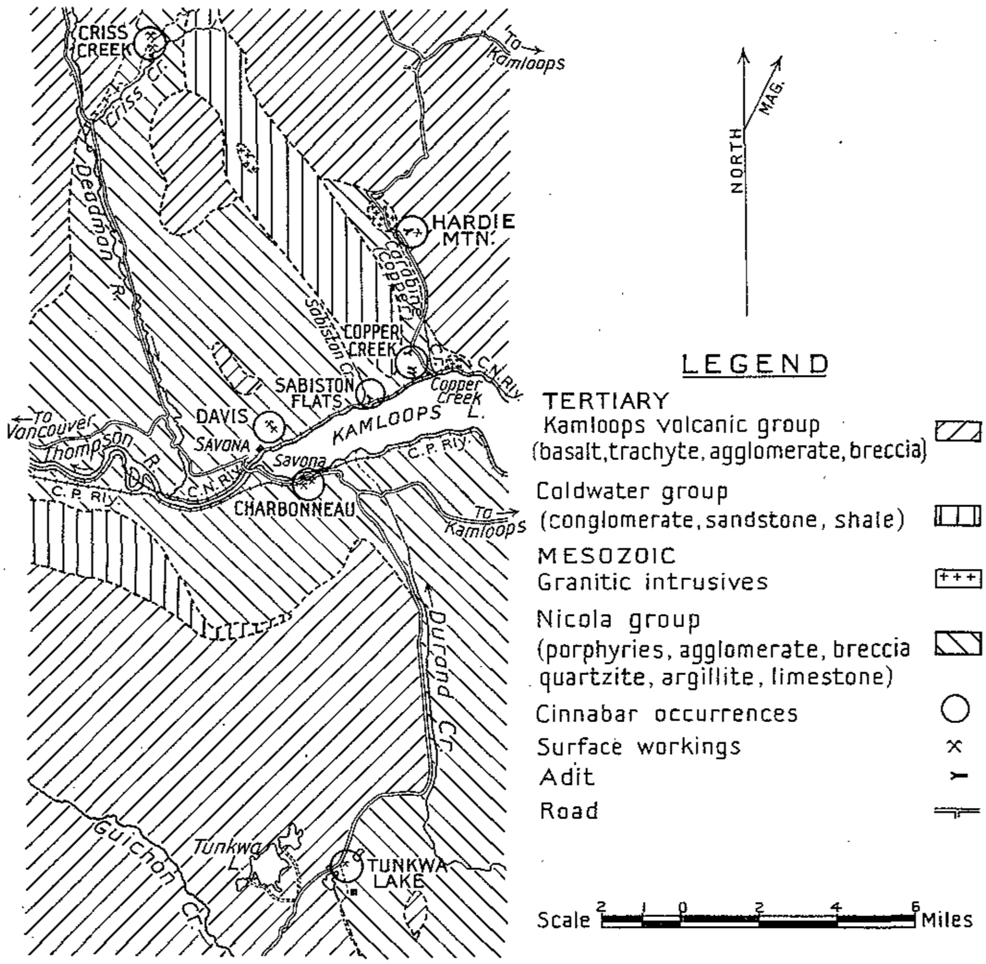


Fig. 2. Key map, cinnabar occurrence, in the vicinity of Kamloops Lake. Areal geology adapted from Dawson with modifications around Kamloops Lake by Drysdale.

Copper Creek Station; this road is steep, narrow and the surface clayey and should not be attempted with a motor-car in wet weather.

The workings are situated on an open hillside which slopes smoothly south-eastward to the level of Kamloops Lake; the slope changing gradually from approximately 30 degrees at the elevation of the workings to only a few degrees near the lake (Plate II A). The only cover on the hillside is a small amount of range-grass, sage-brush, and in the few draws, pine trees.

Geologically the deposit consists of cinnabar-bearing dolomite fissure-veins. These dolomite veins occur chiefly within and parallel to the walls of conspicuous brown-weathering and highly-altered andesitic dykes that cut a series of fragmental volcanics and intercalated sills. Faulting of all these rocks has been extensive and spread over a long time-interval. The dykes, which occupy faults, obviously tended to localize the later faults that were followed by the dolomite-cinnabar veins; the most recent faulting has tended to displace both the veins and the enclosing rock-types.

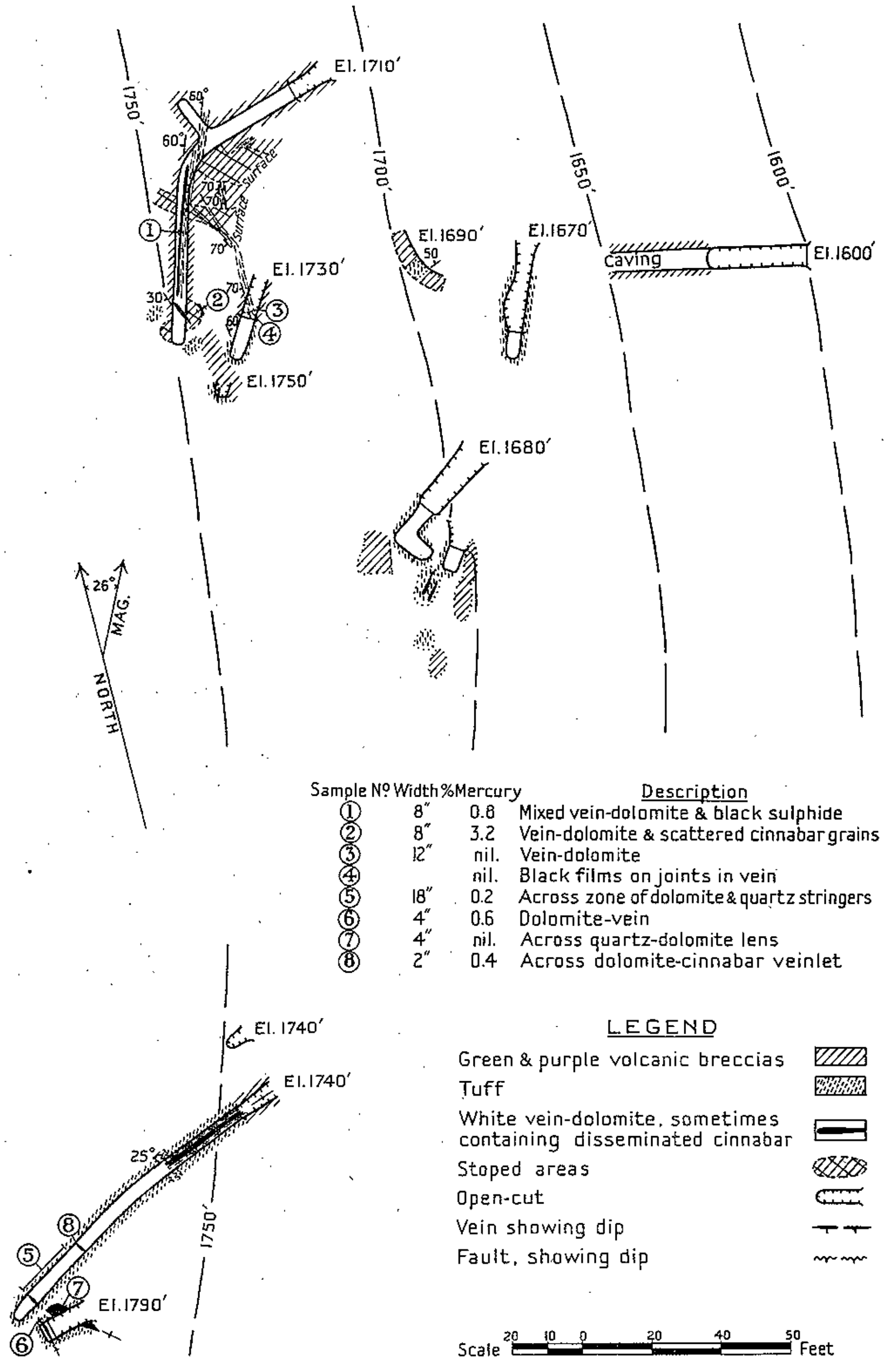
In brief, the workings consist of a labyrinth of drifts, crosscuts, raises and short shafts. These workings are in three main groups, southerly and central groups (Fig. 4) at an altitude of 1700 feet (Kamloops Lake 1125 feet), half a mile north-westerly from Copper Creek Station, and a northerly group (Fig. 3) at approximately the same elevation but half a mile northerly from the southerly group; the relative positions of the southerly and central groups are shown in Fig. 4.

In general the workings are badly caved and several sections of the adits and the stopes were inaccessible at the time of examination (June-July, 1939).

The name Copper Creek appears to have originated from the report that in the past Indians obtained small amounts of native copper from the volcanic rocks outcropping close to and in the bed of Copper Creek. This is indicated by a quotation from Brewer, Annual Report, Minister of Mines, British Columbia, 1914, p. 195 - "This creek derives its name from the fact that the Indians have from time immemorial known it as a locality where native copper was found. Specimens are yet found in the serpentinous decomposed rocks to the east of the stream which show some of this native copper, but whether the quantity is sufficient to be of economic value is questionable."

Between 1890 and 1900 unsuccessful attempts were made to find copper ore in mineable amounts on showings consisting of chalcocite and bornite in quartz-filled fissure-veins that occurred in basic dykes on the Tenderfoot claim situated east of and 800 feet above Copper Creek.

The first intensive work on the Copper Creek cinnabar showings appears to have been done by an American company in 1894, when, in addition to a small amount of surface-prospecting, an adit was driven 137 feet and a shaft and incline sunk for 51 feet and 31 feet respectively. The grade of mercury mineralization at that time is indicated by the statement that the dump at the adit-portal contained 8 tons of material averaging approximately, mercury, 20 per cent., and 12 tons averaging approximately 7 per cent.



Sample No.	Width	%Mercury	Description
①	8"	0.8	Mixed vein-dolomite & black sulphide
②	8"	3.2	Vein-dolomite & scattered cinnabar grains
③	12"	nil.	Vein-dolomite
④		nil.	Black films on joints in vein
⑤	18"	0.2	Across zone of dolomite & quartz stringers
⑥	4"	0.6	Dolomite-vein
⑦	4"	nil.	Across quartz-dolomite lens
⑧	2"	0.4	Across dolomite-cinnabar veinlet

Fig. 3. Plan of north showings, Copper Creek cinnabar property.

In 1895 the Cinnabar Mining Company of B. C. took over the deposits. This company did exploratory work, erected two retorts and operated them for only a few weeks producing, "more than 100 flasks of quicksilver." The underground work done by this company in 1895 appears to have constituted the bulk of the work done on the property. It is reported to have consisted of 750 feet of drifts and crosscuts on one part of the Rose Bud claim of that time, a large stope, and, in another part, an adit 120 feet long and a raise 80 feet long to the surface. On the Yellow Jacket claim of that time, underground work consisted of 900 feet of drifts and crosscuts and two raises to the surface, 80 feet and 100 feet respectively in length; 1200 feet of diamond-drilling was also done in this section.

Between 1896 and 1925 very little work was done on the property. However, in 1924, Mr. J. Fleetwood-Wells, who had operated the property twenty-five years previously, re-opened the workings, operated for three years and obtained about five flasks of mercury. No work has been done since 1927. During this period from 1927 to the present, the old retort (Plate II B) and furnace (Plate III A), have been dismantled and partly destroyed.

The production of mercury from the Copper Creek deposits has been as follows:

1895 - 1897	- 138 flasks of mercury
1924 - 1927	5 flasks of mercury
Approximately	143 flasks of mercury

The bed-rock geology of the Copper Creek cinnabar deposits is complex. The rocks comprise a group of igneous rocks, both extrusive and intrusive. The extrusives include both green and purple volcanic breccias and interbedded tuffs. The intrusives include, diabase and picrite (essentially olivine and augite) sills and brown-weathering dykes; these dykes are of basaltic composition but will be referred to as brown porphyry dykes in the text because of their characteristically brown outcrops and definitely porphyritic texture.

The most prevalent rock, both in the workings and the rock bluffs immediately above them, is green volcanic breccia. This rock consists of angular fragments ranging from 1 inch to 8 inches in average diameter that are set in a more finely-fragmental tuffaceous matrix. The material of the fragments is chiefly dark green basaltic greenstone, sometimes finely-porphyritic. Purple volcanic breccia, consisting of distinctly purple fragments in a purple tuffaceous matrix, occurs irregularly distributed in the workings; they occur in all the workings of the central group and in the east branch of the "1510" level in the south group in the same area. Inasmuch as the purple and green breccias grade insensibly into each other, it was impossible to map definite contacts between these two colour-types of breccias.

As the breccias are extremely massive in structure, bedding-planes are not evident and it is impossible to determine their attitude from the study of the breccias alone. However, the attitude and general contact-relations of well-bedded tuffs occurring in the westerly branch of the "1510" level indicate a north-westerly strike and a moderate dip of about 20 degrees north-eastward for both the breccias and interstratified tuffs. The main occurrence of tuff is in the southerly group of workings, specifically in the westerly branch of the "1510" level, and along part of the easterly branch of the same level. Towards the portal of the westerly branch of "1510," the tuffs are very incoherent; the extreme incoherency being largely due to the percolation of surface waters down the dip from the surface outcrop of the beds; farther in the workings, the beds become blocky and massive. The bedding of the tuffs as seen in the incoherent material strikes north-westerly and dips 20 degrees north-eastward. The compact tuffs are dark-grey in colour and fine, megascopically even-grained in texture. However, under the microscope they are seen to consist of closely-packed crystal-fragments in a dense cloudy matrix. The crystals consist of altered feldspar and pyroxene; the feldspar crystals are largely altered to fine white mica and the pyroxenes to finely-granular, iron-stained carbonate.

Diabase sills occur in the crosscut between the two branches of the "1510" level in the southerly group of workings. The two occurrences in this crosscut are each approximately 4 feet thick; the more westerly sill is conformable with the underlying tuff beds and the easterly sill is parallel to it. In their blocky massive character the sills are similar to the blocky tuffs, but they are much darker in color. Under the microscope the texture is seen to be fine-grained and diabasic; the glassy or dense groundmass which might be expected if these were flows, rather than sills, is lacking. The minerals comprise calcic plagioclase, hornblende and a small amount of olivine.

Augite picrite occurs in the "1615" open-cut and in the short "1600" adit of the central group of workings. The exposures consist of badly-fractured, dark-green rock which contains abundant crystals of olivine, commonly 1/16 of an

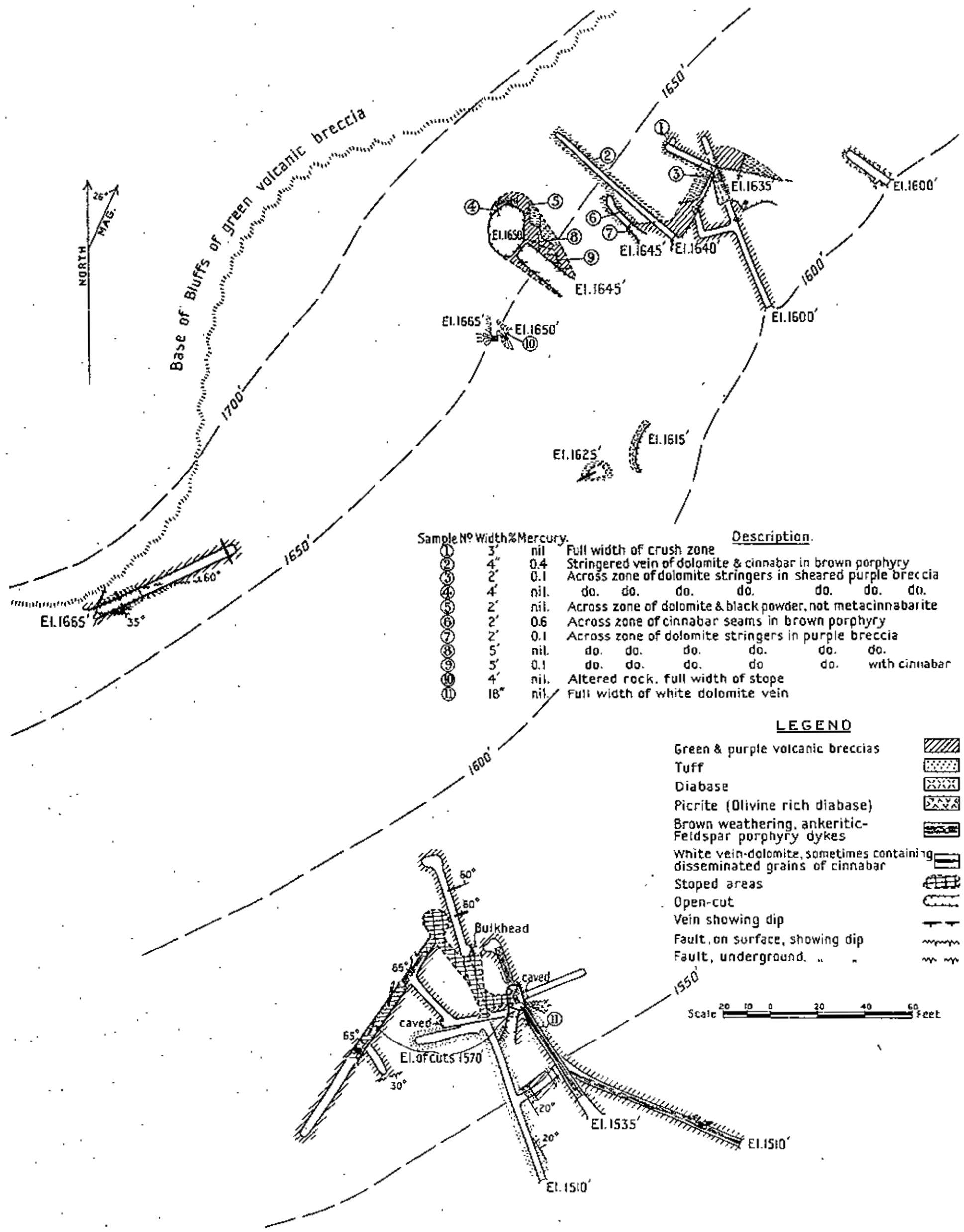


Fig. 4. Plan of central and south showings, Copper Creek cinnabar property.

inch in diameter. These olivine crystals, set in a dense, dark-green groundmass, are easily recognized by the purple colour of the alteration-products formed within the crystals. Under the microscope the rock is seen to consist of numerous grains of olivine largely altered to serpentine and finely-divided hematite. None of the pink material is cinnabar.

This rock is named augite picrite rather than a peridotite because: the texture is porphyritic and results from small phenocrysts of olivine and augite set in a dense groundmass. Although the outcrops of the picrite are badly disintegrated and the contact-relations and the surrounding rocks not exposed; the rock is believed to be extrusive.

Conspicuously brown-weathering porphyries occur as dykes of widely-varying strike and dip. These dykes are conspicuous because of their rusty-brown outcrops; freshly-broken, unweathered surfaces are, however, light-grey in colour. The dykes range in general from 6 inches to 3 feet in thickness; however, scattered outcrops of brown porphyry occurring at places from 100 to 600 feet to the west of the southern group of showings, indicate dykes that have a minimum width of 75 feet.

The dyke-material in weathered outcrops is definitely porphyritic; consisting of well-shaped but badly-altered, crystals of plagioclase and pyroxene set in a dense or fine-grained, brown groundmass. The porphyritic texture is not so evident on freshly-broken surfaces. Under the microscope the feldspars are seen to be altered, in varying degrees, to finely-felted aggregates of white mica and the pyroxenes in all sections completely altered to fine granules of carbonate. The groundmass consists of either a dense, brown aggregate of carbonate and limonite, or of finely-felted laths of altered plagioclase and interstitial limonite and carbonate; scattered clusters of fine-grained magnetite are common. The presence of considerable plagioclase, pyroxene and magnetite indicate that these dykes are of basaltic composition; they will be referred to, however, in the text as brown porphyry dykes. The carbonate of these rocks, both in the altered pyroxene and the groundmass, is largely ankerite and is not to be confused with that of the dolomite veins.

Ankeritization, or the formation of ankeritic carbonate, has been the dominant process of alteration in the brown porphyry dykes. This alteration antedated or was the forerunner of that which was responsible for the deposition of vein-dolomite and cinnabar in fissures within the dykes.

One lamprophyre dyke was seen on the property at a place 350 feet westerly from the southerly group of showings. This dyke is 10 feet wide and strikes north-westerly and intrudes the surrounding green volcanic breccia. In appearance it is a grey porphyritic rock containing long laths of feldspar. Under the microscope it is seen to consist of large, long laths of labradorite-plagioclase set in a felted groundmass of dark-brown biotite; neither amphibole nor pyroxene were seen.

Faulting of the rocks and veins is widespread in the deposit. There is no general strike and dip to the faults although it is to be noted that east-west and north-south faults are uncommon. Dips range from nearly horizontal to vertical. Displacement along the fault-planes is variable, ranging from almost nothing to large but indeterminable amounts. The faults range in width from half an inch to 1 foot, and shear-zones from 1 foot in width to 40 feet.

Faulting both preceded and followed the formation of the dolomite veins. The earlier faulting opened fissures for the brown-porphyry dykes and later for the veins, and in some instances formed shear-zones that later received a small amount of dolomite and cinnabar, as shown in the open-cut at an elevation of 1645 feet in the middle group of showings. It is impossible to say what percentage of the faults in the rock-formations antedated the veins, but probably very few because of the lack of sealing-minerals.

Post-vein faulting is of course the most conspicuous. The dolomite veins are frequently bounded by faults parallel to either one wall, as shown by the vein in the westerly branch of the "1535" level in the southerly group of showings, or to both walls, as shown by the vein in the "1740" level of the northerly group of showings. The veins are sometimes definitely cut by transverse faults and displaced for unknown amounts, as shown by the vein in the last example cited. The effect of faulting on the rock-formations has been the faulting of one rock-type into another as shown to the best advantage by the fault-bounded triangular segment of picrite adjacent to brown porphyry in the open-cut at an elevation of 1570 feet in the southerly showings.

Veins of white, massive to crystalline dolomite, containing sporadic disseminations of cinnabar, characterize the deposit.

These veins occur chiefly within the brown porphyry dykes as:

(1) A continuous ribbon which pinches and swells from 1 inch to 3 feet in width, within or close to, one wall of the dyke.

(2) Gash-veins a few inches in thickness that trend diagonally to the strike of the dyke, but are

wholly contained within the dyke.

(3) Occasionally narrow stringers in the volcanic breccia in the vicinity of the dykes.

Although the dolomite veins range from a knife-edge to 3 feet in thickness, a width of 18 inches is the commonest average for the most persistent veins.

The texture is usually massive consisting of closely-packed crystals of dolomite. However, occasional vugs occur which are lined and frequently nearly filled by projecting crystals of dolomite. A brecciated texture occasionally occurs, particularly near the borders of the veins. In such places the vein consists of fragments and wisps of brown porphyry in the process of replacement by the vein-dolomite.

The vein-matter is predominantly white dolomite. Chemical and optical studies indicate that it approaches very closely the theoretical composition of dolomite. Small amounts of chalcedonic quartz and, in some veins, stringers, of more coarsely crystalline quartz occur. The only sulphide seen in the dolomite veins was cinnabar, although stibnite has been reported. A small amount of tetrahedrite was seen in a lens of quartz in the north workings.

Within the vein there has been a rhythmical precipitation of the chief gangue-minerals; the sequences are best seen around fragments of porphyry-breccia within the vein--the most common sequence is as follows:

1. Dense white or grey chalcedonic quartz.

2. Bands of crystalline dolomite, the crystals of which have grown in a direction normal to the previous band of mineral.

3. Grey chalcedonic quartz.

4. Where open spaces existed, small pyramid-shaped crystals of quartz.

The amount of cinnabar seen in the veins was so small that definite data concerning its time of deposition could not be obtained. However, it was commonly seen on the borders of hair-like stringers of dolomite, a habit suggesting that the cinnabar antedated the deposition of dolomite within such stringers; it was also seen as discrete grains and small masses within main dolomite veins, indicating deposition contemporaneous with that of the dolomite.

In general, this cinnabar was in part slightly earlier than, and in part contemporaneous with, the dolomite.

The most common occurrence of cinnabar is discrete, flaky grains within white vein-dolomite. It also occurs as thin films within fissures, or bordering dolomite stringers that occur within either the brown porphyry dykes or, less frequently, the wall-rock of the dykes. Old reports indicate that much of the mined cinnabar occurred as blebs or nodules of massive cinnabar within the dolomite.

No developed ore-bodies were exposed in the workings at the time of the writer's examination (June to July, 1939). The location and general shape of previously-existing ore-bodies are roughly shown by the old stopes, as outlined on Figs. 3 and 4. Unfortunately, these stopes are badly-caved and inaccessible at the time of examination so that the nature of the occurrence of any possible remnants of ore and of the type of wall-rock, could not be determined. A calculation of the approximate volume of all the stopes indicates that about 500 tons of rock was excavated from them. A calculation of the grade of ore based on this tonnage and a gross reported production of 143 flasks, or 1068 lbs. of mercury, indicates an average grade of 1.08 per cent. mercury for the 500 tons of rock.

It is to be noted that this grade exceeds the percentage of all but one of the samples taken by the writer; the exception being a sample taken across 8 inches of vein-dolomite which assayed: Mercury, 3.2 per cent. All samples of altered rock, even when cinnabar was visible in the hand specimen, assayed much less than: Mercury, 1.08 per cent. This distribution of values and the quotation from Wilmot (1926, p. 55)--"during operations thirty years ago, the greater part of the metal recovered was obtained from one pocket,"--suggests that the ore-bodies occurred within the dolomite veins.

Inasmuch as no ore is at present exposed, the only data obtainable concerning localization are from the positions of the old stopes. The largest stope is between the "1510" and "1535" levels in the southerly group of workings. The stoped area is within the acute angle lying between two brown porphyry dykes. The ground in the angle between the two dykes may have been more fractured and, therefore, of easier access by the mineralizing solutions than that adjacent to the dykes, but not in the vicinity of intersection. Elsewhere on the property the only controlling factor is the presence of the dolomite veins, which in turn are largely localized by the presence of brown porphyry dykes.

The sequence of events leading to the formation of the dolomite veins is conceivably as follows:

1. Early formation of strong fractures.

2. Filling of these by brown porphyry dykes.

3. Later fracturing along the same lines of weakness as followed by the early fracturing and therefore more or less following the porphyry dykes.

4. Deposition of dolomite veins and cinnabar in these intra-dyke fractures and fractured wall-rock, accompanied by replacement of any brecciated material.

Samples were taken of the following types of rock and vein-matter:

1. Volcanic breccia, sheared and shattered, both with and without dolomite stringers.

2. Brown porphyry dykes containing dolomite or dolomite-cinnabar stringers.

3. Typical dolomite vein-matter.

The detailed results of this sampling are given in the assay tables on Figs. 3 and 4. It is to be noted that only samples that showed cinnabar plainly visible to the naked eye contained mercury. Samples in which cinnabar was not visible to the naked eye invariably assayed nil.

This is mentioned to indicate that rock, even to make low-grade ore, contains cinnabar in amounts that is distinguishable by the eye. The following comment by Eardley-Wilmot (1926, p. 55), indicates that he arrived at the same conclusion after sampling the so-called "low-grade ore"--"From the above results it appears that it would not pay to carry out mining on the rocks and vein-matter in which no cinnabar is visible. This is loosely termed 'low-grade ore.'"

A few generalizations may now be made concerning favourable ground for prospecting. The occurrence of cinnabar on this property indicates that further prospecting should be confined to areas of brown-weathering porphyry dykes. Within such areas, it is suggested, that favourable ground may lie within the acute angles formed by the intersection of any two dykes. Referring particularly to the southerly group of workings, it is suggested further, that favourable ground would be found where the downward extensions of the dykes intersect those beds of tuffs that are exposed in the "1510" level, and which immediately underlie the diabase sills. The structure of ground in such a section would supply a porous rock (tuffs) overlain by relatively tight rocks (diabase). Such conditions would permit solutions migrating from the nearby channel made by the main porphyry dyke to travel through a relatively porous tuff with a possible trapping and deposition of cinnabar below the relatively tight diabase.

HARDIE MOUNTAIN. The ground that includes the cinnabar showings on Hardie Mountain at one time comprised the Crown-granted mineral claims Lots 949-959 and Lot 1736, and were owned by the Hardie Cinnabar Mines, Limited. These lots reverted to the Crown several years ago and the surveys, field notes and plots of the claims were cancelled on February 9, 1939.

The workings on Hardie Mountain are 4 miles northerly from the Copper Creek Station along the road that follows the valley of Carabine (Copper) Creek (Fig. 2). They are on the steep hillside on the easterly side of the road; the lowermost working, an adit, being 1045 feet easterly from the road and 255 feet above it, at an elevation of 2355 feet.

The main adits on the property are on a steep, relatively open hillside covered with talus and scattered jack-pine; the slope averages 30 degrees and is unbroken by any rocky bluffs. Most of the surface workings are on a wide relatively flat slope near the top of the hill on which there are many clumps of small fir interspersed with grassy areas; outcrops are relatively scarce.

The geology of the deposit consists of a series of volcanic rocks that strike northerly and dip 30 degrees westward; the rocks include dark-coloured, fine-grained and amygdaloidal basalts, light-grey, coarse feldspar-porphyry and light-grey andesite, some tuffs and volcanic breccias. Many of the rocks have been partly ankeritized so that their outcrops in the surface workings are rusty-brown in colour. Widely-scattered dolomite stringers cut the rocks in a few places.

The workings consist of four adits and several open-cuts. The adits, two of which are caved, have been driven northeasterly into the steep, south-westward-sloping hillside to intercept reported open-cut showings of cinnabar that occur on the more gently-sloping hillside approximately 100 feet above the highest adit. The adits failed to reach points beneath any of the cuts or to cut any cinnabar occurrences. It is reported that samples containing small amounts of cinnabar have been obtained from the surface-cuts. No cinnabar was seen by the writer, but it is probable that the extensive sloughing of soil into most of the open-cuts covered the actual occurrences of the mineral.

The showings on Hardie Mountain were discovered late in August, 1895, by Messrs. McCartney and Irving. The first underground work was commenced in 1896, and continued in 1898, but most of the underground work as it now exists was done in 1902 when five adits were driven aggregating 1066 feet in length. It is reported that each of these showed low-grade ore, and that the open-cuts above showed 2 to 3 per cent. mercury ore. The last reported work on the property was done in 1909 when an adit 106 feet long was driven.

There are no records of production.

The workings will be described beginning with those nearest the road and progressing easterly up the hillside.

The portal of No. 1 adit is 1045 feet easterly from the road and 255 feet above it, at an elevation of 2355 feet. Thorough caving of the portal prevented examination of it.

The portal of No. 2 adit is 420 feet in a direction north 57 degrees east from the portal of No. 1 and 260 feet above it, at an elevation of 2615 feet. This adit has been driven through a series of fragmental and flow-rocks at north 63 degrees east for 173 feet to the face.

Well-defined bedding in the rocks is absent, but narrow zones of crushing marking contacts between different flows strike north and dip 35 degrees westward. Although the adit does not follow any break, it crosses several narrow crush-zones in addition to those on contacts and a 2-inch dolomite vein 120 feet from the portal. Samples taken at the following places assayed: Mercury, nil - along a 2-inch crush-zone, at 117 feet from the portal; at 125 feet across a 2-inch dolomite veinlet; at 150 feet across a crush-zone 8 inches in thickness and containing much black crushed rock; and at 168 feet across similar material. No cinnabar was seen in this adit.

The portal of No. 3 adit is 540 feet in a direction north 55 degrees east from the portal of No. 2 and 130 feet above it at an elevation of 2745 feet. This adit was caved at the portal and could not be examined.

The portal of No. 4 adit is 400 feet in a direction north 60 degrees east from the portal of No. 3 and 165 feet above it at an elevation of 2910 feet. It has been driven north-easterly into the hillside for 136 feet and cuts across a series of lavas and volcanic breccias. Bedding in these rocks is absent, but the crushed contacts between the types indicates a north-westerly strike and dip of 30 degrees south-westward. The most common rock-type is coarse feldspar-porphyry; it consists of tabular feldspar crystals which range from 1/4 to 1 inch in largest dimensions; the feldspars are completely altered to white mica and the determination of the original feldspar is impossible. The other main rock-type is a basalt in which pillow structure is varyingly developed.

At 100 feet from the portal, the adit crosses three stringers of dolomite which range from 1/2-inch to 2 inches in thickness--a sample of the dolomite assayed: Mercury, nil.

No cinnabar was seen in this adit.

Two hundred and seventy feet in a direction north 30 degrees west from the portal of No. 4 adit and at the same elevation, an adit has been driven north-easterly into the hill; the portal of this adit was completely caved.

No. 4 adit is the last of the extensive underground workings, and the following descriptions apply to cuts lying farther north-easterly and on less steep ground.

Cut, or trench, No. 1 lies 685 feet in a direction north 45 degrees east from the portal of No. 4 adit and at an elevation of 3015 feet. This trench has been dug in a direction north 50 degrees east for 20 feet and at present is caved. Ten feet north-easterly from the end of this trench another has been dug 6 feet deep and in the same direction for 26 feet. The material in this trench is highly-altered amygdaloidal lava containing scattered pyrite crystals.

No cinnabar was seen and a sample taken for 10 feet along the north-westerly side of the trench assayed: Mercury, nil.

No. 2 cut is 225 feet in a direction south 60 degrees east from No. 1 and at an elevation 2975 feet. It has been driven north 15 degrees west for 26 feet and south 75 degrees west for 15 feet, the floor of this latter section is 5 feet above that of the 26-foot section. The only vein-matter consists of two 10-inch zones of dolomite stringers exposed in the north-westerly face. A combined sample from both zones assayed: Mercury, nil. The rock is grey porphyritic andesite containing 1/16-inch feldspar phenocrysts.

The only other surface-working seen on the property is an open-cut leading into an old shaft at a place which is 720 feet in a direction north 78 degrees east from No. 1 cut and at an elevation of 3000 feet. The cut and shaft are on a wooded hillside which slopes locally southward into a small, dry water-course. The cut has been driven in a direction north 10 degrees west for 10 feet, thence as a short adit for 8 feet to the bottom of the shaft. The shaft is only 8 feet deep and 3 feet square. The workings are on the northerly-striking contact between basalt on the west and coarse feldspar-porphyry on the east. No vein-minerals were seen and samples of both the basalt and the porphyry assayed: Mercury, nil.

SABISTON FLATS. A showing of cinnabar occurs near the mouth of Sabiston Creek which flows southerly into Kamloops Lake and crosses under the Canadian National Railway two miles westerly from Copper Creek Station (Fig. 2). Although the ownership, if any, of this ground could not be ascertained, the workings were described under the name of Independent group by Camsell (see Bibliography).

A short adit has been driven northerly into the hill at a place 100 feet above the railway on the westerly side of a dry gulch that crosses the tracks 1500 feet easterly from the Sabiston Creek crossing. The adit has been driven at north 48 degrees west for 18 feet and due north for 10 feet.

The first part of the adit follows a vertical dolomite-calcite vein that follows a zone of shearing 10 feet wide and which strikes north 40 degrees west. The vein is 3 inches wide and contains hair-line streaks of cinnabar. A sample of this vein-matter assayed: Mercury, 0.2 per cent. The dolomite-calcite vein continues into the wall at the bend, but for some unknown reason the adit follows a secondary joint-plane to the north.

The rock-formation in the adit is brown-weathering, feldspar-porphyry. On the surface this rock outcrops over an area 500 feet in width and extends an unknown distance northerly up the hillside. It includes a "horse" of greenstone about 50 feet in width that extends for a short distance northerly from near the portal. Extending easterly from the gulch lying 200 feet easterly from the adit and extending westerly from Sabiston Creek, the rock is greenstone.

No work is at present being done on the showings.

There is no record of production from the property.

DAVIS. Dolomite stringers and veins north of Kamloops Lake in the vicinity of Savona Station on the Canadian National Railway (Fig. 2), are understood to have been covered by the Bee Nos. 1 to 8 mineral claims, staked by John Davis for eight principals on July 12th, 1937.

The showings lie on the steep, rocky and bluff hillside that extends up to Mount Uren north-easterly from Savona Station on the Canadian National Railway. The showings begin at an elevation of 1800 feet and continue at scattered points northerly up the hillside to an elevation of 2400 feet.

The mineral occurrences consist of small amounts of cinnabar in white dolomite veins or stringers. These stringers occur in tight shear-zones within the prevailing rock-formation of volcanic breccia and a little tuff. The rock within and adjacent to the shear-zones has been highly altered to a dense rock containing abundant ankeritic carbonate; this process is referred to as ankeritization. The solutions responsible for the ankeritization and also for the deposition of the dolomite and cinnabar, came up along the shear-zones. These ankeritic zones weather to conspicuously rusty-brown outcrops and the colour is in striking contrast to the dark-green of the volcanic breccias.

The first showing is on the hillside at an elevation of 1800 feet and in a direction north 32 degrees west from Savona station on the Canadian Pacific Railway. From this point a shear extends diagonally up the rocky hillside for a slope-distance of 480 feet westerly; the shear strikes north 60 degrees west and dips 30 degrees south-westward. The green volcanic breccia on either side of the shear is altered to a rusty-brown rock for widths ranging from 8 inches to 18 inches; this marked weathering results from the oxidation of fine-grained ankerite, iron carbonate, that has been deposited by solutions issuing from the fissure and seeping into the rock on either side. Vertical shears which branch into the hanging-wall and foot-wall from the westerly end of the main shear are accompanied to a lesser extent by similar but narrower zones of alteration of the wall-rocks.

The ankeritized zones of both the main shear and branch-shears contain single stringers of dolomite and occasional films of cinnabar. The cinnabar commonly occurs within the dolomite stringers; occasionally it is found in the altered rock close to the dolomite stringers. A sample taken across a brecciated dolomite vein 10 inches wide assayed: Mercury, trace.

The next occurrences are in an area of hillside approximately 1000 feet square. The lowest of these is in an east-west saddle at an elevation of 1950 feet on the southward-sloping hillside and lies northerly from the last showing. Here a rusty zone of ankeritic rock strikes north 80 degrees west over an exposed length of 240 feet and a width ranging from 10 inches to 3 feet. Three shallow strippings have been made on the exposure. The rock in the zone is badly sheared and brecciated and contains a discontinuous, central dolomite vein. A sample taken across a full 10-inch width of the zone including a dolomite vein, assayed: Mercury, nil. The rock in the vicinity of the brown ankerite-zone is dark-green, volcanic breccia.

The next exposure of brown ankeritic rock is on a low sidehill-knoll 100 feet above the last exposure and beginning at a place 250 feet in a direction north 10 degrees east from it. Scattered outcrops which occur over an area 200 feet in diameter, indicate an easterly-striking zone of brown-weathering ankeritized rock approximately 200 feet in width. However, the zone of alteration apparently dies out a short distance westerly because unaltered, green volcanic breccia outcrops across the strike of the zone at a place 600 feet westerly. The southerly border of the zone of alteration is a shear-contact with dark-green agglomerate. The material in this showing contains very little vein-dolomite. A 2-foot sample across some narrow stringers assayed: Mercury, nil.

The lower end of the next showing is on a steep section of the hillside at a place which is 300 feet north-westerly from the northern edge of the last showing and 175 feet above it. The showing is a strong, conspicuous zone of brown, ankeritic rock that extends diagonally north-westerly up the hillside for an outcrop distance of 350 feet and disappears in drift. The zone of ankeritization ranges from 4 feet to 20 feet in thickness, gradually increasing north-westerly. The material in it consists of badly-sheared, dense, ankeritized rock containing only a few stringers of white, vein-dolomite. A sample taken across the full width of 4 feet of ankeritized rock and a few dolomite stringers, assayed: Mercury, nil.

The rocks in the immediate vicinity of the showings consist of dark-green volcanic breccia and a few tuff beds; these rocks strike east and dip 30 degrees north. The shearing along and from which the ankeritic alteration has spread cuts across the attitude of these rocks.

There is no record of production from the property.

DEADMAN RIVER. The country on the easterly side of the Deadman River between Kamloops Lake and Criss Creek was examined by members of the Dominion-Provincial Youth Training Project "D" under the direction of M. S. Hedley, British Columbia Department of Mines. In his report, Dr. Hedley describes this area as follows:

"Rusty-weathering zones of carbonatization are found on the easterly-side of Deadman River at a number of places in the Nicola rocks, and four small zones occur on the westerly side. These are all on the lower slopes. The upper slopes, above about 3,000 feet elevation, are made up of unaltered and unbroken rocks. The Criss Creek zone of alteration is large and extends from the creek northerly to the edge of columnar Tertiary basalt. Similar alteration occurs on the lower slopes of the valley to within one-half of a mile of the mouth of Criss Creek and as far southerly as the trail opposite the showings. No new discoveries were made.

"Half a mile southerly of the Indian Village and adjacent to the road are bluffs composed of sandy to arkosic sediments and some limestone, dipping north to north-eastward at 40 to 65 degrees. Rusty-weathering of these rocks is not produced by carbonatization, although there are a few dolomite stringers with narrow bordering zones of alteration. There is a little, sparsely disseminated chalcopyrite and pyrite on the northerly edge of these bluffs. One-quarter of a mile north of the highway bridge prominent bluffs on the easterly bank of the river are considerably altered and contain local fine veinlets of crystalline gypsum (selenite). Alteration, of what are in part at least sedimentary beds, is intense, with the production of a whitish to yellowish porous material, highly oxidized at the surface.

"In a prominent gulch below the highway, on the westerly boundary of the Indian Reserve, there is much carbonate veining in volcanic breccia. Stringers and veins up to several inches in width strike and dip at all angles, and most of them are accompanied by a marginal zone of carbonatization extending beyond the veins from a few inches to several feet in total width. No cinnabar was seen in these vein-zones. A little similar material is "seen in a gulch one-quarter of a mile north-westerly. Northerly for about 5 miles, outcrops are very scarce and only one small zone of carbonatization was seen in this distance, about 3 miles north of the highway. Farther westerly carbonate zones were not observed."

CRISS CREEK. The Mercury Mining Syndicate, care of Arthur McDonald, 23 Hastings Street East, Vancouver, B. C., owns the following claims on Criss Creek: Eclipse, Bluff, Old Spot, Calumet, Nevada, Pal, Quick and Monarch. These claims were staked in June, 1933, by Messrs. Davidson, McDonald, Sharpe and Woodside, of Vancouver, B. C.

The property is about 3 miles by good pack-horse trail up Criss (Chris) Creek from its junction with the Deadman River; this junction is about 14 miles by good motor-road northerly from Savona up the Deadman River Valley (Fig. 2).

The claims lie on the steep, open hillside sloping south-eastward into Criss Creek between elevations of 2150 feet at the creek-level and of 2850 feet north-westerly up the hill-side.

The first claims on the cinnabar showings up Criss Creek were staked in the summer of 1896. Desultory prospecting and surface work was done in 1897 and 1900 on the Spey mineral claim of those years. More recently the ground has been re-staked twice, and between the years 1929 and 1938 some short adits were driven by the owners. At the time of the present examination (July, 1938) a small amount of surface work was being done by A. McDonald. The property has been most recent-ly described by Freeland (1933).

Several small surface workings have been dug in the hill-side north from and immediately above the cabin.

At an elevation of 2250 feet and 500 feet in a direction north 25 degrees west from the cabin, a No. 1 cut 8 feet long has been dug on the westerly side of the trail. This cut is in greenstone; no cinnabar was exposed. Sixty feet and 75 feet easterly from this cut, two small pits have been dug in brown, altered rock; no cinnabar was exposed.

At an elevation of 2380 feet, and, 1050 feet in a direc-tion north 12 degrees west from the cabin, a short incline on the westerly-side of the trail has been sunk in a direction north 80 degrees west on a 65-degree slope. The floor of the incline follows a dolomite vein and slip which strike north 10 degrees east and dip 60 degrees north-westward; the vein ranges in width from 2 inches to 6 inches. The dolomite contains a few specks of cinnabar and realgar. A sample taken across the best 4-inch width of dolomite assayed: Mercury, nil. The rock is brown-weathering, ankeritized, tuff.

The next group of workings are close to an old blacksmith shop that is 130 feet above the old road up Criss Creek and 1200 feet north 15 degrees east from the last working at an elevation of 2540 feet.

At a place 75 feet south 10 degrees west from the blacksmith shop, the easterly of two groups of pits, 50 feet apart, has been dug in a 6-foot band of ankeritized rock which strikes north-westerly up the hillside. This easterly group consists of two pits, an easterly or No. 1 and a westerly or No. 2 pit; they are 8 feet in diameter by 4 feet deep and are 4 feet apart in a westerly direction. The No. 1 pit, exposes a zone 4 feet wide that contains numerous stringers of white vein-dolomite and thin films of stibnite. A sample taken across the 4-foot zone of dolomite stringers assayed: Mercury, nil; antimony, 0.9 per cent. and a sample of stibnite-bearing material from the dump assayed: Mercury, nil; antimony, 1.0 per cent.

No. 3 pit, 50 feet westerly from the last pits, and 6 feet in diameter by 3 feet deep, has been dug on a dolomite vein that strikes north 10 degrees east and dips 60 degrees westward and ranges from 2 inches to 6 inches wide. The vein-dolomite, but not the wall-rock, contains a few minute grains of cinnabar. A 6-inch sample of this material assayed: Mercury, 0.1 per cent.

No. 4 pit, 2 feet deep, is 25 feet westerly from No. 3. A zone of brown-weathering ankeritized rock extends westerly from Nos. 1 and 2 pits through No. 3 to No. 4 pit. No. 5 pit, 40 feet north-westerly from No. 3, is 3 feet in diameter by 3 feet deep. It exposes greenstone in the easterly wall and ankeritized rock containing a few specks of realgar but no cinnabar in the floor. Greenstone outcrops between No. 3 and No. 5 pits.

An adit has been driven in a direction north 43 degrees west as an open-cut for 6 feet, and as an adit for 8 feet from a point on the hillside at an elevation of 2625 feet and 130 feet in a direction south 60 degrees east from the blacksmith shop. In the roof, the adit follows a brecciated vein, ranging from 1 inch to 4 inches in width, that consists of fragments of greenstone sealed by vein-dolomite. At several places fracture-planes in the ankeritized greenstone have been sealed by specular hematite; these hematite stringers cut ankeritized greenstone, but are in turn cut by the dolomite stringers.

A tight 3-inch dolomite vein containing no sulphides, crosses the portal of the adit. A sample of it assayed: Mercury, nil. The rock-formation of both the cut and adit is massive greenstone tuff which has been slightly ankeritized in and close to the brecciated vein.

Below the adit an open-cut 5 feet wide, elevation 2555 feet, has been driven westerly for 8 feet from a point that is 150 feet south 45 degrees east from the adit. A 1-inch dolomite vein crosses the cut at the face; no cinnabar was seen in either the vein or wall-rock. The rock in the adit is typical, brown ankeritized rock which appears to belong to an indefinite zone trending north-westerly up the hillside to pits Nos. 1 and 4.

At a point 225 feet due west from the last cut, and at an elevation of 2540 feet, an adit has been driven north 37 degrees west for 12 feet in massive diabasic greenstone. The diabase is badly jointed and films of hematite occur along the joints.

At a place 1200 feet due west from the blacksmith shop and at an elevation of 2850 feet, an adit has been driven into the hillside in a direction north 55 degrees west for 12 feet, north 18 degrees west for 27 feet and north 60 degrees west for 12 feet to the face. From the portal to the first turn at 12 feet, the adit is in drift and loose rock, but from 12 feet to the next bend at 39 feet it follows a strong dolomite vein that is exposed in a combined open-cut and stripping immediately above the adit. In this surface working the vein, ranging from 3 feet to 4 feet in width, is exposed for 22 feet; but passes into drift at either end and in this length; the vein-dolomite contains scattered grains and stringers of cinnabar. Two samples each across 42 inches of vein-dolomite assayed: Mercury, nil, and, one across 3 feet showing considerable cinnabar, assayed: Mercury, 1.7 per cent.

The rock in the cut is brown-weathering, ankeritic rock. The vein in the drift below the open-cut is much narrower than on the surface, the average width being only 3 inches. It lies in the hanging-wall of a strong fault that dips 60 degrees south-westward. A sample taken across a 3-inch width of vein-dolomite at the second bend assayed: Mercury, a trace. The rock in the adit is massive, grey, ankeritized greenstone which is occasionally cut by hair-like stringers of vein-dolomite.

Search was made, without success, in the company of Mr. McDonald, for a trench that was reported to be about 1500 feet north-westerly from the last adit and at about 3200 feet elevation. However, it was reported to contain only brown-weathered rock. It is to be noted that the high bluffs beginning at an elevation of approximately 3400 feet consist of Tertiary lavas; in this vicinity they are chiefly basalt.

For approximately half a mile up-stream from the cabin, outcrops are numerous in the bed of Criss Creek, beyond this, however, the stream flows in a gravel-bed and between gravel-banks. The outcrops in the half-mile stretch consist of alternating exposures of varieties of greenstone and brown-weathering, ankeritized greenstone. As seen in scattered, single fissures with relatively unaltered greenstone, the ankeritization spreads from a fissure, or fissures, into the rock on either side of the break. The numerous large areas of such alteration represent either areas of intense fracturing or areas in which alteration beginning in fissures has been relatively widespread.

The relatively unaltered greenstone includes coarse diorite porphyry, and cutting this, fine-grained andesite, and dacite dykes.

At a sharp bend in the creek, 2200 feet up-stream from the cabin, an outcrop in the north side of the river consists of a series of bedded rocks that include, progressing northerly, from drift and gravel, 50 feet of ankeritized chert-limestone breccia containing fragments of chert and limestone; 10 feet of fine-grained tuff; 10 feet of coarse-grained tuff; 10 feet of laminated black to grey, crystalline limestone; 50 feet of massive fine-grained tuff; then into drift and gravel. These beds strike north 60 degrees east and dip 35 degrees north-westward.

Up-stream beyond these beds, brown-weathering, ankeritized rock outcrops in the bluffs easterly from the river for an unknown distance.

There are no records of production from this property.

CHARBONNEAU. Separate showings, 1500 feet easterly from and 1500 feet southerly from Savona Station on the Canadian Pacific Railway, were examined (Fig. 2). No record of ownership could be found for these, but it was reported that the surface trenches were made by Jos. Charbonneau of Cloverdale, B. C.

A stripping exposes a dolomite vein in a dry gulch that leads south-westerly into the hills immediately south of Savona Station. The stripping is on the southerly side of the gulch at a point that is 1500 feet south-easterly from the Station. The stripping exposes a brecciated vein 42 inches in width, striking south 75 degrees east and dipping 70 degrees southward. The vein-matter consists of rock-fragments sealed by vein-dolomite; and the walls consist of crushed carbonatized greenstone. A sample taken across the vein assayed: Mercury, nil.

A second cut has been dug in the north-easterly bank of the gulch 8 feet above the stream-bed at a point that is 280 feet south-easterly up-stream from the last working. This cut is in the form of a bench that measures 18 feet in a south-easterly direction and is 7 feet wide. The cut is entirely in sheared and decomposed rock, but had evidently been dug to intersect the downward extension of a 5-foot outcrop of ankeritized rock lying 15 feet north-easterly up the hillside.

The well-washed rock-surfaces in the bed of the gulch indicate that the rock-formation is massive, bright green volcanic breccia.

A deep trench has been dug at the edge of a field north of the Canadian Pacific Railway tracks east of Savona Station. The trench lies 50 feet above and 325 feet in a direction south 20 degrees east from a point on the railway tracks that is 1500 feet easterly from Savona Station. The trench has been dug 6 feet deep for 23 feet in a direction south 70 degrees east toward the base of an 100-foot silt bluff. A brecciated dolomite vein that ranges from 2 inches to 4 inches in width, and dips 85 degrees south-eastward, crosses the middle of the trench; no cinnabar was seen in it and a sample assayed: Mercury, nil.

Five feet from the westerly end of the trench, a vertical fracture-zone, that ranges from 2 inches to 4 inches in width, strikes north 40 degrees east across the trench; and contains a stringer of dolomite which ranges from 1/2 an inch to 1 inch in width. No cinnabar was seen.

At the easterly end of the trench, a tight breccia-zone 6 inches in width, strikes north 45 degrees east across the trench, and contains a stringer of dolomite ranging from 1/8 of an inch to 1 inch in width. A sample of this dolomite assayed: Mercury, nil, and a sample taken across the 6-inch breccia-zone, assayed: Mercury, nil.

The rock in this trench is brown-weathering porphyry that has been highly altered to a dense aggregate of ankeritic carbonate and a few residual altered phenocrysts of feldspar and pyroxene.

TUNKWA LAKE. Showings one mile westerly from Tunkwa Lake were most recently covered by the Ridge and Bull Horn mineral claims, owned by W. A. and Mrs. Jane Ferguson, but which lapsed September 15, 1937, and by the O. K. and Cinnabar, owned by J. B. and D. J. McDonald but which lapsed May 1, 1938. Camsell describes the occurrences under the name of Summit claims (see Bibliography).

The showings, at an elevation of 3850 feet, lie 15.5 miles southerly from Savona on the Savona-Merritt cut-off road in an area that is known as the Summer Range. The workings are on the easterly side of, and adjacent to the road. They lie 1000 feet northerly from an unnamed lake which is on the easterly side of the road and 1 mile westerly from the easterly side of Tunkwa Lake (Fig. 2). More specifically the showings lie on the northerly and westerly sides of some low 5 to 20-foot knolls of range-land that fringe a pond measuring 300 feet in a northerly direction, and 200 feet in an easterly direction.

The main showings and workings are on the westerly side of a knoll 20 feet high that trends southerly. Within a distance of 80 feet, six open-cuts and a shaft (filled with water as of July, 1938) have been dug on the westerly side of the knoll along a strong zone of sheared-rock. The shear-planes strike south 15 degrees east and dip 60 degrees north-eastward. The material in the shear-zone has been altered to a dense ankeritic rock that weathers to a conspicuous brown colour. As shown by the decrease in brown-weathering, this alteration decreases easterly from the shear-zone, so that 60 feet easterly on the east side of the knoll the rock is much less ankeritized. On the easterly side of the knoll the rock in the outcrop is still somewhat sheared; examination of this material indicates that the rock is a sheared tuff. Numerous hair-like stringers of vein-dolomite traverse the zone, most of them paralleling the shearing. Cinnabar was seen only in the south end of a cut at a point 20 feet south of the shaft.

The following samples were taken in the more or less connected cuts on the westerly side of the hill; the distances are given as measured southerly from the shaft:

Sample No.	Distance South of Shaft	Per Cent. Mercury	Description
1	12 feet	nil	Across a 4-foot width of shear-zone, numerous stringers of dolomite.
2	20 feet	nil	Across a 4-foot width of shear-zone, numerous stringers of dolomite. A few specks of cinnabar seen here.
3	36 feet	nil	Across 6-foot width of shear-zone.
4	72 feet	nil	Across 3-foot width of shear-zone, numerous stringers of dolomite.

Small outcrops of brown-weathering, ankeritized rock may be seen in three low 5-foot knolls that skirt the southerly and easterly side of the pond. A sample taken across 25 feet of such material on the exposed northerly nose of a knoll lying 275 feet in a direction south 80 degrees east from the shaft, assayed: Mercury, nil, and a sample taken across 5 feet of similar material on the nose of a small knoll lying 150 feet north-easterly from the last, also assayed: Mercury, nil.

The brown-weathering, ankeritized zone of rock, probably the zone of shearing, as seen in the main knoll, can be traced for half a mile southerly from the shaft by rock-fragments in the soil of the range; farther southerly along the projection of this zone no fragments of any kind are to be seen, because of ponds and muddy soil.

The nearest outcrop of rock, other than that immediately around the shaft, lies 900 feet south-westerly. In this outcrop the rock consists of massive, very chloritic greenstone, cut by widely-spaced joint-planes that are filled by calcite stringers--there has been no ankeritization of this greenstone. Elsewhere, the only rocks are basalt boulders lying on the range-land.

At the time of examination (July, 1938), the property was idle. However, at some short time previous, possibly the summer of 1937, a 12-inch by 20-inch by 9-feet retort (Plate IV A) made by the Pacific Foundries, Limited, had been erected close to the shaft. The only buildings on the ground were a shed housing the retort, a tool-shed and a roof over the shaft.

There are no records of production from this property.

Yalakom River Cinnabar Occurrences

The area including these occurrences is reached by following the road from Lillooet up the Lower Bridge-Yalakom Rivers for a distance of 23 1/2 miles to Christy's ranch (Pre-emption Lots 3102-3) which lies beyond Moha post-office on the easterly side of the Yalakom River. From this ranch a good pack-horse trail is followed up the eastern side of the Yalakom River for 3.6 miles, to the Golden Eagle tent camp-site on the western bank. At the camp-site the river may be crossed by a good foot-log, or forded by the horses at short distances down-stream from the camp. An alternative route of comparable length follows up the western side of the Yalakom River beginning at the end of the road at Baumgartin's ranch, which is across the river from Christy's. The known occurrences of cinnabar are covered by two groups of claims, (1) the Golden Eagle group, lying mostly on the north-easterly side of the river, and (2) the Red Eagle, or MacInnes-Parker group lying on the south-westerly side. These two groups will be described separately.

The area, adjacent to the Yalakom River and both up-stream and down-stream from the Red Eagle and Golden Eagle workings, was prospected late in the autumn of 1939 by members of the Dominion-Provincial Youth Training Project "D", under the direction of M. S. Hedley of the British Columbia Department of Mines. In his report and accompanying plan (Fig. 5) Dr. Hedley describes the geology of this section of the Yalakom River area as follows:

> "The rocks of the region are, according to Geological Survey, Canada, Memoir 130, 1922 on the Bridge River Map-area, members of the Eldorado series of Lower Cretaceous age on the north-easterly side of the river and of the Bridge River series of Carboniferous age on the south-westerly side. Between these rocks is a prominent band of peridotite, not mapped by McCann. The structural relations between the two series are obscured.
>
> "The rocks north-easterly of the river, provisionally

"all referable to the Eldorado series, are predominantly sedimentary. Some volcanic breccias and possibly some flow-rocks occur in the valley proper, but elsewhere they are sandy to shaly sediments and many are arkosic to conglomeratic. A division has been made for purposes of this report into three members, of which the boundaries are shown approximately on Fig. 5.

"In the valley proper are green and purple volcanic breccias, preponderantly porphyritic and including apparently some flow-rocks; in addition there are bands of fine-grained silty and argillaceous sediments and a little limestone. To the north-east is a broad band of finely-granular sediments including some shale and some coarse sandstones and fine conglomerates. This member breaks down readily to fine talus and detrital cover. The upper member is characteristically massive, is greenish in colour and varies from fine arkose and sandstone to unsorted conglomerate. Stratification is only locally developed, and the massive character and resistance to weathering accounts for the fact that this rock type makes up the higher summits and ridges from the head of Four-Mile Creek, across Beaverdam Creek, to Yalakom Mountain.

"The peridotite body is too poorly exposed to be well studied. It is strongly serpentinized and appears to have been a peridotite of variable pyroxene content rather than a pyroxenite or dunite. It follows the south-westerly side of the river from at least a mile above Burkholder Creek to the Bridge River, where it apparently lies in the valley bottom. The body is about 1 mile in width, and includes a local and minor amount of sedimentary rock.

"The large body of serpentinized peridotite contains several interesting exposures that were carefully searched for cinnabar, but none was found. These occur both easterly and westerly of Shulaps Creek and midway between that stream and Junction Creek. They are rusty-weathering patches as much as 400 feet in apparent width, but since they only outcrop on short, steep slopes the actual size, attitude and continuity of each is not known, nor the possibility of continuity between some of them. The rusty colour on weathering results from an alteration presumably the same as the carbonatization at the Eagle properties.

"The rock is so altered that the original character can only be determined by occasional 'ghosts' of pyroxene. The whole is cut by many veins and stringers of white

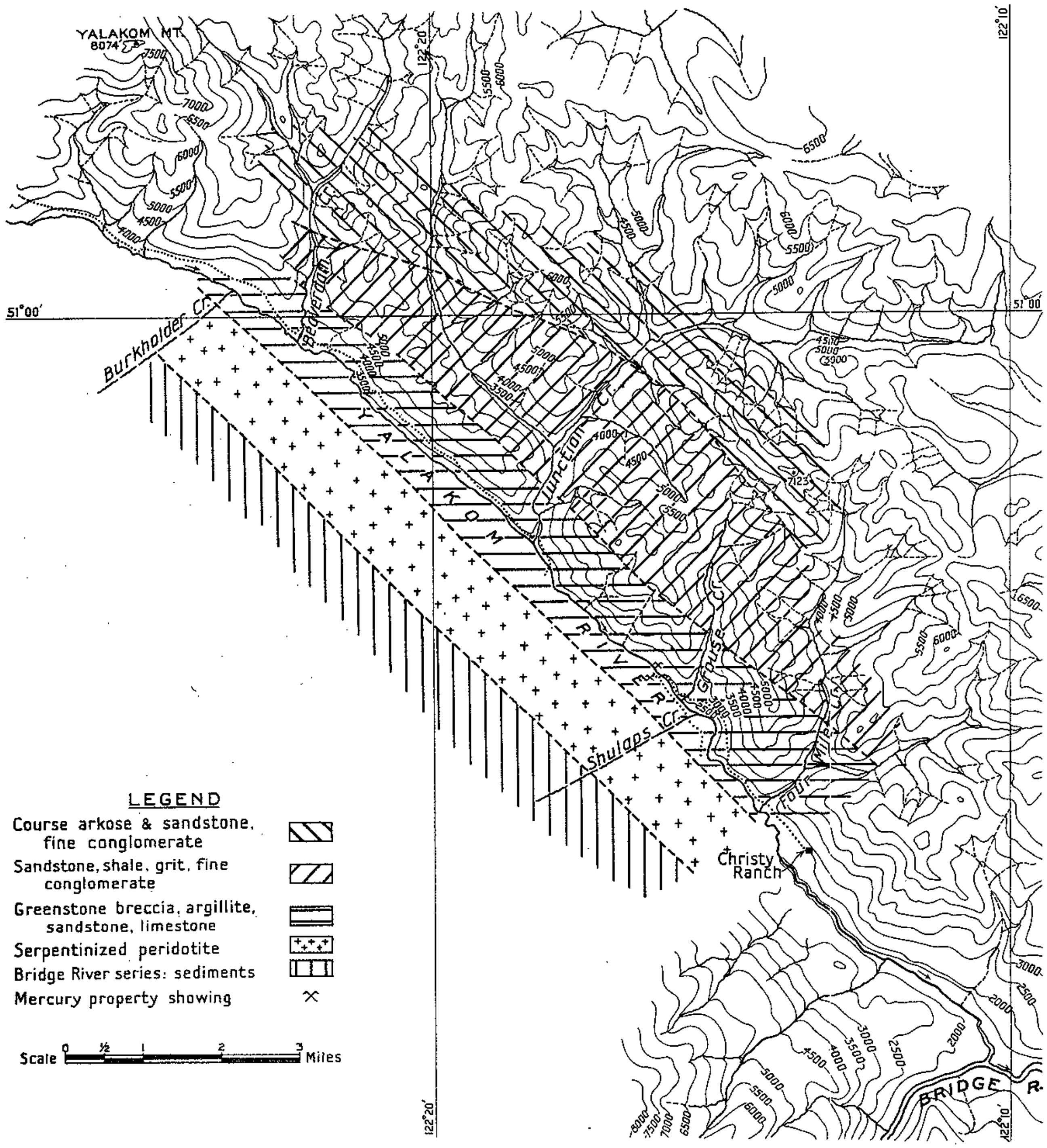


Fig. 5. Geology of the Yalakom River area after M. S. Hedley.

"dolomite and a few veinlets of opal. Some veinlets contain both carbonate and silica and, locally, some silicification on a minute scale. The rock is whitish to flesh-coloured and tends to be patchy and flecked with green. No cinnabar was seen, and only a very few specks of what is apparently stibnite.

"The rocks south-westerly of the serpentine underly the high, heavily-timbered slopes of Shulaps Mountains at elevations in excess of 5,000 feet, and were not studied. They include, so far as known, slaty and schistose types at the lower, observed elevations.

"The attitude of the Bridge River series is not known, but the serpentine body and the Eldorado rocks strike parallel to the river. Dips in the Eldorado series are steep north-eastward, with a few minor flexures and overturns. The axis of a syncline of major importance is believed to exist on upper Junction Creek, but too little work was done to prove this point conclusively; certainly there is a local change in general attitude.

"Patches of carbonatization were found at a number of localities on the north-easterly side of the river-valley from Four-Mile Creek to Beaverdam Creek. These patches or zones are restricted almost entirely to the lower member of the Eldorado series. The volcanic breccia is, in addition, much fractured and finely and irregularly veined with carbonate but with no attendant alteration. Considerable petrographic study would be necessary to describe fully or to classify these zones, and none has been attempted. Many are bedded, or follow some evidently favourable horizon, but others, notably up-stream from the Golden Eagle, clearly cut the formation. The zones appear for the most part to follow fractures or shear-zones and some may be localized by dykes, but the degree of alteration makes determination of original rock-types difficult.

"No cinnabar was seen in any of these zones, all of which are characterized by carbonatization and the presence of dolomite stringers and veins. Among the most prominent zones are those between the main lower fork of Four-Mile Creek; both easterly and westerly of that stream; on the summit of the ridge between Four-Mile and Grouse Creeks; on the bluffs up-stream from the Golden Eagle property for 1 mile; on the easterly side of lower Junction Creek; and above the trail 1 mile below Beaverdam

"Creek. One zone in finely-granular sediments on the north-westerly side of Beaverdam Creek, a mile from the river, was traced 2,000 feet up the hillside, and another similar zone was searched on the high ridge corner in the south-easterly angle between the same creek and the river, but without success.

"Clearly the most favourable belt, and that in which most carbonatization occurs, is here termed the lower member of the Eldorado series as exposed. This belt occupies the main valley, largely on the north-easterly side below Junction Creek and wholly on the north-easterly side below Four-Mile Creek. Above Beaverdam Creek, at least for two or three miles, the north-easterly side of the valley is one of very few outcrops and the favourable belt appears in part to be narrower, perhaps truncated by the serpentine. The least favourable belt for the occurrence of mercury in the area examined is the one of massive fragmental rocks which includes the high summits through the head of Four-Mile Creek and Yalakom Mountain. The intermediate belt does not appear to contain many at all prominent carbonate-zones, and is not deemed favourable owing to the incompetent nature of the shaly to sandy, finely-fractured sediments.

"That belt of country lying north-easterly of the main body of Junction Creek is one of long slopes with very few exposures. The rocks close to Junction Creek are gritty sediments which, so far as can be judged from a distance, are bedded nearly parallel to the long slopes.

"In the Yalakom River area a definite belt of carbonate-zones includes the valley-bottom, the north-eastern valley-wall, and the south-western valley-wall to the known limits of the peridotite body. Farther north-easterly there are few indications of mineralization and the rocks are not considered favourable. There appear to be no major structures such as folds that might tend to localize fissuring and possibly to "trap" mercury. There is apparently a syncline on the north-eastern side of upper Junction Creek, but no evidence of mineralization in this vicinity; minor open flexures in several other localities do not appear to have influenced a localization of fracturing or of mineralization.

"Zones of carbonatization within the favourable belt may all be found within a few days by climbing the summits adjacent to the river, and preliminary work is "greatly aided by the use of field-glasses. It is to be noted that even the smallest zones and carbonate-veins produce a liberal amount of easily-recognizable float. The region does not appear to have been closely prospected and is relatively easy to examine, one disadvantage being the scarcity of water. The favourable belt is believed to continue to the south-east on the high summits flanking the river."

925-95 GOLDEN EAGLE. The Golden Eagle group (Fig. 6) consists of the mineral claims Golden Eagle Nos. 1 to 6 and 8 to 9 inclusive, lying on the north-easterly side of the Yalakom River, 23 1/2 miles by auto-road and 3 1/2 miles by trail from Lillooet; they are immediately opposite the Red Eagle owned by Messrs. Parker and MacInnes. These claims were staked in 1938 and are severally owned by Geo. M. Murray, P. J. Wilson and associates of Lillooet and Vancouver.

The easterly valley-wall in the immediate vicinity of the showings consists mostly of talus-slopes and draws sloping steeply at an average angle of 35 degrees to the river-bottom. Above the workings the valley-wall rises in a series of talus-slopes and bare unscalable bluffs to the top of the ridge. The elevation of the top of the ridge is 5400 feet and that of the river-bottom is 2400 feet; the elevation of the workings is 2650 feet.

The Golden Eagle tent-camp is on the opposite or south-westerly side of the river and approximately 400 feet down-stream from a point in the river immediately downhill from the workings.

The rocks on the hillside in the vicinity of the showings on the north-easterly side of the Yalakom River consist of both green and purple volcanic breccias overlain by sediments consisting of sandy shale, limestone-lenses, and chert. The volcanic breccias strike north 60 degrees west and dip from 30 to 60 degrees north-eastward. The overlying sediments strike north 55 degrees west and dip 60 to 70 degrees north-eastward. The only intrusive seen was a greenstone sill in the sediments; no granitic rocks were observed.

The volcanic breccia has been altered at two horizons to two zones of dense, brownish-weathering, ankeritic rock; a lower zone in the vicinity of the workings and an upper one 2150 feet above, at an elevation of 3800 feet. These zones are traversed by narrow stringers of white vein-dolomite that extend into the adjacent unaltered breccias. Most of the cinnabar grains seen are either in or adjacent to the dolomite veinlets.

In the immediate vicinity of the Golden Eagle workings the rocks comprise volcanic breccia and an irregular zone of brown ankeritic rock, more or less conformable to the attitude of the breccia; narrow bands of chert and tuff occur above the workings. The exposed zone of ankeritic rock is lenticular in outcrop, the maximum exposed width measuring approximately 380 feet on the slope of the hill. The workings are in a small, triangular-shaped area of purple volcanic breccia that extends south-easterly from its apex for 200 feet to end in talus just east of No. 2 cut; at this place the width is 25 feet. This area represents a fragment of volcanic breccia still unreplaced by the solutions that have converted the rock above and below and on the westerly end into brown-weathering, ankeritic rock. Easterly across the talus-slide the rock is volcanic breccia.

One hundred and fifty feet above the workings the ankerite-zone contains a series of well-bedded rocks striking north 60 degrees west and dipping 40 degrees north-eastward. Beginning at the bottom, the series includes 2 feet of grey chert, 25 feet of ankeritized breccia, 8 feet of jasper in 8-inch bands, 25 feet of purple and green breccia, 8 feet of green tuffs, and lastly, definitely-green volcanic breccia that extends up the hillside to the next ankeritic zone 1000 feet above, as shown on Fig. 6. The intense ankeritization ends beneath the jasper beds; the alteration of rocks above these beds is very slight. These beds are cut and displaced about 5 feet by a fault trending up the gulch and dipping 40 degrees eastward. The rock is intensely ankeritized to a massive carbonate rock for 4 inches on either side of the fault-plane and contains a small stringer of white vein-dolomite. This alteration and mineralization indicates the nature of the processes involved in the formation of the extensive brown-weathering ankerite-zones, namely a process involving a permeation of altering solutions from channels afforded by faults or by open-textured rocks, into the surrounding rock. Apparently, the relatively open-textured, volcanic breccia, and this in varying degrees, was more permeable to the altering solutions than the chert, jasper or tuff beds. The vagaries of replacement processes are responsible for the irregular and lenticular shape of these ankerite-zones within the areas of volcanic breccia.

The lower ankerite-zone appears to be at the contact of two bands of volcanic breccia, a lower that weathers predominantly purple and an upper that weathers predominantly greyish-green. Tongues and lenses of the purple breccia within the ankeritic zone indicate that this zone lies within the purple rather than the greenish breccia, the preference is

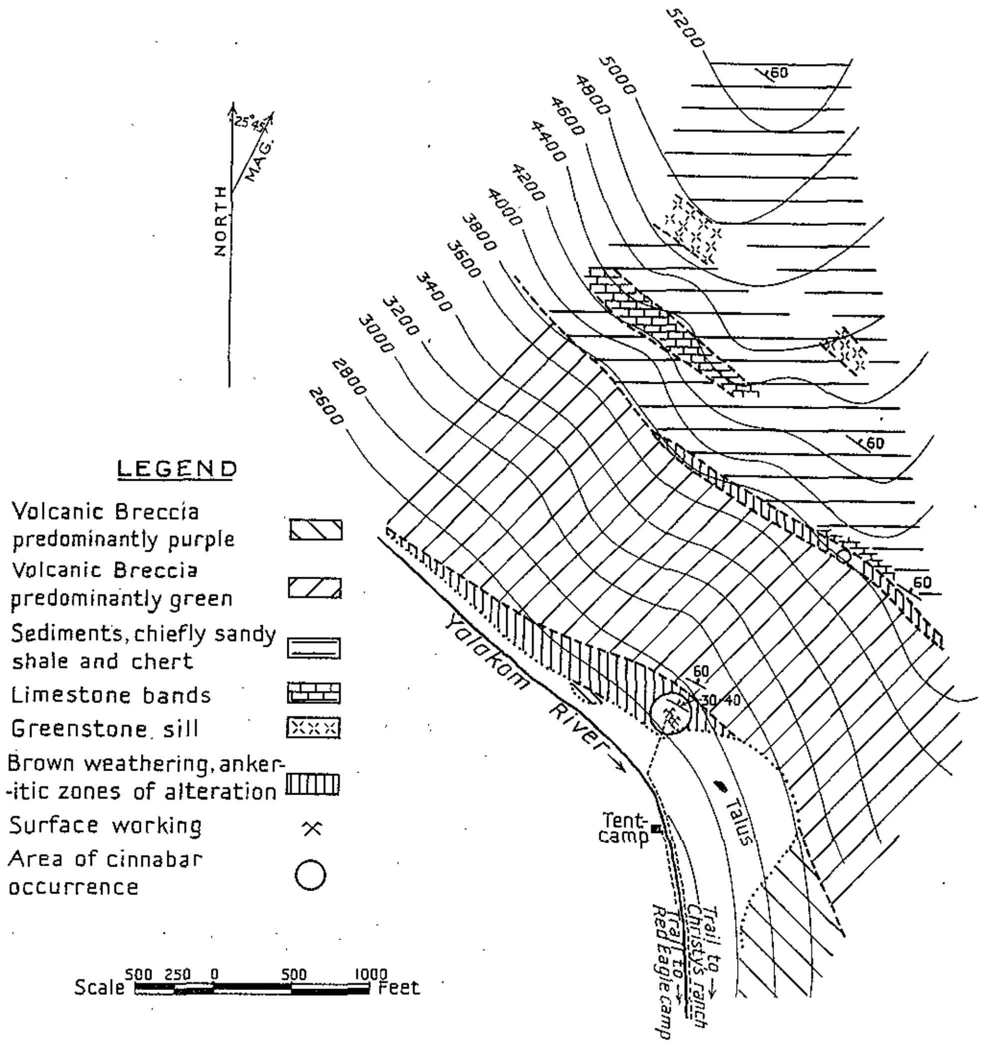


Fig. 6. Detailed geology in vicinity of Golden Eagle showings, Yalakom River.

probably related to a difference in the permeabilities of the two breccias.

A traverse was made up the hillside above the workings to the nose of the ridge thence northerly up the ridge-nose for 3,000 feet to the crest at 5,400 feet, and down to the river-bottom. The rock-types that were encountered are shown on Fig. 6. At an elevation of 3,800 feet, a second or upper brown-weathering ankeritic zone occurs between green volcanic breccia and overlying sediments; the breccia is too massive for a determination of attitude, but the sediments are well bedded and a general strike of north 60 degrees west and a dip of 70 degrees north-eastward was observed. The zone of most intense alteration is about 200 feet thick and it extends approximately 1500 feet north-westerly and approximately 500 feet south-easterly, the intensity of the alteration dying out at either end. The sediments overlying the zone were slightly-altered, ankeritic carbonate for a distance of 15 feet from the contact. The greater permeability of the rock in the contact-zone between the volcanic breccia and overlying sediments probably aided in localizing the intensity of ankeritic alteration in this second or upper zone. A few grains of cinnabar were found in some 1/4-inch veinlets of white vein-dolomite that occur in the lower part of the zone.

The sediments overlying the volcanic breccia consist of sandy shale, a few lenses of limestone and well-bedded chert. At an elevation of approximately 4900 feet a greenstone sill 200 feet in thickness was seen.

As of August, 1938, the workings consisted of two open-cuts 280 feet above the river. No. 1 cut has been driven at north 27 degrees east for 22 feet to a 20-foot vertical face in the easterly wall of a small northerly-trending rock-draw. The cut is entirely in purple volcanic breccia. At distances of 6 feet and 18 feet from the face, there are two stringer-zones, 2 feet and 4 feet wide respectively; they strike easterly across the cut and dip 60 degrees southward. These two zones consist of a few lenticular and discontinuous dolomite veinlets ranging from 1/2-inch to 1 1/2 inches in thickness. Cinnabar occurs in these zones either as discrete grains and blebs within the dolomite stringers, or short criss-crossing, hair-like stringers of pure cinnabar. A sample taken 6 feet from the face across a 6-inch brecciated zone, sealed by dolomite and hairs of cinnabar, assayed: Mercury, 0.3 per cent. Three samples were taken across a mineralized zone, 18 feet from the face. One, taken across 1 foot in the floor, assayed: Mercury, 1.0 per cent; another, taken on the easterly wall 2 feet above the floor and across a kidney of high-grade 6 inches by 12 inches, assayed: Mercury, 8.0 per cent; and another taken one foot above and northerly from the last, assayed: Mercury, 0.2 per cent.

No. 2 cut is 75 feet in a direction south 35 degrees east from No. 1. It is a shallow sidehill-cut extending 18 feet along the hillside in a south-easterly direction, the face along this length ranges from 2 feet to 7 feet in height. This cut is also in volcanic breccia, but the general outcrop has a brownish cast resulting from the formation of films of limonite along the joint-planes in the rock. There is much less cinnabar in this cut than in No. 1. A sample taken across the only patch of cinnabar seen, a patch one foot in diameter, assayed: Mercury, 0.1 per cent.

A third cut, very much smaller than the others, has been made in the slope-face, 50 feet westerly from No. 1 cut. This cut measuring 5 feet along the slope by 2 feet up it, is in a thin band of volcanic breccia only 2 feet wide. Only a few grains of cinnabar were seen in this working.

At the time of examination of the property (August 9th to 10th, 1938) one of the owners, Mr. Lands, was doing surface work.

There is no record of production from this property.

92J/120

RED EAGLE. The Red Eagle group consists of the mineral claims Red Eagle Nos. 1 to 21, originally staked in May, 1937, by Chas. J. Parker, and owned by Geo. L. MacInnes and associates of Vancouver, B. C. The property lies immediately south-westerly across the Yalakom river from the Golden Eagle, and is most conveniently reached by the same trail.

92J/95

The topography is similar to that described for the eastern side of the valley where the mountain-side slopes steeply up from the river, but, as compared with the eastern side of the valley, the western side is covered with a much denser growth of evergreens and less talus-material. The exposures are fewer until a point is reached that is 1,000 feet above the river; here the bush gives way to bare open rock-slopes and terminates in a saw-tooth ridge of volcanic breccia. The workings at an elevation of 2875 feet are 500 feet above the river; they are south 50 degrees west up the hillside from a point 500 feet down-stream from the Golden Eagle camp. However, at this point the slope is too bluffy to climb and the cuts are reached by a trail that leaves a camp-site 2,140 feet down-stream and winds along the side-hill north-westerly to the cuts.

The workings consist of four open-cuts in purple, volcanic breccia; in most of the cuts the breccia is brownish and badly decomposed.

No. 1 is the first cut met on the trail when climbing up from the river. It is only 2 feet wide and has been driven westward for 5 feet into the slope. The rock is badly-fractured breccia, but it contains neither dolomite veinlets nor cinnabar.

No. 2 cut is 22 feet northerly along the hillside. It is 3 to 4 feet wide and has been driven westerly for 6 feet into the hill in breccia. The only showing of cinnabar was a 1/8 by 1/4 by 2-inch bleb of cinnabar associated with some dolomite. A sample taken across this material assayed: Mercury, 5.4 per cent. A sample taken in 1937 across the face of this cut, containing at that time three hair-like stringers of cinnabar, assayed: Mercury, 1.3 per cent.

No. 3 cut is 10 feet below and north-easterly down the 45-degree slope from No. 2. It is more like a small stripping than a cut, extending along the hillside for 5 feet with a 2-foot face. No cinnabar was seen in this cut.

No. 4 cut is 15 feet below No. 3 in a south-easterly direction. It extends 8 feet along the hillside with backs 3 feet high. A sample taken across the 8-foot face in 1937 assayed: Mercury, 1.0 per cent. At that time there were a few specks of cinnabar visible, but in August, 1938, there was only one grain of cinnabar and a few dolomite stringers. A large sample of cinnabar-bearing rock from the dump taken in August, 1938, assayed: Mercury, 0.7 per cent.

Between Nos. 3 and 4 cuts, three diversely-oriented, tabular, brown, ankeritic-dolomite veins, ranging from 3 inches to one foot in thickness, cut the volcanic breccia; cinnabar was not visible in these veins. The veins represent intense ankeritization of the rock adjacent to fissures subsequently filled by white vein-dolomite.

No. 5 cut is 120 feet northerly along the hillside from No. 2. It has been driven 2 feet westerly into the hillside in decomposed purple breccia. No cinnabar showed.

Three feet northerly from this cut, small one-foot outcrops of brown ankeritized volcanic breccia were scattered over an area 25 feet in diameter. No cinnabar was seen in these outcrops, but the area is worthy of note because it contained the only brown ankeritic rock seen on this hillside of a kind similar to that on the Golden Eagle claims across the river.

No. 6 cut is 100 feet northerly along the hillside from No. 5. This cut exposes a rock-face 20 feet long in a north-south direction and 4 feet high. The rock is purple volcanic breccia that is irregularly cut by 1/4-inch dolomite veinlets;

only one 1/16 by 8-inch film of cinnabar was seen along a joint-plane in the breccia. A sample taken in 1937 across 10 feet of the face and cutting more cinnabar films than were visible in 1938, assayed: Mercury, 0.05 per cent. A large specimen of ore measuring 2 inches by 3 inches by 6 inches, containing two films of cinnabar, one, lenticular, 1/16 inch by 3 inches, and a second, 1/8 inch by 2 inches, assayed: Mercury, 2.3 per cent.

A traverse was made up the hillside from the workings to the top of the ridge at an elevation of 3650 feet. The exposures did not commence until near this point, and then were continuous along the bare ridge-top. The rock-formation was seen to be exclusively volcanic breccia. The breccias are cut by an occasional shear from which ankeritization has spread for a few inches, resulting in conspicuous brown-weathering veins consisting mostly of ankerite, which are sometimes cut by stringers of vein-dolomite. No cinnabar was seen in either the ankerite veins or the adjacent volcanic breccia.

At the time of examination (August 10, 1938) work had been temporarily suspended on the property.

There are no records of production.

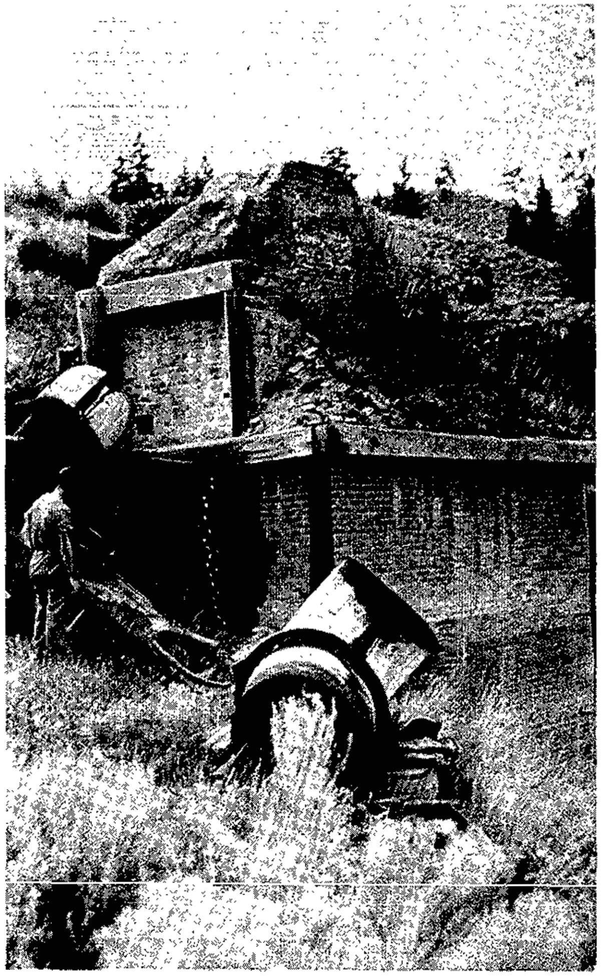
<u>Bridge River Occurrences</u>

The known occurrences in the Bridge River area are those up Tyaughton Creek. They include those at the Empire (Manitou) Mines, Limited, between Relay and Mud Creeks, and at the Conardon Mines, Limited, approximately 6 miles north-westerly from Tyaughton Lake. Cinnabar occurs in small amounts on claims owned by Messrs. Phillips and Lorntzsen in the vicinity of Mercury Creek, a small westerly-flowing tributary of Tyaughton Creek.

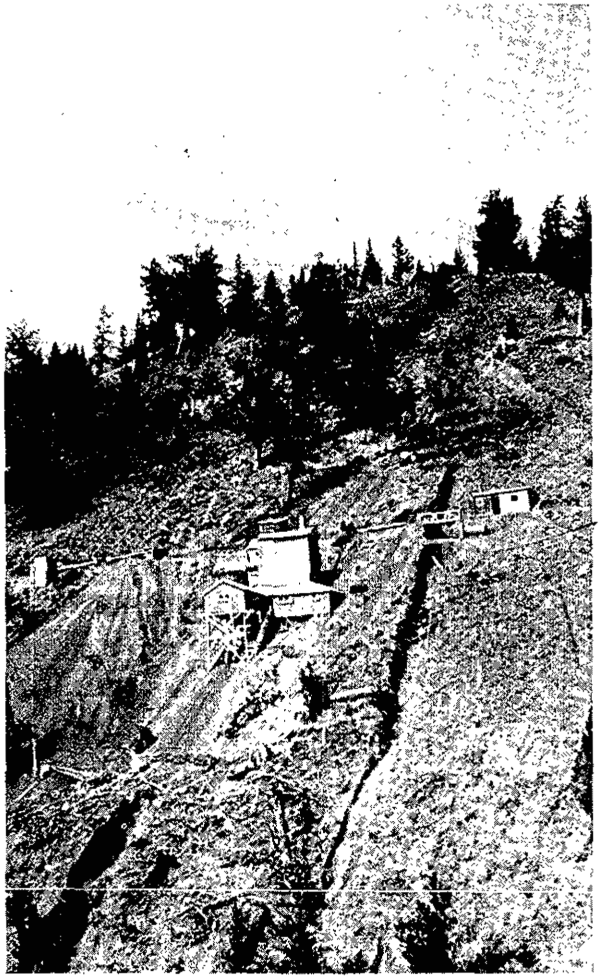
EMPIRE MERCURY MINES, LIMITED (N. P. L.) This company with offices in 1021 Hall Building, Vancouver, B. C., formerly known as the Manitou Mining Company, owns the following mineral claims: <u>Rose Nos. 1 to 5</u> inclusive, <u>Relay Nos. 1 to 10</u>, inclusive, and <u>Brier Nos. 1 to 11</u>, inclusive. These claims staked in 1932 by Ben Cromer, lie between Mud Creek on the east and Relay Creek on the west, close to the junction of these creeks with Tyaughton Creek. The camp is on a bench at an elevation of 3,880 feet on the south-easterly side of and approximately 100 feet above Mud Creek.

Most of the workings are on a steep open hillside on the

PLATE III.

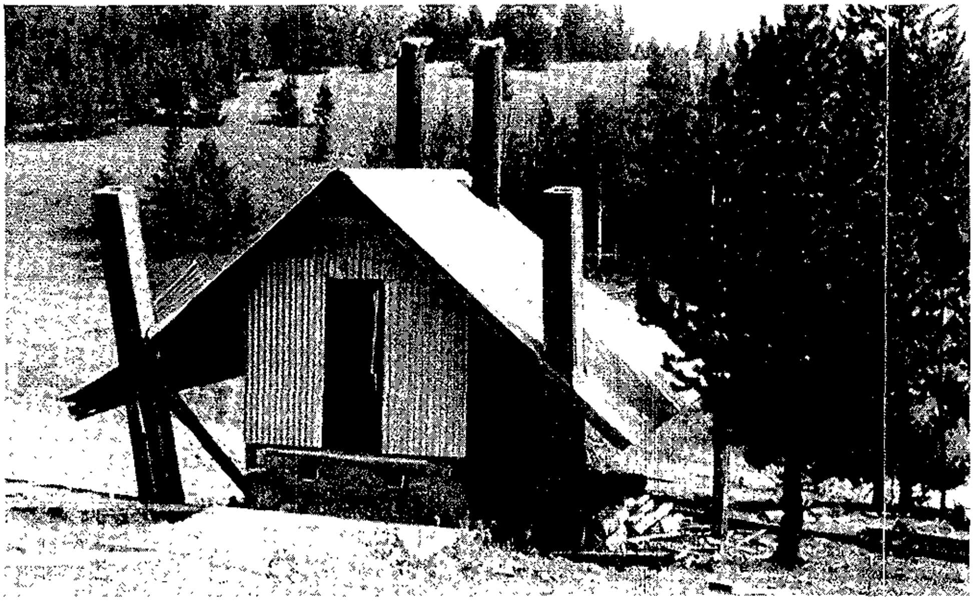


A. Old Scott furnace at Copper Creek cinnabar property.



B. Empire Mercury Mines, Limited, showing mill building, *ground-sluiced trenches* Nos. 3 and 3A (middle foreground) and portals of adits Nos. 7 and 2 (left centre).

PLATE IV.



A. Small D-retort at Tunkwa Lake cinnabar property, showing flues from condensers (outer stacks) and flues from fire-box (inner stacks).

B. Mill building of Empire Mercury Mines Limited, housing 10-ton Gould rotary kiln.

opposite or north-westerly side of Mud Creek between elevations of 3,780 feet and 4,300 feet. (Fig. 7 and Plate III B). This hillside which is grassy and in steeper places partly covered by talus, slopes westward and south-westward into Mud Creek. Rock-formations are only moderately exposed and the depth of the overburden is as much as 15 feet in places.

The property is reached by a recently-constructed motor-road, 16 miles long, that leaves the Bridge River road at a point 1.7 miles east of Minto City.

The workings comprise four main adits, several shorter ones, a 180-foot raise and several long ground-sluiced trenches (Fig. 7); the latter have largely sloughed and rock-exposures have been covered by sand and gravel.

In addition to the usual mine-buildings and a camp to accommodate approximately thirty men, the present company constructed a 10-ton Gould rotary-kiln in 1938.

The deposit consists of mineralized shear-zones within purple amygdaloidal and green even-grained lavas. The best mineralization is confined to two main shear-zones which strike north-westerly and range from a few inches to 10 feet between main slip-walls. Assays are shown on Fig. 7.

The rocks consist of interbedded ribbon-cherts, slates and lavas, intrusive serpentine, massive arkosic sandstone, and felsite dykes or sills. The cherts, slates and lavas have been intensely folded and the beds are very contorted and usually have very steep dips, the massive sandstone and interbedded shaly material have a more uniform attitude and usually gentler dips.

Ribbon-chert is the most prevalent rock-type, occurring in all the workings and outcropping in various places. It is interbedded with lava in many places and with a bed of slate that occurs in No. 2 adit and also outcrops above the adit. The rock consists of bands of white to grey chert or cherty quartzite that range from 1 inch to 3 inches in width; these bands are occasionally separated from each other by a parting of greenish-grey or black argillaceous schist ranging from 1/16 to 1/4-inch in thickness. The beds are rarely uniform in strike and dip; they are more commonly contorted or curved so that the strike and dip records tend to be confusing.

Concerning the origin of the chert, Cairnes (see Bibliography), believes that it is a chemical precipitate that was deposited from siliceous solutions which emanated from the associated volcanic rocks and in part from submarine siliceous springs.

Slate outcrops in a small area that lies immediately north-westerly from the collar of the shaft and occurs underground in No. 2 adit near station 216. Although overburden obscures actual contacts at the surface, and only fault-contacts appear underground, the occurrence of chert-outcrops on either side of the slate-area and of a 4-foot band of chert in contact with slate on either side, indicates that the slate is interbedded with the chert. The indicated thickness of the slate is approximately 80 feet.

The slate is dark-grey, fine-grained, and breaks with a glossy, slaty cleavage into tabular slabs of rock. It probably represents argillaceous material deposited more or less contemporaneously with the ribbon-chert and lava.

Both purple and green lavas are widely distributed throughout the workings; they are second in order of abundance to the chert, and inasmuch as they form the host-rock for the cinnabar, perhaps first in importance.

The lavas are interbedded with the ribbon-chert and took part in the same intense folding. Individual beds of lava range from 3 feet to possibly 100 feet in thickness.

There are two main rock-types, a purple lava that is amygdaloidal and an apple-green lava that is fine, even-grained and contains small black inclusions of chilled lava approximately 1/16-inch in maximum dimension; both types are andesitic in composition.

These two types have been separately mapped, but their contacts are very irregular, and often times one lava contains faulted lenses of the other. The stratigraphic relation of the one lava to the other is therefore not clear.

In contrast to the green lava, the purple lava is hard and massive, both on the surface and underground. It is usually fine-grained and contains conspicuous amygdules of calcite ranging from 1/16- to 1/32-inch in diameter. The matrix for the amygdules consists of a felted mass of abundant feldspar microlites with an interstitial groundmass of decomposition products, of which magnetite is the most abundant mineral. Some phases, seen in an outcrop near the "Old Tunnel," tend to be extremely dense and where sheared, quite shaly; this probably represents the rapidly-cooled part of a flow.

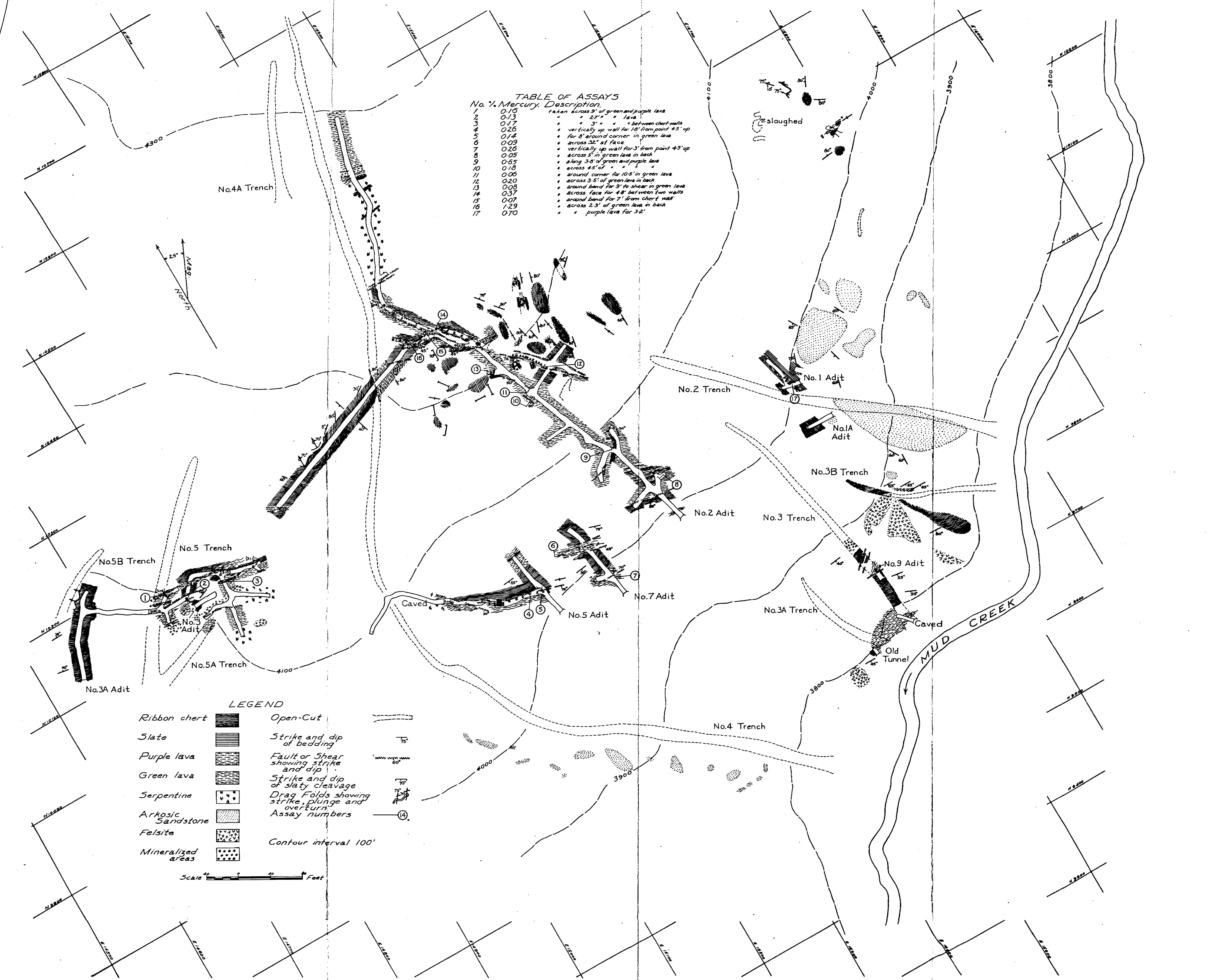


Fig. 7. Plan of workings, Empire Mercury Mines, Limited.

The green lava is usually coarser-grained, less massive and more frequently sheared than the amygdaloidal. As a result, outcrops of this rock tend to be rotten and to decompose readily. The unweathered rock is apple-green in colour, particularly underground, and contains conspicuous black angular fragments of chilled lava. It is highly altered so that thin-sections usually consist of an indefinite aggregate of chlorite, carbonate and clinozoisite; considerable leucoxene was seen in one slide. The angular black fragments of included lava consist of a very finely-felted mass of chloritic laths. The green lava is more highly sheared than the amygdaloidal and for that reason served to a greater extent as a host-rock for the cinnabar.

Both lavas probably represent flows poured out in periods that alternated with those during which the beds of ribbon-chert were being deposited.

Serpentine occurs in Nos. 2, 7 and 3A adits, and also outcrops outside the present map-area. Widths of serpentine as intersected by these workings range from 20 feet to 125 feet.

The serpentine appears to be intrusive into the surrounding chert and lava. The contacts are always strongly-faulted and crushing and shearing are very abundant. In No. 2 adit beds of chert were seen that were bent upwards towards the serpentine, as if in response to upthrusting during emplacement of the serpentine mass. Emplacement by intrusion has been ascribed to the serpentized rocks, President intrusives, of the Bridge River area, by Cairnes; Walker and Cockfield, also suggested that some of the serpentines may be intrusive (see Bibliography). As explained above, the present writer believes that the serpentine on this property is an intrusive body.

The serpentine is glossy, greenish-black in colour and massive, but badly fractured and where not timbered, the walls of the workings slough badly. The rock is completely serpentinized and all traces of its original nature have been destroyed.

Felsite occurs in and outcrops above No. 3 A adit, and also outcrops in a large area in the vicinity of No. 9 adit. The various occurrences indicate the presence of at least three different bodies in the map-area, one, in No. 3 A adit, a second, immediately south-west of the "Old Tunnel" and a third north and east from No. 9 adit.

The general distribution of the outcrops and nature of the occurrences in No. 3 A adit suggest sill-like relations to the enclosing rocks. However, in the vicinity of No. 3 trench felsite is in slip-contact with beds of chert which strike directly towards the felsite. The outcrops of felsite that lie both immediately north from and east from No. 9 adit are hummocky and occasionally have adhering fragments of dense rock similar to lava. These outcrops are believed to represent the upper surface of an intrusive sill.

The only estimate of thicknesses of the sills that could be made is in No. 3 A adit, where the felsite occurrences indicate a thickness of approximately 5 feet.

The felsite is light-grey and those occurrences within the map-area are fine, even-grained in texture; porphyritic felsite was seen in outcrops south-easterly across Mud Creek.

A comparatively fresh-looking andesite dyke, or sill, 4 feet thick, occurs adjacent to the northerly contact of the serpentine in No. 2 adit. The rock is characterized by andesine phenocrysts, a few glistening phenocrysts of biotite and hornblende set in a fine-grained groundmass.

Arkosic sandstone occurs in two main areas, one area, comprising a north-westerly-trending "hogback" immediately south-westerly from and parallel to No. 4 cut, and a second area, in No. 2 cut and immediately north-easterly from it.

The outcrops indicate a possible stratigraphic thickness of approximately 30 feet for the first area, and a minimum of approximately 120 feet for the second.

The sandstone is grey in colour and medium to even-grained in texture. It consists of angular grains of quartz and andesitic lava-fragments all closely packed in a brown, decomposed, textureless matrix; it may be a tuff rather than a sandstone.

Some of the sandstone-outcrops contain bands of finely-laminated shale, which range from 1 inch to 25 feet in width within the massive tuff. The sandstone is too massive to show bedding-planes sufficiently well-defined for dip and strike determinations, but the finely-laminated shale serves very well for this purpose.

Drag-folds and bedding-plane faults occasionally occur within the shale bands.

The relationship of the arkosic sandstone to the other rocks is uncertain. The abundance of shearing in the vicinity of the contacts between lava and the north-easterly area of sandstone, suggests a fault-contact between these two rock-types. Scarcity of outcrops and lack of bedding in the vicinity of the south-westerly body prevents a determination of the relation of this body of sandstone to the other rock-types.

The rocks in the map-area have been intensely folded, particularly the cherts and lavas which have been partly folded into steeply-oppressed isoclinal folds. Steep dips and overturning of folds prevail, but the extreme complexity of the folding, lack of definite stratigraphic markers, and particularly the widespread faulting to which the area has been subjected, have prevented the complete interpretation of the folding and the projection of folds for any distance.

The rocks have been displaced and sheared by minor bedding-plane faults within the lavas and the cherts and by major faults which follow the lavas, and may or may not follow bedding-planes.

The bedding-plane faults occur chiefly at the contacts between the lava and chert and give rise to single-slip contacts or to contacts of crushed and sheared rock between the two. The fault-material is seldom very thick, ranging from a mere film of gouge to crush-zones 6 inches thick. Where the chert contains any quantity of argillaceous material as partings, folding has resulted in considerable slippage within the argillite, so that sections of such rock consist of chert and slickensided carbonaceous material.

Two zones of major faulting traverse the rocks within the map-area. The first is in No. 2 adit where a zone of intense faulting and crushing extends along the drift adjacent to the raise, and continues across into the main drift from station 212 past 214 and into the wall near station 218. This fault branches at station 212 (Fig. 7) the main branch continuing as first described and the minor branch going north-westerly past stations 213, 215 and 216 (Fig. 7). The second fault-zone occurs in numbers 5 and 3 A adits. In No. 5 adit it crosses the drift near the winze at station 504 (Fig. 7), and its apparent continuation is found in No. 3 A adit extending easterly and south-easterly from station 305 past 308 to 311 (Fig. 7). A parallel fault extends from station 306 to 310 (Fig. 7) in the same working.

The faults are zones of extreme shearing which range from 6 inches to 10 feet in thickness. The zones of crushing are localized in green lava rather than in the ribbon-chert.

Zones of faulting and of sheared rock, not necessarily related to the previously-described faults, occur in the rock-types, adjacent to the serpentine occurrences. These zones of faulting were probably formed as a result of the intrusion of the serpentine.

A raise has been driven from near station 209 (Fig. 7) in No. 2 adit through to the surface, a distance of approximately 180 feet from the floor of the adit. Well-mineralized lava can be seen in the raise at 10 feet and 35 feet from No. 2 adit; timbers prevented thorough examination of the walls of the raise, but it is reported that well-mineralized rock extends from No. 2 adit for 78 feet up the raise; a small amount of cinnabar was seen at 100 feet up. Taking into consideration the south-westward dip of the main slip-planes in the mineralized fault-zone that extends north-westerly in No. 2 adit from station 209, it is probable that at elevations in the raise above 35 feet from the floor of the adit, the main fault-zone and therefore the main mineralized zone, lies to the north-east of the raise; the last intense faulting was seen on the 35-foot landing. On this landing the well-mineralized rock ranges from a width of 10 feet between fault-walls on the north-westerly end to 18 inches in the south-westerly face approximately 25 feet distant. Bad ground prevented sampling this material. At the 60-foot landing no cinnabar was visible.

Cinnabar occurs (1) chiefly in the shear-planes of the lava associated with the fault-zones, (2) less abundantly as 1/8 to 1/2-inch kidneys of mineral in the middle of calcite veins 1/4 to 1 inch in thickness, (3) only occasionally as discrete grains within the rock-mass.

Both pyrite and calcite are commonly associated with the cinnabar; but in most cases the cinnabar is later than both these minerals. A small amount of native mercury was found by the writer in the winze in No. 5 adit. In addition to the cinnabar-calcite veinlets, quartz-calcite, and chlorite-calcite veinlets occasionally occur in the lavas.

The above minerals are absent in all the other rock-types, none of which, excepting the serpentine, having been sheared sufficiently to provide the fracture-planes apparently necessary for the mineralizing solutions.

The ore-bodies are the more heavily mineralized parts of the shear-zones within the lavas, and in some instances, sections of lavas adjacent to these. Apart from the localization of the general cinnabar-mineralization by the shear-zones, there does not appear to be any local structural control over the occurrence of the higher-grade sections. Delimitation of these for mining purposes can only be done by extensive sampling and then only approximately.

Cinnabar is found in all the underground workings. The areas of mineralization and representative assays are shown on Fig. 7. The areas or zones of best mineralization occur (1) in No. 2 adit extending north-westerly from the raise to station 218, a distance of 200 feet, and extending upwards to the 35-foot landing in the raise, and ranging in width from 18 inches to 10 feet, (2) in No. 5 adit extending from station 501 north-westerly for approximately 70 feet to station 503 and approximating 6 feet in width, (3) in No. 3 adit, two parallel zones extending easterly from stations 306 and 305 to near station 310, a distance of 80 feet and approximating 5 feet each in width. Areas outside these main mineralized shear-zones contain cinnabar, but in widely-scattered and very small amounts.

The samples taken by the writer and extensive sampling done by the company, indicate that the amount of material averaging 0.5 per cent. or more in mercury, in these shear-zones is small. The only better-grade material seen by the writer was in the raise on the 35-foot level, where it extended along the back for 25 feet and ranged from 18 inches to 10 feet in thickness. It is understood that most of the material which was run through the furnace came from this vicinity.

Production has consisted of 10 flasks of mercury from a Gould 10-ton, oil-fired rotary-kiln erected in the autumn of 1938. The plant (Plate IV B) operated during the autumn and winter of 1938, but closed down in February, 1939. Fifty tons of broken ore is reported to be available in the ore-bins and ore-chutes as of June 23, 1939.

The property has been inactive and in charge of a watchman since February, 1939.

CONARDON MERCURY MINES. The Conardon Mercury Mines (office at 615 West Pender Street, Vancouver) owns the <u>Lillomer Nos. 1</u> to <u>6</u> group of mineral claims.

The property is situated (*see* Frontispiece) on the south-westward slopes of the divide between Pearson and Taylor Creeks, at elevations ranging from approximately 6,000 feet to 7,000 feet. The workings are reached by approximately 6 miles of good pack-horse trail that leaves the Tyaughton Lake road close to the southerly end of that lake and proceeds north-westerly on a good grade to the property. The workings themselves are reached by a trail that branches from this main trail, at approximately 5 miles, at an old cabin that is situated adjacent to and on the southerly side of the trail. The branch-trail leads north-easterly up a series of good switchbacks for a distance of approximately 1 mile in the open, alpine country to the workings; the main trail goes westerly and north-westerly past the cabin and eventually to the northern slope of Taylor basin.

The workings are on and above timber-line; open, alpine meadows, small clumps of dwarf-balsam and spruce and rocky ridges characterizing the slopes. The workings consist of several open-cuts in and on the north-easterly side of a south-easterly-trending draw, which leads into a much larger south-westerly-trending valley. An adit, now caved, has also been driven northerly from a point in the bottom of the draw.

At the time of the writer's visit to the property (June 25, 1939), the draw was almost filled with deep, packed snow and the surrounding area with 5 inches of freshly-fallen snow. The following description of the workings is, therefore, taken from a report made by V. Eardley-Wilmot for the Department of Mines, Ottawa, dated October 3, 1938; the date of the examination being August 19, 1938:

"The rocks are mainly quartzite, greenstone and argillite. The main workings are on one side of a shallow dry ravine and consist of four cuts in a zone of greenstone which overlays quartzite. These cuts cover a length of about 100 feet and a vertical distance of about 20 feet.

"No cinnabar was noted in the top three cuts, the highest of which is partly in argillite, but in the lowest and most southerly cut traces and veinlets carrying the mineral were seen. A few tons of selected ore from the latter cut have been piled up to one side. As is evidenced from this dump, a calcite vein of high grade ore, in places up to 1/2-inch of solid cinnabar, must have been encountered and good hand specimens can be selected. However, it appears as if this were only a local concentration since the veinlets actually now in place are very thin and lean. Also, on this dump there is a considerable amount of reddish-brown and streaked rock. This appears as if it had been erroneously set aside as being cinnabar.

"Just below, an adit has been driven for a distance of about 90 feet under the above cut. A little cross-cutting and raising has been done at the end of this adit. Only the faintest trace of mercury was noted in the underground workings, but in any case this work is in quartzite and below the greenstone which appears to dip fairly flatly to the south-west.

"On the gently sloping soil and grass-covered ground to the east of the above workings, a number of scattered trenches and small pits have been made, exposing altered greenstone and argillite. All these openings were examined, but cinnabar was not found in any of them.

"Nine or ten years ago, a small retort was erected about 1,000 feet below the workings. Very little ore was put through. There are a considerable number of unassembled tiles and pipes still lying about.

"The development work to date indicates that cinnabar occurs in calcite veinlets towards the lower contact of a comparatively small zone of flatly dipping altered or sheared greenstone, and that these veinlets are erratic as they may be strong in one round of drifting and almost completely disappear in the next.

"Several small creeks cross the trail a few hundred feet below the above workings. Gravels from these were panned and almost in every case colours of cinnabar were found.

"It is likely, therefore, that cinnabar-bearing zones occur somewhere to the south and south-east of the present workings, and not very far from them. Such ore probably occurs within greenstone bodies, particularly near their contact with quartzite.

"Intensive panning and following up the above is recommended rather than continued development of the small ore zone of the present workings."

PHILLIPS' CINNABAR SHOWINGS. Edwin Phillips of Minto City has staked and owns (as of October, 1939) the Cinnabar Nos. 1 to 4, the Tyax Nos. 11 and 12 and the Sandy Nos. 2 to 8 mineral claims in Tyaughton Creek Valley.

The claims cover ground that lies on the easterly side of Tyaughton Creek and extends southerly from Mercury Creek, a tributary flowing westerly into Tyaughton Creek (see Frontispiece). The Phillips cabin is at an elevation of 3,085 feet on the upper or easterly side of the road at a point approximately 2,000 feet southerly from the Mercury Creek-crossing. The property may be reached by motor-road from Minto City by following the Tyaughton Lake road up Taughton Creek; the distance from Minto City to Phillips' cabin is approximately 14.5 miles.

The hillside in the vicinity of the showings is steep but the slopes are open, grassy or talus-covered and except for a few outcrops, are covered with a thin mantle of overburden.

Several small open-cuts and one short adit have been dug by E. Phillips in prospecting for cinnabar on his claims.

At a place 1,500 feet southerly from the cabin, Phillips has driven an open-cut in a direction north 15 degrees east for 25 feet in fine-grained, diabasic greenstone. Towards the face of the cut the rock is cut by three north-easterly-striking and northward-dipping crush-zones, which range from 1/2 to 2 inches in width and contain a little carbonate and stibnite, but no cinnabar. However, grains of cinnabar and realgar occur disseminated through the massive greenstone. A sample taken across 1 foot of such material assayed: Mercury, nil; arsenic, nil.

Several cuts have been dug above or north-easterly from Phillips' cabin.

At a point 100 feet above and north 75 degrees east from the cabin, a cut has been driven north-easterly for 5 feet into feldspar-porphyry. No cinnabar was seen in this cut.

At a point 185 feet above and north 75 degrees east from the cabin a cut has been driven in a direction north 80 degrees east for 18 feet, mostly through a mixture of soil and talus. Sheared argillite and ribbon-chert occur in the face. No cinnabar was seen in this cut.

At a point 360 feet above and north 75 degrees east from the cabin, a cut, 6 feet to 10 feet in width, has been driven in a direction north 75 degrees east for 18 feet. For a distance of 14 feet from the mouth, the cut exposes sheared, decomposed lava, and for the remaining 4 feet to the face, sheared argillite and broken ribbon-chert. All the rocks are badly sheared and contorted. The contact between the lava and the argillite and chert strikes north 10 degrees west and dips 60 degrees eastward. Of the rocks, only the lava contains any cinnabar. This occurs as thin sheets along the shear-planes and as rimming-material around 1/4-inch carbonate-quartz amygdules in unsheared parts of the lava. A 3-foot sample of lava taken outward from the contact assayed: Mercury, nil, and a 5-foot sample taken as a continuation from this, outward, assayed: Mercury, 0.03 per cent. A sample of high-grade ore from the dump assayed: Mercury, 0.47 per cent.

At a point on the easterly side of the road 800 feet northerly from Phillips' cabin an adit has been driven in a direction south 82 degrees east for 20 feet. The adit-section of the working is across sheared argillite and ribbon-chert; the general strike of both the shearing and bedding being north 30 degrees west and the dip vertical. The open-cut leading up to the portal of the adit exposes purple, amygdaloidal lava. No cinnabar was seen in any of these rocks.

LORNTZSEN MERCURY SHOWINGS. Egil Lorntzsen has prospected ground in the vicinity of the road and the bed of Mercury Creek (for location refer to description of Phillips' cinnabar showings) for cinnabar. In only one cut has he found more than the odd speck of cinnabar. This cut is on the east side of the road at a point 330 feet southerly from the Mercury Creek-crossing. The cut has been driven 5 feet north-easterly across sheared purple volcanics; this sheared rock contains a few thin films of cinnabar along the shear-planes, a sample taken along 5 feet on the south-east side of the cut assayed: Mercury, nil.

Alberni Canal

The only occurrence near Alberni Canal is on the north side and known as the Sechart property.

SECHART MERCURY PROPERTY. This property consists of the Sechart Crown-granted mineral claim known as Lot No. 3, in the Clayoquot Mining Division, Alberni district. The assessed owners are: Mercury Mines, Limited, 212 Belmont House, Victoria; Canadian Quicksilver Company, Limited, 2551 Alma Road, Vancouver; Caples and Shannon, Rogers Building, 470 Granville Street, Vancouver.

The existence of mercury at Sechart seems to have been known as early as 1890 for the Annual Report, Geological Survey Canada, 1890, p. 65-R, contains the following statement: "Native mercury has been met with, in situ, in the form of minute globules scattered through a thin seam of cinnabar traversing a greenish felsite, occurring at the entrance to

Seshart Channel, Barclay Sound, Vancouver Island, British Columbia."

A claim covering the ground was Crown-granted under the name Sechart on March 30, 1892. By 1911 considerable development-work had been done on the showings, staked at that time as the Balmoral group. The ground appears to have been re-Crown-granted in 1921 under the name Sechart, and it has remained so until the present.

The property seems to have lain more or less idle until 1927, when it was acquired by the Mercury Mines, Limited, incorporated in October of that year.

In 1928, the holdings of Mercury Mines, Limited, were acquired by the Canadian Quicksilver Mines, Limited, incorporated in August of that year. In 1929, some development work was done under the direction of J. Boss. There is no official record, but the present shaft appears to have been sunk either in 1929 or shortly thereafter.

The remains of what appears to have been the foundation of an old retort and a considerable quantity of carbonate rock around these remains, were seen by the writer. However, no official records of production can be found.

The property is on the northern shore of Barclay Sound on the western coast of Vancouver Island. An old camp, consisting of two buildings in a bad state of repair, still exists at a point on the shore on the easterly side of the mouth of a small stream. This stream empties into Barclay Sound approximately three-quarters of a mile south-easterly from the old whaling-station that comprises Sechart; the whaling station and accompanying buildings have long since been abandoned. Sechart may be reached either on Mondays or Fridays by a mail-boat that runs between Port Alberni and Ucluelet; or by launch from Bamfield on the southerly side of Barclay Sound.

The workings are approximately three-eighths of a mile back from the camp, and are on the eastern side of the same stream. They may be reached by following an old shingle-bolt road from the camp for approximately a quarter of a mile back from the beach and thence by a branch of this road that follows the main stream for the remaining distance. Near the beach this old road is very badly overgrown by raspberry and large salal bushes and toward the workings by a dense growth of thimbleberry bushes; the way is not only difficult to follow, but the road hard to find.

The ground is relatively flat between the beach and the workings; but behind or northerly from them, it begins to rise steeply toward the hilltops approximately 1 1/2 miles inland. Immediately down-stream from the shaft-working the banks of the creek are low and consist entirely of sand and silt, but up-stream the creek-valley is deep, rocky and canyon-like. Down-stream from the shaft only sinking is possible, but up-stream, adits can be driven into the creek banks, although the amount of backs would be but little more than 100 feet for a distance of at least 1,000 feet up-stream.

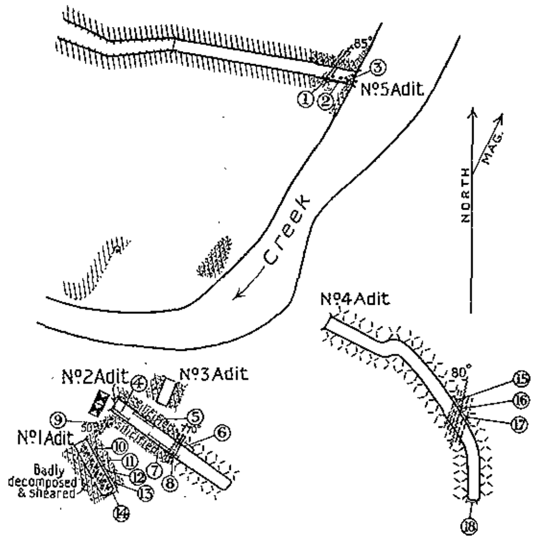
The workings consist of several adits and a shaft as shown on Fig. 8. A short distance up-stream from No. 5 adit, two short adits and one open-cut have been driven; the adits were inaccessible at the time of the writer's examination.

In the immediate vicinity of the workings the rocks consist of andesitic greenstone, gabbro and both carbonatized and silicified phases, presumably, of the greenstone. Quartz-diorite lies north-westerly of the greenstone; the contact between the two rocks lying approximately 400 feet north-westerly of No. 5 adit and striking in a general north-easterly direction. Traverses north-westerly indicate that the width of the quartz-diorite mass in the vicinity of this property is approximately 1 mile. Where observable, the area of contact between the quartz-diorite and greenstone consists of badly-brecciated greenstone, veined by granitic material. This feature is particularly noticeable along the beach between the creek that flows into the ocean at the old camp-site and the old whaling-station, up the creek-bottom up-stream from the workings and north-easterly for approximately half a mile. It may be noted that the quartz-diorite-greenstone contact crosses the creek in a north-easterly direction approximately a quarter of a mile up-stream from the workings.

The andesitic greenstone, in the vicinity of the workings and where unaltered, is a massive, dark-green rock possessing a uniform, fine-grained texture.

The gabbro is a similarly massive, dark-green rock but it possesses a very coarse-grained texture. Under the microscope the gabbro is seen to consist of coarse, calcic plagioclase and coarse hornblende; both minerals have been badly-sericitized and carbonatized.

The quartz-diorite, as seen up-stream from the workings and for 1 mile northerly is light in colour and fine-grained; the quartz-diorite outcrops probably belong to a relatively small intrusion rather than to one of batholithic proportions.



Sample N°	Width		% Mercury
1	1'	Across gouge & crushed rock	nil.
2	10'	Across ankeritized zone	"
3	4'	" " "	0.03
4	10'	In silicified zone	nil
5	10'	" " "	"
6	5'	In gabbro in F.W. of fault	"
7	10'	In silicified zone	
8	2'	Across fault zone in silicified rock	0.15
9	2'	Across contact between massive silicified rock of N°2 adit & sheared rock of N°1	0.10
10	5'	In sheared, rotten greenstone	nil.
11	5'	" " " "	"
12	5'	" " " "	0.05
13	5'	" " " "	0.16
14	5'	" " " "	nil
15	5'	Across sheared H.W. gabbro	"
16	2'	" crushed gabbro & gouge	"
17	5'	" sheared F.W. gabbro	"
18	5'	In massive gabbro	"

LEGEND

Andesitic greenstone
Gabbro
Carbonate rock, silicified where noted
Cinnabar occurrences
Zone of faulting
Sample reference N°

Scale 20 10 0 10 20 30 Feet

Fig. 8. Plan of workings at Sechart cinnabar property.

Ankeritized greenstone, which will be referred to as carbonate-rock, is a massive, fine- to medium-grained rock that possesses on the weathered surface a conspicuous buff-brown colour, but on fresh surfaces a light-grey colour; the brown colour on weathered surfaces is due to oxidation of iron in the ankeritic carbonate. Carbonate-rock occurs: in Nos. 2, 3 and 5 adits, in outcrops along and in the bed of the creek, and extends north-easterly about 300 feet beyond No. 5 adit, then apparently dies out.

Silicified greenstone occurs in No. 2 adit. It is a massive, dense, cherty rock, consisting of abundant fine-grained quartz and carbonate and a little chlorite as relict material from the original greenstone.

The rock in No. 1 adit is badly sheared and decomposed. The rock is fine-grained, and shaly, because of closely-spaced shear-planes. It consists of abundant yellow-green to colourless chlorite and kaolin, and limonite. The decomposition is due only in part to alteration by surface waters. Alteration by mineralizing solutions proceeding from the numerous shear-planes in this sheared mass is considered largely responsible for the decomposed nature of this rock.

The rocks are cut by four main fault-zones, one in No. 1 adit, a second in No. 2 adit, a third in No. 4 and a fourth in No. 5. The locations and attitudes of these faults are shown on Fig. 8.

The fault-zone in No. 1 adit is the full length of the adit in width. The material is not badly crushed, but it has been sheared into material of flaky or shaly habit by the many closely-spaced shear-planes. Cinnabar was seen to occur along these shear-planes. The rock is sheared, and although gouge is absent, the sheared rock is considered to be part of a fault-zone.

The fault-zone in No. 2 adit ranges from 1 foot to 4 feet in width, and lies between the silicified greenstone and presumably later gabbro. A small amount of cinnabar was seen along the shear-planes within this fault-zone, otherwise it had not been mineralized by solutions.

The fault-zone in No. 4 adit is 12 feet in width and lies entirely within gabbro. No cinnabar was seen in this fault-zone.

The fault-zone in No. 5 adit is only 1 foot wide, but within this width the rock has been intensely crushed to material of nearly gouge-like fineness. A small amount of cinnabar was seen along the shear-slips in this fault.

Mineralizing solutions have effected the widespread ankeritization, and less widespread silicification, sericitization and chloritization of rocks in the general vicinity of the northerly-striking shear-zones; the rocks altered in the above ways have already been described. Subsequent to these processes and subsequent to most of the faulting, cinnabar-bearing solutions have deposited cinnabar along the shear-planes of some of the faults. Cinnabar appears to have been most abundantly deposited in the shear-planes of the zone in No. 1 adit and in the outcrop between No. 1 and No. 2 adits at a place where the shear-zone is adjacent to, or in contact with, the silicified rock of No. 1. The strike of this contact is north 35 degrees west and the dip 50 degrees south-westward.

Eighteen samples, ranging in weight from 5 lbs. to 15 lbs. each, were taken from the showings. The location, width, nature and assay-results of these are shown in the table on Fig. 8. The shaft, full of water at the time of examination, and the dump, were not sampled.

Judging only from occurrence of cinnabar, the vicinity of the contact between the sheared rock of No. 1 adit and the massive silicified rock of No. 2 adit, would constitute the best prospecting ground. The shaft was apparently sunk with this idea in mind. Inasmuch as no further work seems to have been done since the sinking of the shaft, it is to be inferred that commercial ore was not found in the shaft.

Further prospecting could be done with the hope that discoveries considerably better than existing showings, would be made. The indicated location of such prospecting is in the vicinity of the shaft, as described in the last paragraph.

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