BRITISH COLUMBIA DEPARTMENT OF MINES

HON. E. C. CARSON, Minister
JOHN F. WALKER, Deputy Minister.
J. DICKSON, Chief Inspector of Mines.
G. CAVE-BROWNE-CAVE, Chief Analyst and Assayer.
HARTLEY SARGENT, Chief Mining Engineer.
P. J. MULCAHY, Chief Gold Commissioner.

NOTES ON PLACER-MINING IN BRITISH COLUMBIA

FOR THE

INFORMATION OF THE INDIVIDUAL MINER

(Reprint of 1938 Edition)

BY

OFFICERS OF THE DEPARTMENT

PRINTED BY
AUTHORITY OF THE LEGISLATIVE ASSEMBLY.

VICTORIA, B.C.:
Printed by CHARLES F. BANFIELD, Printer to the King's Most Excellent Majesty.
1943.

BCDM
PLACER
NOTES
1943 EMPR
c. 2

0005063271

BCDM placer notes
1943
C.2

BRITISH COLUMBIA DEPARTMENT OF MINES

HON. E. C. CARSON, Minister
JOHN F. WALKER, Deputy Minister.
J. DICKSON, Chief Inspector of Mines.
G. CAVE-BROWNE-CAVE, Chief Analyst and Assayer.
HARTLEY SARGENT, Chief Mining Engineer.
P. J. MULCAHY, Chief Gold Commissioner.

NOTES ON PLACER-MINING IN BRITISH COLUMBIA

FOR THE

INFORMATION OF THE INDIVIDUAL MINER

(Reprint of 1938 Edition)

BY

OFFICERS OF THE DEPARTMENT

PRINTED BY
AUTHORITY OF THE LEGISLATIVE ASSEMBLY.

VICTORIA, B.C.:
Printed by CHARLES F. BANFIELD, Printer to the King's Most Excellent Majesty.
1943.

PREFACE.

War conditions make it very difficult to continue placer-mining for gold and it is doubtful if new operations could be started. Nonetheless, it is desirable that placer-mining should be kept in mind and that, where possible, information about gold-bearing ground should be accumulated so that operations can be commenced with the minimum of delay when men and material again become available.

Despite the present conditions there is a continuing demand for information on placer-mining. Bulletin No. 15, " Hydraulic Mining Methods," and Bulletin No. 16, " Dragline Dredging Methods," published in 1942, are still procurable. More general information on placer-mining has been available in a series of bulletins, of which the most recent is " Notes on Placer-mining in British Columbia for the Information of the Individual Miner," published in 1938. The supply of this bulletin is exhausted. To meet the demand until a revised edition or a new bulletin is brought out it has been decided to reprint the 1938 publication.

In the reprinted edition a map showing the principal physiographical divisions of the Province has been added and a few minor changes have been made in the text, excepting in the " Synopsis of Mining Laws," which section has been completely revised. The reader is asked to keep in mind the fact that the text was written for publication in 1938.

Prices given for mercury, supplies, and tools were for the Lower Mainland in 1938. Many of these prices do not apply to-day and a number of the items may now be unobtainable. The prices for ordinary supplies scheduled in this bulletin, if increased about 20 per cent. will serve as a rough guide to present prices on the Lower Mainland. Prices elsewhere in the Province would be higher. A recent quotation for mercury (quicksilver) in small lots in Vancouver was $3.75 to $3.50 per pound.

Work done since the 1938 edition was written and the general conditions now prevailing have important bearings on the possibilities of economic operation. For these reasons parts of the section entitled " Placer-mining—Future Possibilities for the Individual Miner," pages 7–15, 1938 edition, scarcely apply to-day.

As distant new areas are apt to lack dwellings and transportation facilities, it is suggested that to keep expenses for transportation and shelter to the minimum, individuals who wish to undertake placer-mining for gold during any period which they cannot apply more directly to the war effort should work in or near established camps.

Most of the more easily prospected gold-bearing gravels have been mined, but new concentrations of gold are sometimes formed on the surfaces of bars in the Fraser and other other rivers, in periods of high water. Therefore the bars offer a possible field for the individual operator, during low water, especially in the autumn and early spring, when little difficulty from frost need be feared.

Any one wishing to prospect for placer gold or to work unproven ground should be well enough financed to provide the food, lodging, transportation, and equipment required for the entire period in which he proposes to work.

NOTES ON PLACER-MINING IN BRITISH COLUMBIA.

PHYSIOGRAPHY.

Most of the Province of British Columbia lies within the region of mountain systems and intervening plateaux known as the Western Cordillera, which forms the western border of the North American Continent. The extreme north-eastern corner of the Province, however, lies east of the Cordillera and is part of the Great Plains region.

The Rocky Mountains extend along the eastern boundary of the Province for a distance of 400 miles, and continue north-westward for an additional 500 miles entirely within the Province. This high, rugged mountain system, averaging about 50 miles in width, is bounded on the west by a remarkably long and straight valley, known as the Rocky Mountain Trench, which is occupied from south to north by the Kootenay, Columbia, Canoe, Fraser, Parsnip, Finlay, Fox, and Kechika Rivers, of which the first four flow into the Pacific and the second four join the Mackenzie River to flow ultimately into the Arctic Ocean.

In the southern part of the Province the Purcell Mountain system is immediately west of the Rocky Mountain Trench while the Selkirk and Monashee Mountain systems are roughly parallel with and successively west of the Purcell system. Just north of them, within the bend of the Fraser River, the Cariboo Mountains form the western wall of the Rocky Mountain Trench. The four mountain systems are separated by deep intermontane valleys. In the northern part of the Province the Cassiar-Omineca Mountains form the western wall of the Rocky Mountain Trench.

The Cariboo and Cassiar-Omineca Mountains are separated by a plateau, part of the Interior Plateaux which continue in a southerly direction separating the mountainous country on the east from the Coast Mountains on the west. The plateaux present a variety of land forms from rolling country to that which is mountainous but lacking the rugged alpine character of the bordering mountains.

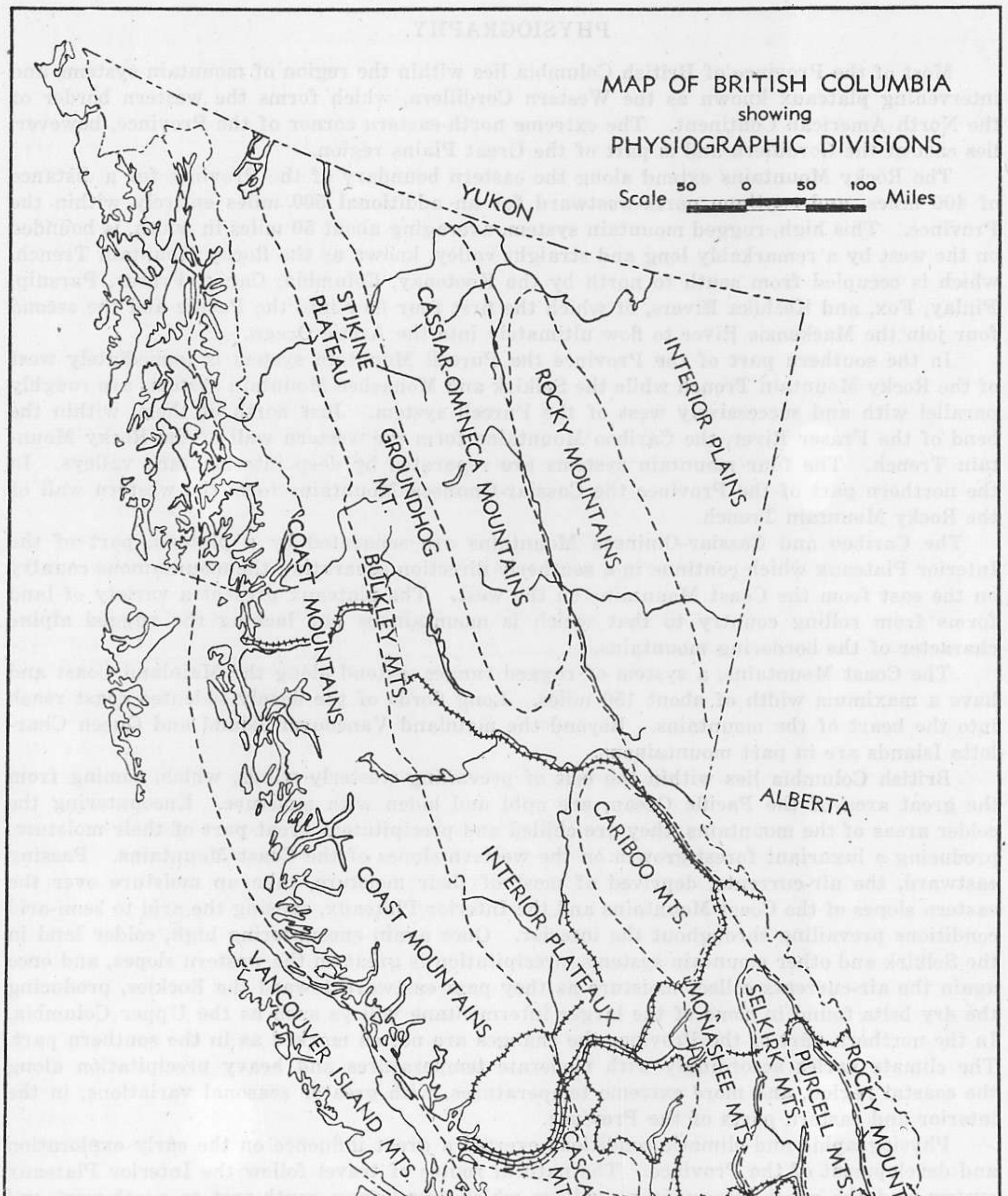
The Coast Mountains, a system of rugged ranges, extend along the Mainland Coast and have a maximum width of about 150 miles. Long fiords of the deeply indented coast reach into the heart of the mountains. Beyond the mainland Vancouver Island and Queen Charlotte Islands are in part mountainous.

British Columbia lies within the belt of prevailing westerly winds, which, coming from the great area of the Pacific Ocean, are mild and laden with moisture. Encountering the colder areas of the mountains, they are chilled and precipitate a great part of their moisture, producing a luxuriant forest-growth on the western slopes of the Coast Mountains. Passing eastward, the air-currents, deprived of most of their moisture, take up moisture over the eastern slopes of the Coast Mountains and the Interior Plateaux, causing the arid to semi-arid conditions prevailing throughout the interior. Once again encountering high, colder land in the Selkirk and other mountain systems, precipitation is great on the western slopes, and once again the air-currents collect moisture as they pass eastward toward the Rockies, producing the dry belts found in some of the larger intermontane valleys such as the Upper Columbia. In the northern part of the Province the changes are not as marked as in the southern part. The climate varies accordingly with moderate temperatures and heavy precipitation along the coastal region, and more extreme temperatures, with greater seasonal variations, in the interior and eastern parts of the Province.

Physiographic and climatic conditions exerted a great influence on the early exploration and development of the Province. The natural routes of travel follow the Interior Plateaux system and the great intermontane valleys which trend from south-east to north-west and from south to north. Only a few passes suited to all-year transportation exist between the interior of the Province and the coast, and the great plains region of Canada to the east of the Rockies.

GEOLOGY.

The north-eastern corner of the Province, east of the Cordillera, belongs to the Great Plains region and is underlain chiefly by sedimentary rocks of Mesozoic age. Fine deposits of coal are known to occur in this area, some gas has been discovered and it is possible that oil may be discovered. Igneous rocks are not known to occur and therefore it is not to be expected that metalliferous deposits associated with them are likely to exist. It is possible that, besides coal, deposits of non-metallic minerals associated with sedimentary rocks may be discovered.



Principal physiographic divisions of British Columbia.

The Rocky Mountains are largely built of sedimentary rocks of Palæozoic and Mesozoic age. At only a few places, as Ice River, are igneous rocks known to exist. Metalliferous deposits are therefore, so far as known, restricted to relatively small areas, chiefly south of the main line of the Canadian Pacific Railway. Coal is found in the Mesozoic sediments chiefly in the south-east corner of the Province. On the whole, the Mesozoic rocks lie along the eastern slopes of the Rocky Mountains in Alberta. Other non-metallic deposits, such as phosphatic limestone and gypsum, occur and still others may be found. Seepages of oil occur in the Flathead area, but otherwise oil and gas possibilities are not considered to be very great within the Rocky Mountains. Therefore, with the exception of restricted areas where metalliferous deposits are found, the Rocky Mountains are looked upon as an area holding a few non-metallic deposits and perhaps materials suited to the building industry. The northern parts of the Rocky Mountains have not been widely explored, but so far as known are built of sedimentary rocks.

Not a great deal is known about the northern Stikine Mountains, except that they are built of Palæozoic and Mesozoic rocks intruded by the Cassiar batholith of granite and granodiorite. The extent of the batholith has not been determined. Placer gold has been found in this region and recently lode-gold prospects are attracting attention. Development has been slow, due in part to a lack of knowledge of the area and because of its distance from transportation with little inducement for prospecting for other minerals than gold. The extent of the batholithic rocks is not known and there may actually be a scarcity of mineralization in some parts of the area.

Similar conditions exist in the southern part of the Stikine Mountains, only there are more known mineral showings of lead, zinc, copper, and gold. The outcrops of batholithic rock in this area appear to be more extensive, but this may be due to a somewhat better knowledge of the country. Mica occurs near Fort Grahame on the east side of the Omineca Mountains.

On the western slopes of the Cariboo Mountains south-easterly across the Nechako Plateau from the southern Stikine Mountains is found the famous Barkerville placer area, and in the same region lode-gold deposits, and some containing tungsten. Lode-mining is being established in this area. Batholithic rocks are not known to be present in abundance and this may well account for relatively large areas in the Cariboo Mountains where mineralization appears to be scarce.

Continuing south-easterly into the Monashee and Selkirk Mountains batholithic rocks become more abundant and outcrop over large areas extending westerly across the Interior Plateaux country to the Coast Mountains. In this area south of the Canadian Pacific Railway right across the southern part of the Province are many of the oldest and best-developed mining camps, in which are found ores mainly of gold, lead-zinc, silver, and copper. Locally in the Interior Plateaux section Tertiary lavas and sediments overlie and hide from view the older rocks in which metalliferous deposits may be found. Coal, however, is found in some of the Tertiary basins.

North-westerly throughout the Interior Plateaux country to the Prince Rupert line of the Canadian National Railways are great areas overlain by Tertiary volcanics. The underlying rocks where exposed are highly deformed, metamorphosed, and in places intruded by igneous rocks. The Tertiary cover has undoubtedly hidden from view mineral deposits at one time exposed at the surface. The Interior Plateaux country, however, contains a great number of saline-lake deposits. Deposits of diatomaceous earth and volcanic ash are also present. Mercury occurs near Savona but has not been developed. Chromite occurs north of Ashcroft and it is possible that commercial ore may be found.

North of the Canadian National Railway, Prince Rupert line, the plateau country is interrupted until near the Yukon boundary by mountains extending from the Coast Mountains to the Stikine Mountains. This area is largely underlain, so far as known from existing meagre knowledge, by Palæozoic and Mesozoic sediments and volcanics, and possibly by extensive areas of batholithic rocks. Coal deposits are found in this area, but few lode deposits are known except in the vicinity of the railway.

Along the entire western side of the Province lies the Coast Range batholith. Deposits of copper and gold ore are found along its western side and along the eastern side are deposits of gold, silver, lead-zinc, and copper. The large granitic areas of the main batholith are not favourable sites for mineralization, but remnants of the intruded formations may contain metalliferous deposits. The most favourable areas lie along the flanks of the batholith in the intruded rocks.

Vancouver and Queen Charlotte Islands are underlain by Palæozoic and Mesozoic rocks intruded in part by igneous rocks. Coal measures are found in the Mesozoic rocks, chiefly along the east side of Vancouver Island. Deposits of copper, gold, lead, and zinc are found in the more highly deformed intruded rocks.

Deposits of molybdenum are fairly common in close association with granitic rocks at numerous places in the Province but so far have not been extensively developed. Magnetite deposits occur on Vancouver Island, Texada Island, and on points along the coast but no great tonnage has yet been developed.

It would appear from the foregoing that British Columbia west of the Rocky Mountains is an area favourable for the occurrence of metalliferous deposits, particularly of gold, silver, lead, zinc, and copper, but that almost any deposit associated with igneous rocks may be found. It is also a Province rich in coal but not in oil or gas west of the Rockies. The formations are too badly deformed and intruded by igneous rocks to hold great possibilities for the accumulation of oil and gas. The Tertiary deposits of the Interior Plateaux region are of fresh-water origin and therefore unfavourable to extensive accumulation of oil or gas.

PLACER DEPOSITS.

When rocks and mineral deposits are attacked by the agencies of weathering some minerals are destroyed to produce new ones, and others, more resistant, are set free. Thus feldspar is converted largely into kaolin, and pyrite into limonite, while quartz, gold, magnetite, and ilmenite are set free. The products of weathering are in part carried into stream-valleys and sorted according to size of grain and specific gravity.

Placer Gold.—Placer gold is derived from the deep weathering and subsequent erosion of primary gold ores contained in veins, etc. There is an old saying that where good placer gold is found lode-gold deposits are not likely to be of much importance, and, conversely, that where good lode deposits are found placer-gold deposits will be poor. The reason for this saying which is not always true, lies in the knowledge that rich placer deposits are frequently found in regions underlain by soft, easily eroded rocks containing numerous small, rich stringers and veins. Many of these stringers and veins are too small to mine as lode deposits. Where good lode deposits are found the enclosing formations are generally hard, competent rocks, resistant to erosion. Only small placer deposits result from the destruction of such formations.

Residual Deposits.—When a primary gold deposit is weathered the gold is gradually concentrated over the outcrop, while a considerable amount of the gangue, sulphides, and enclosing rock formation is gradually carried away. If the outcrop is situated on a hillside the gold will gradually work down the slope towards the valley-bottom. These deposits are called " residual placers." They are generally easy to work.

Stream Deposits.—Placer deposits formed by running water are by far the most important kind found in British Columbia.

Streams cutting across formations containing primary gold deposits will sort the eroded material according to size of grain and specific gravity. As gold is six to seven times heavier than quartz and such materials, it will settle rapidly and become concentrated in the stream-bed below the outcrop, while the lighter vein-matter and rock debris will be carried farther along. Some of the gold adhering to quartz will be carried along and gradually freed, and naturally the smaller particles of gold will travel farther than the larger ones. The result will be a pay-streak extending down-stream from near the outcrop.

The distance to the commencement of the deposit below the outcrop will also depend upon the velocity and grade of the stream. If this is torrential there may be a considerable distance between the outcrop and the deposit which will commence at a point of change to a lesser grade. It is not likely to be continuous, but will be interrupted according to the variations in the grade and consequently in the current of the stream owing to the configuration of its course. If the stream follows a sinuous course there will be successive deposits on the inner sides of the bends and these deposits will become progressively finer down-stream. Coarse gold will be found closer to the source and will tend to work down to bed-rock. If the stream transporting it flows over bed-rock the gold will be caught in irregularities or natural riffles. The finer gold will be carried farther and deposited on the sand-bars in bends of the stream.

Ideal conditions exist where long-continued weathering has attacked a primary deposit and then for some reason erosion has become active. This may be due to a land movement whereby the area deeply weathered is raised with consequent deepening of stream-valleys and erosion into the weathered materials. In British Columbia there is evidence of deepening of the stream-valleys in Tertiary time and it is possible that the deep deposits in the Cariboo were formed at that time. The majority of the deposits in British Columbia are, however, younger in age.

In the early stages of glaciation there was undoubtedly a very great run-off during the summer months from the melting of the accumulating snows that brought about the glacial period. This run-off swept the weathered rock debris into the valleys and with it residual gold deposits.

During interglacial periods and again in recent times the earlier deposits have been eroded and redeposited so that we have placer deposits of various ages, origins, and richness.

In the early stages of glaciation the stream-valleys were filled with the debris washed in from the hillsides, the streams being unable to transport the tremendous load supplied to them. In interglacial periods the streams cut down through these deposits and in places through rock spurs projecting into the old valleys.

Following the final retreat of the ice, the streams have again cut down their channels in the valley deposits and also into bed-rock, not always following their original courses but generally following along some part of the old valleys. The result is that old channels are found buried under varying thicknesses of stream and glacial deposits, paralleling or criss-crossing the present channels. Some of these old channels are higher in elevation than the present ones and some are lower. The higher ones form what are now known as bench deposits and the lower ones deep leads. Bench and stream deposits are ordinarily mined by hydraulicking and sluicing or more simple methods, while deep leads are mined by sinking and drifting.

Stream deposits may, through subsidence, be covered by barren detritus, the present stream having insufficient current to transport all of this material. Such deposits are worked by dredges.

Beach Placers.—Deposits of this type are generally formed by wave action attacking gold-bearing sands and gravels, and particularly during storms, forming local concentrations on the beaches. Sometimes these deposits yield considerable amounts of gold. Such deposits are found on Graham Island, Queen Charlotte Group, where, however, the deposits are small and so far have yielded only wages to experienced miners.

Size of Placer Gold.—Placer gold occurs in all sizes from large nuggets to minute particles requiring many thousands to yield a value of 1 cent. The gold may be rough and adhering to particles of quartz or it may have been pounded and worn into smooth, flat nuggets or flakes. Nuggets are formed from plates and masses of gold weathered out of lode deposits. Many nuggets are found which show the manner in which irregular branching pieces of gold have been pounded into a solid lump.

Most of the large nuggets found at various places in the world have come from very close to the source. No evidence has been presented to show that chemical action has played any part in the formation of placer gold, whereas there is abundant evidence to prove that it has been released by the mechanical processes of weathering and erosion of lode deposits.

Associated Minerals.—Magnetite and ilmenite are the most abundant minerals found with placer gold and form the common black sands. Garnet and several of the other heavy minerals form the light-coloured constituents generally present in black sands.

Distribution of Gold in Placers.—It has been intimated that coarse gold is usually found on bed-rock. This is often true, but coarse and fine gold may also be found on false bed-rock, or in streaks within sand or gravel beds. A false bed-rock is formed by deposition of compact clay or some such impervious material on gravels and sands, creating an obstruction to the downward movement of the gold. The downward movement of gold in the sands or gravels of a stream-bed will continue as long as the sands and gravels are agitated by the current of the stream. Where agitation ceases the gold will come to rest and if in sufficient quantity it will form a pay-streak. Gold is seldom found uniformly distributed through great thicknesses of gravels but generally on or within a few feet of bed-rock or false bed-rock, or in streaks. Small quantities may be distributed throughout the whole thickness of gravels but seldom in workable amounts. Where the whole thickness of gravel has to be worked as in hydraulic operations the higher values close to bed-rock must be averaged over the total thickness to be worked.

Platinum.—All that has been said regarding gold applies to platinum. It frequently occurs in small amounts in gold placers and also as the chief constituent of placer deposits, where it is commonly found with chromite in the vicinity of peridotite and pyroxenite rocks. Palladium and iridium are generally intimately combined with placer platinum.

Other Minerals.—Cassiterite and some gem-stones are found in placer deposits, but so far such deposits have not been discovered in British Columbia.

History.

Placer gold was found on Columbia River near the mouth of the Pend d'Oreille in 1855, and though of little importance in itself it led to the discovery of gold two years later at the junction of the Fraser and Thompson Rivers, where Lytton now stands. This discovery was as important to the future British Columbia as the discovery of gold in 1849 was to California. The next year, 1858, the wilderness, now British Columbia, was invaded by some 30,000 people seeking for gold. Most of the people came from California, some 20,000 to 23,000 by boat to Victoria, and about 8,000 overland to the Fraser River. Few crossed from Victoria to the mainland and only a few thousand ascended the Fraser River and worked its bars as far as Lillooet. The day of the fur-trader was over and a new land opened for settlement. The following year the miners ascended the Fraser to the Quesnel and explored it and its tributaries. In 1861 they crossed over from the Quesnel River to discover the fabulously rich deposits of Williams and Lightning Creeks, and the Cariboo blossomed for a few years as one of the world's greatest placer camps.

Miners travelling overland to the new diggings on the Fraser discovered placer gold in the Similkameen and Tulameen in 1860. In 1863 placer gold was discovered on Wild Horse Creek in East Kootenay and two years later in the Big Bend District of the Columbia.

The Cariboo excitement waning, the miners spread out northerly in their search for gold and found it in 1869 on Manson Creek, and in 1872 reached the Cassiar and found it along the tributaries of the Dease. The Atlin Camp was discovered in 1898 at the time of the great Klondyke rush.

PLACER-MINING—FUTURE POSSIBILITIES FOR THE INDIVIDUAL MINER.

While the record of placer-mining in the various camps in British Columbia shows that after the originally discovered rich ground was exhausted many unsuccessful enterprises have been started, it should not be concluded that there are not many possibilities for the future. These opportunities may be listed as follows:—

(1.) The discovery of new untested deposits in the vast area of the Central Belt. It is not likely that bonanza deposits on unmined creeks will be as easily found as in the early days of the Province, but there are undoubtedly many creeks that have never been properly prospected.

(2.) The major possibility for the future is probably the finding of ancient channels (Tertiary drainage) which have not been recognized. Many of these channels may be barren of pay-gravels, but some of them may contain workable placer deposits.

(3.) Low-grade deposits occur in many places, and though many of these are too low in gold content to be profitably worked, it is probable that adequate testing will show some deposits that could be hydraulicked, provided there is an adequate supply of water and physical conditions are suitable. Some of these deposits as well may provide suitable ground for dredging or drag-line operations.

NORTH-WESTERN DISTRICT.

Skeena Mining Division.

Graham Island.—Fine gold can be recovered, especially after storm periods, from patches and lenses of black-sand beach deposits on the east coast of Graham Island. Special methods are required for handling this type of material and some experience is necessary.

Douglas Creek.—Values occur on low benches and bars and on the bed-rock of this creek in the Kitsumgallum Lake area. In the same area, Maroon, Hall, and Clear Creeks and several dry gulches on the east side of the valley, about 3 miles northerly of Rosswood, are worthy of investigation. The area is conveniently reached by motor-car, lake, and trail from the town of Terrace on the Canadian National Railway.

Stikine Mining Division.

The area in this Division favourable for discovery of placer gold lies in the commencement of the upland plateaux east of the Coast Range. The drainage-basin of the Upper

Stikine River and its numerous tributaries lies within this area. Like the coastal section, the Stikine Division has been subjected, in parts, to intense glacial erosion. Sections that have not been affected by destructive glaciation should be selected for prospecting.

Barrington River.—A tributary of the Clearwater (Chutine) River, about 25 miles below Telegraph Creek, is a likely section for individual operations on low benches, bars, and low-water banks on clay bed-rock.

Stikine River.—Fine gold is known to occur in the bars of the Stikine River below Telegraph Creek and also above that place to the tributary Tahltan and Tuya Rivers. On the Stikine River, about 9 miles above Telegraph Creek, are occurrences of lava-buried gravels which would be worth prospecting.

Tahltan River.—At the confluence of this stream with the Stikine River, about 12 miles above Telegraph Creek, is a likely section for shovelling-in operations from low benches which are known to contain gold values.

These areas of the Stikine Division are easily accessible by river-boat from Wrangell, Alaska, to Telegraph Creek, and thence by motor-road.

Hotel Creek.—This creek and its tributaries constitutes a likely prospecting area contiguous to and east of Dease Lake.

Little Eagle River.—This stream and its west-side tributaries in the vicinity of Gold Pan Creek is also a likely prospecting area for shallow shovelling-in or ground-sluicing operations.

Dease, Thibert, and *Deloire Creeks,* with their several tributaries, westerly of Dease Lake, although extensively mined by "old-timers," still offer opportunities for shovelling-in and ground-sluicing operations on neglected sections of low benches and also drifting under high benches in selected localities.

These areas are reached by river-boat from Wrangell to Telegraph Creek; thence by motor-road to Dease Lake, from where trails extend up the various creeks.

McDame Creek.—Although extensively worked by "old-timers," this creek still presents opportunities on bars and low and high benches.

Spring Creek and its tributaries and *French Creek,* about 25 miles below Spring Creek, prospected and to some extent worked by "old-timers," are likely sections for shovelling-in.

These sections of the Dease River area are remote and are reached by river-boat down Dease Lake and River; thence by trail up the various creeks.

Atlin Mining Division.

Birch Creek.—A fair opportunity exists for drift-mining under the high bench of the right limit. Patches of virgin ground and areas of imperfectly cleaned bed-rock left after earlier hydraulicking operations are likely localities for shovelling-in.

Spruce Creek.—Reopening of old drift-workings offers opportunities for recovery from marginal ground that may prove highly profitable at the present price of gold. "Lays" may be arranged with present leaseholders, but only experienced men should attempt to work ground of this character.

Strips of creek ground contiguous and inaccessible to steam-shovel operations are also very likely locations on which "lays" may possibly be negotiated.

Old clayey tailing-dumps from creek and bench operations are also possible shovelling propositions on which "lays" may be arranged.

In the *Blue Canyon* area of Upper Spruce Creek likely patches occur on the right rim-rock and on low benches of the present creek-trough in an extensive possible area for shovelling-in from shallow false bed-rock.

Rant and *Rose Creeks,* north-side tributaries of the Upper Spruce Creek area, are likely prospecting localities.

Dominion Creek.—This is the main tributary of Spruce Creek on its south side. The upper section is a promising locality for shallow shovelling ground and also for drifting under the right limit bench on a possible location of the old channel.

Pine Creek.—Opportunities exist for drift-mining under the high bench of the right limit, contiguous to the old hydraulic workings and commencing about 1 mile above the old town of Discovery. This ground is generally covered by leaseholds, but "lays" may possibly be negotiated.

In the extensive old hydraulic and mechanical-shovel workings contiguous to the old town of Discovery, shovelling-in patches of imperfectly cleaned bed-rock or uncleaned low and hard sections of bed-rock, together with resluicing of old clayey tailings, offer likely opportunities for profitable " sniping." This ground is generally covered by leaseholds, but it may be possible to negotiate " lays."

Horse Creek, on the east side of the upper end of Surprise Lake, is a likely virgin creek for prospecting.

O'Donnel River, 8 to 22 miles south-easterly of the town of Atlin, is a very promising prospecting and mining area. On *Wilson Creek,* a tributary of the O'Donnel, gold occurs on a false clay bed-rock amenable to shovelling-in at shallow depth. *Slate, Feather, Carvill, Bull, Fox,* and other tributaries of the O'Donnel River are very likely prospecting areas. In the central section of the O'Donnel River area " lays " may possibly be arranged on good drifting-ground under the high bench of the right limit.

The majority of the creeks in the immediate Atlin area are accessible by motor-road from the town of Atlin; others have good trails leading to them from the roads.

Terrahina, Zenazie, and other west-side tributaries of Sucker River, in the Gladys Lake area east of Atlin, are likely prospecting sections, but are somewhat remote and only reached by trail or aeroplane.

Squaw Creek.—The Tatshenshini River area, about 125 miles north-westerly of Atlin, is best reached by road and trail from Haines, Alaska, and also from Whitehorse, Yukon. Access is expensive. The depth of gravel to bed-rock is 4 to 8 feet in the lower section and 10 to 15 feet in the upper section, and heavy wash and large boulders are present. Shovelling-in operations are conducted from creek ground and from low benches. There is a likely area for drift-prospecting under the high bench of the left limit in the central section.

NORTH-EASTERN DISTRICT.

Placer deposits originate from lode-gold deposits, which latter are, save in rare instances, due to batholithic intrusion. Therefore the geographic distribution of placer deposits of local origin must of necessity be controlled by the location of the batholiths which cross the country, and the situation of any outlying bodies or satellites of these batholiths.

The three batholiths which cross this district—namely, the Coast Range, Central, and Cassiar-Omineca or Eastern—have all given rise to lode deposits from which placer deposits have been formed. In addition to these, in a region lying partly in the Cariboo and partly in the Quesnel Mining Division, there is probably a concealed and deep-seated batholith which has originated lode deposits from which the richest placer deposits of these Mining Divisions have been found. It should, however, be understood that in these Mining Divisions there are many other valuable placer deposits which have had their origin from lode deposits of the Central batholith.

The facts cited above are fundamental to a proper understanding of the occurrence and distribution of placer deposits, and a knowledge of the geographic positions of the batholiths mentioned is one of the most important of the considerations which the prospector must bear in mind.

The Coast Range batholith passes along the western boundary of the district. Important satellites outcrop on Rocher Déboulé and Hudson Bay Mountains.

The Central batholith outcrops at the following points: The North-west Arm of Takla Lake; at the south end of Babine Lake; Sinkut Mountain; Fraser Lake; Hixon and Terry Creeks; Mostique Creek (tributary of Lightning Creek); Cariboo Mountain; North Fork of Quesnel River; and Boss Mountain.

The Cassiar-Omineca or Eastern batholith outcrops at the following points: McLaren Creek; McConnell Creek; head of Mesilinka River; Duck Creek (tributary of the Omineca River); Manson section; Mount Milligan; McLeod River; and Giscome.

The aureoles of these batholiths are the paths of promise for the prospector. Individual intrusions of batholithic rock may be found at many points between the batholiths, and such may be regarded as points of potential promise.

The foregoing facts are quite independent of the effect of glaciation, to which this country was subjected, whether that effect was to (*a*) merely cover with glacial debris, or (*b*) to disturb, or (*c*) to entirely destroy the pre-existent bed-rock placer deposit.

The following considerations are of great practical importance to the prospector:—

(1.) The effect of glaciation on previously-formed bed-rock placer deposits *increases* northward, and is at a maximum in the region of the headwaters of the Finlay and Skeena

Rivers. North of this point danger diminishes towards the limits reached by this ice-sheet. Generally speaking, it may be said that the region north of the Manson section is in the danger-zone as far as glacial erosion is concerned. In this region hopes would seem to lie mainly in finding post-Glacial false bed-rock deposits such as are exemplified on McConnell Creek. The presence of large boulders in this type of deposit frequently, but not always, impairs its commercial value.

(2.) Rugged mountainous topography did not favour the formation of rich placer deposits originally, even when a lode-gold source was present.

(3.) The major promise exhibited by northward-flowing creeks (that is, a north-westerly, north-easterly, or northerly flow) over those flowing south, *as a general rule*, is a fact well worth recognition in this district. This may be accounted for by the fact that it has been discovered by recent investigation that a glacier moves twice as rapidly on a south-flowing creek as on a north-flowing creek, with correspondingly increased erosive power. While there are noteworthy exceptions to this general rule, it is generally the case that such exceptions are southerly-flowing creeks flowing into a somewhat deeply-incised master-valley, the topography being such as to arrest movement of the glacier.

(4.) The presence of a canyon or gorge on a creek in a placer region usually indicates that this is a post-Glacial portion of the creek's valley, and on one side or other there probably lies buried under glacial debris a pre-Glacial portion which may contain good values on bed-rock. This is one of the easiest features to recognize, and its possible importance should be thoroughly appreciated by the prospector.

Those who contemplate prospecting for placer should consider the advisability of selecting an area rather than the vicinity of an individual creek on which placer has been found. It does not by any means follow that better opportunities will be afforded in a distant region than in one easy of access.

Omineca Mining Division.

Placer deposits are distributed as follows:—

(1.) In the Skeena section in an area adjacent to the Skeena River between Lorne and Kleanza Creeks.

(2.) In the central part, in the Manson section. The Manson section doubtless offers a field for prospecting, but it is to be borne in mind that placer deposits in this section are likely to be comparatively deeply buried, and previous experience of "deep-lead" mining is advisable if not necessary. There is, however, in this area a field for lode-gold prospecting, and it is now readily accessible either by boat from Fort St. James to the western portion or by road from Fort St. James to the eastern portion.

(3.) In the northern part, in the vicinity of McConnell Creek and McLaren Creek. Placer deposits on these creeks are laid down mainly on false bed-rock, but the regions are remote and the cost of food and other supplies correspondingly great. It is considered that prospectors will do well to select areas less remote.

(4.) In the eastern part, in the McLeod River area, and on bars of the Nation, Parsnip, Finlay, and Ingenika Rivers. All these are reached by the water route from Summit Lake (distant 32 miles by motor-road from Prince George). It should, however, be clearly understood that there are dangerous rapids on this route, which can only be negotiated by experienced rivermen.

(5.) At individual points, such as Sauchi, Rainbow, Philip (Robinson), Bob, and Dog Creeks. Of these, Sauchi Creek exhibits most promise, but it is understood that the ground is closely staked.

Of the foregoing, the Manson section is by far the most important.

Cariboo and Quesnel Mining Divisions.

In these Mining Divisions placer occurrence is particularly widespread, much more so than in other sections of the district. Further, in spite of the fact that it has been the scene of activity for so many years, each year affords additional evidence that there are new discoveries yet to be made. Again, the many bars on the Fraser, Quesnel, and Cottonwood Rivers offer, to the *experienced* prospector, the possibility of earning a grub-stake by dint of hard work.

A strip of country some miles in width, stretching south-east from Wingdam to Spanish Mountain, merits close prospecting.

Peace River Mining Division.

In this Mining Division concentrations in the form of bar and bench deposits on the Peace River annually engage the attention of a number of individuals.

CENTRAL AND SOUTHERN DISTRICTS.

Most of the stream-valleys in these districts have undergone many changes since Tertiary times. As a result, concentrations of placer gold have, in many valleys, been effected at different times and in different parts of the same valley. Pay-streaks may, therefore, bear no relation to the present stream-bed, and require careful search for their detection and careful testing to determine their extent and value. In the larger, gravel-filled valley-bottoms many local pay-streaks perhaps occur, some of which may reward individual enterprise, but an estimate of the gold content of the whole can only be derived from thorough and systematic testing.

Remnants of Tertiary drainage-channels, far from present stream-valleys, have been found covered by lava-flows, and other remnants probably are still to be located, covered by lava or by glacial drift. Old channels within the existing valleys are sometimes covered by glacial materials or by stream-deposited gravels of little or no commercial values. Shorter, unglaciated stream-valleys may, in areas of gold-quartz veins, contain in the stream-bed pay-dirt to reward the individual miner.

Greenwood Mining Division.

Prospecting areas include the following, all easily accessible:—

(1.) Streams and benches in the region of gold-quartz veins near Paulson, such as McRae Creek and its tributaries, and Saunders Creek.

(2.) Pass Creek, which flows into Granby River 12 miles north of Grand Forks.

(3.) Fourth of July Creek and tributaries.

Much of the more accessible bed-rock was mined many years ago and attention in recent years has been directed towards obscured benches and channels. Many portions require capital for prospecting and testing, while others may return a yield by hand methods from short sections of bench or channel.

Rock Creek.—This creek and its tributaries is known to have left old high channels (worked by the early miners), some best worked by hydraulic methods and others by drifting. Jolly and McKinney Creeks are the most important. Easily accessible.

Main Kettle River.—This section of the Kettle River about 15 miles long commencing at Keefer Lake, the headwaters, cuts through an area of argillaceous rocks containing free gold in quartz. The tributaries of the river from the west warrant prospecting. Easily accessible.

Similkameen Mining Division.

Opportunities for placer-mining of gold, platinum, and iridium still remain along the benches, old channels, and bottom of the Similkameen and Tulameen Rivers and their tributaries, such as Granite Creek and its tributaries. Also some possible dredging areas occur below Princeton. Capital is required for exploration and operation. On Siwash Creek there are some placer deposits, but the area requires further prospecting. Mostly mined, but easily accessible.

Vernon Mining Division.

On streams east of Vernon, such as Cherry Creek and its tributaries, there are chances for gold-recovery from stream-beds as well as benches and buried channels. Gold-bearing gravels occur on Siwash Creek, which flows into the north-west end of Okanagan Lake, and Mission Creek, near Kelowna.

The finding of a gold-bearing channel 25 feet above the bed of Harris Creek, east of Vernon, and another, capped by lava, 1,600 feet above the east side of Woods Lake, indicate the possible range of occurrence of placer gold in this general district. The drainage pattern of this district has undergone many changes and other buried channels may be found by the careful and intelligent observer. Easily accessible.

Kamloops Mining Division.

Gold occurs in bed-rock gravels under glacial moraines at Heffley Creek. Other interesting creeks include Hobson, Tenquille, Eakin (3-Mile), and Louis. The latter were mined by the early prospectors.

In this Division there are larger areas of metamorphic rocks, some sections of which, as at Scotch Creek, contain gold-bearing quartz veins and stringers, and such localities are worthy of intensive prospecting, even the old dry creek-beds. The bars of the Thompson River at low water are also worthy of consideration.

SOUTH-EASTERN DISTRICT.

At various times production of placer gold in this district has reached considerable magnitude. The original prospecting of much of the country was done by placer-miners. Placer operations of some size have been carried on in the Revelstoke and Fort Steele Mining Divisions, and these two Mining Divisions have had the largest productions.

West Kootenay District.

In the Revelstoke Mining Division, Goldstream, entering the Columbia River from the east, some 60 miles north of Revelstoke, with its tributaries, French and McCulloch Creeks, have a record of substantial production at intervals since 1865. These with Camp Creek have been the scenes of the more important activity in recent years, though a number of other streams entering the Columbia River from the east also are known to have produced values. Commonly, large boulders give some difficulty in mining. There is a little production during the low-water period from bars in the Columbia River.

The Lardeau Mining Division has a small record for production from the Lardeau River, work there having been reported as early as 1890.

Along the Pend d'Oreille River in the Nelson Mining Division, " sniping " above low-water level annually yields moderate returns. Its tributary, the Salmo River, is also productive near the mouth, and some bench leases there have yielded encouraging results of late. Forty-nine Creek, south-west of Nelson; Lemon Creek and Barnes Creek, in the Slocan Mining Division; the Duncan River and benches along Lower Kaslo Creek, in the Ainsworth Mining Division, have been yielding small returns. In Lemon Creek there are many large boulders. Quite coarse gold was reported from the Duncan River in 1935.

East Kootenay District.

In the Fort Steele Mining Division, Wild Horse Creek, which enters the Kootenay River from the east of Fort Steele, was the scene of early placer-development and large-scale operations have been carried out along the creek. Recently small hand operations on Boulder Creek, tributary to Wild Horse Creek, have yielded fair returns. Bull River is being worked by " sniping " and is reported to be yielding moderate returns. On Palmer Bar Creek, about 3 miles north-west of Lumberton, the Consolidated Mining and Smelting Company operated a power-shovel early in the season; later the operation was carried on by " shovelling-in." The pay-gravel is 3 to 5 feet thick and consists of the surface gravel, overlying a considerable thickness of unprofitable gravel. The gold is moderately coarse in flattened grains or nuggets. A great many larger glacial boulders of granite are encountered. Granite is mapped on the Cranbrook Geological Sheet, about 3 miles to the north. On the Moyie River a tunnel, driven to an old channel west of the falls by Messrs. Ewen and Oscarson, has resulted in a profitable operation. Some current production is reported from Perry Creek. The Moyie River and Weaver Creek, Palmer Bar Creek, Fish Creek and Valley Creek to Perry Creek and Perry Creek from above the falls to Old Town, are indicated as favourable areas for prospecting. A Tertiary conglomerate outcropping along the St. Mary River, in the vicinity of Wycliffe, is worthy of investigation. The conglomerate is loosely consolidated, contains a considerable amount of iron-oxide cement, and also wood largely converted to lignite. Plant remains are found in the weakly consolidated sands and clays overlying the conglomerate.

In most of the streams entering the Rocky Mountain Trench from the west, as far north as Beavermouth, some placer gold has been found. Canyon Creek, south of Golden, Quartz Creek, which enters the Columbia River near Beavermouth, and Porcupine Creek, a tributary of Quartz Creek, have been the scenes of most recent activity in this area.

SOUTH-WESTERN DISTRICT.

Vancouver Island.

South-west and West Coast.

On the south-west coast of Vancouver Island gold-bearing gravels have been worked in the San Juan, Sombrio, Loss, Jordan, and Leech Rivers. These streams all cut across slates of the Leech River formation and disintegrate the numerous quartz veinlets occurring in these rocks.

The valley of the San Juan River contains a large amount of gravel, but it is of glacial origin and, with the exception of very local concentration, is probably low grade. Gravel-beds which are 300 feet thick at the beach and 400 feet wide extend up the Sombrio River for 2 miles from its mouth. Panning in the gullies entrenched in the gravel-beds indicates that low gold values occur in the top gravels; much of the ground is reported to be well situated for hydraulicking.

Deposits along the Jordan and Leech Rivers have been worked intermittently since 1864. In 1931, 1933, and 1937 some hydraulicking was done on Leech River; the 1933 and more recent work disclosing what is believed to be an old channel 50 feet between rims and 7 feet deep, containing partly cemented gravel and some coarse gold.

Colours have been panned in the bed of Goldstream River, but very little work has been done. Comparatively unprospected gravels are those in the low upper stretches of Loss River, Wye and Bear Creeks, tributary to the Jordan River, and part of Jordan River itself.

China Creek.—The first recorded placer-work on China Creek was that of 1862 and over a period of years about $40,000 worth of gold was obtained. However, in recent years there has been very little production. About 1895, hydraulic leases extended for approximately 14 miles up the creek from its mouth; i.e., nearly its full length. China Creek is a large stream, possessing an approximate average gradient of 5 per cent. The valley is V-shaped, but fairly open and contains an abundance of coarse gravel, the constituent small boulders and pebbles of which are quite angular and poorly sorted.

Bedwell River.—This stream was worked for placer as early as 1862, and in 1893 it is reported that as many as thirty Chinese were working creek claims. There is no activity there at present.

Zeballos River.—Placer gold has been known for some years along the Zeballos River, and recently small operations have been attempted in the beds of the main Zeballos River, the North Fork and Spud Valley Creek, a tributary of the main river. The presence of large boulders and the difficulty of handling them, except by machinery, is one of the major problems affecting operation. Part of the drainage area of the Zeballos River is underlain by igneous rocks containing gold-bearing quartz veins, and because of this the gravels in the various streams are potential sources of placer gold.

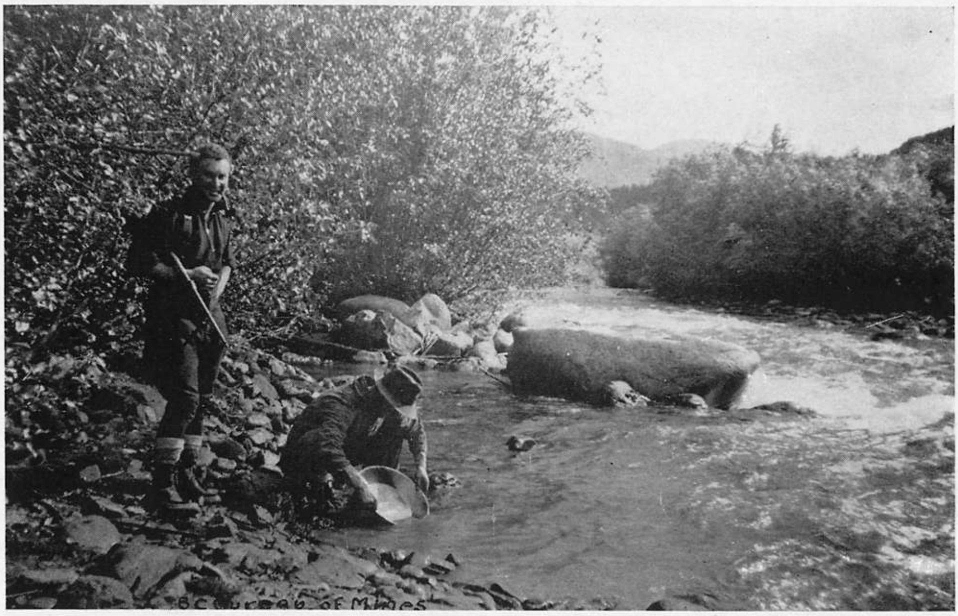
East Coast.

Nanaimo River.—About 8 miles north-west up the river from Nanaimo, some fine gold accompanied by occasional $4 nuggets has been found in the stream-bed. The creeks flowing into the river from the south have been panned and have shown fine colours, indicating that prospecting for concentrations of placer gold is warranted.

Black Sands.

Black sands, carrying widely varying amounts of fine gold, occur around the mouth of the Sombrio River on the south-west coast, along a 3-mile stretch of beach at Wreck Bay on the west coast and around the mouth of the Nahwitti River on the north coast. The beach sands at Wreck Bay have been the most productive and have yielded considerable gold in the past. A man named Muirson, working alone between 1930 and 1935, is reported to have obtained, by dint of intelligence and much hard work, considerable gold from black-sand concentrations on the beach after each storm.

Although various attempts have been made at working the sands around the mouth of the Sombrio and Nahwitti Rivers, the results have not been encouraging. Only experienced miners should attempt the working of beach deposits.



McDame Creek, near Centreville—Panning for Gold.

Spruce Creek, Atlin—Method of washing Gravel with Rocker.

Fraser River—A Long-tom in Use for Sluicing Gravel.

Spruce Creek, Atlin—Shovelling in to Sluice.

Lillooet Mining Division.

Small amounts of gold have been produced from the Lower Bridge River, Cadwallader Creek, Cayoosh Creek, and the Fraser River. Most of the production was from the Fraser River.

Clinton Mining Division.

A discovery of gold was made in 1933 about 56 miles due west of Clinton at an elevation of about 6,000 feet, near the headwaters of Churn Creek, which flows from Poison Mountain into the Fraser River a few miles south of the Gang Ranch. A trail leads to the locality from near Big Bar, where horses are available. The seasons are short, due to snow. The gold is rough-edged and coarse and is found in the creek-gravels, which vary from 5 to 30 feet in depth. Large glacial boulders occur in the creek-bed. Plenty of water is available. Prospecting down the creek should be favourable. The area is unlikely to be open until about the end of May. Advice is obtainable at Clinton.

Other chances for gold-recovery occur along the benches and on the bars of the Fraser River. These can best be worked in the late autumn or early spring, when the water is low. Gold-quartz veins occur in the Whitewater River section and the creeks may contain placer gold.

Ashcroft Mining Division.

Attractive results from prospecting the bars and lower benches on the Thompson and Fraser Rivers are reported; also from minor mechanical operations in favourable locations below Lytton. Development-work done on Kanaka Bar suggests the possibility of an old cut-off Fraser River Channel.

New Westminster Mining Division.

To the individual, the old Cariboo Highway, where left intact, often offers attractive ground for prospecting because the road-bed was left undisturbed when mining was at its height, and was forgotten later.

The attention of those interested may be called to the Coquihalla River, its tributaries and low benches. There are numerous gold-bearing quartz veins that are intersected at right angles by the streams, and placer deposits are known to exist. Peers River and Ladner Creek are also attractive for the same reason.

Some coarse gold has been found on Siwash Creek and Log Creek, which latter flows into the Nahatlatch River. These are tributaries of the Fraser River north of Hope.

PLACER-MINING METHODS.

Panning.—Panning is the most simple and also the most laborious method of recovering placer gold. The gold-pan is a circular sheet-iron dish with flaring sides varying from about 10 to 18 inches in diameter at the top and about 2½ to 3 inches in depth. The pan commonly used is 16 inches in diameter at the top, 2½ inches deep, and has an angle to the rim of about 50 degrees from the vertical. The Australian type has a rounded lip and the American a straight lip, as shown in the section. The inner surface of the pan must be kept free from grease, and a new pan, before use, should be heated to remove its oily protective covering. Do not polish a pan or it will become too slippery.

Some pans are made of copper, or have a copper bottom, so that a coating of mercury (quicksilver) may be applied to catch fine gold.

The usual practice is to fill the gold-pan about level with the top; then submerge it in still water and knead the material with the hands until it is thoroughly loosened and saturated. Rocks and larger pebbles are washed clean at this stage and picked out. The pan is next shaken in a horizontal position, to permit the gold to settle to the bottom; then raised with a tilting motion away from the panner to the surface of the water, to allow the lighter material to be washed over the lip. The motion of slightly lowering the pan horizontally and then raising it with the forward tilt is repeated until all the lighter materials are washed

2

away. The pan should be shaken at intervals, either submerged or raised above the surface of the water to allow all the gold to work its way to the bottom. The actual motion of the pan may be varied considerably, according to the preference of the operator and the character of the material handled. Some operators adopt a jerky circular tilting motion, whereas others prefer the foregoing method.

When the lighter material has been largely removed and the gold and heavier minerals remain in the pan, it is advisable to complete the operation in a tub of water, so that any gold lost in the final stages of the operation may be ultimately recovered by panning the material accumulated in the tub. The process of panning gravel is necessarily a slow one and care must be taken or gold will slip over the edge of the pan and be lost.

When the water is very cold two pans can be used, one punched with ¼-inch holes fitted into and on top of another pan. After filling the top pan with gravel and thoroughly wetting and shaking the finer gravel into the lower one, all the coarse material in the top pan can be put on one side and only the residue in the bottom pan worked for gold. This saves much time. Another plan is to punch two small holes on each side through the lip of the pan and thread two wire handles through them. In this way the operator's hands can be kept out of the water to some extent.

The final residue left in the pan is dried and the magnetite, if any, removed with a magnet. The larger gold particles are now picked out or separated from the remaining sand by means of a needle. Very fine material may be removed by adding a little mercury or by carefully blowing away the sands with the aid of a straw. The latter procedure should take place on a smooth surface, and great care must be exercised or the fine gold will be lost.

The weight of sand and gravel varies considerably, according to the size of the particles and also the moisture content. About 3,000 lb. per cubic yard is a fair average, and if 20 lb. of material is used to a pan (enough to fill a 16-inch pan about level), it follows that 150 pans of dirt are equivalent to 1 cubic yard of material in place. Experienced miners can pan about 10 pans per hour, or, allowing for time lost in various ways, about 75 pans per day, or ½ cubic yard average material. It is quite obvious that, if a man hopes to make average wages, he must work dirt worth $8 per cubic yard, which is now considered very rich ground in British Columbia.

Panning is now largely resorted to as a means of roughly testing placer-ground, rather than as a means for the recovery of gold as a mining method.

Rocking.—The " rocker " or " cradle " (*see* page 20) is a simple oblong box made of wood that can be operated by one or two men, with the result that between five and six times more gravel can be washed with less effort than by panning. One man can rock up to 3 cubic yards of dirt per day, depending on its character, the distance it has to be moved, and the availability of water.

The rocker is easily constructed with a hammer, saw, nails, a piece of galvanized iron or metal screen, some blanket or sacking, and a few pieces of 1- by 12-inch lumber. It can be made any size, within reason, to suit the occasion. The smaller type, shown on the plan, is good for recovering coarse gold, and the larger variety, built on the same principle, is more efficient for saving fine gold on account of the greater length of the sluice. The smaller type has the advantage of being easily moved from place to place when prospecting, and when the tray and apron are removed it makes a good pack-board. A convenient type for the larger rockers is a " knock-down " or one that is held together with bolts and nuts. Care must be used when constructing the latter so that the joints are tight, otherwise much fine gold will be lost. A piece of canvas, galvanized iron, or tin spread over the bottom and partly up the side of the sluice will prevent the loss of fine gold to some extent. When moving, the bolts are withdrawn and the sides and bottom laid flat together, which makes a more convenient pack.

It is necessary to set up a rocker either close to the banks of a stream or where clean water can be bailed or piped into the tray. The water should be poured on the gravel shovelled into the tray in as steady a stream as possible, and not in a sudden rush, which tends to wash the fine gold out of the sluice. If there is a high percentage of clay mixed with the gravel, a stratum of mud will often form on the blanket covering the apron and gold will not easily settle. Puddling the gravel in a separate box before rocking sometimes assists in eliminating this trouble, but more often than not the gold is mixed with the clay and the residue in the bottom of the puddling-box will have to be panned separately.

The operation of a rocker can be made more efficient when two men are working, one shovelling in and dumping the tray when the gravel is washed, and the other rocking and bailing water. When the tray is filled, pour water over the gravel and at the same time rock the box from side to side. The movement of the rocker must not be violent, as too much motion will tend to wash the gold as well as the sands over the riffles. When the gravel is clean, search the bottom of the tray for any nuggets that may be too big to pass through the punched holes, remove and throw the remainder away. The finer gold will pass through the holes and be caught either in the apron or sluice-riffles. Pan the tailings occasionally to see that gold is not being lost. If the ground is rich the apron and the sluice-riffles must be cleaned up often. This can be ascertained by watching the sand behind the riffles and on the blanket, and if much gold is in evidence, run clean water through and at the same time rock the box gently to clear off the loose sands. Take out the apron and wash the residue into a pan or bucket full of water. Remove the riffles from the sluice and wash the residue into a pan placed across the mouth of the box. If canvas is used, take up and wash into a pan.

Fig. (1) on the plan portrays the side view of a rocker showing the 2- by 4-inch side-braces, one of which is extended and tapered for a handle, nailed to the side-boards of the box. Each side of the box and sluice can be cut out of one piece of 1- by 12-inch lumber, 42 inches long, or longer if suitable. The bottom of the box, Fig. (2), can be made of one piece of board 16 inches wide and 42 inches long. If not procurable, two pieces planed so that they fit tightly together can be used. It is safer to cover the bottom of the sluice with canvas, galvanized iron, or tin, to prevent leakage, and, in the latter case, assist the flow of sand and gravel. The tray, which is built of 1- by 6-inch lumber, 17 inches long, with screening or a punched galvanized plate nailed to the bottom or held in place with a 1- by ½-inch wooden strap, is set upon two 2- by 2-inch supports nailed to the side of the box at an angle sufficiently great so that when the entire rocker is set at the proper gradient it will tilt slightly forward. Make the outside measurements of the tray small enough so that it can be removed easily. Two pieces of wood nailed on the ends of the tray will be useful for handles. Be sure that the boards used for the rocker are free from knot-holes, otherwise much gold will be lost.

At the bottom of Figs. (1) and (2), two rockers, made of 2- by 6-inch or 2- by 4-inch lumber, the width of the sluice, and bevelled from the centre outwards, are nailed to the box sufficiently far apart so that it will rock to and fro easily. Underneath, two rocking-plates or flat stones are laid to keep the rocker in place. In some rockers a steel pin or large spike is inserted in the centre which fits into a loose socket bored in the plate. In this way the box is kept from slipping down-grade.

In Fig. (2) the front view of the rocker-frame is not drawn to scale, but to show the construction of the different supports, etc., clearly. For instance, the bottom of the tray is, in reality, hidden by the 1- by 4-inch brace.

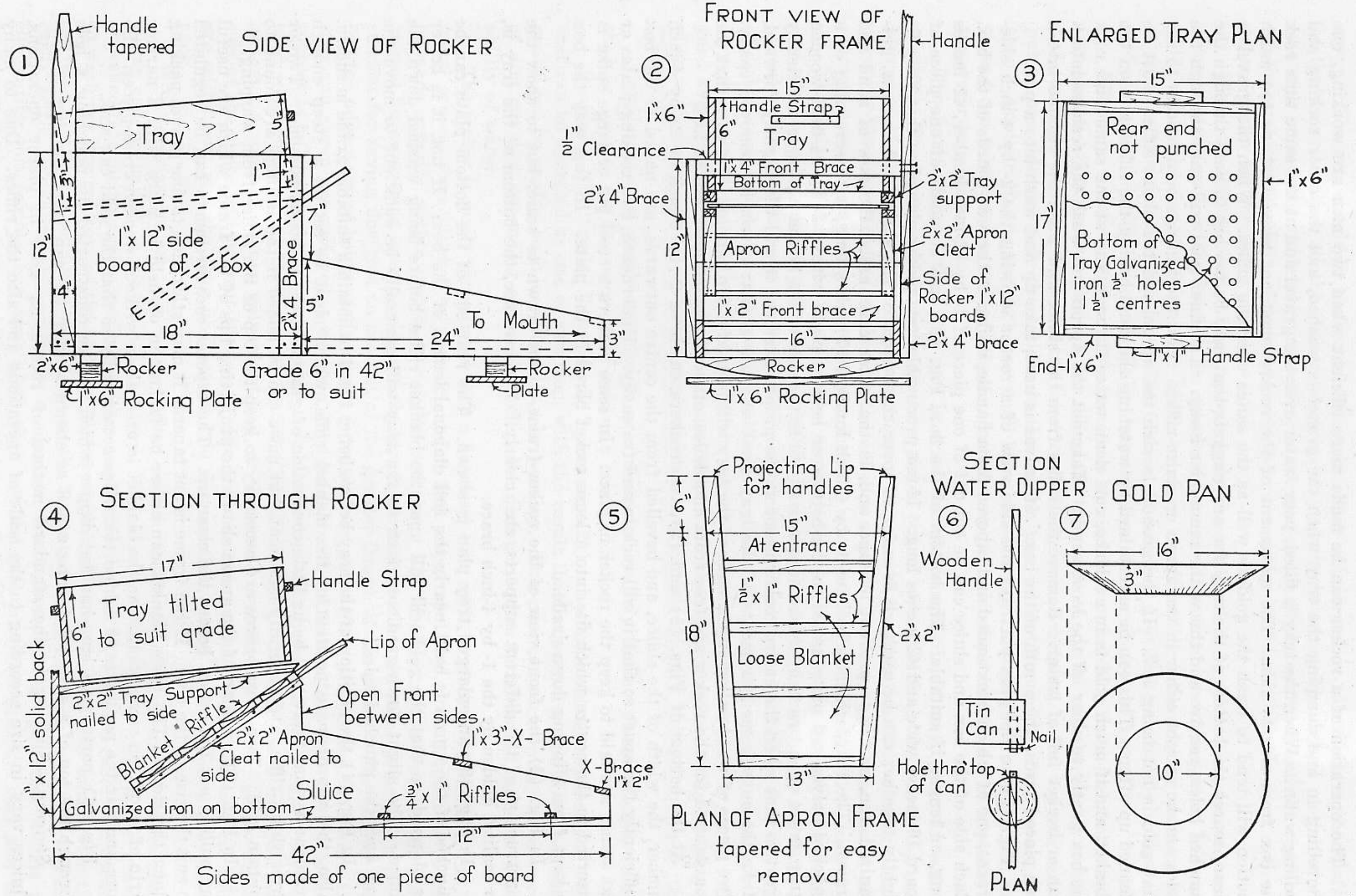
In Fig. (3) an enlarged tray plan is shown. The rear end of the bottom plate can be punched if the apron is built nearly the full diagonal length of the box. If not, it is better as planned, so that the gold will fall upon the blanket riffles before being washed down the sluice. The slight down-gradient given to the tray will generally be sufficient to move the gold over the punched holes.

In Fig. (4) the position of the tray before being tilted to obtain a suitable grade is shown. Also, the approximate position of the blanket riffle, which must be set on a steep enough gradient so that there will be as little congestion of gravel on the riffles as possible. Two or three sluice-riffles are generally sufficient, but more can be added if the tailings are found to contain gold. Two cross-braces are necessary to keep the top of the sluice from warping.

In Fig. (5) the plan of the apron shows the projecting lips of the frame which are useful for pulling out the apron before the clean-up. The tapered measurements can be regulated to suit the size of the box. If the frame is not tapered it may stick, due to fine gravel packing along the sides. The loose blanket can either be tacked on or held in place with a narrow strip of wood; in some operations the blanket is used alone without wooden cross-pieces. Be sure and stir the packed sand behind the riffles occasionally so that the gold can sink.

Fig. (6) portrays a long-handled dipper which can be constructed by punching a hole through the top of a can and driving a nail as shown to keep the can from slipping.

Sluicing.—Sluicing is the standard method of recovering gold in placer operations. Sluices vary in size according to the scale of operations and also the riffles. Due to many



Plan and Sections of Rocker, Dipper, and Gold-pan.

varieties of riffles, most of which are successful in catching the gold, it is not deemed necessary to portray them all on the accompanying sketch. Those described are of a simple variety and more easily constructed in out-of-the-way places. Although the plan shows milled lumber used, practically the entire set up can be made with peeled poles, split poles, whip-sawn lumber, sacking, and nails. Even the latter can be dispensed with and wooden pegs used in holes bored with a hot iron.

Small sluice-boxes (Fig. 1; *see* page 22) are three-sided and generally made of 1- by 12-inch lumber 12 feet long and the smoothest side placed on the inside of the box. The depth of the box is not so important as the width. When choosing lumber see that it is free from cracks and knots and planed on the edge used next to the bottom. If a close fit is not obtained between the side and the bottom board much gold will escape. Caulk any leaks with moss or sacking. A peeled pole split in four pieces to resemble a ¼-inch round, if nailed on the inside joint of the boards, not only helps to make the box tight, but accelerates the movement of the gravel when sluicing. To prevent spreading of the sides of the box a 2- by 4-inch cap and side-brace can be used where necessary (Fig. 7). In any case a cap is advisable and useful for lifting the sluice-box. If more than one box is used they can be butt-jointed and held together by braces portrayed in (Fig. 7), or the upper box-end can be tapered by cutting the sides of the bottom board so that it will telescope into the top end of the one following. The butt-joint is more satisfactory for a permanent operation and the telescope for working small deposits where the boxes have to be constantly moved. Packing the joints must be carefully done with sacking or moss and when the operation is finished the sacking, etc., burnt and panned for gold.

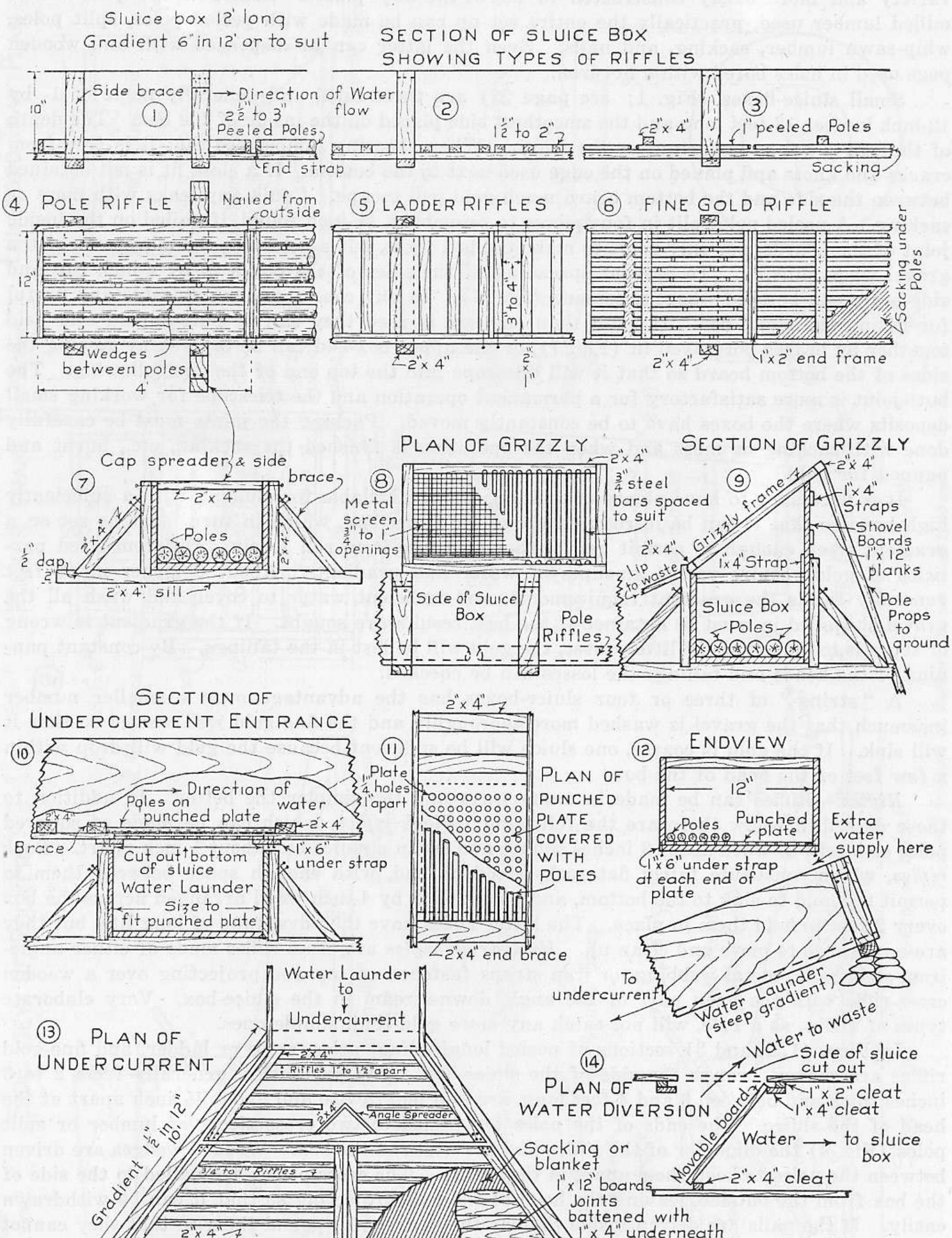
It is necessary to have plenty of running water available for sluicing with a sufficiently high head so that it can be introduced above the sluice-box, which in turn must be set on a gradient steep enough to permit gravel shovelled into it to roll freely. Different-sized particles of gold require varied amounts of water and gradients. About 6 inches in 12 feet generally fulfils the gradient requirements, and sufficient water to cover and wash all the gravel shovelled in must be obtained if the best results are sought. If the gradient is wrong or there is too much or too little water, the gold will be lost in the tailings. By constant panning of the heads and tailings the losses can be checked.

A "string" of three or four sluice-boxes has the advantage over a smaller number inasmuch that the gravel is washed more thoroughly and the fine gold well wetted so that it will sink. If the gold is coarse, one sluice will be sufficient because the gold will drop within a few feet of the head of the box.

Riffles.—Riffles can be made in many ways and the simpler the better. In addition to those described below there are the following: *Block riffles,* which can be made of squared poles or blocks of wood about 3 inches square and set in a sluice-box about 1 inch apart. *Rock riffles,* which constitute fairly flat rocks stood on end, with enough space between them to permit the gold to sink to the bottom, and pieces of 2- by 4-inch wood arranged across the box every 2 feet to hold them in place. The latter riffles have the advantage of long life, but they are a nuisance to move and clean up. *Hungarian riffles* are cross-riffles made of either angle-iron, steel rails, metal webbing, or iron straps fastened on top and projecting over a wooden cross-riffle with the open part of the angle down-stream in the sluice-box. Very elaborate types of riffles, as a rule, will not catch any more gold than simple ones.

In Figs. (1, 2, and 3) sections of peeled longitudinal poles, cross or ladder, and fine-gold riffles are shown through the side of the sluice-box. The pole riffles, generally from 2 to 3 inches thick and between 3 and 4 feet long, are laid lengthwise and about ½ inch apart at the head of the sluice. The ends of the poles are nailed to two cross-pieces of lumber or split poles (Fig. 4) the diameter of the riffles and the width of the box. Wooden wedges are driven between the poles to keep them apart in the centre. The cross-pieces are nailed to the side of the box from the outside, leaving the head of the nail projecting so that it can be withdrawn easily. If the nails are driven inside the box the gravel will pound them so that they cannot be pulled out when it is necessary to remove the riffles prior to cleaning-up.

The cross or ladder riffle (Fig. 5) is generally placed next to the poles. The cross-pieces may be made of squared poles, 1 by 2 inches, or of lumber and placed about 4 inches apart, and the ends fastened to two longitudinal 1- by 2-inch straps 4 feet long built similarly to a ladder so that the section of riffle can be easily removed. As this type of riffle wears down easily, duplicates should be held in readiness for replacement.



Types of Riffles, Grizzlies, Undercurrent, and Water Diversion.

Next in order (Figs. 3 and 6) follows a fine-gold riffle to be placed at the end of the sluice-box. First a blanket or doubled sack is laid on the bottom of the box. On top of this a small peeled-pole-framed riffle with wedges between is placed to protect the sacking from pounding by the gravel and from disturbing any gold that has settled in the bottom. The 2- by 4-inch cross-riffles on top of the poles and generally placed about 3 feet apart cause the necessary swirl in the water to thoroughly wet the fine gold. This type of riffle is more successful when (1) all the gravel larger than a marble has been screened out of the sluice-box, (2) when about 100 feet or more of boxes is used, and (3) when given a gradient of about 2 feet in 12 feet with plenty of water.

Grizzly.—A grizzly (*see* Figs. 8 and 9) is a set of parallel steel bars or rails, or even poles when the former are not available or metal screen, set in a 2- by 4-inch rack and spaced according to the size of gravel which is to be kept out of the sluice-box. The grizzly is set over the head of the sluice at an angle sufficiently steep so that the waste material will roll off easily. The upper side is held in place at the required height by two pole props nailed to the frame of the grizzly and stuck in the ground. If a wheelbarrow is used, a wooden hopper can be built over the grizzly and the water-line raised to the height of the top of the hopper so that the boulders will be washed before dumping. If the boulders are covered with mud, and the latter contains gold, which is often the case, it is advisable to hand-wash or puddle the larger ones and put the remainder through the sluice-box. If this is done an undercurrent should be used.

Undercurrent.—(Figs. 10, 11, 12, and 13.) There are many types of undercurrent sluice-boxes which are successful. The idea of a box of this type is to save fine gold that otherwise would be washed away in the ordinary sluice by the disturbance caused by coarse rolling gravel. There are three important rules for the beginner to remember: (1.) That fine gold must be wet before it will sink. (2.) That when it has sunk it must be undisturbed; consequently coarse gravel must be kept out of the box in which the fine gold has fallen to the bottom. (3.) That riffles must be big enough so that a swirl is established, causing a break in the surface of the water in the sluice-box. Fine gold floats.

In Fig. (10) a section through the side of the sluice-box is shown portraying details of the position of the intake for an undercurrent. First of all, the bottom of the sluice-box is cut out the required length and width of the screen or plate punched with ¼-inch holes 1 inch apart. Underneath the box and projecting far enough into the hole cut so that the plate will rest safely upon them are nailed two 1- by 6-inch pieces of lumber, the width of the sluice-box. After placing the plate in position a riffle made of framed small peeled poles, spread about ¼ inch apart with wedges, is placed lengthwise over the plate and nailed in place from the outside of the sluice-box. Congestion often occurs in any type of undercurrent entrance, especially if the gravel contains much "black sand," so that care must be taken to keep the punched plate clear. The 2- by 4-inch riffle shown on the upper side of the plate opening can be set at the proper distance according to the volume of water used, to give the final swirl.

In Fig. (12) the undercurrent water-launder is shown in section. An extra amount of water is often necessary to drive the "black sand" on to the undercurrent. The gradient of this launder can be adjusted with rocks as shown.

In Fig. (13) one of many types of undercurrents is portrayed. The idea, generally, is to spread the product received from the intake over as large an area as possible to give it a chance to subside more readily than it would in an ordinary sluice-box. The angle-spreader, made of two pieces of 2- by 4-inch, set on edge near the top of the undercurrent, assists in accomplishing this as well as keeping the product away from the junction of the two separate frames below.

In the plan, Fig. (13), the bottom of the undercurrent is made of 1- by 12-inch boards, planed, if possible, and fitted closely together. Underneath 1- by 4-inch strips are nailed to the joints to prevent as much leakage as possible. On top of the boards a blanket or sacking is laid, and on top of this are set ¾- to 1-inch riffles about 1½ inches apart. Be sure that the hairs of the blanket or sacking do not project over the riffle. Instead of wooden riffles, metal webbing, if procurable, can be used to advantage. The dimensions given are arbitrary and any convenient size can be used. Plenty of water is necessary and a gradient of at least 1½ in 12 inches. All the riffles must be constructed as separate trays and easily removable.

Fig. (14) portrays one plan of water-diversion when it is necessary to clean up the sluices. The side of the sluice-box is cut out so that the piece removed will fit across the box and divert the flow of water through the opening.

If water is scarce and insufficient impetus created to roll the gravel quickly down the sluice-box, leave a space of a few feet between the riffles and cover it, if possible, with a metal plate or flattened tin can. This will accelerate the flow of water.

Clean-up.—The riffles, especially the one at the head of the sluice-box, should be cleaned up every few days if the ground is rich. This can be ascertained by cutting off the water and scratching away the accumulation of sand between the riffles. When the clean-up is to be made, stop shovelling-in and run clear water through the boxes until all the material, except that which is held by the riffles, is removed; then cut off the water by means of the control-board shown in Fig. (14).

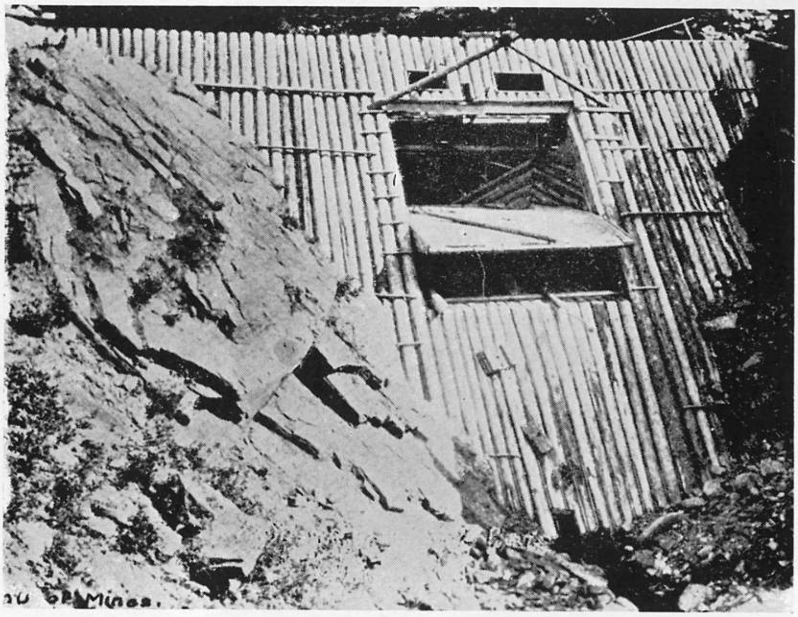
Commence removing the riffles and washing them off in a tub or bucket of water. Next scrape the sands from the bottom of the box and put in a tub. A hand-made wooden shovel about 4 inches wide makes a good scraper; the coarser gold can be taken out by panning or rocking, or, if only a small amount, the concentrate can be dried in a pan over a fire and the gold removed with a pin or knife. If the gold is very fine, mercury can be used at the ratio of about five parts of mercury to one of gold, depending upon whether there is much foreign material present. If the gold is coated with fish-oil or other foreign substances, so that it will not amalgamate, clean with soda before applying the mercury. When the mercury is dirty, clean with lye or cyanide solution. If the operation is a comparatively large one and the sluice-box concentrates are handled with difficulty by the methods suggested above, an *amalgam-barrel* can be used. This type of barrel is made of metal the shape of a butter-churn and the concentrates and mercury are placed inside and churned until amalgamation takes place. Small copper plates dressed with mercury can also be used to catch the fine gold in conjunction with an undercurrent.

As mercury costs between 75 cents and $1 a pound in 76-lb. flasks, and more when bought by the pound, and as it is very heavy and escapes easily, great care must be observed when using it to prevent loss. The proper method for separating the gold from the mercury after amalgamation is by means of a metal retort. This can be procured from any chemical supply company. A gentle heat will volatilize the mercury, and it passes up through the sealed cap of the retort and down the tube into a bucket of water. Care must be used to prevent the escape of the mercury through the junction of the cap and the retort, otherwise the user may be salivated. The early miners used a large halved, partly hollowed potato bound tightly with wire in which the amalgam was placed. The potato was put standing upright in the ashes of a fire or oven. The mercury was absorbed by the baked inside of the potato and the gold separated in this way. By rubbing and washing the residue in a pan some of the mercury was recovered. The remains of the potato are poisonous.

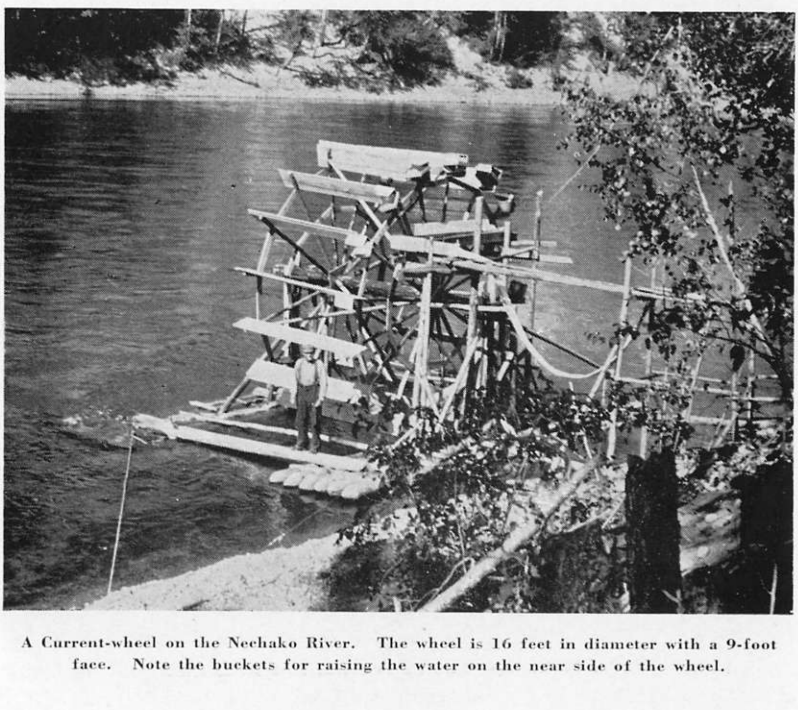
Long-tom.—The long-tom is seldom used, as a simple sluice is easier to construct and is just as efficient. A plentiful supply of water is necessary. Therefore the long-tom has little or no advantage over a sluice-box.

The long-tom consists of three boxes, the first or longer being about 6 to 12 feet long, 12 inches wide, and 6 to 8 inches deep. It is set on a grade of about 1 inch per foot and rests on the closed upper end of the second or washing-box, which is 6 to 12 feet long, 20 inches wide at the upper end, and 30 inches wide at the lower end. The lower end of the second or washing-box is made from a perforated metal screen set at an angle of about 45 degrees outward from the bottom of the box. The washing-box rests on the closed upper end of the sluice-box, which is about 12 feet long and 36 inches wide. Cross-riffles are placed in the bottom of the sluice-box.

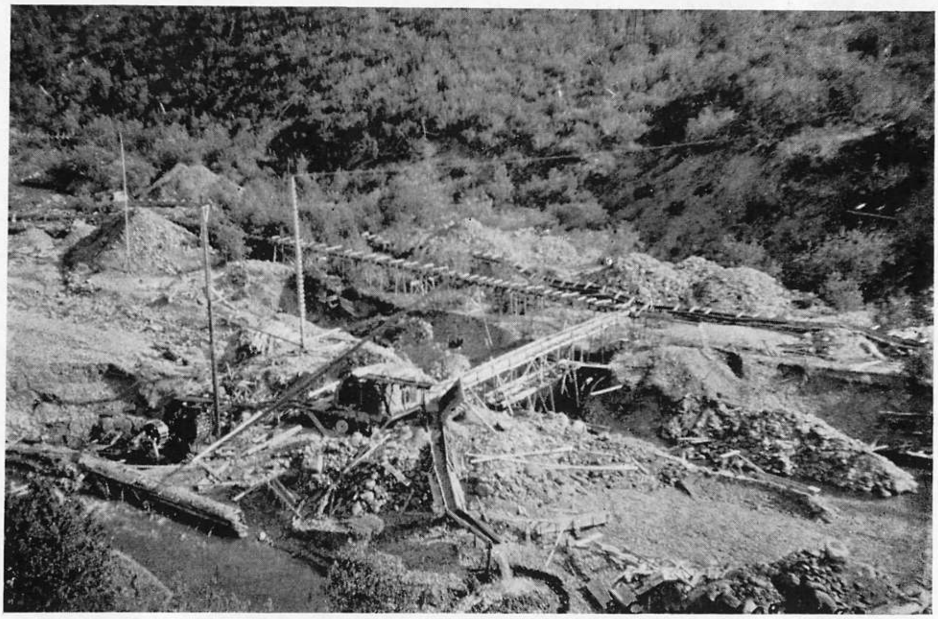
The water enters the receiving launder or first box, into which the dirt is shovelled. The drop into the second box helps to break up the clayey and sticky material. The finer material passes through the screen at the lower end of the washing-box into the sluice-box, and the larger material is allowed to remain in the washing-box until it is thoroughly cleaned, when it is forked out. Two men can handle about 6 yards of average gravel per day. One disadvantage of the long-tom is that the water must be elevated to convey it to the first launder. This is ordinarily done by bringing the water in a flume from a point higher on the creek, and where the grade of the creek is low it follows that a considerable length of flume may be necessary.



Weaver Creek—A Boomer-gate for Placer-mining.



A Current-wheel on the Nechako River. The wheel is 16 feet in diameter with a 9-foot face. Note the buckets for raising the water on the near side of the wheel.



Spruce Creek, Atlin—Placer-workings.

Hydraulic Mining—Wild Horse Creek, Fort Steele M.D.

Booming.—Booming is a term used when a dam with an automatically operated gate is built across a creek or gully where an insufficiently large stream of water flows for sluicing or for stripping overburden. The accumulated water is released suddenly when the reservoir is full, with the result that the top soil or gravel in its path can be washed into sluice-boxes. The boomer permits the operator to obtain a heavy flow of water for a short period. It is used, as a rule, for ground-sluicing, and consequently larger sluice-boxes than are used for ordinary sluicing must be constructed if booming is to be successful.

The photograph facing this page portrays the front section of a boomer-gate and dam built of logs which will give the operator some idea of the type of construction. Earth with boards on the inside may be used instead of logs or poles, but care must be taken to reinforce the structure according to its size and consequent weight of water to be accumulated in the reservoir behind it. If the dam should break when nearly full of water there would be danger to those working below.

The dam should be built in such a position that the required volume of water will accumulate in a natural reservoir behind it. The foot of the dam should be firmly fixed either by timber cross-bracing or hitches cut in the bed-rock if it is smooth. Moss or other material may be used for tamping the cracks between the logs to avoid seepage. Some clay or earth should be thrown into the bottom of the reservoir against the dam to act as a cushion.

If a smaller volume of water is necessary during more frequent intervals, the size of the dam and gate may be built to suit this requirement.

The gate requires but little attention by the operator, and when the water in the reservoir reaches a certain height it is automatically spilled through the gate. When the reservoir is empty the gate shuts and the reservoir refills.

Several different types of gates and dams can be constructed to suit the site chosen or the requirements of the operator.

The gate can be made any size, but generally from 3 to 8 feet wide, of stout timber or double planks. The pivot or hinge is placed horizontally about one-third the height of the gate from the bottom so that it will swing outward from the top when it empties.

Counterbalancing weights and floats can be used attached by cables or ropes to assist the opening and shutting of the gate.

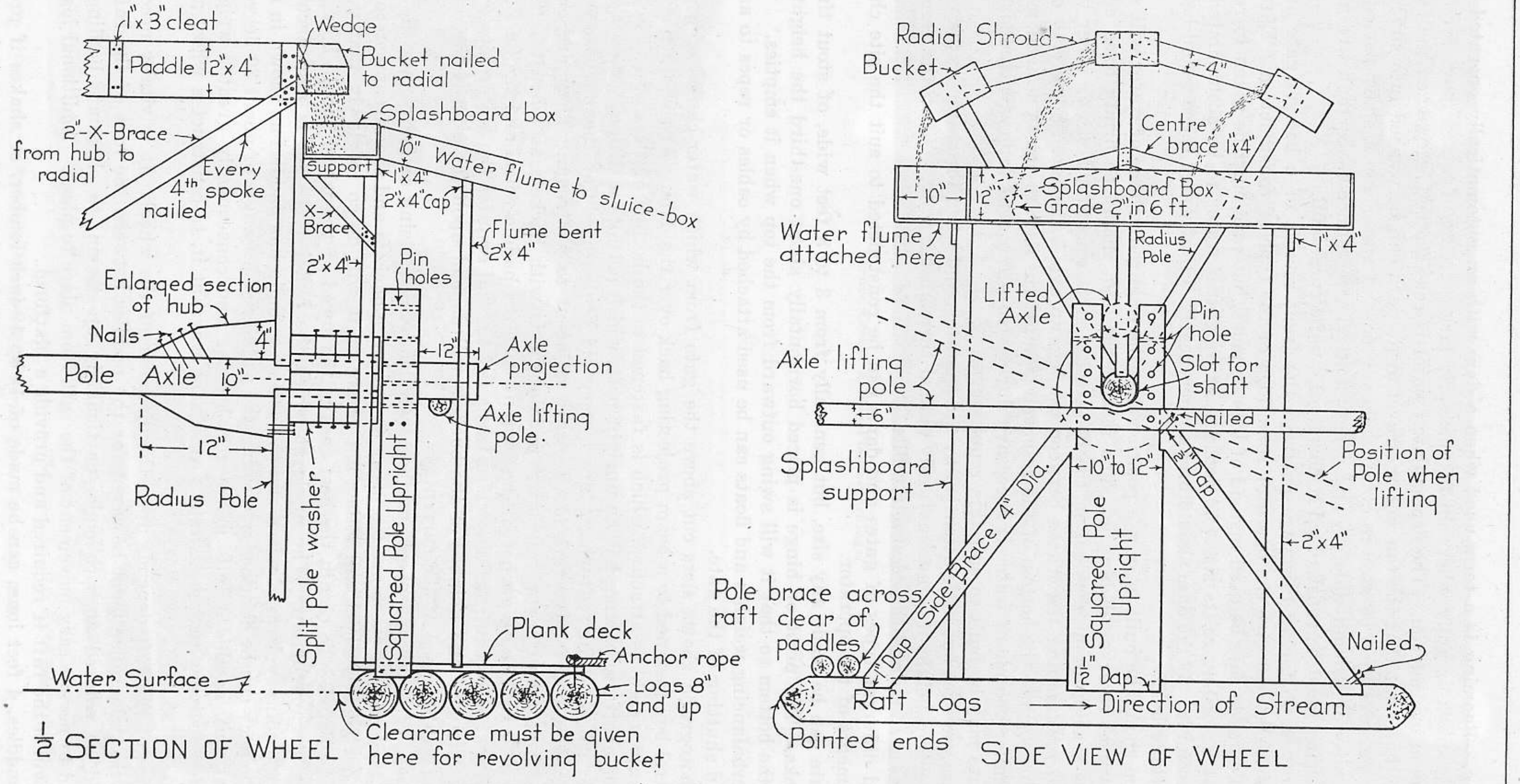
The photograph shows slots cut above the gate from which water-chutes empty into a drilled control-box fastened to a beam projecting back over the dam. At the other end of the beam a counterweight is attached, which is fastened to the bottom of the gate. The beam is pinioned and centrally balanced to an upright post, which permits a tilting motion.

Current-wheels.—Current-wheels are a very old device used for the purpose of lifting water, particularly for irrigating low benches adjacent to a stream. They are ordinarily mounted on a raft and are merely large paddle-wheels with buckets attached to one end of the wheel. The raft being anchored, the current runs the paddle-wheel and the buckets scoop up water from the stream; as the wheel turns it lifts and empties the water into a launder or trough. The size and number of the buckets will depend upon the size of the wheel and paddles and on the speed of the current.

The speed of a current-wheel may be controlled by decreasing or increasing the size and number of buckets. If there are too many or too large buckets and the stream-current is not sufficiently swift, the wheel will either not rotate or it will do so so slowly that very little water will be lifted. To obtain the best results the speed of the wheel should be about half that of the stream-current. The angle at which the paddles are set is also a controlling factor. The ordinary form of wheel and the easiest to build has paddles as shown in the plan. Greater efficiency can be obtained by setting the paddles at an angle of about 30 degrees from the vertical, but, as this entails more cross-bracing and consequently greater weight, it is advisable for ordinary purposes, unless conditions warrant it, to construct a wheel according to the plan.

The size of the raft depends upon the diameter of the wheel. It is vitally necessary to remember that clearance must be given for the paddles between the logs of the rafts. The logs should be pointed at both ends, particularly up-stream, to eliminate baffling by the stream and to permit easy movement of the raft from place to place. Additional logs can be placed to widen the raft if required and provide a platform.

The paddles, 4 feet long, can be made of 1- by 12-inch lumber, or shakes if procurable, or whip-sawn lumber. Cleats 1 by 3 inches can be nailed on the paddles to give them strength



Sections showing construction of Parts of Undercurrent-wheel.

and prevent warping. Nail the paddle on to the radius-pole on both sides. Paddles should be placed about 2 feet apart, or about 16 paddles on a 12-foot-diameter wheel. To provide the greatest efficiency, three paddles should be in the water at the same time and not more than half the width of the paddle under the water. About a 12-inch paddle-width is given in the sketch. Wider boards can be used.

If a sufficient number of coal-oil or gasoline cans are obtainable they can be used for buckets; if not, board buckets can be made. It is better to leave a quarter of the can-lid intact at the top to prevent too much spilling of water as the bucket rises from the water, or slots can be cut on the side of the can near the top. It is very important to remember that the open part of the bucket is fastened at an outward angle to the main wheel; this is necessary so that the water will be emptied away from the wheel into the splash-board box; a wooden wedge will serve the purpose.

The buckets begin to empty before they reach the highest part of the wheel and continue emptying on the downward side, so that the splash-board box, which is a wooden launder, must be made long enough to take care of this condition, but not long enough to interfere with the paddles. The mouth of the splash-board on the down-grade end opens into the water-flume leading to the sluice-boxes. Too much gradient is inadvisable because less water splashes out of the box when it is half-filled with water. The water-flumes are set up on pole trestles with a cap nailed to the bottom of the flume.

It is necessary, when moving the wheel from place to place, to lift the paddles clear of the stream. This is done by means of the axle-lifting pole (*see* plan). The wheel can be kept in a lifted position by means of a wooden or metal pin. Holes must be bored with an auger for this purpose. If two or more men are working the wheel, it may be unnecessary to construct a lifting-pole and by means of the projecting axle the wheel can be lifted and propped up with a board. It is inadvisable to lift one side more than a few inches at a time before raising the other side; this prevents racking. The axle-hub is made of split and bevelled poles (*see* plan and photo) and nailed both on to the axle and radius poles. This is very necessary to give sufficient strength to the radius-poles. Extra braces across the radial poles will also stiffen the structure.

An 8-inch washer made of split poles nailed to the axle, but free from the squared pole upright, keeps the wheel in position. Cross-pole braces must be used at every fourth radius-pole, nailed to the radius-pole at the top and the hub opposite from it. These poles keep the wheel in a rigid position.

The raft must be anchored to the bank of the stream at both ends by means of a rope. Be sure the wheel is set at right angles to the current.

If the wheel is not deep enough in the water, weight the raft with rocks, but be sure it is level. If the wheel has to be anchored some distance from the bank of the river, access can be had, providing no boat is available, by means of a platform on the bents beside the water-flume.

Be sure and grease the axle-socket.

Drift-mining.—It sometimes happens that rich ground, where the values are on bed-rock covered by heavy overburden, can only be mined by the individual operator, or small groups of miners, by drifting. If the deposit is buried in the bottom of a valley a shaft is sunk and drifts driven along bed-rock following the pay-streak. Water is the great problem to the small operator in this kind of mining, but in fairly dry ground he can operate successfully. If the deposit lies on a bench he can sometimes drift directly on it. The methods are similar to those used in driving through unconsolidated materials in lode-mining.

It frequently happens in starting an adit* that it is necessary to drive through unconsolidated material. A cut of sufficient size should be made so that the face will stand a few feet higher than the height of the working. If the ground stands up well the cut may be completed before timbering. If the ground runs, timbering will have to proceed with the excavation. In running ground a set should consist of two posts (uprights), cap, and sill (top and bottom cross-pieces). (*See* Fig. 15.) The posts sit on the sill and the cap rests on the posts. The cap and sill are notched so that the posts will not slip under pressure from the sides. Bridges or strips of plank are placed outside of and parallel to the posts,

* An adit is commonly called a tunnel, which is not correct, for a tunnel is open to the surface at both ends, whereas an adit is open to the surface at one end.

from which they are separated by wedges, leaving spaces between the posts and bridges through which lagging can be driven. Lagging is made of lumber, split timber, or small poles; the latter are not very satisfactory.

The lagging is placed outside of the posts on the first set and outside of the bridges on the second set. The lagging from the second to third sets, and so on, is driven through the spaces between the posts and bridges of the second set slightly outward so that it will come outside of the bridge on the next set. A similar procedure is followed for the lagging driven over the caps. The lagging is driven forward as the ground is excavated. When the lagging has been driven forward about half of a set-length a false set is placed to guide it. When the full set-length has been driven the set is put in place, the lagging driven forward over the bridges, and the false set removed, allowing the lagging to be pressed against the bridges of the completed set. The sets are usually placed 4 feet centre to centre and lagging 4½ to 5 feet in length is used. The operation is continued as long as necessary.

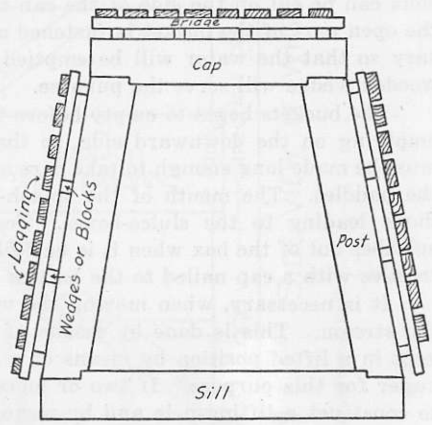


FIG. 15.

A full set showing posts, cap, sill, wedges, bridges, and lagging. This is a breast set right up at the face of the working, with the lagging resting on the bridges. During the excavation of the next set-length the lagging is pushed through the spaces between the bridges and posts and cap and driven ahead.

An adit should be driven with sufficient but not more than enough grade to provide good drainage. A ditch should be made along one side of the working and its size will depend upon the flow of water, which of course depends upon the extent of the working and the character of the ground. Where full sets are used (two posts, cap, and sill) the ditch will naturally pass under the sills. In soft ground the ditch should be replaced by a trough made of planks or split-timber.

When a wheelbarrow is used for handling the muck a split-timber or plank runway should be laid down. The saving in time and energy as the working is advanced will more than compensate the prospector for the time spent in making such a runway.

If an ore-car is to be used (they can be easily constructed if flanged wheels are available), simple wooden rails are quite satisfactory for preliminary work. They may be improved by surfacing them with strap-iron. Strap-iron can be bent into conveniently sized bundles for transport by pack-horse and is much cheaper than light steel rails.

Shaft-timbering for preliminary work is carried out in much the same manner as timbering an adit in soft ground. The heavy timbers serve the same purpose as the posts, cap, and sill of a full set, but are called wall and end plates. The wall-plates of the collar set should be of sufficient length to project beyond the ends of the shaft opening so that they can be placed on a solid foundation. The second set is ordinarily suspended from the first set by hanging-bolts, and so on, for each succeeding set. The prospector, however, seldom uses the more refined method and simply wedges his sets into place. When the ground stands up fairly well he can complete a set before lagging it up, but in the case of soft ground he drives his lagging in the same manner as described in timbering an adit.

A simple head-frame and windlass can be erected on the collar-plates and a bucket suspended on a rope used to raise the muck. A ladder should be built in every shaft.

If the shaft is inclined, skids must be placed on which the bucket can slide up and down. Small peeled poles will serve the purpose and they can be nailed to the sets on the foot-wall side of the shaft.

The ground is ordinarily excavated by a pick or drill. When powder is necessary, short holes should be drilled so that the blasting will not destroy the timbering.

When rock is encountered, blasting, except in rare instances, is an essential part of the operation. The beginner should gain some practical experience in drilling and blasting from an experienced miner.

TRANSPORTATION, EQUIPMENT, AND FOOD.

The expense of a prospecting-trip depends on the distance the ground to be explored is from rail or motor transportation. With the improved motor-roads now available, good prospecting-ground can be reached by car. The use of airplanes gives ready access to points at long distances from the railway, but for the beginner nearer fields are suggested, as the cost of aerial transportation is high, and only experienced men should risk the relatively great expense entailed.

Conditions in British Columbia are remarkable for their variety and consequently require great adaptability on the part of the prospector. Even within an easy radius of railway communication he may, for example, find it convenient to drive a car in the early stages of his journey, to transfer his outfit to pack-horses where the trail begins, and to find his back his sole resource at the higher elevations.

Probably the commonest means of transportation in British Columbia is the pack-horse. The animal in general favour for this purpose is the hardy, half-wild pony familiarly known as the cayuse. The cayuse is intelligent, sure-footed, and in most places quite able to forage for itself. It can carry 150 lb. with ease, and on short trips, or where travelling is good, up to 250 lb. In the southern interior of British Columbia these animals may be purchased " off the range " for from $5 to $10 each. When " broken " or trained to the saddle, however, the charge may run up to $50 or more for select stock. For purposes of transport these animals are equipped with specially constructed pack-saddles, on either side of which are slung boxes or bundles of about equal weight, which are spoken of as the " side-packs." Other goods piled between these and on top of the horse constitute the " top-pack." A considerable amount of skill is required in balancing the load and in lashing it tightly in place by one of several well-known hitches. For side-packs, specially made canvas, fibre-board, or wooden alforjas may be used. The latter two types have the lower edge bevelled to avoid catching on trees, rocks, etc., where trails are narrow or absent.

In northern British Columbia and the Yukon the upkeep of stock is expensive. Pack-animals are therefore scarce, and travel in consequence is chiefly by canoe in summer or dog-team in winter.

On the many lakes of British Columbia and the Yukon shallow-draught steamers, small power-boats, skiffs, and canoes may all be employed to advantage, and even the multitudinous streams, though on the whole rough, tortuous, and unnavigable, are made frequent use of along stretches of quieter water. The chief difficulty attendant upon the use of such craft is generally the expense of transportation. Boats are, of course, the one means of transport in all explorations conducted along the coast and coastal islands of British Columbia, but a trained pilot and navigator should be carried unless some member of the party is experienced in handling the type of boat used and is also familiar with the local waters.*

Equipment.—The most important item in a prospector's outfit is a good pair of well-nailed boots. They may be either low or high but should not be over 12 inches. A boot 18 inches high tends to bind the muscles of the leg; it is stiff and also costly. The next item is a good sleeping-bag or good wool blankets. A man may endure exposure and hardship provided he can get rest and sleep. For summer weather a good 9-pound eiderdown or kapok sleeping-bag or a pair of double blankets weighing 8 to 10 pounds, with a light shower-proof sail-silk or canvas cover, will be sufficient in nearly any place in British Columbia. For winter use a 16-pound eiderdown or two pairs of double blankets are required.

For a tent, anything from a 7 by 9 light-weight canvas sheet to a good tent of sufficient size to accommodate the prospector and his partner will do, depending on the season, country, and means of transportation. If only a fly is carried, it is a good policy to take along a small mosquito tent. The weight is next to nothing and the comfort derived from its use is great. It is merely a small wedge tent made of mosquito netting, large enough to cover a man in his sleeping-bag. If the prospector can afford it and has the means of transportation, a 7 by 9 wall-tent with 2½-foot walls, or an 8 by 10 tent with 4-foot walls made of sail-silk or with roof of canvas and walls of silk, with an oiled floor-cloth sewn in and mosquito bar across the front and windows, makes a most comfortable shelter.

* From " Prospecting in Canada," by Officers of the Geological Survey, Ottawa.

An axe should be of good quality and weight and a single-bitted one is the most serviceable type. A small axestone and file are essential. A rifle is useful when game is in season or when a man is far from civilization and must depend on the country for part of his food. A fishing-line and some hooks and flies take up little space and are most useful.

Some sort of geological hammer, pick, or mattock should be carried. A light-weight mattock or prospector's pick on a long handle are good types.

Either a pack-sack or pack-board is essential unless horses are to be used solely. A pack can be made out of a pair of overalls, but when a man is going to carry a heavy load long distances a good pack-board or pack-sack is indispensable. The pack-board is preferable except in heavy brush or steep country, where the pack-sack has the advantage.

For cooking utensils those made of either tin or aluminium are the best except for cups, which should be made of enamelware.

Provision-bags are inexpensive and handy. Large bags, capable of holding sacks of flour and sugar, made of paraffin canvas are worth the cost, while small bags holding 2 to 10 pounds keep provisions clean and intact.

Some bandages, a bottle of iodine, and one or two simple medicines, such as tabloid laxatives, should be in every pack.

For clothing, the man living out-of-doors should have woollen underwear and khaki or blue cotton pants and shirt of good weight and strength. Heavy, all-wool socks are one of the best investments he can make and it pays to get good quality. A sweater and either a mackinaw or water-proof canvas coat completes the outfit.

Fly-oil.—Do not forget this very essential preparation. There are endless varieties put up in tubes, tins, and bottles. Be sure to get the best, and plenty of it. The following is a good mixture:—

1 pint pine-tar.
1½ pints olive or sweet oil.
1 oz. citronella.
½ oz. carbolic acid.

Fly Tox is very commonly used to kill mosquitoes inside the tent at night. A simple and effective protection against mosquitoes is oil of pine-needles.

Lastly, and very important, he should have a strong water-proof container for matches.

Every prospector should carry a compass and note-book, and record in the latter his observations daily.

Food.—The following ration list will serve as a guide when ordering provisions:—

(From "Prospecting in Canada.")

Pounds Per Man Per Day.

	Lb.	Lb.*
Flour or hardtack	0.90	1.00
Baking-powder	0.025	0.025
Cereal (oatmeal)	0.15	
Beans	0.20	0.14
Rice	0.075	0.08
Evaporated potatoes	0.161	0.50 (fresh)
Split peas	0.025	
Evaporated soup vegetables	0.022	
Bacon and ham	0.75	0.35
Lard	0.06	
Cheese	0.05	0.14
Crystallized eggs	0.03	
Beef-tea capsules	If desired	
Sugar	0.35	0.25
Tea	0.06	0.03

* This column has been added to show a variation in quantity due to a possible difference in taste of the individual.

Pounds Per Man Per Day—Continued.

	Lb.	Lb.*
Coffee	0.03	------
Chocolate	1 bar (small)	0.06
Onions (desiccated)	0.005	------
Barley	0.02	------
Milk (powdered)	0.15 can	0.06
Salt	0.04	0.04
Evaporated fruit	0.22	0.25
Pepper	0.002	------
Spices	0.002	------
Soap	0.02	------
Butter	0.15	0.14
Totals	3.50	3.025

* This column has been added to show a variation in quantity due to a possible difference in taste of the individual.

Mustard, matches, candles, jam, yeast-cakes, soda, spices, essences, syrup, macaroni, corn-meal, pickles, molasses, corned beef, and ketchup may also be added according to taste and conditions.

A few suggestions may be offered concerning some of these items. Bacon and hams are now provided packed in pitch or gelatin casings which protect the meat against dampness, make it more convenient to handle, and preserve it for several months. Sides of dry salted pork keep well, and are cheap, and are very welcome food in cold weather. For very long trips, pemmican is useful as it will keep indefinitely and is a highly concentrated food, although not suited to all tastes. Canned meat of various sorts is palatable and convenient where no difficulties are experienced in transportation. Among the cereals, oatmeal is thought superior to rolled oats, but requires longer cooking. Desiccated vegetables are light to carry and are very good food. Dried potatoes are most convenient when shredded or sliced. Soup vegetables are a valuable addition. Pea-meal thickens soup and is nourishing and tasteful. Tea of good quality is economy in a diet where it is such an important article. Sweetened chocolate in small bars is convenient to carry and an excellent food, particularly when lunch is eaten away from camp. For carrying, powdered milk is much superior to the ordinary liquid condensed varieties. Both skimmed and whole milk are available in powdered form and are mixed with water as required, thus eliminating waste and economizing in weight.

APPROXIMATE COST OF MINING TOOLS AND SUPPLIES.

Saws, hand	$1.95
Shovels	1.25
Anvil (combined vice)	3.75
Files	.25
Chisel	.45
Draw-knife	1.60
Picks (complete)	1.65
Mattocks	1.65
Hammers, single-jack	1.50
Hammers, hand	1.00
Brace and 6 bits	5.50
Nails and spikes, per pound	.06
Axes (single bitted)	1.95–3.50
Carborundum or whetstone; whetstone, 6-inch	.50
Powder	------
Gold-pan	.50
Quicksilver	------

CAMPING EQUIPMENT.

Tent (with pipe-shield), 7 by 9 by 2	$10.95
Sleeping-blankets	8.95–16.50
Sleeping-bag, summer weight, 8 to 10 lb.	17.50
Sleeping-bag, arctic, 90 by 90, 16 lb.	55.00
Mosquito-net (for bed)	2.75
Candles, per dozen	.20

OTHER EQUIPMENT AND SUPPLIES.

Rifles, 30/30 carbine	$52.00
Ammunition, 30/30 cartridges	1.75
Compass	.85
Match-box, metal	.75
Fishing-line, hooks, and sinkers	.75
Magnet	.50
Magnifying-glass	1.00
Jack-knife	1.00
Rope, ½-inch, 13 feet	.25
Pack-board or pack-sack	3.50–5.00
Paper and pencil	.20

CLOTHING AND PERSONAL EFFECTS.

Boots	$8.50
Socks, wool, pair	.25–.75
Underwear, wool	3.95
Needles, 1 pkg. darning and 1 pkg. sewing, per pkg.	.05
Thread, 200 yards	.08
Yarn	.05
Tobacco, per lb.	1.00
Soap, per cake	.05–.07
Gauze (sterilized) bandages	.20
Quinine, 1 oz.	1.50
Pants	1.95–2.75
Matches (12's), per pkt.	.20
Iodine, 2 oz.	.25

COOKING-UTENSILS.

Frying-pan (long handle)	$0.25
Bake-pan	.30
Pots (with bails), nested, set of 7	9.00
Plates (enamel), each	.25
Cups (enamel), each	.20
Spoons, each	.10
Forks, each	.10
Knives, each	.19
Dish-towels, 3 for	.25

FOOD-SUPPLY.

Ham, per lb.	$0.29
Bacon, side, per lb.	.24
Flour, per sack, 49's	1.95
Hardtack, per lb.	.16
Milk, dried (5-lb. tins)	3.00
Sugar, granulated, per sack, 20's	1.10
Sugar, brown, per lb.	.05

FOOD-SUPPLY—*Continued.*

Salt, per lb.	$0.01½
Mustard, ¼ lb.	.15
Pepper (black), ¼ lb.	.07
Cinnamon, ¼ lb.	.08
Yeast (Royal), per pkt.	.07
Chocolate (hard, sweet), per lb.	.24
Tea, per lb.	.37
Coffee, per lb.	.19–.30
Butter (canned), (2-lb. tins), per tin	.78
Eggs (dried), 4-oz. tin	.17
Cheese (mild), per lb.	.19
Beef cubes, per tin	.19
Apples (dried), per lb.	.15
Figs (black cooking), 3 lb.	.25
Apricots (dried), per lb.	.19
Prunes (30–40's), per lb.	.10
Raisins (seedless), per lb.	.12
Potatoes (desiccated) (5-lb. tins), per lb.	.50
Onions, 10 lb.	.25
Rice (Jap), per lb.	.06
Barley, per lb.	.07
Beans (small white), per lb.	.07
Peas (split), per lb.	.05
Oatmeal (24's), per sack	1.15
Corn-meal (5's), per sack	.26
Baking-powder (5's), per tin	1.15
Baking-soda (1's), per pkt.	.10
Tomatoes (canned) (2½'s), per tin	.10
Beans (canned), per tin	.10
Honey (5-lb. tins), per tin	.49
Jam, strawberry, 4-lb. tins	.55
Syrup, 10-lb. tin	.59
Corned beef, 1 for	.11
Pemmican	

SYNOPSIS OF MINING LAWS OF BRITISH COLUMBIA AS RELATING TO PLACER-MINING.

FREE MINERS' CERTIFICATES.

Any person over the age of 18 may obtain a free miner's certificate on payment of the required fee.

The fee to an individual for a free miner's certificate is $5 for one year.

The free miners' certificates run from date of issue and expire on the 31st day of May next after its date, or some subsequent 31st of May (that is to say, a certificate may be taken out a year or more in advance if desired). Certificates may be obtained for any part of a year, terminating on May 31st, for a proportionately less fee.

The possession of this certificate entitles the holder to enter upon all lands of the Crown and upon any other lands on which the right to so enter is not specially reserved, for the purpose of prospecting for minerals, locating claims, and mining.

A free miner shall not be entitled to locate or record, in any period of twelve consecutive months, more than one placer claim or leasehold in his own name, and one placer claim or leasehold for each of three free miners for whom he acts as agent, on any separate creek, river-bed, bar, or dry diggings.

In the event of a free miner allowing his certificate to lapse, his mining-property (if not Crown-granted) reverts to the Crown (subject to the conditions set out in the next succeeding paragraph), but where other free miners are interested as partners or co-owners the interest of the defaulter becomes vested in the continuing co-owners or partners *pro rata*, according to their interests.

Six months' extension of time within which to revive title in mining property which has been forfeited through the lapse of a free miner's certificate is allowed. This privilege is given only if the holder of the property obtains a special free miner's certificate within six months after the 31st of May on which his ordinary certificate lapsed. The fee for this special certificate in the case of a person is $15.

PLACER CLAIMS.

Placer-mining is governed by the " Placer-mining Act," and is defined as the mining of " any natural stratum of unconsolidated material or cement mined for the mineral content thereof." Placer claims are of three classes, as follows:—

" Creek diggings ":
" Bar diggings ":
" Dry diggings."

" Creek claims " 250 feet long and 1,000 feet wide, 500 feet on either side of the stream. " Bar diggings " between high- and low-water marks, 250 feet square on a bar covered at high water, or a strip 250 feet long at high water, extending between high-water mark and extreme low-water mark. " Dry diggings," over which water never extends, 250 feet square. Placer claims are recorded similarly to lode claims, and at the office of the Mining Recorder for the division in which they are located. A claim must be worked by the owner, or some one in his behalf, continuously during working-hours. Discontinuance for seven days, except in close season, lay-over, leave of absence, sickness, or other reasons satisfactory to the Gold Commissioner is deemed abandonment. To hold a placer claim over one year it must be again recorded before expiration of the year.

CO-OWNERS AND PARTNERSHIPS.

In the " Placer-mining Act " provision is made for the formation of mining partnerships, both of a general and limited liability character. These are extensively taken advantage of and have proved very satisfactory in their working. Should a co-owner fail or refuse to contribute his proportion of the expenditure required as assessment-work on a claim he may be " advertised out " and his interest in the claim shall become vested in his co-owners who have made the required expenditure, *pro rata* according to their former interests.

It should not be forgotten that if any co-owner permits his free miner's certificate to lapse, the title of his associates is not prejudiced, but his interest reverts to the remaining co-owners; provided that said co-owner has not taken advantage of the six months' period of grace allowed for the taking-out of a special free miner's certificate, thus reviving the title to his interest.

PLACER-MINING LEASES.

The holder of a free miner's certificate may stake a placer leasehold and within thirty days after date of location post a notice in the office of the Mining Recorder for the division in which the ground is situate of his intention to apply for a placer-mining lease; and within sixty days after location make application to the Gold Commissioner for the mining division, together with a deposit of $20, which is refunded if application is not granted. An ordinary lease shall not exceed one-half mile in length by one-quarter mile in width. The annual rental is $30 and development-work $250 per lease. Annual rental must be paid and development-work recorded during the current year or the lease is forfeited. Excess work may be recorded for three years in advance. Payment of cash in like amount may be made in lieu of development-work. For details, consult the " Placer-mining Act."

VICTORIA, B.C.:
Printed by CHARLES F. BANFIELD, Printer to the King's Most Excellent Majesty.
1943.

500-343-3580