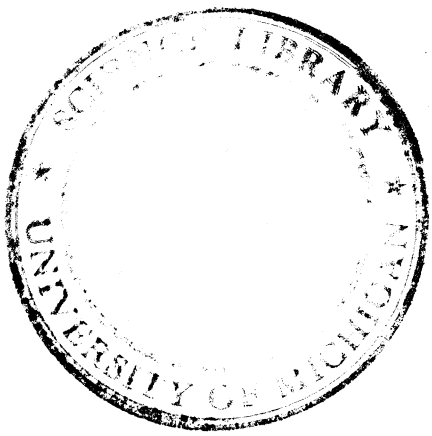


MINE EXAMINATIONS, VALUATIONS, AND REPORTS.

Louise A. Bush.
MS June 1929

Mine Examinations, Valuations, and Reports.

Valuation of metals.

Sampling of metals in situ.

Sampling of placer deposits.

Care of samples.

Conclusions.

Quantity and Classification of Ore.

Methods of arriving at quantity of ore.

Classification of ore.

Proved.

Probable.

Prospective.

Prospective Values.

Extension in depth.

Origin and structure of deposit.

Secondary enrichment.

Neighboring mines.

Depth of exhaustion.

Percentage of recovery, cost of production, and marketing of metals.

Amortization of capital.

Valuation of mines ~~leaves~~ having little or no assured mineral.

Conduct of examination and writing of reports.

Typical mining reports.

One of the basic considerations in the valuations of mines is the value of the ore, or the "gravels" if the mine in question is a placer. After one is assured of this value, questions of quantity, methods of developement, transportation, and other issues become of importance.

Ore value is arrived at by means of sampling and assaying. In the case of metals in situ, if the metal occurs in rich pockets scattered thruout the gangue, previous yields must be looked to for information, or if there has been no exploitation of the deposit, test runs must be made, which is an expensive proceeding. Providing the deposit is of the ordinary type, that is, a fairly homogeneous mixture of metal and gangue, a sufficiently large number of samples taken at proper intervals and at correct locations will give a determination of the value of the ore. In ore bodies of fissure origin the metal is distributed most evenly, parallel to the strike, so samples are taken on lines at right angles to the strike at intervals of five feet. This is the common interval for sampling. In massive deposits samples are taken in all directions.

There are different kinds of sampling. In soft material, interval channel sampling is the common method. As its name implies, this is done by cutting out channels, the material from which is used as a sample. In hard material chip sampling is used. This resembles channeling

except that the material is chisled out. "Grab" sampling refers to the method in which pieces are picked up at random. Due regard must be given in the selection to the proportion in which the various types of ore occur.

To prepare the material obtained for assaying, it is crushed, rolled or coned, and quartered the number of times necessary to reduce it to the convenient size required for the next treatment.

Placer sampling is a somewhat different matter. Besides the amount of gold, one should determine whether it is coarse or fine, and the distribution of the gold. Other features should be noted, such as freedom from timber and boulders, water present, slope of bed-rock, and dump room. Placers are sampled by means of shafts or drill holes. Bed rock should always be reached and sampled if possible since the maximum amount of gold is frequently just over bed rock.

Samples are numbered as they are taken and their numbers are entered on an assay plan of the workings, with the value and width of the sample also. Ordinarily a longitudinal section is all that is necessary, but in the case of a going mine the different levels must be shown.

The care of the samples is a concern of no little importance to the person in charge of them, since "salting" always must be guarded against, although there may seem to

be little necessity for caution. The samples should be kept under lock and key and should be constantly watched, notwithstanding. A few samples of country rock should be included with the others, to be checked up on later.

Conclusion from the results of sampling are based upon the volume of material represented by the samples. Erratically high values should be eliminated since even if they indicate rich spots these cannot be depended upon. After this elimination the calculation of averages is made by considering each sample as representing a prismoid of ore whose dimensions are:

width- width of ore sampled. (W)

length- length of ore sampled. (L)

depth- depth to which values (D) are supposed to penetrate.

If C equals the number of cubic feet per ton of ore, and V equals the assay value of the sample, then $V \frac{WLD}{C}$ equals the total metal content of the prismoid. The sum of the results for all the prismoids is averaged and so the final average is obtained.

It is almost always true that this value is higher than subsequent developements prove it to be so that a percentage of error is subtracted from the value arrived at: this amount is usually between ten and twelve percent.

The cause of the exaggeration is:

* "First, inability to stop a mine to such fine limitations of width, or exclusion of unpayable patches as would appear practicable when sampling, that is, the inclusion of barren rock. Even in deposits of normal stoping width it is impossible to prevent the breaking of a certain amount of waste, even if the ore occurrence is regularly confined by walls."

"Second, the metal content of ores especially when in the form of sulphides, is usually more friable than the matrix, and in actual breaking of samples an undue proportion of friable material usually creeps in. This is true more in lead, copper, and zinc, than in gold ores."

The quantity of ore is calculated as the tonnages contained in the blocks of ore as they are defined by the levels, shafts, etc. To calculate this tonnage one must obtain the number of cubic feet of ore to the ton. This ratio depends on the specific gravity of the ore, its porosity, and moisture. Any method of finding it is but an approximation, and the most practical one is based on an estimate of the proportions of the various minerals in the ore, and the compactness of the ore. The specific gravity of each mineral is given in a table of such values. Thus the tonnage of the composite mass can be calculated.

The classification of ore by the term "ore in sight" is not commonly used now. Due to the abuse of the term it has come to have no definite meaning. A classification

*Page 12, Principles of Mining, by Herbert Hoover.

which can have only one meaning, whatever the location described is one of:

Proved ore: no risk in continuity.

Probable ore: some risk.

Prospective ore: large quantities possible but much risk involved.

Proved ore is that which is a reasonable distance from a point sampled. This varied according to the type of deposit from fifty to two hundred and fifty feet. Probable ore is a greater distance from such points, and requires evidence from the character of the deposit, and position of the openings. The assignment of a quantity to prospective ore depends largely on the geology of the deposit. The factors included are:

Origin and structure of the deposit.

In this respect ore deposits generally fall into three classes:

infiltration type,

fissure vein deposits,

replacement and impregnation.

The first is quite regular as regards continuity of values, the second has its regularity depending on earth movements, and the third type is not dependable at all.

Position of openings in respect to secondary alteration.

The effect of erosion is to produce a downward

migration of zinc, iron, and lead, so that if an enriched upper zone is found, it is common to find lean sulphides with depth. Silver does not migrate so easily but does somewhat and is commonly found just over the horizon of the metals mentioned above. Gold migrates to a less extent than any of these and commonly the oxide zone is richest in this metal. Tin shows practically no migration.

Size of deposit.

Of this it can be assumed that the probabilities of extension are in proportion to the length and width of the ore body.

Developement of Neighboring Mines.

Mines adjoining generally have similar probabilities of extension.

Depth of Exhaustion.

All mines play out with depth and the superficial character of ore deposits is becoming every year better recognized.

In any calculation of the net value of ores from the gross value, the percentage of recovery is a necessary factor. Practically all the metal can be recovered from any ore. The question is what is the percentage of recovery which will not involve a prohibitive cost of extraction. Provided the mine is under operation this is easy to learn from the records. Otherwise test runs may be made, or sometimes a study of similar ores is sufficient. In the case of

large low grade ore deposit a test plant is usually erected to operate for a considerable length of time. The cost of operation is determined in connection with the percentage of recovery. The scale of operation has a pronounced effect on the costs. With a very large scale of production such as prevails in the western porphyry-copper mills the cost of production is only half of that which would obtain in a hundred ton mill. The other factors which govern the cost are the cost of labor and supplies, size and form of ore body, and the kind of treatment necessary.

In the marketing of all metals except gold the engineer experiences the difficulty of arriving at a price which will be reasonably close to the average of the prices which will hold for the metal during the life of the mine. This is of course not the lowest price which the metal reaches in a period of depression nor does it approach the highest price which obtains during a period of inflation. It may even differ from the average price during a period of years, since the life of the mine may not endure for the length of this period. It is therefore somewhere between the basic and normal prices. Just where is for the engineer to say after he has made a study of the fluctuation of the price for a considerable time in the past. In 1909, Mr. Herbert Hoover's estimates for the basic and normal prices of metals were as follows. He considered the outlook for lead the most promising.

	Lead	Spelter	Copper	Tin	Silver
Basic	.035	.040	.115	.220	.44
Normal	.043	.050	.140	.290	.52

In 1925 the average prices for June were:

Lead	Spelter	Copper	Tin	Silver
.091	.0855	.1398	.625	.53

The gain for lead and tin has been about equal, both being worth nearly three times their value in 1909. Of course the war caused a serious disturbance in the metal market. The values during the war and for sometime afterward were abnormal and should not be included in any attempt to forecast conditions.

Amortization is the term which applies to the setting aside each year of a certain amount from the profits of a mine so that when the exhaustion of the deposit is reached these sums together with the interest will be equivalent to the outlay of capital used in the developement. Otherwise the dividends will not be clear profit for the investor. Provided no amortization is attempted it is up to the investor to reinvest a certain amount if he wishes to recover his original expenditure. Because the life of a mine can never be exactly determined and because extension of the deposit is such a problematical consideration it is not necessary to introduce too great a mathematical refinement into calculations concerning amortization. The nature of the deposit has a very great bearing on the ques-

tion since some are so very uncertain that one must consider the only sure profit as that in sight. The minimum profit demanded in mining in return for the inherent risks is seven percent. If the profit in sight does not insure a return of the investment and this minimum profit, the possibilities of profit must far exceed seven percent. In other words the possibilities of return must be inversely proportional to the guaranteed profit.

As a matter of fact actual amortization is very seldom carried on in practice, but the theory is very useful. If one has an estimate of the probable annual return, the number of years necessary for the mine to operate in order to make a return on the investment can be calculated. This estimate of the necessary life of the mine can be compared with the one which seems probable from geological considerations. Thus a valuable check is provided.

Amortization of the equipment is accomplished simply by writing off a certain amount each year for instance ten percent of the gross cost, so that within a few years new equipment may be bought.

The valuation of mines with little or no ore in sight must be made largely from a consideration of the geologic character of the deposit. The engineer should also study mines of similar character to see what the extension has been as a rule in such properties. This sort of valuation is dependent largely on the judgement and not a little on the instinct of the engineer. Prop-

erties adjoining profitable mines are frequently purchased in the hope of a lateral extension of the values into adjacent areas. There may be no exposures of ore whatsoever and no engineer can give anything but a very indeterminate valuation on such a property. The risk involved is bound to be great. If an opinion must be formed without inspection of a mine- that is, on data alone, the question arises as to the reliability of the data. Data which is untrustworthy betrays itself many times when subjected to close scrutiny.

Before the thorough examination of a property is undertaken, a preliminary investigation should be made to determine whether or not an expensive sampling campaign and more detailed examination are justified. The ore may be too scattered or too poor to insure sufficient returns or impurities may necessitate processes which have a prohibitive cost. An unfavorable location may condemn a mine which would be of great value in a less isolated or difficult locality A man whose experience has not been wide may be sent into the field to learn whether conditions such as these prevail. Then if further investigation seems justified a higherpriced man may proceed without fear of having his work being of small use to his ~~climate~~ client. Sampling is the first consideration since it is the most tedious and time-consuming workto be done. This may be detailed entirely to the assistant or assistants as the case may be. In the ordinary type of material ten samples a day can be

taken out by each party. If a map of the ore footage exposed is available to the engineer it will help him to make an estimate of the time involved in sampling. Usually the client requires an estimate of the time and expense likely to be required.

There are of course features which vary according to the nature of the mine. Some of these which should be considered are:

Coal-- Volatile, fixed and total carbon, moisture, heat value, coking quality, sulphur, presence of gas, character of roof and floor rocks, water problems.

Iron and Manganese-- quantities of sulphur, phosphorus, silica, and alumina.

Other metals must be considered according to circumstances. If several are present the cost of separating them should be determined.

Precious metals in solid rock.- The proportion of value recoverable by free milling, concentration, cyaniding, or direct smelting are the principal considerations.

Placer deposits-- Fineness of gold, or platinum, or tin; amount and head of water supply; available dump room, character, depth, and slope of bedrock. buried timber and boulders, cost of removal of vegetation, and government restrictions are all considerations involved in placer deposits.

The customary form of a report is to have a sum-

mary at the beginning with a conclusion followed by a more detailed account of conditions,and of the reasons leading to the conslusion. A complete report includes the following items:

Summary and conclusion.

Location of the property and relative position of claims.

History.

Economic geology, topography, vegetation, climate transportation facilities.

Taxes, laws, illegal influences, police protection.

Sampling methods, checks, assay maps.

Tests on character and value of mineral.

Assured mineral, calculations and amount.

Prospects and limitations of property.

Present equipment, developement, underground maps, methods of working and treatment.

Supply and cost of labor, water, power, fuel, timber, explosives and other materials.

Operating costs, general, conditions, and profits.

Market conditions, and assumptions.

Advice concerning developement, scale of operations, equipment and capital required.

Estimated returns on investment.

Acknowledgements.

Reports do not always contain matter pertaining to all of

these subjects however. Included as illustrative of many reports are three rather condensed reports of two copper properties and one silver lead property in British Columbia. The silver lead deposit is the least fortunately situated of the three but the richness of the ore is evident enough to make the report an interesting one.

WARD B. SMITH, E. M.
FLINT, MICHIGAN

Flint, Michigan
November 5,1927
D-W. S. Page 1.

The Detroit-Western Syndicate,
607 Ford Building,
Detroit, Mich.

Gentlemen:-

I have the honor to submit herewith a preliminary report on the three mining properties under your control, which were visited with your party of Inspection in September and October of this year; - viz -

TEDDY GLACIER, THEODOSIA, AND WESTERN COPPER.

I am now arranging data and maps in detail for a more comprehensive report, but there is such a vast amount of map work and calculations necessary in this connection that it will be several days before it is ready for delivery.

This preliminary report will be clear, definite and brief. No personal feeling or bias will prompt any statements herein, which have been ascertained with exactness. Nothing guessed at or supposed.

Conclusions will be justly drawn and based on cold hard facts as they have presented themselves, with the main thought constantly in mind that "Mining is the Business of Making Money Out of Ore", therefore the subject is approached with a judicial temperament.

It is my conviction that a busy man wants to know the answer first as he will then more easily comprehend the subject, from knowing the conclusions at the outset.

Respectfully Submitted,

W.B. Smith

WARD B. SMITH, E. M.
FLINT, MICHIGAN

-----R E P O R T-----

----TEDDY GLACIER PROPERTY----

Conclusions - Extraordinary Silver Lead Prospect.
Largest body of silver-lead outcrop ore ever discovered in British Columbia.
High grade ore zone - 600' long, - 5' wide, - 100' deep.
Developed ore - (exposed on 4 sides) none.
Probable ore - (exposed on 3 sides) 300,000 cu. ft.
5 cu. ft. to ton = 60,000 tons.
Assay value - Average $94.12 per ton. $5,647,200.00 value.
Net smelter returns 84.71 " " (90% of value)
Cost to mine & haul 65.00 " " (hand mining & mule haul)
Net returns per ton 19.71 " " (69.71 with mchy & road)
60,000 tons - $1,182,600.00 present value.
$4,182,600.00 with machinery and road.

Situation - 23 miles due S. E. from Revelstoke, B.C.

Accessibility - Good - via R.R. - Boat - Auto - Horseback.

Transportation - Poor - Pack train only.

Topography - Rugged. Elevation 7,500 ft.- 5,500 above valley. Abundant timber and water power.

Climate - Warm, June to October.-Cold winters - lots of snow.

Claims - 15.- (750 acres) held on location - all requirements complied with.

Buildings - New log cabin, barn, and tool house half way up trail for 10 men and 10 horses at Agnes cabin. Small cabin at claims for 10 men.

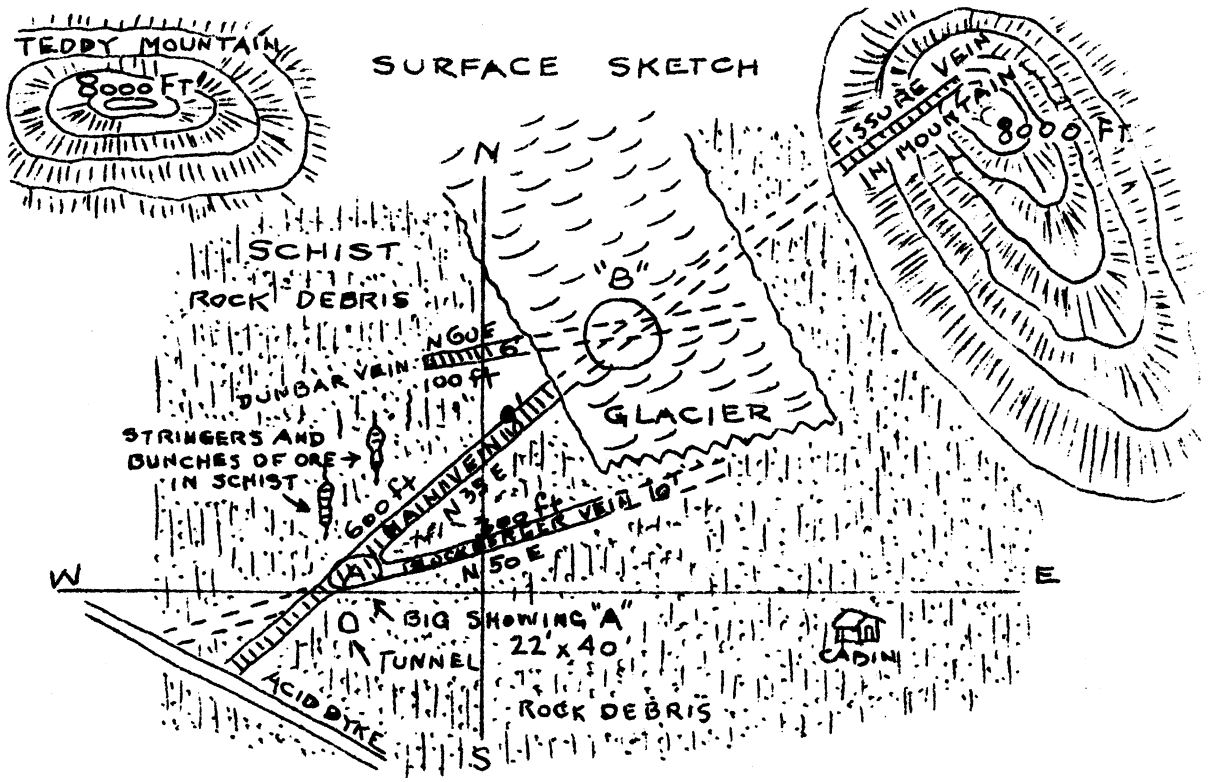
Water - Fresh cold glacier water for all camp purposes.

Roads - Good wagon road for 10 miles from Beaton; Balance, steep horse trail for 8 miles.

Title - Perfect.- Will be crown granted when Dominion Engineers check developments.

History - Outcrop discovered in 1924 after retreat of glacier. In litigation one year 1925. Now cleared up.

WARD B. SMITH, E. M.
FLINT, MICHIGAN



Geology - Country rock.- Altered limestone Schist. Strike N-S. Favorable for ore deposition - Faulted and Fractured.
Main vein - strike N 35° E. Dip vertical - exposed for 600 feet long - 8 feet wide. Strong mineralization up to glacier. Can be seen 1500 feet beyond glacier in fracture on mountain.
Blockberger vein - Strike N - 55 - E Dip vertical offshoot from main vein. Exposed 300 feet x 10 feet wide from big outcrop to where it hits glacier.
Dunbar vein - strike N-60-E Dip vertical. Exposed 100 feet long 6 feet wide to where it hits glacier.
Main vein is a fault fissure filled with quartz gangue.

Mineralogy - The veins are all fissures, filled with quartz gangue carrying heavy Galena & Argentite in large masses and bunches - some as large as 4 x 4 x 6 feet - with some auriferous pyrite and sphalerite.

Ore zone - 600 feet x 200 feet surface exposure.- Highly fractured with stringers and offshoots from main vein and bunches and masses in country rock showing intense mineralization. Main vein appears to continue under glacier for 1000 feet and emerges on side of mountain 1500 feet beyond. Total length of vein at least 3,000 feet.

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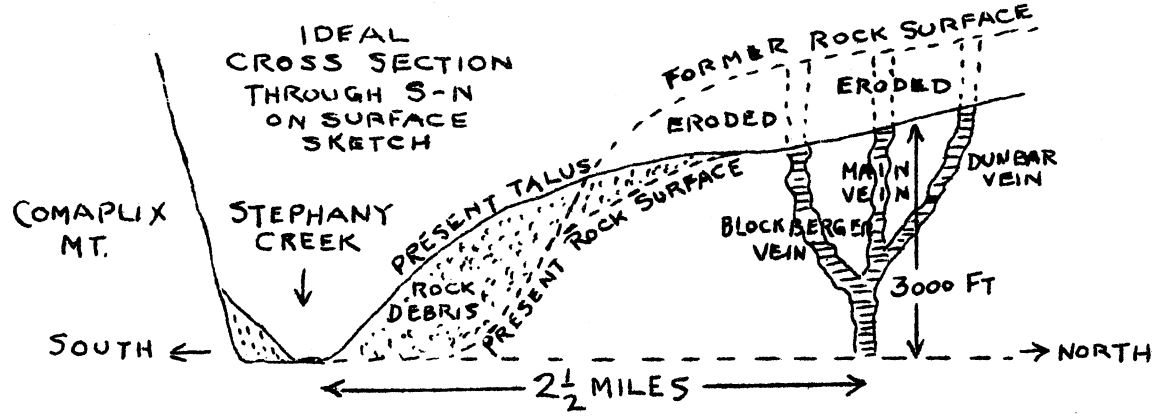
FLINT, MICHIGAN



Character of Deposit. - Outcrop ore is the natural sulphides of lead, silver, iron and zinc in the zone of secondary enrichment. The oxides and carbonates appear to have been eroded by Glacial Action - truncating a large rich deposit as shown in cross section.

The country rock of Schist can be seen for a depth of 3000 feet in the bed of Stephany Creek. Therefore, it is reasonable to expect that these veins extend to this depth at least; with a variation in width from 1 foot to 20 feet. The continuation of the Dunbar vein will intersect the main vein beneath the glacier as shown by circle "B" on surface sketch, where we may expect another ore shoot of large dimensions; as we would have a duplicate of the conditions evident at the big showing "A".

Although the Blockberger and Dunbar veins carry large amounts of high grade ore, we will consider them subordinate fractures from the main vein fault-fracture, and not be persistent for any great distance and may be offshoots from the main vein.

By assuming that the main vein only, goes to a depth of 3,000 feet, we can calculate the possible ore values in this vein on a length of 600 feet x 5 feet wide and 3,000 feet deep at 30 x 5,000,000 or $150,000,000.00.

Assays and Sampling. - Uniform-sized samples were taken across the vein every foot from hanging to foot wall, at intervals of 100 feet along the strike and gave average values of Gold $5.27, Silver $12.58, Lead $76.27, - Total $94.12.

Assays of coarse grained galena ran		$172.53 per ton
" " Fine	" " "	104.70 " "
" For Gold values in iron pyrites		43.46 " "

Ore Developed. - Exposed on 4 sides - none.

Ore Probable. - " " 3 " - 60,000 tons.

Ore Value. - Average $94.12 per ton. Gross value $5,647,200.00

WARD B. SMITH, E. M.
FLINT, MICHIGAN

Costs.- Superintendence (overhead)	$10.00	per ton
Mining (including supplies & food)	15.00	" "
Transport to wagon road (trail)	25.00	" "
" " Boat (road)	2.50	" "
" " Smelter (boat)	2.50	" "
Smelter charges (10% of value)	10.00	" "
Total cost to mine & smelt	$65.00	" " .

These costs are necessarily high on account of the initial difficulties of transportation and Pioneering work, but are only temporary and can be reduced to an outside cost of $15.00 per ton. - See paragraph on Recommendations.

Labor & Tools.- Labor plentiful or can be procured. Men now on job: 1 Superintendent, 1 trail foreman, 2 laborers, 1 cook, and 2 pack mules at Agnes Cabin; 3 miners at upper cabin. Tools are all hand tools, - no electric or pneumatic.

Developments.- Cross-cut tunnel 4' x 6' has been driven to intersect the main vein 50 feet below the big showing. - Now in ore. - Will drift on vein NE to a point opposite Dunbar vein, then cross cut to Dunbar.
Water power rights have been secured on Menhennick Creek, where a hydro-electric generator is being installed and power lines run up to Teddy Glacier - distance 7 miles.

Treatment.- High-grade is direct smelting ore. - Balance of vein concentrating ore of which 85% to 90% of assay value can be recovered. Gangue rock will run at least $20.00 per ton making a 5 to 1 concentrate.

Recommendations.- Do not ship ore by pack train. The Trail smelter will advance 30% of the value of all ore on the dump, which would be more than could be procured by shipping under present conditions. With an air compressor on location, a wagon road and aerial tramway, 15 tons or more of ore per day could be mined and delivered to smelter for $15.00 per ton. As tonnage increases, cost per ton would lower.
Drift both ways,- SW & NE on main vein. Cross-cut to Dunbar and drift both ways on this vein. Provide for electric generating plant on Menhennick Creek with seven mile power line to property - cost - $20,000.00
Motor & Compressor plant for 10 drills 10,000.00
Total, for production of 100 tons per day 30,000.00

Smelter 30% advance will supply all money needed for wagon road and aerial tram.

Wagon road around nose of Comaplix Mt.
distance 5 miles Max. 10% grade 50,000.00
Aerial tramway from workings to Stephany Creek
$2\frac{1}{2}$ miles @ $7.00 per foot 91,000.00
Total, to ship 100 tons or more per day --------$171,000.00
Concentrator can be provided out of earnings.

Opinion.- These expenditures are justified, considering the value of ore to be gained - $5,600,000.00.
Ample water power is available for all purposes.
No hoisting plant or pumping plant necessary.
Abundance of fine timber for all purposes.

To speed up mining and reduce cost, the:
1st step - Install power plant at Menhennick Creek with power lines, compressor and drilling machines at mine.

2nd step - Develop mine by drifting both ways on main vein & east on Blockberger vein. Cross cut to Dunbar vein to point of outcrop and drift both ways. Thus working at 5 points until you are producing 100 tons per day.

3rd step - Build road from Scott Creek around nose of Comaplix Mt. and up Stephany Creek.

4th step - Build aerial tramway for 500 tons per day from mine to road.

5th step - Build 1 unit (100 tons) of 500 ton concentrator at foot of aerial tramway on Stephany Creek.

Respectfully Submitted,

Ward B. Smith

WARD B. SMITH, E. M.
FLINT, MICHIGAN

REPORT.

WESTERN COPPER GROUP - KHUTZE INLET.

Conclusions - Greatest number of ideal natural conditions I have ever seen assembled in one mining property.
Ore zone - 5300 ft. long - 4 feet wide - 1000 feet deep.

Developed ore -	(exposed on 4 sides)	none.
Probable ore -	(exposed on 3 sides)	13,500,000 cu. ft.
	10 cu. ft. to ton	1,350,000 Tons
Assay values - average	$33.00 per ton	44,550,000 gross value
Net smelter returns	29.70 " "	(90% of value)
Cost to mine & haul	9.40 " "	(Power mining &
Net value per ton	20.30 " "	transport)

1,350,000 tons - $27,405,000 - Present net value.

Situation - On Pacific coast of British Columbia, 400 miles N.W. of the city of Vancouver.

Accessibility - Excellent - via boat and mine Railway.

Transportation- Excellent - Aerial tram - Railroad - Boat.

Topography - Gentle slope 1/2% grade from tidewater to camp. Elevation 260' - Rugged at claims - Elevation of outcrop - Max 2400 ft. Min 1800. Abundant fine large timber. Waterpower at camp 6000 H.P. Garden soil in river valley.

Climate - Temperate year around - acct warm Japan current. 200 inches annual rainfall.

Claims - 48 - (2134 acres) All crown granted (Mine)
5 lots (313 ") " " " (townsite)

Buildings - Good.New Rough board buildings to house 100 men.

Roads - None - No need for them.

Title - Perfect. Present owners title direct from Government.

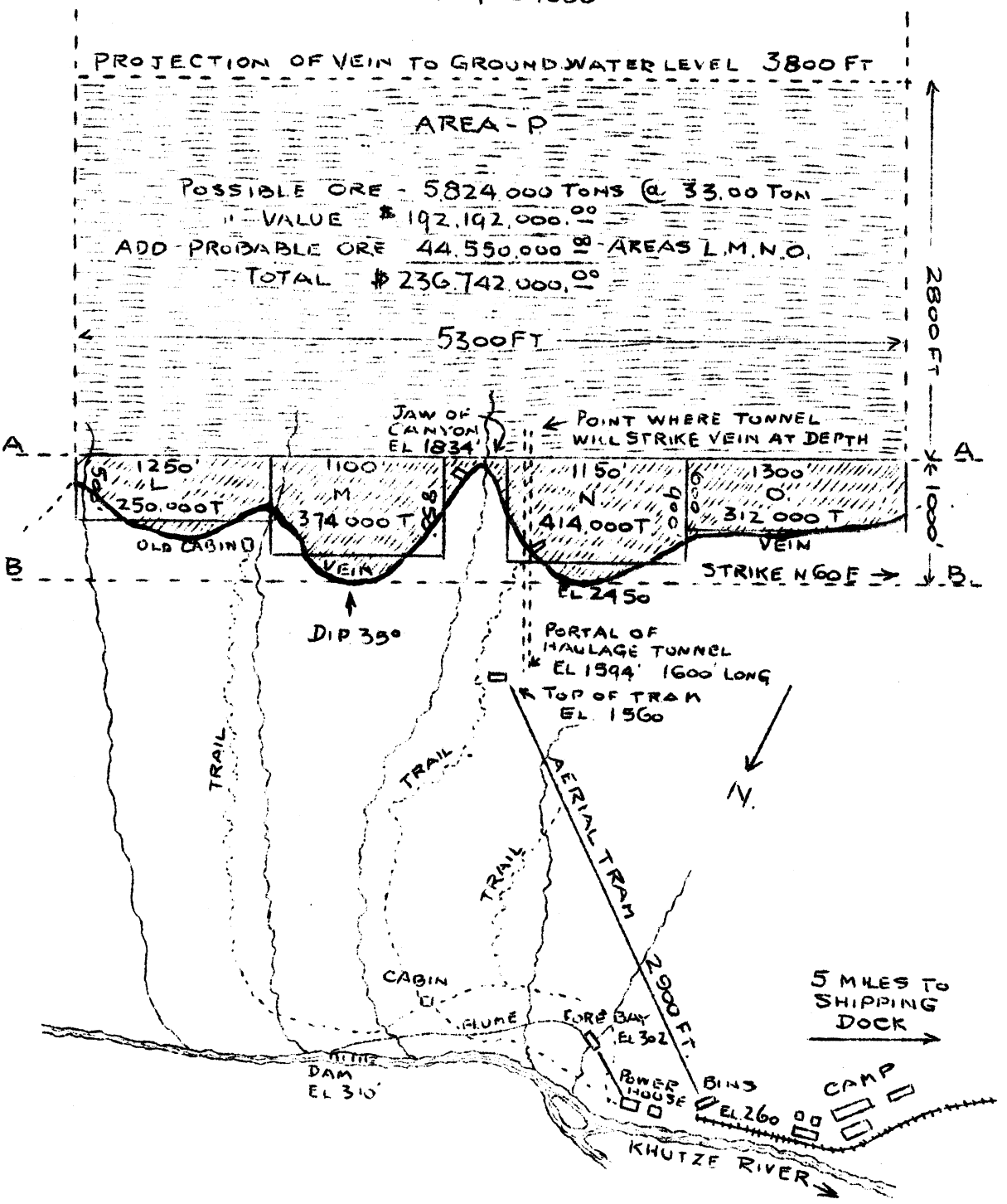
History - Discovered twenty years ago by present owners, who hold timber grants on the land. They spent $200,000 in exposing vein for 7000 feet along strike and building 3 miles of expensive Railroad. World war stopped them, and they now wish to retire.

WARD B. SMITH, E. M.
FLINT, MICHIGAN

SKETCH PLAN

WESTERN COPPER GROUP AT KHUTZE

SCALE 1" = 1000'



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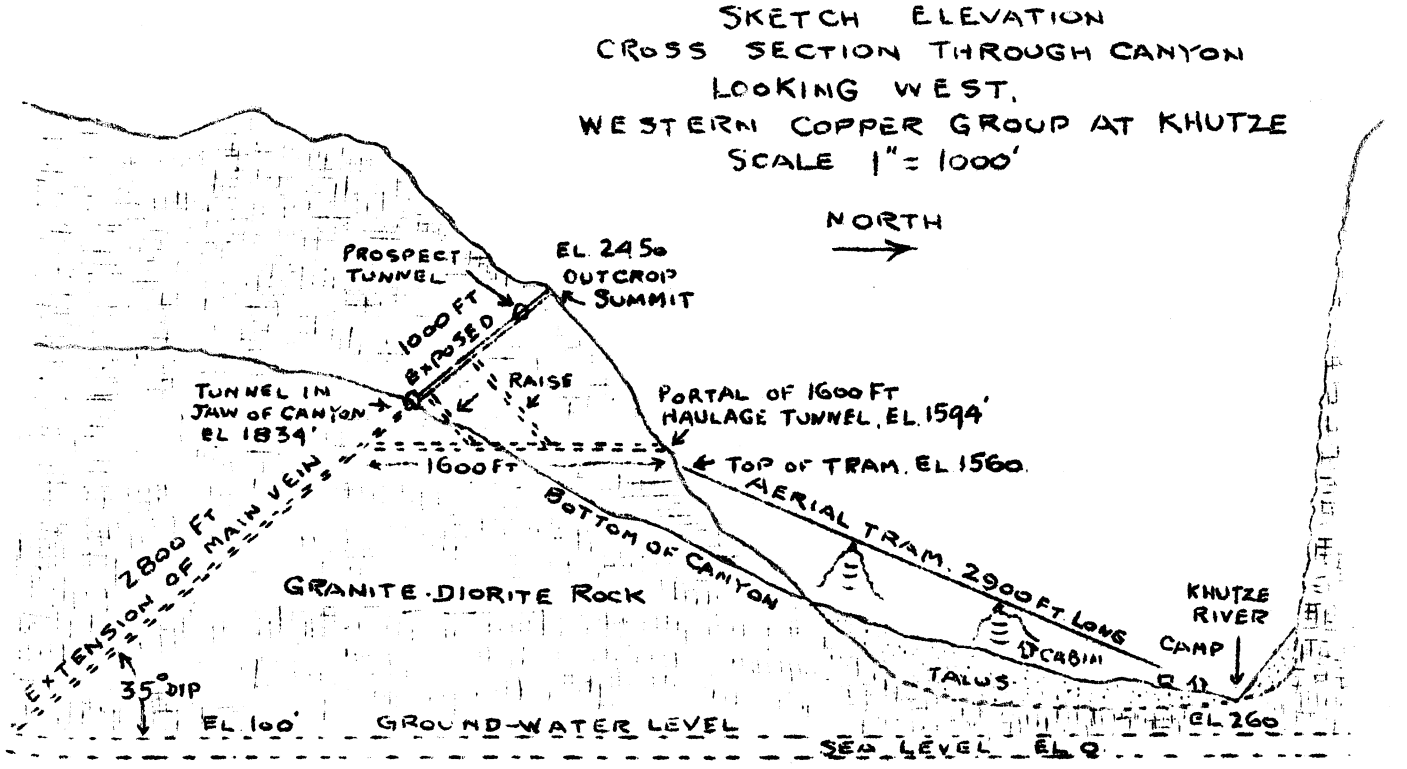

Geology - Country rock - Massive Granite - Diorite. Faulted and fractured along rectangular bedding planes, pecular to granites. Later fractures mostly vertical and at right angles to each other. Pegmatite dykes in many places. Rocks on north side of river have almost vertical faces with slight talus. Those on south side which contain the ore, slope toward the south, showing effect of faulting along the vein. Causing top of mountain to slip southward. The main vein is a fault fracture filled with highly mineralized quartz gangue from 1 to 20 feet wide - average width 4 feet. Strike N. 60 E. Dip 35° to S.E. into mountain. Maximum elevation 2400 feet - minimum 1800 feet.
A later series of vertical non-mineralized fractures strike N-S cutting the vein in 3 places about 3,000 feet apart, forming deep and narrow canyons which expose the vein continuously along both sides of these canyons, and prove a visible depth on the dip of the vein of 1,000 feet.

Mineralogy - Main vein is quartz gangue - carrying bunches streaks and lenses of Chalcopyrite and gold bearing pyrite in the upper portions and the heavy gold bearing secondary copper ores - Chalcocite, Covellite, and Bornite - occurring in the lower portions - near the Jaws of the North Star or No. 1 Canyon.

WARD B. SMITH, E. M.
FLINT, MICHIGAN

Character of Deposit - The main vein is a true fault fissure, filled with quartz, intensely mineralized with gold, copper and iron ores. It varies in width from 1 foot to 20 feet. Where it shows a 20 foot width, it is due to the hanging wall rocks dropping down into the quartz mass, in process of formation - leaving islands of granite in the vein proper. This condition has had no effect on the mineralization.

The gold is not visible even under the microscope but it shows up in every assay - Especially high values in the Pyrite, and hematite-stained quartz, but not a trace of value in the Bare Quartz. Therefore, the gold was deposited at the same time with the Pyrite - the first mineral solutions to impregnate the vein, wherever there was a fracture or crevice to lodge in. The copper solutions came last and replaced the iron in the Pyrite forming Chalcopyrite. This accounts for the gold in the copper ores - and we may expect gold values to persist throughout the vein even after the conversion of the Pyrite and Chalcopyrite into the rich secondary enrichment ores of Chalcocite, Covellite, Bornite and the copper oxides and carbonates.

There is no evidence of folding caused by lateral pressure. The vein maintains a uniform dip as far as it can be seen. Therefore, it is reasonable to believe that it is persistent at least to ground-water level - say 100 feet above sea level - giving a total distance on the dip of 3800 feet.

After a thorough examination, measurement, and assays of a large number of ore showings, calculations show that one third of the vein is pure ore, and 10 cubic feet of vein material will make one ton of commercial ore

The vein is very extensive. Its real value lies in large tonnage and concentration. There will be a great deal of "dead work" - breaking down barren rock-in the extraction of the ore, in the proportion of 2 tons of poor rock to 1 ton of ore. By hand sorting the ore where it falls, will bring the value of transported ore from mine to $100.00 or more per ton. There will not be much high grade, but great quantities of concentrating ore of medium value, which is characteristic of all great and permanent mines.

Assays & Sampling - Assays of separate pieces of ore, only tend to inform us of the mineral constituents and money value of the individual pieces. A true, characteristic sample is taken at regular intervals across the whole width of vein including both rich and lean sections. Values determined from samples taken in this manner will give a reasonably true value of the vein to be mined.

Mr. R. C. Pryor sampled the vein in this way with the following results:

No.	Location	Vein Width	Assay Value
1	Above tunnel - W. side of canyon	3.0'	$ 33.75
2	At tunnel in jaw of canyon	4.0'	43.50
3	150 ft. west from #2	2.5'	21.50
	Total	9.5'	$ 98.75
	Average	3.17'	$ 32.92

A pecular condition - The wider the vein the richer the ore.

R. C. Campbell's samples:

No.	Location	Streak	Vein	Assay Value
1.	East side of canyon	6"	2'	$ 7.70
2.	" " " "	15"	3'-6"	71.80
	Totals	21"	5'-6"	$ 79.50
	Average	4"	1'	$ 39.75

C. G. Bush Samples:

No.	Location	Streak	Vein	Assay Value
1.	East side of canyon	6"	2.0'	$147.10
2	" " " "	6"	4.0'	131.90
3	" " " "	12"	1.5'	106.85
4	" " " "	24"	4.0'	91.75
	Total	48"	11.5'	$477.60
	Average	4"	1'	$119.40

In these instances the average mineralization shows 4" of ore to 1 foot of vein width or 1/3.
The specific gravity of Quartz is 2.6 or 162 lbs. per cu.ft.
" " " " Pyrite " 4.9 or 306 " " " "
At the ratio of 2 quartz to 1 Pyrite - the weight would be 162 + 162 + 306 = 630 lbs. or 210 lb. per cu. ft.
Therefore, 10 cu. ft. of vein = 2100 lbs. = 1 ton of ore.
A tabulation of several sets of assays - shows as follows:

Name	Office	Samples	Value
R. C. Campbell-Johnson	Geologist	37	$54.74
R. C. Pryor	Mining Engineer	3	32.92
R. C. Campbell	Capitalist	2	39.75
Prof. J. P. Rowe	Geologist	14	52.27
C. G. Bush	Mine Manager	4	117.60
J. M. Taylor	Mine Owner	4	67.70
G. A. Clothier	Dominion Engineer	1	91.00
	" "	1	161.00
	" "	1	784.40

The extreme range of these results is due to the gold content and demonstrates that any piece of rock that carries a reasonable percentage of milling ore will show surprising values.

Ore Zone - 5300 feet long - 4 ft. wide 3800 feet deep to water level, as shown in sketch. There are not many evidences of cross fracturing or off-shoots of the vein, Values are based on a proven length on strike of 5300 feet. The map of the property shows claims running east and west for a length of over 4 miles with ore showing on all of them. It is also reported by Mr. J. M. Taylor and Mr. A. C. McCullough that there is a large low grade deposite of leached ore on top of one of the claims, containing gold to a value of $14.00 per ton. This statement will be checked up. In computing the value of probable ore, two lines A-A and B-B are drawn parallel to the strike, and at the limits of the exposed ore; rectangular areas are laid off on the plan - to "give and take" on the corners, then measured and computed. This gives a fairly accurate total area of vein.

Ore Developed - Exposed on 4 sides - none.

Ore Probable - 1,350,000 tons as represented on sketch by areas L.M.N. and O. - value $44,550,000.00.

Ore Possible - 5,824,000 tons. As represented by area "P" Value $192,192,000.00.

Ore Value - Total of above - $236,742,000.00 Value based on $33.00 per ton as this is the lowest average assay.

Cost - Based on 1,000 tons per day.

Superintendence (overhead)	$ .50	per ton
Mining, sorting and tramming	2.00	" "
Transport, mine to smelter	3.40	" "
Smelter charge	3.50	" "
Total cost to mine and smelt	$ 9.40	" "

Ultimately, after erection of concentrator and small smelter to matte the concentrates - cost would be reduced to $7.00 per ton.

Labor - Labor is plentiful and non-union.
Men now on job - 1 Superintendent (McCullough, 1st class) 1 construction engineer and crew, (A-1) - 1 Clerk - 1 Cook and helpers - saw mill crew - Railroad crew - miners - swampers - carpenters and laborers - Total of 60 men.

Tools & equipment - 1 sea going flat bottom scow - 5 miles of 36" railroad - 1 ford tractor locomotive - 14 logging cars - 1 saw mill (capacity 10,000 ft. per day) - complete set of camp buildings for 100 men - 1 hydro-electric generating plant, complete with flume, forebay and Penstock - 1 air compressor plant 1 aerial tramway (capacity 30 tons per hour) - 1 blacksmith shop - Machine drills and all necessary small tools to carry on mining operations.

Developments - The vein has been opened up and sampled at intervals of 100 feet along the outcrop for a distance of 7,000 feet. Several prospecting tunnels varying in length from 20 to 150 feet have been driven to open up the ore.
The property has been examined and reported on by:
R. C. Campbell-Johnson, Former Dominion Geologist.
Prof. J. P. Rowe, Geologist, University of Montana.
Harvey Hanna, Mining Engineer, Detroit, Michigan.
G. A. Clothier, Resident Dominion Engineer.
R. C. Pryor, Mining Engineer, Houghton, Michigan,
all of whom have unqualifiedly recommended the property for immediate development into what promises to be an extraordinary, large valuable mine. As listed under tools and equipment all necessary machinery has been purchased - Camp and mine buildings are already erected and in course of erection. High grade ore is being mined and prepared for shipment to the Tacoma smelter. The main Haulage tunnel is being driven, from which raises will be run to tap the vein at regular distances along the dip.

Treatment - High grade ore - mineral which carries a very small percentage of gangue rock, if any - is direct smelting ore. Balance of ore to concentrator.

Recommendations - Due to excessive charges for freight on ore and smelting same it is desirable to provide for concentrator, and small smelter, as soon as possible, and ship the matte to refinery until you can establish your own refinery. While the main Haulage tunnel is being driven, high grade ore could be mined in several placed along the vein - on the east and west sides and at the jaw of Canyon - conveyed by chutes to a point in canyon, where it could be delivered to the top of the aerial tram, with a jig back outfit. Speed up installation of Power House, so as to provide air and electricity for these operations. Load ore on scow, to capacity, and tow scow to Tacoma smelter.
The railroad should be extended to deep water either along the north short of Kutze River on the side of the mountain, a distance of 2 miles of new work, or utilize the waste rock from the mine to build a rock road bed across the tide flats - distance one mile. Rock for this purpose could also be procured from several rock cuts along the railroad, thereby eliminating several curves in the line.
The extension of the main vein should be proven up by vertical churn drill holes from the bottom of the southerly extension of canyons.

WARD B. SMITH, E. M.
FLINT, MICHIGAN

Opinion - This property is almost an ideal mine - all rock is handled by gravity - no hoisting - no pumping - 6,000 H.P. of Hydro-electric energy for all purposes including heating. Abundance of finest timber on property for buildings, railroad and mine timbers.

Railroad all down grade to tide water, maximum grade of less than 1%.

Temperate Climate - very little snow. Harbor never freezes. Large level areas along river for townsite, rich soil for gardens.

You have a very capable Manager in Mr. C. G. Bush, who possesses the rare attribute of selecting first class men for the different positions in his operating organization.

Every dollar has been judiciously expended, toward the ultimate purpose of putting this property in production at the earliest possible date, with the least possible expense. There are no extravagences apparent anywhere - Housing and food for the men are good.

The aerial tramway was purchased new - because it was not economy to buy a used one. The rails, rolling stock, generating plant, compressor plant, motors, mining machinery, ore cars and other equipment, were bought at 20% of their value. - at a saving of thousands of dollars.

After looking over the lay of the property and the plans for solving the various problems of attack, the impression prevails that "These Fellows Know Their Business".

Respectfully Submitted,

W. B. Smith

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--- REPORT ---

THEODOSIA GROUP - THEODOSIA RIVER

I did not visit this property because of injury due to a fall from my horse at Teddy Glacier. The property has been visited by the other members of the party of inspection and reports have been made by:

Mr. F. W. Guernsey - Mining Engineer of Vancouver, B.C.
Prof. J. P. Rowe - Geologist - U. of Montana.
Mr. Wm. M. Brewer - Res. Mining Engineer, Dist.No. 6 of B.C.
Mr. R. C. Pryor - Mining Engineer of Houghton, Michigan.

Whose observations and opinions will here be recited and from whom maps, plans and other data have been secured as a basis for this report.

Conclusions - Very spectacular showing of sulphide copper ore Prof. Rowe says it is the largest of its kind he has ever seen.
Ore zone - Area 260' x 1,000' x 12' deep in glory hole.
Developed ore - Exposed on 4 sides - 306 tons already extracted from glory hole, value $4,565.00.
Probable ore - exposed on 3 sides 3157 tons, value $47,102.00
Assay Values average $25.69 per ton.
Net smelter returns 23.12 (90% of value)
Cost to mine & Transport 8.20 (using power)
Net value per ton $14.92
3463 tons @ 14.92 - $51,667.00 present probable value.

Situation - On Pacific coast of British Columbia 100 miles N. W. of the City of Vancouver, near Powell River.

Accessibility - Excellent via boat and logging railway to claims.

Transportation - Excellent, when install 2500 ft.aerial tram. Railroad, 5 miles to tide water (Now in)

Topography - Gentle grade up Theodosia River Valley for 5 miles to base of mountain. Country generally rugged with steep mountain sides. Abundant timber and water power available.

Climate - Temperate year around; slight snow in winter.

Claims - 24 (approx 1200 acres) of which 5 are crown granted, balance held on location with all requirements complied with.

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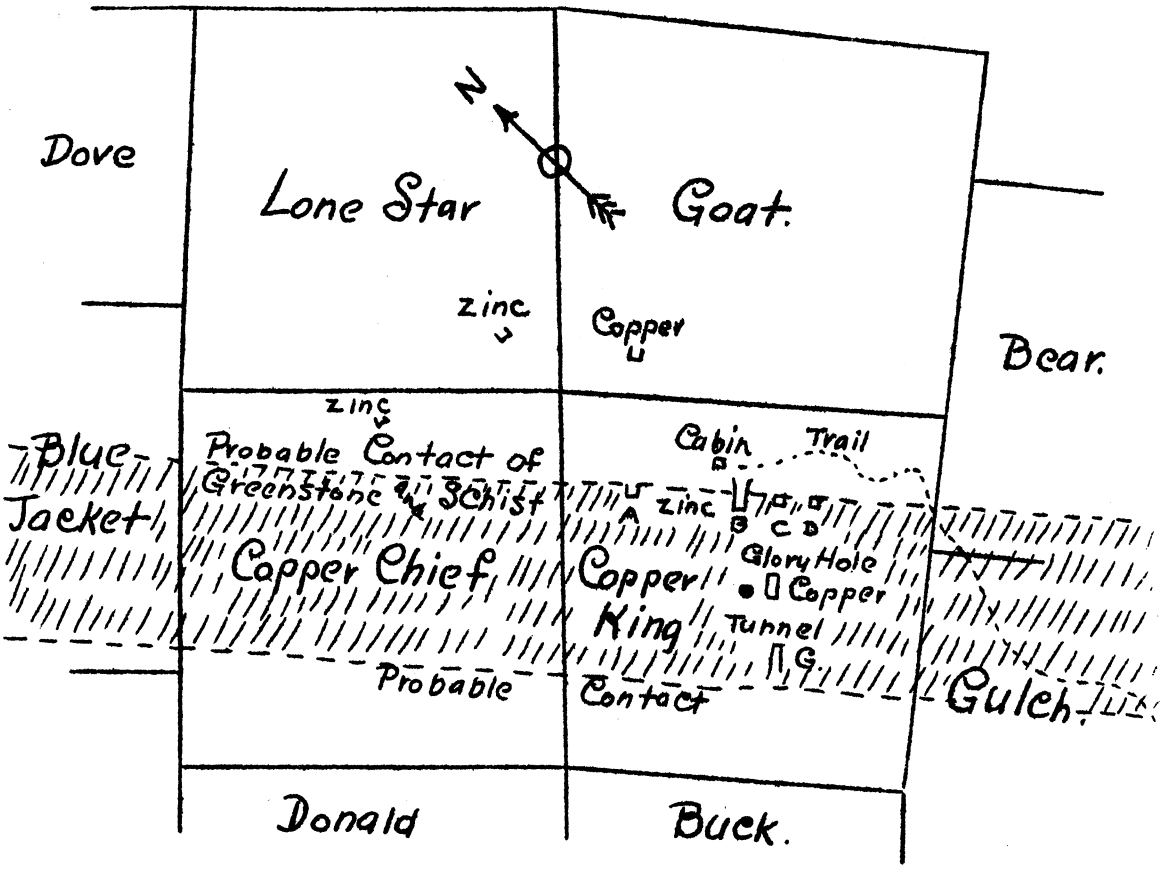
Sketch of Main Theodosia Claims.



Buildings - Two small shake cabins - one at base of mountain one at claims for 6 men.

Water - For upper camp purposes wells on hillside, but not extensive. - For lower camp, plentiful in streams.

Roads - None.

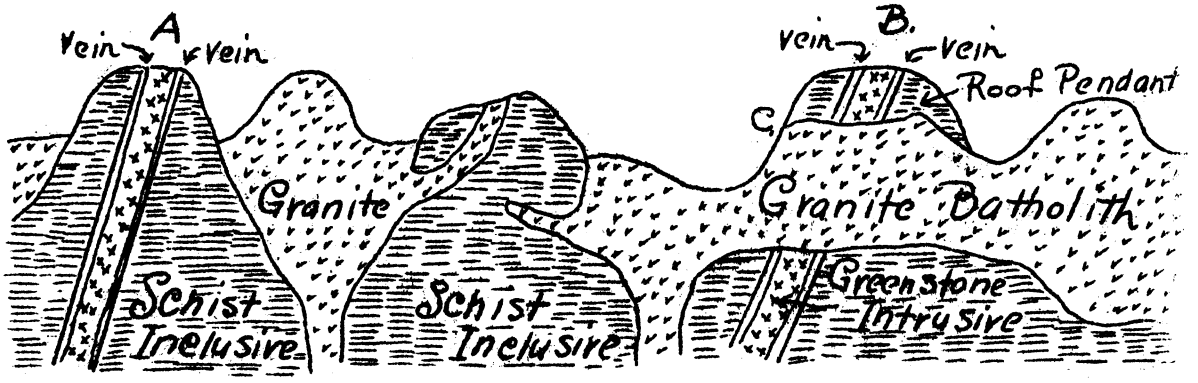
Title - Perfect.

History - Located in 1898 as a zinc property and owned by Col. McKinnon of Vancouver, acquired by present owners, Revenue Mining Co. in 1925.

WARD B. SMITH, E. M.
FLINT, MICHIGAN

Geology - General - The property occupies a part of an inclusive in the Coast Range Batholith.
"Inclusive" is the term given to the original Schistose rocks of the West Coast - which have been later intruded by, raised and elevated by, and entirely surrounded by, the great Batholitic Intrusive Granite. This intrusive is so extensive, that the mountains of the original formation, resemble islands of rock in a vast sea of grano-diorite. Some of these remains or remnants are quite large; they range in size from one mile wide by 3 miles long - to 10 miles wide by 25 miles long. The larger inclusives apparently are in their original position, and go to considerable depth. (See "A" in sketch) The smaller ones "B" are remnants of the Schist which have been elevated and form the roof or hat of a Granite Mountain - referred to as roof pendants. Subsequent erosion has reduced their thickness considerably. Therefore, it is reasonable to believe that where a small remnant is entirely surrounded by Granite, the position of contact "C" of Schist and granite along the sides of the mountain will determine the thickness of the roof pendant. In the case of Theodosia, I understand that there are at least 1000 feet of Schist above the granite.

= Ideal Geological Cross Section =

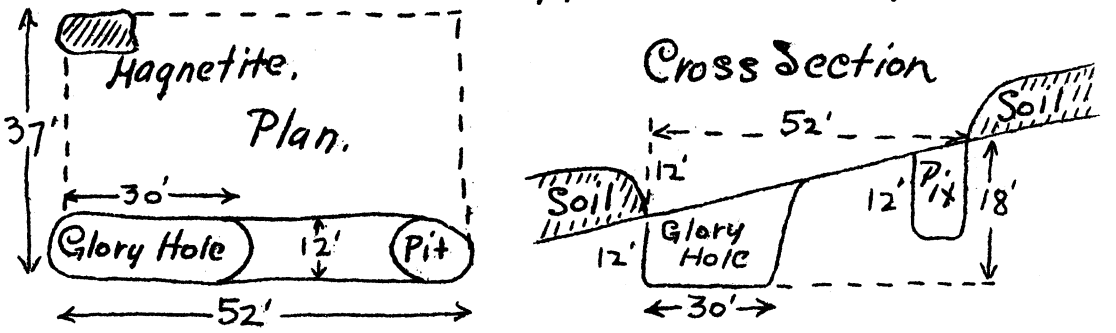


Geology - Economic - The report of the Minister of Mines for 1922, Page 309, Wm M. Brewer, Res. Mining Engineer Dist #6 says, "The ore deposits occur on the Copper King Claim and consist of a well defined body of Zinc Blend ore at the contact between limestone and igneous rocks. There is also quite an extensive deposit of magnetite with which is associated Chalcopyrite, the mineralization occurring as a deposit of the Contact Metamorphic type between limestone and greenstone, with a great deal of epidote in the greenstone.

WARD B. SMITH, E. M.
FLINT, MICHIGAN

The Magnetite - Copper ore occurs about 264 ft in a S-W direction from the zinc blende ore. Development work consists of an open cut 64 feet long driven in a S-W direction or as a cross-cut in which ore is exposed for a length of 52 feet. Also a glory hole at the west end of the open cut about 10 feet deep and 12 feet wide at the top, all in ore. The distance from the glory hole to the upper side of the stripping is 37 feet and shows that apparently ore may be continuous across that distance. In the glory hole the ore is exposed for a length of 30 feet, 5 feet wide at bottom and 12 feet at top.

Sketch of Copper Ore Trench.



F. W. Guernsey says - "The deposits occur in a belt or band of very much altered sedimentary and volcanic rocks, classed generally as greenstones."
The country rock is a roof pendant of limestone Schist.

Mineralogy - The chief minerals are Pyrite, Chalcopyrite, and Sphalerite. The Pyrite and Chalcopyrite (copper ore) occur closely associated and intermixed in the large open pit deposit. The Sphalerite (zinc) occurs in one or several veins, having steep dips and different strikes.

Character of Deposit - From the meager information we have, regarding the outcrops on this property, it is impossible to describe their character. This question can be best answered by systematic development of the ore bodies.

Assays & Sampling -

Name	Samples	Gold Oz.	Silver Oz.	Copper %	Value
F.W.Guernsey	5	.014	2.18	5.30	15.15
R.C.Pryor	1	.06	3.80	9.80	28.77
Prof J.P.Rowe	1	.16	10.00	13.00	42.00
Dominion Engineer	1	trace	2.00	5.70	16.82
				4--	102.74
				Average Gross Value -	25.69

Prof. Rowe mentions one sample that Mr. Meldrum brought to him, taken from a new zinc vein recently opened up - that is 6 feet wide of nearly solid Sphalerite. This will run 67% zinc @ .06 per lb. = $80.40 per ton.

Ore zone - According to location of outcrops the ore zone must be very extensive over an area of at least 260 x 1000 ft. This area contains several veins of zinc ore and 1 massive vein of copper ore, which apparently strike in various directions. Owing to the soil overburden the veins have not been traced for any considerable length. The copper outcrop is extraordinary. There was no report made of striking the hanging or foot walls, so we do not know whether the trench is a drift or a cross-cut.

Ore Developed - By taking Mr. Guernsey's dimensions - also the figures from the Minister of Mines report and Mr. Bush's data, the glory hole has produced 306 tons of ore value $4,565.00.

Ore Probable - Exposed on 3 sides - using the same data, gives us 3,157 tons, Probable value of $47,102.00

Costs - Costs are hard to determine at present stage of development. Considering all the natural advantages of close proximity to tide water - water power in rivers, timber, altitude of veins, character of ores, and also the Railway and Aerial transport, ore can be mined and marketed very cheaply.
The character of this property is similar to the Hidden Creek Mine - and I will quote from the 1922 Dominion Geological Survey reports, as to the costs there:
"The largest copper deposit in British Columbia is the Hidden Creek Mine at Anyox, owned and operated by the Granby Consolidated Mining Smelting & Power Co., and is at present producing nearly 3,000,000 lbs of copper per month. The ore bodies are well to the center of a large body of greenstone and metamorphosed Argillaceous sediments (slate rock) which forms an inclusive in the Coast Range Batholith. There has been developed to date 13,215,000 tons of high grade ore averaging 2.14% copper and 1,534,000 tons of low grade ore carrying 0.94% copper. The cost in May, 1922 on one ton of ore delivered to the smelter was $0.949 with labor at the following prices.

Unskilled labor	3.30	per day
Blacksmith & Helper	5.00	" "
Shift bosses	5.75	" "
Foremen	6.40	" "
Miners	4.25	" "
Muckers	3.85	" "

These costs were possible, because of a production of 3,000 tons per day.
Costs in a new mine, with ground developed for a steady production of 100 tons per day will run around $2,00 per ton. Transportation by aerial tram and R.R. to tidewater is $.60, Boat to Tacoma smelter $1.60, smelter charge is $3.50, Superintendence $.50 - Total $8.20 per ton.

Labor - Labor is plentiful all along the coast. There are no men on the property at this writing.

Tools & Equipment - None.

Developments - The contact zinc vein has been opened up by 3 pits and 1 adit tunnel 40 feet long (shown at A-B-C-D- on surface sketch) Ore shows in all places and 10 ft wide in tunnel "B".
The copper deposit has been stripped over an area of 40 x 60 feet and trenched across, showing ore for 57 feet x 12 ft. wide. Pits are sunk at both ends of trench, all in ore to depth of 12 feet. Copper also shows on the Goat Claims. Zinc shows on the Lone Star & Copper Chief Claims as per sketch. This is probably where Meldrum took his sample of Sphalerite and reported solid vein 6 ft wide.

Treatment - The ore, because it carries so much sulphur, should be delivered direct to a smelter on the property, reduced in a blast furnace to matte and the matte then blown in converters to Blister Copper.

Recommendations - I am informed that the surface pitches steeply to the S.W. from the copper outcrop. It is advisable to drive a tunnel from the side of the mountain, directly toward and 100 feet below the big showing so as to cross cut the vein as quickly and cheaply as possible. Subsequent tunnels lower down, can be driven after the vein is proven up which would justify longer and larger permanent haulage ways. The surface vein system should be thoroughly prospected by trenching and open cuts. A Geological and topographical survey should be made to correlate the outcrops. A haulage cable, trolley and winch should be erected to deliver materials and supplies to top of mountain from end of railroad grade.
Churn drill holes should checker-board the Glory Hole vein to block out, and determine depth and character of formation.
After ore body is proven beyond a doubt to a sufficient extent and value of ore, to warrant permanent mining operation, provide a small smelting plant, develop water power in Theodosia River, and erect aerial tramway and establish townsite.

WARD B. SMITH, E. M.
FLINT, MICHIGAN

Opinion - The display of magnetite ore indicates oxidization and leaching of the primary sulphide ores now exposed on surface. Therefore, the vein should show increasing values with depth as zone of secondary enrichment is approached.

By erecting your own smelter, the savings effected by elimination of transport charges would pay cost of smelter in one year. It should be oil burning and direct smelting blast furnace (using raw ore without concentrating or roasting) making a matte which would be blown in converters to blister copper - your merchantable product to sell to the refinery.

Every mining man who has inspected this showing, recommend the property for extensive development.

Respectfully submitted,

Ward B. Smith

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DATE DUE