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Nickel Plate Mine

CIM Visit April 1948
(largely A.E. Buller)

The Hedley Mascot Gold Mines Limited and Kelowna Exploration Company Limited welcome you as a member of the Kettle Valley Excursion Party on the occasion of your trip to Hedley on Saturday, April 10th, 1948. We sincerely hope that your visit will prove pleasurable and profitable.

Enclosed is a detail of the program arranged for your visit and some pertinent technical data concerning the two operations.

F. A. McGonigle, Manager,
Kelowna Exploration Company Limited

C.W.S. Tremaine, Resident Manager,
Hedley Mascot Gold Mines Limited

E. W. Johnson,
Hedley Representative,
C.I.M.M. Committee.

GENERAL PROGRAM

The Hedley Group of the Kettle Valley Excursion Party will be met at Princeton at 8:15 A.M. by Mr. Eric Johnson. The Hedley Party will have breakfasted on board and be ready to leave at 8:30 A.M. by car for Hedley.

Arriving at Hedley, they will proceed to the Mascot Staff House, where "digging clothes" will be supplied for the mine tour. At this time, the ladies can decide whether they wish to continue on to the mines or spend the day in Hedley. At both places arrangements will have been made for their entertainment.

Persons particularly interested in visiting the mills, will visit the Mascot Mill in the forenoon and then have lunch at the Hedley Mascot Staff House. The afternoon will be spent at the Kelowna Exploration Mill.

The party for the Mines visit will leave Hedley about 10: A.M. by car, for the Nickel Plate Mine. On arrival they will be given a short briefing on the operation, with the aid of maps and models. Guests will be served lunch in the Nickel Plate Mess House and then be conducted underground, where geologists and operators will be shown features of relative interest. The Hedley Mascot guides will pick up the groups not later than 3: P.M. at the 4300 level. At this point, persons not wishing to proceed further may return to the surface through the Nickel Plate workings and thence to Hedley by car.

The Mascot party will continue on through the Mascot workings and travel to the mill via the aerial tramway. After a tour through the mill they will return to the Staff House. Persons who have not previously had the opportunity, and are desirous of visiting the Kelowna Mill, will then be taken on a quick tour through the plant.

At the convenience of the members, the party will proceed to the Kelowna Guest House, as guests of the Hedley Mascot and Kelowna Companies, for refreshments and to meet with staff members and their wives. A buffet dinner will be served at 7:00 P.M.

After dinner opportunity will be given for a discussion period or cards for those who prefer.

Cars will be available for the return trip to Princeton later in the evening.

NOTES ON THE NICKEL PLATE AND HEDLEY MASCOT MINES, HEDLEY, B. C.

I. Introduction:

The following notes and maps were prepared for the members of the C.I.M.M. who plan to take the post-Convention trip to Hedley, and in particular for those primarily interested in the geology and mining operations of the mines.

These notes are intended only as an outline to help the visitor familiarize himself with some of the main points of interest before his arrival at Hedley. They cannot adequately cover in such brief form the many aspects of the geology and operating problems of this interesting ore deposit.

II. Location and Access:

Hedley is situated at an elevation of 1700 feet in the Similkameen Valley on Trans-Canada Highway Route 3. It is some 25 miles southeast of Princeton, which is on the Kettle Valley branch of the C.P.R. A branch line of the Great Northern Railway from Oroville, Washington, ends at Hedley, and over this line the concentrates from both mills are shipped to the Tacoma Smelter.

III. History:

Placer gold was discovered in the 1860's at Granite Creek above Princeton, and at other points along the Similkameen River, notably near the present site of Hedley in the 20-Mile Creek valley. In 1894 the first three lode claims were staked on Nickel Plate Mountain, but were allowed to lapse. In 1897 claims which are now part of the Nickel Plate holdings were staked, and ore from the showings was exhibited at the Fall Fair in

Vancouver in that year, where it was seen by M.K. Rodgers, a scout for Marcus Daly, of Butte. Rodgers immediately travelled to the property (by horseback across country) and at once optioned it.

Work was started on the property in 1899 and by 1902 sufficient ore had been indicated to warrant the construction of a tramway and mill. This was completed by 1904 and production started in that year.

In 1909, after mining 167,000 tons of ore averaging 0.70 ounces per ton from near-surface workings, the Daly interests sold control of the property to the Hedley Gold Mining Co. Ltd. This company, with G.P. Jones as Manager, operated the Nickel Plate Mine continuously until forced to shut down in 1930 due to exhaustion of known reserves.

In 1932 the Mercer Exploration Syndicate optioned the property and this later became the Kelowna Exploration Company Limited, a private company controlled by the South American Development Company, of New York, which purchased the property outright in 1934. After careful and detailed geological studies and a good deal of development work the present company commenced production in December, 1934. Production has been continuous ever since, being gradually increased to the current rate of 325 tons per day.

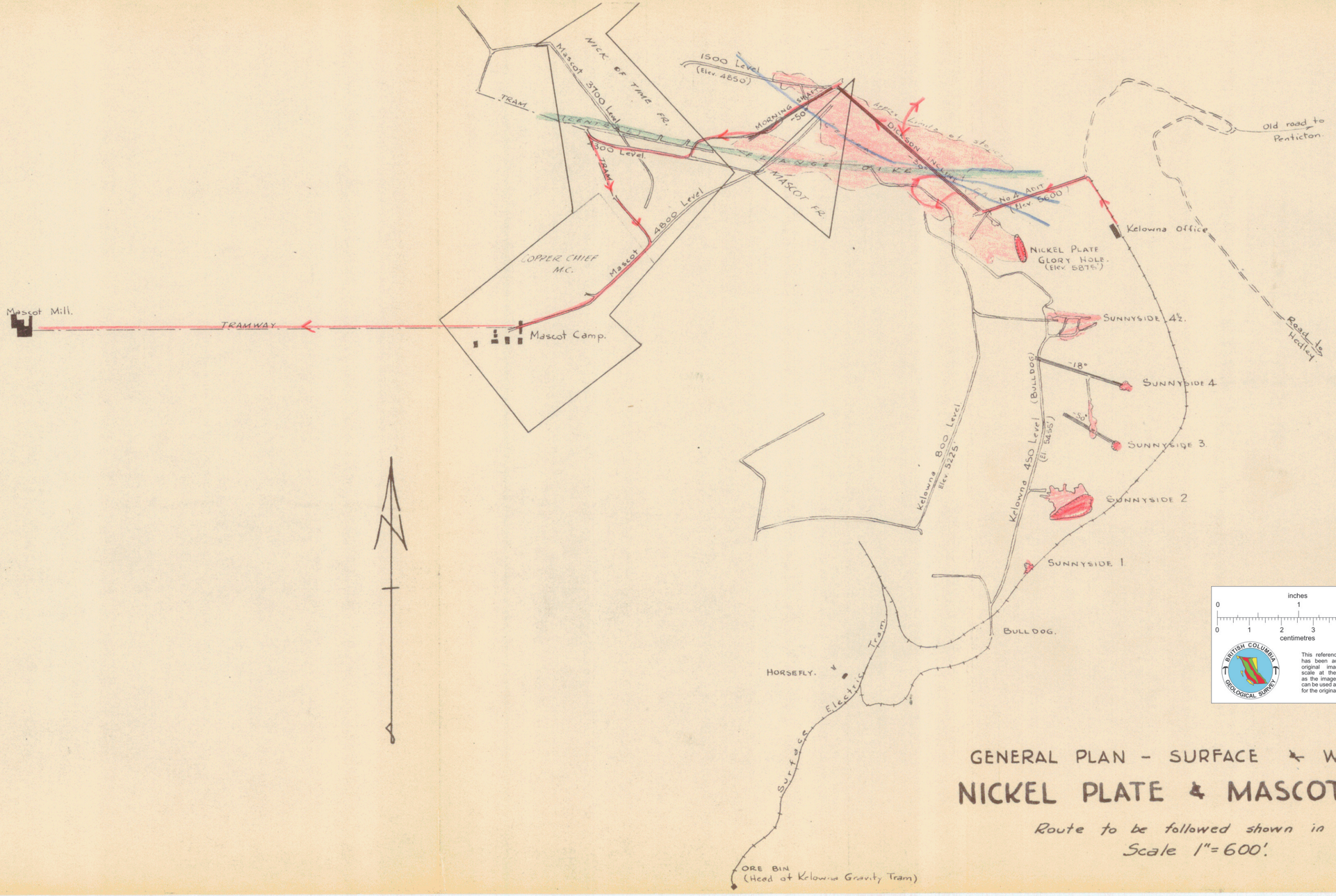
In 1935, Vancouver interests acquired the Mascot Fraction and other claims on the western slope of Nickel Plate Mountain and formed the Hedley Mascot Gold Mines, Ltd. Despite great physical difficulties, a camp was built on the cliffs above Hedley and a tramway built to connect it with the mill in 20-Mile canyon. A long cross-cut tunnel was driven to

reach the ore zone in the Mascot Fraction and on its completion in 1936 production was commenced and continues at the present time.

It should be noted that the workings of these two mines are connected in many places, and in fact the two Companies are mining the same series of ore bodies, separated only by property lines.

The successful rejuvenation of the old Nickel Plate Mine is largely due to the work and guidance of Paul Billingsley, the Consulting Geologist for the Kelowna Exploration Co. It was he who realized the potentialities of the property after examining it in 1927 for the Hedley Gold Mining Co., and who persuaded the South American Development Company to purchase it. His early geologic studies yielded the clue to the structural picture which has not been changed in its essentials since that time. He has continued to direct all the geological work which has been most successful in finding new ore.

Careful geological work by the Mascot staff, under the very able guidance of Dr. Victor Dolmage, has added greatly to the knowledge of the ore bodies as a whole, and has aided in solving the problems encountered in the deep development in the Mascot and Kelowna workings in recent years. A very free interchange of information between the two Companies has greatly facilitated the work of each.



GENERAL PLAN - SURFACE & WORKINGS

NICKEL PLATE & MASCOT MINES.

Route to be followed shown in red.

Scale 1"=600'.

A.E.B.

IV. Production:

The total production and dividends to the end of 1947 from both mines is as follows: (approximate figures only)

Production by	Tons Produced	Value	Grade ozs/ton	Dividends
Daly Interests) Hedley Gold Mining Co)	1,250,000	$12,500,000	0.50	$3,423,191
Kelowna Exploration	1,059,577	15,000,000	0.377	1,740,000
Hedley Mascot	627,676	7,625,902	0.36	1,290,553
Totals	2,937,253	$35,125,902		$6,453,744

V. The Mines: (See attached General Plan - Surface and Workings)

(a) The Nickel Plate:

The Nickel Plate was originally started as a surface pit on the one single outcrop of the entire Nickel Plate system of orebodies. Later Adit No. 3 (elevation 5750 feet) served for some time and about 1909 Adit No. 4 was driven. From this the Dickson Incline, a three-compartment shaft dipping 30°, N.48° W, was sunk in the footwall of the orebodies for a slope length of 1500 feet. The lower part of the incline passes through the north corner of the Mascot Fraction.

Levels are at intervals of 100 feet on the slope of the incline. The 1500 level at elevation 4850 feet was the lowest main level of the Nickel Plate workings. There is a short winze below 1500, with two short sub-levels, which has not been unwatered since the present Company's operations began.

In 1941, following the discovery of deep ore to the south and west of the lowest workings, the Morning Shaft was sunk in the direction S 60° W, dip 50° from the 1500 station. Levels on this shaft are the 4600, 4450, 4300 and 4150 (elevation above sea level).

Ore was mined from the four Sunnyside mines by the Hedley Gold Mining Co, from small near surface workings. The new discovery, the rich Sunnyside 4½ orebody, was mined by the Kelowna Exploration from the 450 Level, and its ore transferred via the Bulldog Tunnel to the surface tram.

Ore is or has been mined from all levels in the Nickel Plate and Morning workings. It is hoisted to the Adit Level and transferred over the surface electric tramway about a mile and a half to the head of the gravity tramway. The gravity tramway drops it 3400 feet from the Ore Bin to the Mill in a slope length of about 10,000 feet.

(b) The Mascot:

The Mascot Mine was originally opened up by means of a 3000 foot tunnel driven in at 4800 feet elevation. When this tunnel was driven, all the known ore on the Mascot holding was above this level. Later, diamond drilling and development work proved the extension of the ore considerably below this level.

To reach the lower section, two more tunnels were driven at the 4300 and 3700 elevations.

Ore from the 4300 and 3700 Levels is hoisted on short aerial tramways to the 4800 Level where it is transported to the ore bins at the


Canadian National R.
Canadian Pacific R.
ASHCROFT
KAMLOOPS
MERRITT
VERNON
KELOWNA
PENTICTON
PRINCETON
HOPE
COPPER MT.
HEDLEY
OLIVER
KEREMEOS
CAMP McKINNEY
GREENWOOD
BEAVERDELL
MIDWAY
Tertiary cover
Tertiary cover
Tertiary cover
Okanagan Valley
Okanagan Batholith
OKANAGAN LAKE
SHUSWAP
COMPLEX
Remmel Batholith
Coast (Cretaceous and younger) Range
Thrust fault zone
Similkameen Batholith
Colville Batholith
Paleozoic rocks
INTERNATIONAL BOUNDARY
49°
50°
121°
120°
119°
Scale: 1" = 15·78 miles
A.E.B.

FIGURE 1

head of the main tramway. This main tramway is 5000 feet long and handles all the supplies to the mine and ore to the mill.

VI. Geology of the Ore Deposits:

(a) Regional Setting: (See Figure 1)

The Hedley orebodies are contained in a series of limestones and limey argillites, part of a thick panel of Triassic sediments which lies transverse to the regional structure in the district. Figure 1 shows the generalized regional geology, the red areas being Mesozoic and younger granitic intrusives, and the uncolored portions being Triassic formations. The Triassics are rather tightly folded along lines indicated by the fold axes in Figure 1, and steep dips are the rule throughout the area.

These folds have themselves been warped into a rather sharp bend around the nose of a large northwest-plunging fold in the underlying Palaeozoics to the southeast. The Hedley camp lies near the axis of this warp.

The panel of Triassics is enclosed on the northwest and southeast by the Okanagan and Similkameen batholiths, and apparently cut off to the northeast by the gneisses of the Shuswap Complex. The immediate district is underlain by a granitic intrusive which forms the core of an assymetric anticline, the gently dipping west limb of which contains the Hedley orebodies.

(b) Local Geology:

Nickel Plate Mountain is underlain by granite, the top of which outcrops just above the Kelowna mill and whose gentle westerly dip is slightly flatter than that of the overlying sediments. Above the granite

is a series of thin bedded cherts, argillites and limestones - the Red Top formation.

Above this lies the Nickel Plate formation - the productive horizon. Its base is the massive Sunnyside limestone which forms the cliffs above the Kelowna mill. The upper beds of the Nickel Plate formation are limey argillites, limestones and some thin quartzite beds.

The sediments strike approximately north-south and dip west at about 30°, the western slope of Nickel Plate Mountain being practically a dip-slope. The westerly dip is complicated by transverse crumples whose axes strike northwesterly and which are slightly overturned to the northeast. The most northerly of these zones of crumples forms the major control for the Nickel Plate system of orebodies.

Striking northeasterly through Hedley and the lower valley of the 20-Mile and up Bradshaw Canyon, is a major, steeply west-dipping thrust fault - the Bradshaw Thrust. What appear to be subsidiary footwall strands of this zone of thrusting form flattish zones of brecciation on and near the summit of Nickel Plate Mountain. These overlie the orebodies and are the loci of extreme alteration resulting in strange siliceous and garnetiferous breccias.

Intrusive into the Nickel Plate formation is a host of sills of dioritic composition and porphyritic texture varying in thickness from a few inches to over one hundred feet. These sills follow flattish shears which climb slightly through the bedding and crosscut the earlier sharp folds. They are themselves slightly folded and brecciated by later folding along the same axes as the earlier folds.

Coincident throughout the whole system of stopes with rich, continuous ore is one particular porphyry sheet called the "Midway" in the Nickel Plate, and the "Hot Sill" in the Mascot. Further reference will be made to this under the heading of "Ore Controls".

In addition to the sills there is a dike of similar composition and texture, whose average dip is vertical and strike east-west, which divides the Nickel Plate stopes into two units. It has been followed on surface and underground for a distance of some 3600 feet, for which length its course is remarkably straight. In vertical north-south section it appears as the trunk of a tree of which the sills are the limbs. No contacts can be mapped between the sills and this dike. It is called the Flange Dike in the Nickel Plate and the Central Dike in the Mascot.

Post-ore dikes of two kinds - one rhyolitic and the other andesitic - cut all formations and rocks within the ore zone.

(c) Alteration:

The rocks of the upper part of Nickel Plate Mountain have been highly metamorphosed and are now an assemblage of marbles, banded skarn rocks (garnet, diopside, epidote, calcite), massive garnetites and banded cherts. The alteration has not been confined to any one bed or rock type, although it has affected each differently. It cuts across the whole upper section of the Nickel Plate formation. The lower boundary of this zone of alteration is bowl-shaped. Its northern edge outcrops near the portal of the No. 4 Adit and thence trends northwesterly and westerly across and down the slope of Nickel Plate Mountain. It dips steeply south through the

beds of the Nickel Plate formation, coinciding approximately with the northern edge of the Nickel Plate zone of crumples. The bottom of the alteration bowl coincides roughly with the top of the Sunnyside limestone and its southern edge climbs up through the bedding in the vicinity of the Bulldog and Horsefly. The bottom of the bowl outcrops along the surface tramway between the Sunnyside 4 and the Bulldog, and on it lie the Sunnyside orebodies.

Within the alteration bowl the normally dark diorite sills have been altered and bleached, largely by the alteration of the dark hornblend phenocrysts to colorless augite, giving a rock of dense whitish appearance, first mapped as gabbro.

The alteration bowl is capped by highly silicified cherty sediments and by the breccias already referred to.

The zone in which skarn gives way to silicification and marbleization is called the Marble Line, or better, the Marble-Skarn Transition Zone. All ore found to date lies near or within this zone, mostly in the medium- to coarse-grained skarn rocks, in favorable structures.

It appears that silicification was the earlier and more widespread alteration, and that silication followed.

(d) <u>The Ores</u>:

The ore consists essentially of arsenopyrite with some pyrrhotite, and minor amounts of chalcopyrite, sphalerite, cobaltite, pyrite and gold, in a gangue of garnet, augite, dipyrite, calcite, epidote and chlorite. The scapolite, dipyrite, is closely associated with gold values.

The gold is extremely fine grained and is never seen in hand specimens, even when assays show tens of ounces per ton. It appears to have been deposited with the arsenopyrite, earliest in the succession of sulphides. Late calcite veins and all other minerals; strong-looking, calcite filled faults with insignificant displacement cut all the ore bodies.

The arsenopyrite generally favors the medium to coarse grained skarn bands and is found less frequently in cherty layers and seldom in porphyry, except in obvious cracks.

The ratio of gold to arsenopyrite shows wide variation both within one stope and as between different ore horizons. Certain horizons are commonly of higher grade than others, notably those lying against the Midway (Hot) Sill, but in general it is impossible to judge the grade of ore by its appearance alone.

(e) Ore Controls:

The elements of the structural control within the Nickel Plate system are: the northwesterly striking folds, the Flange (Central) Dike, the Midway (Hot) Sill, and the mine sills. Throughout the main Nickel Plate system the ore bodies have formed as replacements of favorably located beds, between porphyry sills, near the Flange-Midway crotch, and within the Marble-Skarn transition zone. There are five main ore horizons in the upper part of the ore zone. In the Kelowna workings these are named, from bottom upwards, the Yellow, Orange, Red, Purple and Upper

Purple. They are arranged shingle fashion one above the other, each higher bed being successively further to the northeast. This is due to the slight overturning of the fold axes and to the dip of the Marble-Skarn transition zone.

Throughout most of the Nickel Plate workings the picture is complicated by a west-northwest trending vertical fault zone. It is post-ore and is occupied by post-ore rhyolite dike .and it divides the mine workings into two parts. It coincides with the Flange dike for much of its distance in the mine but crosses it slowly from northwest to southeast. It coincides also with the north limb of the south Nickel Plate crumple and as its downthrow is to the north it accentuates the crumple.

The Midway (Hot) Sill lies between the yellow and orange beds and follows the bedding quite closely throughout most of the Nickel Plate workings but near the east boundary of the Mascot Fraction it steepens to about 50°, cutting through both the beds and the sills from here downward and westward. Whereas above this point the ore made on broad open folds in wide, continuous ore bodies, which rake northwesterly down the folds axes, below this point the ore is much more confined and is closely controlled by the crotch intersection between the Flange and Midway. This rakes downward to the west at about 50°. Here, however, the ore is generally of much higher grade.

Locally within the lower Mascot and Morning workings, the ore makes out on crumples away from the Flange-Midway crotch, but never as extensively as in the upper workings. The crumples are here tighter, and their axes strike more nearly north-south than in the upper workings.

The Sunnyside and Bulldog ore bodies lie on or near the Sunnyside limestone on the bottom of the alteration bowl, where inlets have coincided with favourable ore structures. These may be simply folds, as in the case of the Bulldog and Sunnyside 2 ore bodies, or a combination of crosscutting porphyry dike (Flange type) with folds, as in the case of the Sunnyside 3 and Sunnyside 4½ ore bodies.

VII. Mining Methods at the Nickel Plate Mine.

The flat-lying ore bodies of the Nickel Plate are mined in open stopes, the ground being exceedingly hard, and standing indefinitely. A raise is first driven from the haulage-way to the hanging wall of the ore in the new ore block, and where possible, carried up on the hanging wall to the next working level, as a serviceway and for ventilation.

Stoping is commenced by slashing from the walls of the raise around the draw point, using automatic-feed drifters mounted on a vertical column. The slashing is carried forward on the hanging wall to the limits of the ore block, and up dip to the next level.

The remainder of the ore is mined by benching the floor to the footwall, using tripod-mounted drifters, the benches being started at the draw points and carried up dip in a series, depending on the thickness

of the stope. All muck is moved to the draw points by gravity, or by scraping, and working faces are arranged in the stopes to allow of simultaneous scraping and mining.

Due to the convenient location of the Dickson Incline in the footwall, trams are seldom long and, where possible, ore passes are driven to draw ore direct from stopes to the shaft pockets.

Porphyry generally forms the foot and hanging walls of the stopes, but one or both side walls is an assay limit. Daily sampling of all stope and development faces serves as a guide for mining.

Detachable bits are used in all stopes, and conventional steel in some development headings, where transport of materials is not a problem.

In the Morning workings, one large section lying between two post-ore faults is so broken and oxidized as to require square set stoping. Other small, steeply inclined ore bodies have been mined as shrinkage stopes.

Very detailed geological mapping is done, on 15 scale, after all faces have been washed down. Working maps and sections are on 30-scale, and cross and long sections are kept throughout the Nickel Plate workings at 25 foot intervals. These show all drill holes with geology and values, all workings and stopes and the details of geology. They are indispensable in developing and mining such complex ore bodies.

Exploration and development is largely by diamond drilling and ore blocks are delimited as completely as possible by drilling before mining is commenced. Wherever possible holes are drilled on section lines to facilitate the interpretation of the geological information.

THE KELOWNA MILL

The Kelowna Mill's history and metallurgy is interesting, from a visitor's as well as an operator's viewpoint.

Construction of the building and installation of the original machinery was undertaken by the Daly Reduction Company in 1903 and the first stamps were dropped on May 4, 1904. After the initial break-in period, the plant continued in regular operation (excluding winter closures) under ownership of the Daly Reduction Company and then the Hedley Gold Mining Company, until the shut down in 1930. The Kelowna Exploration Company started milling operations on a year-round basis in December, 1934.

The original operation utilized two small jaw crushers, 40 stamps, amalgam plates, Frue vanners and sand and slime vats for batch cyanidation.

As the mine workings deepened, the content of gold recoverable by amalgamation progressively decreased and finally in 1912 the plates were removed.

Thereafter, the principal step was gravity concentration by means of cones, Frue vanners and Deister tables followed by batch cyanidation of the sands and slimes.

Later the process was reversed, and batch cyanidation became the principal operation, followed by gravity concentration of the sulphides. This order was followed until the shutdown in 1930.

Since 1934, the Kelowna Exploration Company has renewed sections of the plant, replaced batch cyanidation with the continuous process and gravity concentration with flotation.

The essential features of the present day operation are noted on the accompanying flow sheet. More detailed information will be given at the time of the plant visit.

Bibliography:

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1929 - "Operations of the Hedley Gold Mining Co." by G.P. Jones, B.W. Knowles and J. Wheeler. Annual Report of the Minister of Mines, B.C. 1929, pp. 263-267.

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1945 - "Contact Metamorphism at Nickel Plate Mountain, Hedley, B.C." by Victor Dolmage and C. E. G. Brown. Trans. C.I.M.M. Vol. XLVIII, pp. 27-67.

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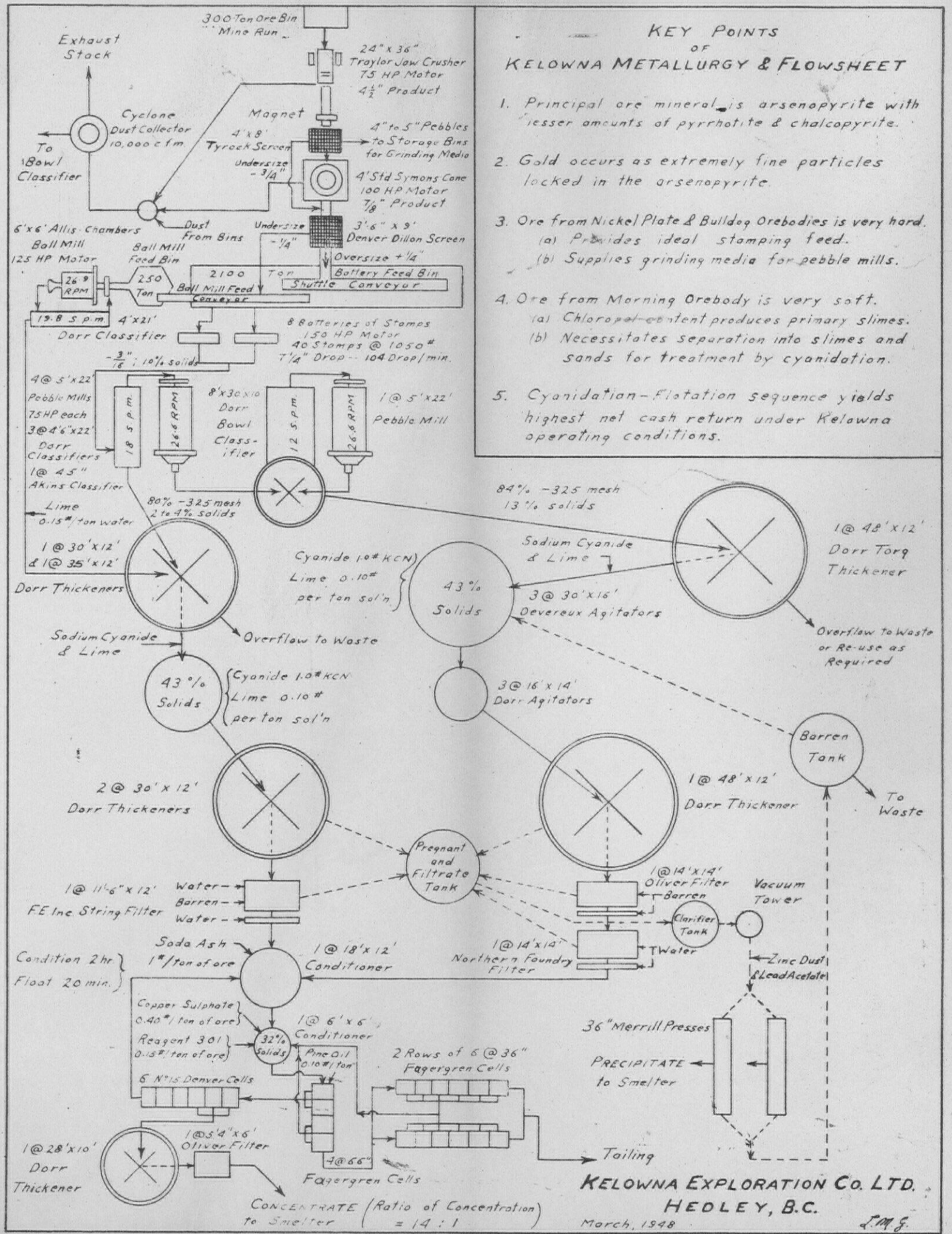
Maps (Other than those accompanying reports)

1. G.S.C. Map No. 568A - Hedley Sheet (1 mile) 1940
2. G.S.C. Map No. 628A - Ollala Sheet (1 mile) 1941
3. G.S.C. Map No. 341A - Keremeos Sheet (1 mile) 1940
4. G.S.C. Map No. 888A - Princeton Sheet (4 mile) 1947



KEY POINTS OF KELOWNA METALLURGY & FLOWSHEET

1. Principal ore mineral is arsenopyrite with lesser amounts of pyrrhotite & chalcopyrite.
2. Gold occurs as extremely fine particles locked in the arsenopyrite.
3. Ore from Nickel Plate & Bulldog Orebodies is very hard.
   (a) Provides ideal stamping feed.
   (b) Supplies grinding media for pebble mills.
4. Ore from Morning Orebody is very soft.
   (a) Chloropal content produces primary slimes.
   (b) Necessitates separation into slimes and sands for treatment by cyanidation.
5. Cyanidation–Flotation sequence yields highest net cash return under Kelowna operating conditions.

KELOWNA EXPLORATION CO. LTD.
HEDLEY, B.C.

March, 1948

L.M.S.