BRITISH COLUMBIA DEPARTMENT OF MINES

HON. GEORGE S. PEARSON, Minister.
ROBT. DUNN, Deputy Minister. JOHN F. WALKER, Provincial Mineralogist.
J. DICKSON, Chief Inspector of Mines.
D. E. WHITTAKER, Provincial Assayer and Analyst.

NOTES ON PLACER-MINING IN BRITISH COLUMBIA

FOR THE

INFORMATION OF THE INDIVIDUAL MINER

BY

OFFICERS OF THE DEPARTMENT

PRINTED BY
AUTHORITY OF THE LEGISLATIVE ASSEMBLY.

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BRITISH COLUMBIA.

PHYSIOGRAPHY.

The Province of British Columbia lies almost wholly within the Western Cordillera. The Western Cordillera includes all the mountain systems and interior plateaux bordering the western side of the North American continent. The extreme north-easterly corner of the Province lies to the east of the Cordillera and is a part of the great inland plains region of Canada.

The Rocky mountains form the southern part of the eastern boundary of the Province, continuing in a north-westerly direction to the Yukon. They form a rugged barrier averaging 50 miles in width and over 900 miles long, and are separated from the mountain systems immediately to the west by a remarkably long intermontane valley occupied from south to north by the Kootenay, Columbia, Canoe, Fraser, Parsnip, Finlay, and Kachika (Fox) rivers. These mountain systems are, from south to north, the Selkirk, Columbia, Cariboo, Omineca, and Cassiar. The Cariboo and Omineca mountains are separated by part of the Nechako plateau, which abuts directly against the Rocky mountains east of Prince George. These mountain systems, varying from 60 to 125 miles in width, merge into the Interior plateaux stretching north-westerly from the International boundary throughout the central part of the Province. The Interior Plateaux country has been formed by the deepening of the river-valleys in an area originally of plains and low hills lying between the mountain systems aforementioned and the Coast ranges. The result is that the Interior plateaux present a variety of land forms, from comparatively level country to that which is mountainous, but lacking the rugged alpine character of the bordering mountain ranges. They average 60 to 125 miles in width.

To the west of the Interior plateaux lies the 150-mile-wide belt of mountains forming the Coast mountains. The coast-line is deeply indented and long fiords reach into the heart of the range.

Beyond the mainland are Vancouver and Queen Charlotte islands, in part mountainous, belonging to what is considered a mountain system westerly and distinct from the Coast mountains.

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, again take it up 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, 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-east 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 and it is possible that gas and 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.

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 Cassiar mountains, except that they are built of Palæozoic and Mesozoic rock 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, but there are few known lode deposits of any kind. This may be 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 Omineca mountains, only there are some 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 Omineca mountains is found the famous Barkerville placer area, and in the same region lode-gold deposits, and some containing tungsten. Lode-mining is still largely in the development stage 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 Gold range 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 lakes from which sodium sulphate is obtainable. 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 plateaux country is interrupted until near the Yukon boundary by mountains extending from the Coast mountains to the Cassiar and Omineca 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 rock 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 proved to be of little importance. 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 toward 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

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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 and the present stream have insufficient current to transport this material. Such deposits are worked by dredges.

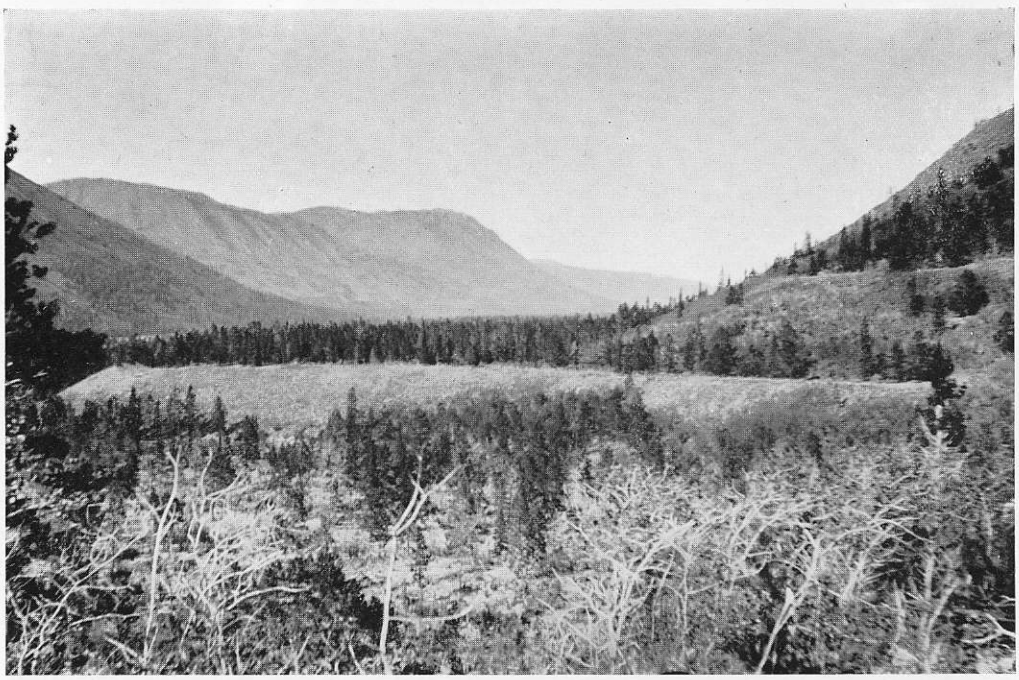
Beach Placers.—Deposits of this type are generally formed by wave action attacking gold-bearing sands and gravels, and particularly during storms, forming local concentrations on the beaches. Sometimes these deposits yield considerable amounts of gold. Such deposits are found on Graham island, Queen 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.

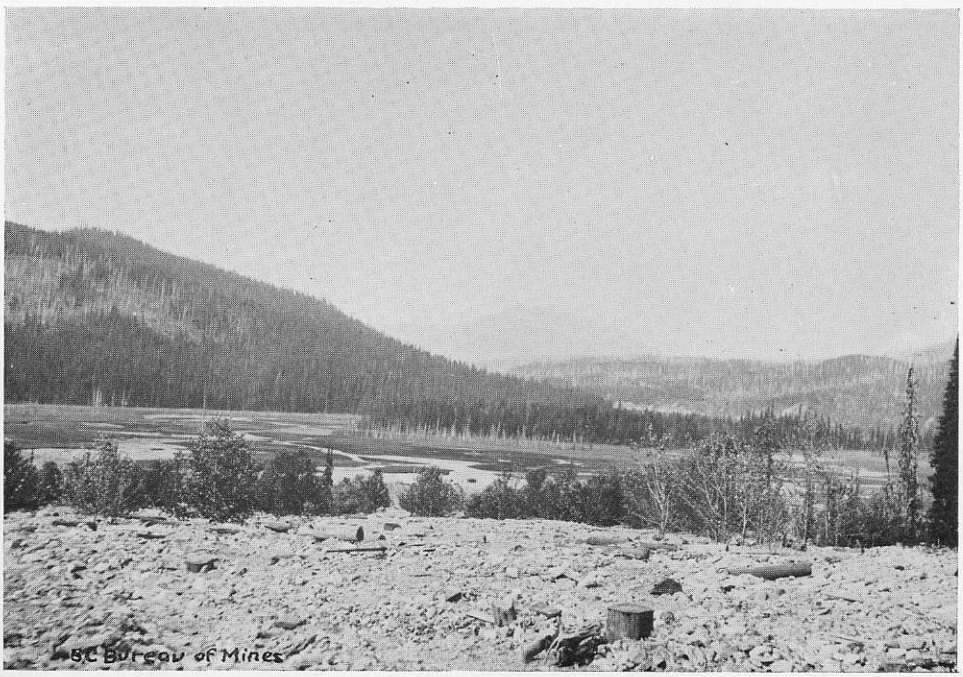
Most of the large nuggets found at various places in the world have come from very close to the source. No evidence has been presented to show that chemical action has played any part in the formation of placer gold, whereas there is abundant evidence to prove that it has been released by the mechanical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

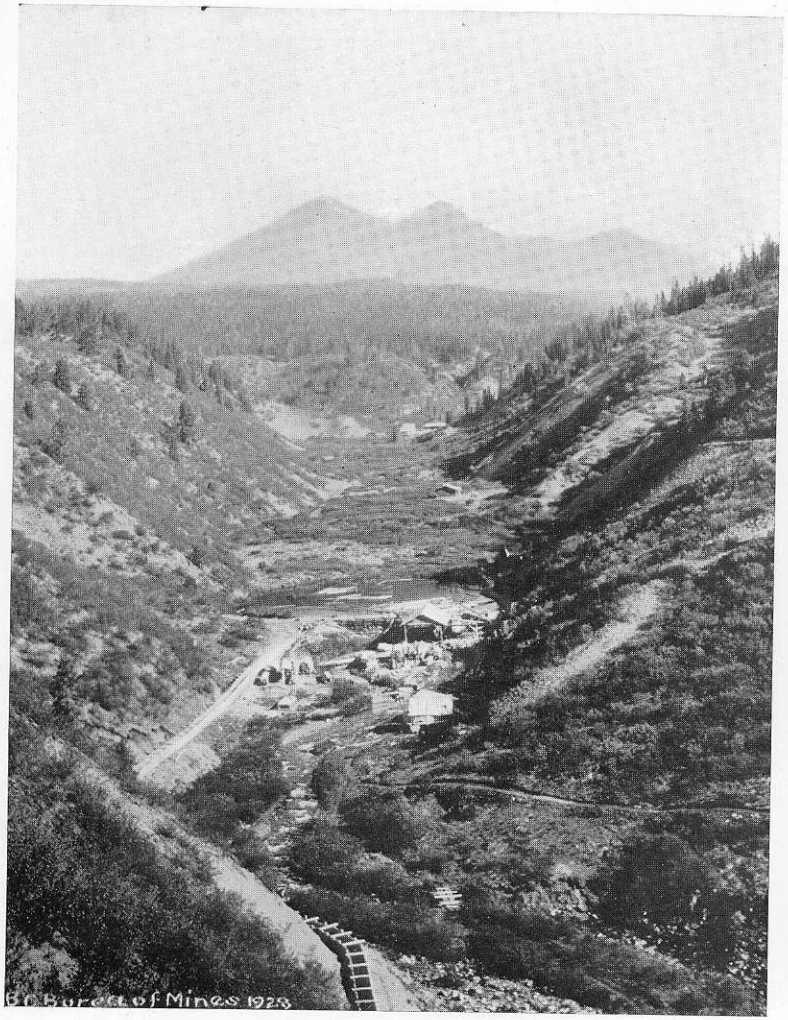
Distribution of Gold in Placers.—It has been intimated that coarse gold is usually found on bed-rock. This is often true, but coarse and fine gold may also be found on false bed-rock, or in streaks within sand or gravel beds. A false bed-rock is formed by deposition of compact clay or some such impervious 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



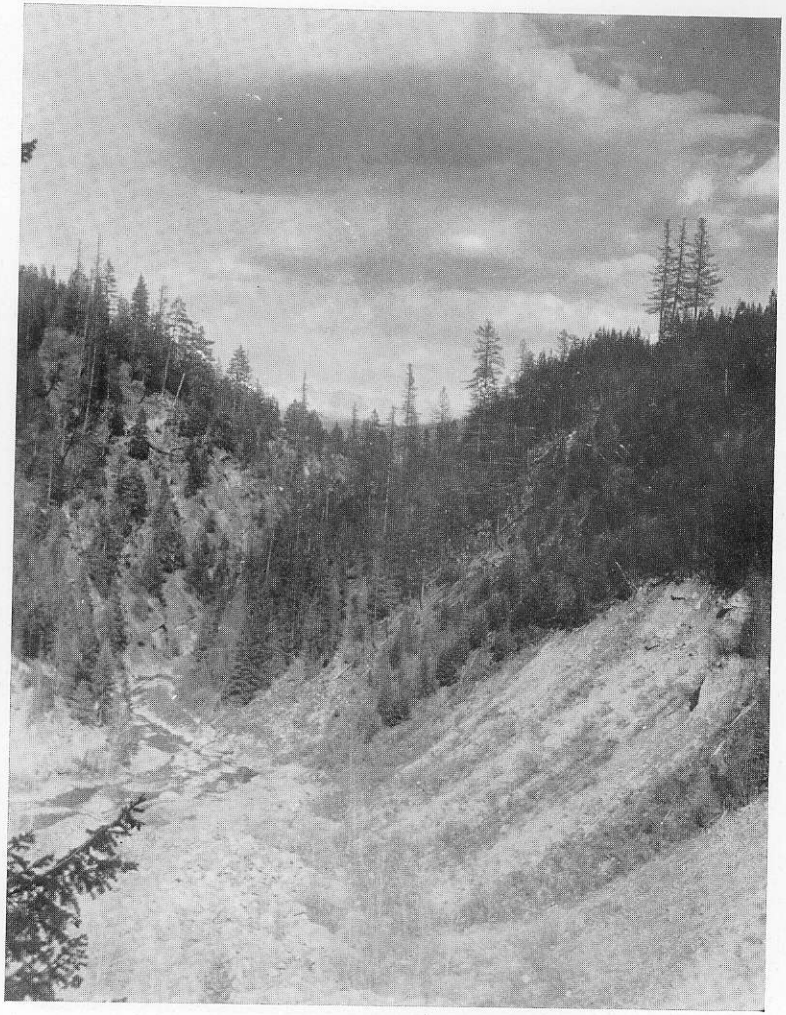
Fourth of July Creek—looking North-east towards Gladys Lake, Atlin Area.



Williams Creek, below Barkerville.



Mosquito Creek, Liard Mining Division.



Upper Perry Creek, Cranbrook Area.

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 post-Glacial deposits occur in many places which have been formed by concentration of Glacial gravels by post-Pleistocene stream-action. While many of these are too low in gold content to be profitably worked, it is probable that adequate testing will show many 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.

(4.) In some areas, particularly in the Tulameen and Quesnel sections, the efficient handling of the black-sand concentrates from placer operations to recover the gold and platinum content may make possible the working of present known deposits.

NORTH-WESTERN MINERAL SURVEY DISTRICT (No. 1).

Queen Charlotte Mining Division.

Graham Island.—The black-sand beach deposits on Graham island offer opportunities only to those well conversant in mining.

Skeena Mining Division.

On Douglas, Maroon, Hall, and Clear creeks values are to be found on low benches and bars and on bed-rock. Fairly difficult of access.

Stikine Mining Division.

On Barrington river, likely section for individuals. Values are found on false bed-rock and shallow bars. Fairly difficult of access.

Liard Mining Division.

Likely sections are McDame creek, Spring creek and tributaries, and French creek, about 25 miles below Spring creek. Difficult of access.

Atlin Mining Division.

Birch Creek.—A fair opportunity for drift-mining.

Ruby Creek.—Deep diggings—drift-mining.

The region around Atlin is fairly easy of access once it is reached. Transportation to Atlin from Vancouver is fairly expensive.

Tatshenshini River.—More or less virgin ground. Geologic evidence suggests it may be a likely area for placer-mining.

Squaw Creek.—Heavy wash and large boulders. Depth of gravel from 4 to 8 feet on bed-rock. Fairly expensive of access.

NORTH-EASTERN MINERAL SURVEY DISTRICT (No. 2).

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.

(3.) In the northern part, in the vicinity of McConnell creek, and also in the vicinity of Jimmay creek, tributary of the Osilinka river. Placer is also reported at one or two other points.

(4.) In the eastern part, in the McLeod River area.

(5.) At individual points such as Bob creek, Rainbow creek, and Dog creek.

Of these, the Manson section is by far the most important. Recent discoveries on the McLeod river indicate an area of decided promise and a good field for further prospecting.

Skeena Section.—Prospects in the wide valley at the head of the North fork of Lorne creek on the divide towards Douglas creek, also tributaries. Fairly difficult of access.

McLeod River Area.—Fairly difficult of access. Good values, shallow overburden, and not many boulders. Prospect from McLeod river north-west towards Mount Milligan.

Cariboo Mining Division.

Prince George Section.—Fairly easy of access. On Skaret creek, North fork of Hixon creek, and Terry creek. Coarse gold on false bed-rock.

Quesnel Mining Division.

Quesnel Section.—Mostly deeply buried channels that will cost money to operate, but possibly some remnants fairly easily mined. Easy of access.

CENTRAL MINERAL SURVEY DISTRICT (No. 3) AND SOUTHERN MINERAL SURVEY DISTRICT (No. 4).

Placer-mining in these districts has not prospered as it should, for the following reasons: First, those interested have not realized the absolute necessity of prospecting their ground by mechanical or other means to ascertain depths of bed-rock, the sinuosity of the gold-run, and values, before installing a plant. Secondly, practically all the remaining likely large deposits of pay-gravel lie beneath either water-soaked material, glacial moraines, or lava-flows, and the removal of possible barren overburden was not taken into account before commencing operations. Thirdly, the microscopic gold values found in the black sand of the Fraser and Thompson rivers do not appear as colours in a pan and consequently much valuable gravel may have been overlooked. Fourthly, prospecting for dry placer in sections where free gold in quartz is found has not received the attention it should.

During 1932 C. S. Parsons, of the Mines Branch, Ottawa, made a special study of placer-mining conditions in the districts in relation to the saving of values contained in the black sands (magnetite or chromite), and sufficient evidence has been obtained to show that in many instances the "would-be" hidden values are microscopic gold, sometimes thinly coated with foreign substances which prohibits mercury adhesion, but, more often than not, entirely clean and capable of being saved by simple barrel amalgamation. This discovery should especially benefit the larger operations where the undercurrent residues are often extensive.

Grand Forks Mining Division.

Likely prospecting areas comprise the following: Benches and streams flowing through and away from the gold-quartz veins near Paulson, such as McRae creek and its tributaries; Saunder creek, which drains Burnt basin; Pass creek, which might have drained Jewel lake, where free gold occurs in quartz, and which flows into the Granby river 12 miles north of Grand Forks; Fourth of July creek, in which placer gold was mined in 1863. Easily accessible.

Greenwood Mining Division.

Gold was mined in 1860 from the more accessible bed-rock. Future opportunities lie in the water-soaked creek-gravels and dry benches where prospect-shafts have averaged $1 to the cubic yard. Coarse gold is found in the basin above the mouth of Norwegian creek. There are numerous likely benches. Recent lava-flows have possibly covered some of the placer-gravels. Operations will require capital to thoroughly prospect possibilities, and, if values are constant, will necessitate damming surface waters and draining gravels before operating.

Rock Creek and Jolly Creek.—The suspected presence of old high channels has been proved in several instances, and in one, on the Rock Creek Consolidated Placers, Limited, ground, very attractive gold values have been found. Numerous drifts have not delimited the old channel area which lies about 25 feet above the present creek. Other channels occur on leases Nos. 51, 58, 73, and 55. There are plenty of similar opportunities for finding gold on Jolly creek, McKinney creek, and the lower reaches of Rock creek. Easily accessible.

Main Kettle River.—The section of the Kettle river, about 15 miles long, commencing at Keefer lake, the headwaters, and extending down-stream, cuts through an area of argillaceous rocks containing free gold in quartz. The tributaries of the river from the west warrant prospecting. Some gold was mined from this area in the early days. 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. 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 Cherry creek and its tributaries east of Vernon there are chances for gold-recovery from the creek-bottom as well as along the benches and under old buried watercourses which have cut through the gold-quartz vein systems in the argillites. More detailed reports on this section can be found in the 1925 Annual Report. On Siwash creek, which flows into the north-

west end of Okanagan lake, gold-bearing gravels occur. On Mission creek, near Kelowna, gold has been mined spasmodically for many years and there still appear to be opportunities.

Kamloops Mining Division.

The occurrence of gold on the bed-rock gravels under glacial moraines at Heffley lake are encouraging and warrant exploration. Other interesting creeks include Hobson, Tenquille, Eakin (3-Mile), and Louis, all mentioned in former Annual Reports.

In this Division there are large areas of metamorphosed rocks containing sections of gold-bearing quartz which have undoubtedly been eroded by glacial and stream action, and although the values may have been transported long distances, nevertheless the locality is worth intensive prospecting, even the old dry creek-beds. The bars of the Thompson river are also worth consideration.

EASTERN MINERAL SURVEY DISTRICT (No. 5).

From the evidence of past production and new discoveries it is generally accepted that the more important placer-gold areas in District No. 5 are located in the southern part of the East Kootenay, chiefly in the Fort Steele Mining Division, and the Big Bend district north of Revelstoke, more especially French, McCulloch, and Camp creeks. To a lesser extent placer-gold occurrences are known in the adjoining parts of the Lardeau and Ainsworth Divisions covering the Lardeau river, and certain streams, such as the Pend d'Oreille and Salmo rivers, and 49 creek in the Nelson Mining Division. In addition to the localities mentioned, minor placer-mining activities have been carried on at widely separated points in this district, such as Canyon and Quartz creeks in the Golden Division, Dutch creek and Findlay creek in the Windermere Division, Lemon creek in the Slocan City Division, and Eureka and Barnes creeks in the Arrow Lake Division, but the recorded production from these streams is not important. The placer areas of the district will be briefly dealt with in the order of their apparent importance for future production.

Fort Steele Mining Division.

Localities considered favourable for placer exploration include:—

(1.) The valley of Perry creek between Old Town and the falls.

(2.) Perry creek at the hydraulic workings above the falls.

(3.) Valley Creek valley on either side, particularly east of Valley lake.

(4.) St. Mary river at and below Wycliffe.

(5.) Fish Lake Creek valley, one or both sides of the stream. That some gold has been found is considered most significant and therefore these benches should be prospected more extensively.

(6.) Moyie river and Weaver creek, where exploration should be extended to and along bed-rock.

(7.) Palmer Bar creek and vicinity. It is suggested the bed-rock conditions should be more fully investigated.

(8.) Wild Horse Creek valley and some tributaries.

(9.) Lower part of Salmon valley near junction with Pend d'Oreille.

All the above are of fairly easy access.

Revelstoke Mining Division.

McCulloch creek, Smith creek, and Goldstream. Many large boulders which create difficulties. Good "pay" has been found on bed-rock.

WESTERN MINERAL SURVEY DISTRICT (No. 6).

Vancouver Island.—There are several places on the island, mainly on the west coast, where indications of placer gold have been found. Hand-mining is being attempted in a number of places, without very encouraging results, such as the Leech river, mouth of the Sombrio river, Wreck Bay beach, Zeballos river, the beach on the north end, and on Nanaimo river.

Placer leases have been taken up on Wolfe creek, on the opposite side of the Sooke river. Leases have been staked near the mouth of the Jordan river and several leases are held on the Sombrio and Loss rivers, a few miles farther up the coast. Several have tried the beach

placers on Wreck bay and the north coast, but this beach gold is very fine, accompanied by black sand, and hard to recover. An amateur has no chance, and even with expert handling the returns are small.

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. Some placer gold was reported as found in Boss creek, which flows into Canim lake. This locality is promising. 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.

Yale Mining Division.

A considerable amount of churn-drilling was done at Yale and Hope on the Fraser river, the results of which have not been published. 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. Pierre 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.—The most simple method of recovering placer gold is by panning. The gold-pan is a circular dish made of sheet iron, with sloping sides, varying from 10 to 18 inches in diameter, with a depth of 2½ to 3 inches. The pan should be light and strong with a smooth inner surface, kept free from grease and rust. Sometimes gold-pans are made of copper, so that the bottom may be coated with mercury (quicksilver) to catch fine gold often otherwise lost.

The pan is filled about two-thirds full with the material to be tested, placed under water, and the material worked with the hands to break up any clayey or hard lumps. Rocks and pebbles are washed, picked out, and discarded. The pan is now raised to just below the surface of the water and shaken vigorously from side to side with a slightly circular motion, which keeps the lighter material in suspension and works it out of the pan, which is slightly tilted away from the operator. The motion of the pan keeps the material in a state of agitation, allowing the heavier matter to settle, while the lighter is worked over the lip. This is done by alternately raising and lowering the lip of the pan above and below the surface of the water. The pan should occasionally be lifted from the water and shaken vigorously with the same circular motion to hasten the concentration without the chance of some of the gold being washed out. The procedure is continued until only the gold and heaviest minerals remain. About this stage it is well to complete the operation in a tub of water, so that any gold lost may be recovered by panning the contents of the tub. The final product is dried and the magnetite separated with a magnet. The coarse gold may be picked out and the fine recovered

by amalgamation with mercury or by blowing the sands away from the gold with the aid of a small straw. Care must be exercised in the latter procedure.

Experienced placer-miners can pan about 100 pans in ten hours, depending on the coarseness of the gold and the character of the material containing it, and the skill of the operator. It takes about 180 average pans to work a cubic yard of gravel. A good man can pan about ½ to ¾ cubic yard per day, and in order to make $4 per day the gravel would have to average $7 to $8 per yard—very rich ground to-day in British Columbia.

Rocking.—Rocking requires very little more in the way of equipment than panning, and it may be employed by the small operator to substantially increase the amount of gravel which he can wash in a day. The rocker may be operated by one man, but two men are better, as one of them can be excavating and carrying the gravel while the other operates the rocker, turn and turn about. Two men working steadily will wash from 3 to 5 cubic yards of gravel per ten-hour day, the actual amount washed depending on the nature of the gravel, the distance it has to be carried, etc.

A sketch is given of a rocker (Fig. 1) which may be easily and cheaply constructed. It is built so that it can be knocked down and carried from one locality to another. The explanation of the lettered parts in the sketch is as follows:—

A. Cleats for holding the back of the rocker.
B. Cleat for holding bottom of the rocker L.
C. Cleat for holding front of the rocker.
D. Cleats for holding canvas-covered inside riffles.
E. Cleats for holding brace at the top of rocker.
F. Cleat for holding sieve-box.
G. Bolt-holes for ½-inch tie-bolts.
H. Wooden riffles ¾ inch high and 1 inch wide.
I. Rockers.
J. Handle for rocking.
K. Bottom board for rocker, which should be in one piece or of matched board construction ¾ inch thick.
L. Spikes which project 1½ inches to prevent rocker slipping down-grade.

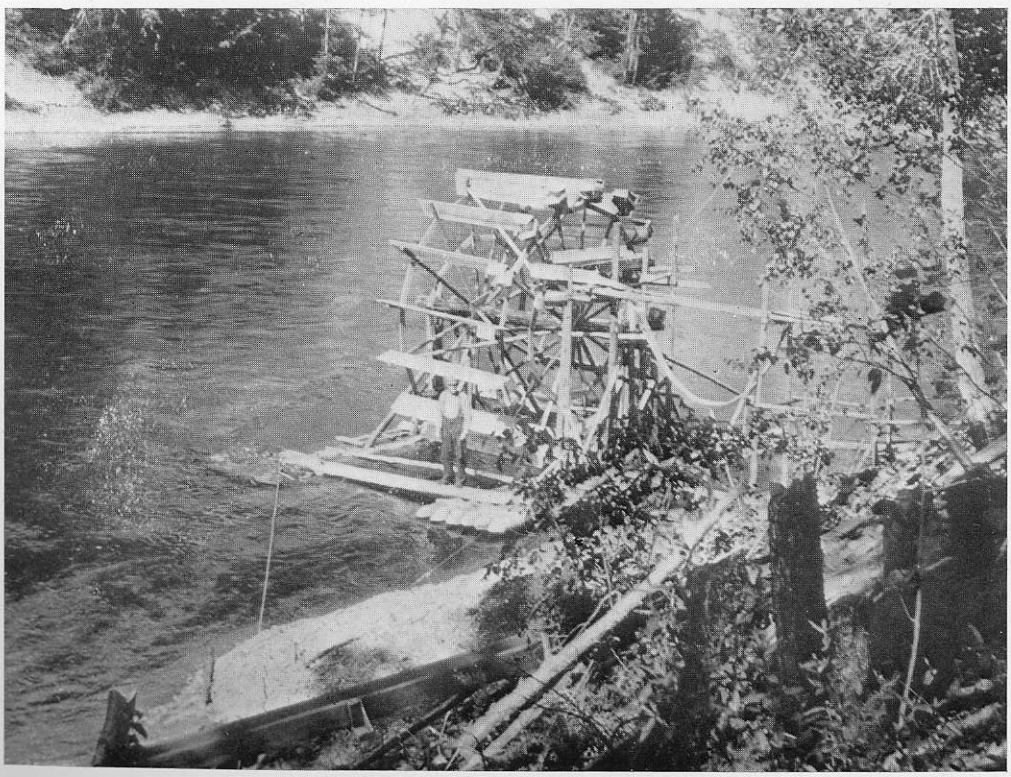
The drawing is fully dimensioned, and if a knock-down construction is not wanted at least three or four ½-inch tie-bolts should be used to give the rocker added strength. The sieve-box should fit loosely in the top of the rocker and can be fitted with handles for ease in removing it from its place. The sieve-bottom proper is made of heavy sheet iron punched with ½-inch holes.

The rockers (I) rest on heavy planks slotted to receive the spikes (L). The planks are laid crosswise to the length of the rocker, the one at the left or front of the rocker being approximately 2 inches lower in elevation than the one at the back. This gives a grade of 2 inches to 3 feet, but it will be found that the grade will have to be adjusted to suit the material being washed. The grade should be set so that all the clay is thoroughly broken up before it is discharged from the rocker. If much fine gold is encountered, it would be advisable to add one or two more riffles to the bed of the rocker. If very little clay is present in the gravel and the gold is coarse the grade may be profitably increased, thus slightly increasing the speed of washing and the capacity of the machine.

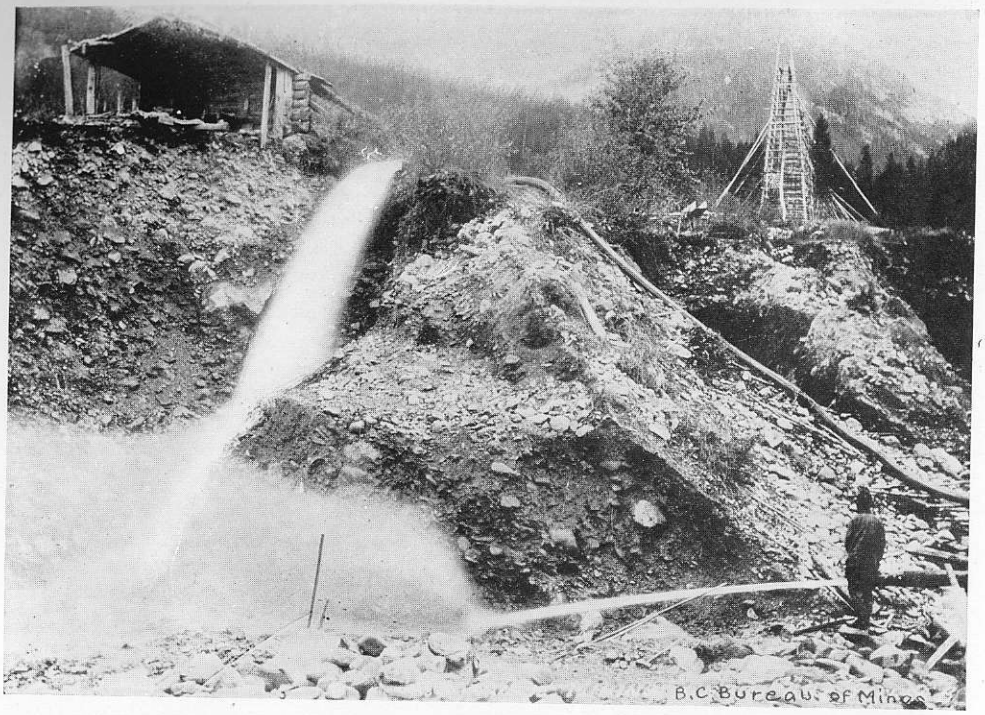
The two inclined canvas-covered riffles (blanket-cloth or other suitable material may be used in place of canvas) will be found helpful in thoroughly disintegrating the clayey types of gravel and making a high recovery of the fine gold.

Operation of the Rocker.—In using the rocker, the screen or sieve-box is placed on the cleats F and the gravel to be washed is shovelled into the box. The rocker is vigorously shaken back and forth with a jerky motion, while water is being poured over the contents of the box in such quantities and at a rate that will thoroughly break up and remove lumps of clay and wash the gravel clean, yet not so rapidly as to carry small particles of gold out over the riffles to the waste-dump. The flow can be regulated with but slight experience to just carry the tailings over the riffle, and a steady flow is to be preferred for this purpose. This can be accomplished by feeding the water to the rocker through a small section of pipe or flume, though general practice is to dip the water with a can attached to the end of a stick and pour the water over the gravel as required. The man operating the rocker handles the water-

Spruce Creek, Atlin. Shovelling in to Sluice.



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.



A One-man Ground-sluicing and Hydraulic Operation on Wild Horse Creek, Cranbook Area.

Spruce Creek, Atlin. Method of Washing Gravel with Rocker.

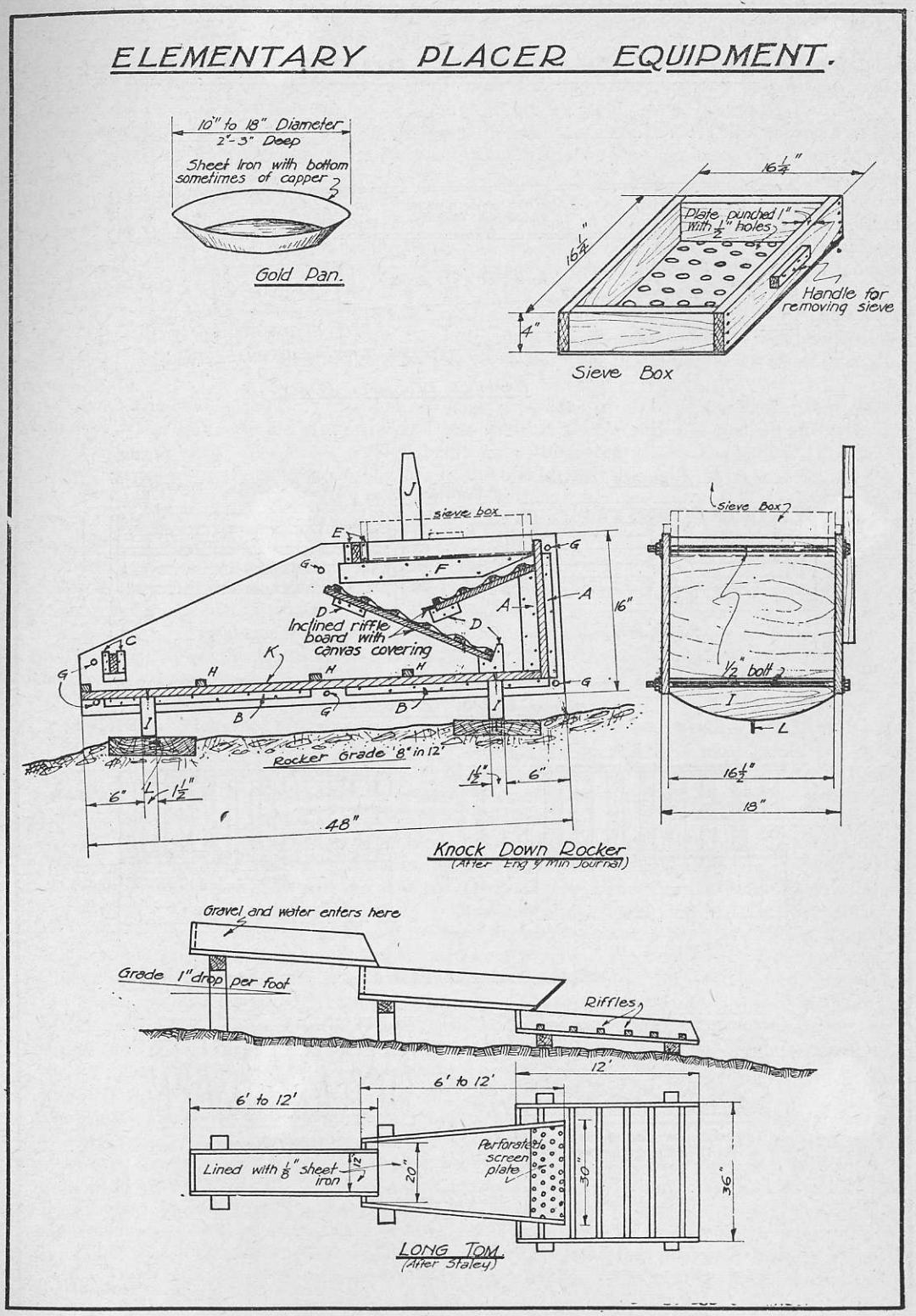
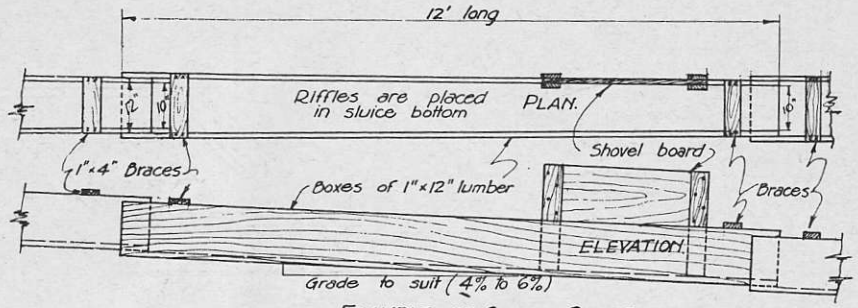
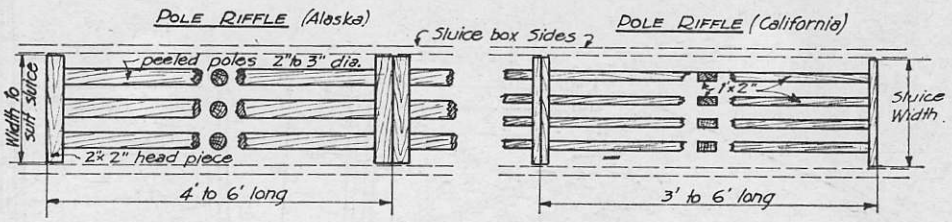

ELEMENTARY PLACER EQUIPMENT.
10" to 18" Diameter
2'-3" Deep
Sheet Iron with bottom sometimes of copper
Gold Pan.
16¼"
16¼"
Plate punched 1" with ½" holes
Handle for removing sieve
4"
Sieve Box
sieve box
Inclined riffle board with canvas covering
Rocker Grade 8" in 12'
6"
1½"
48"
16"
Sieve Box
½" bolt
16½"
18"
Knock Down Rocker
(After Eng & Min Journal)
Gravel and water enters here
Grade 1" drop per foot
Riffles
6' to 12'
6' to 12'
12'
Lined with ⅛" sheet iron
20"
Perforated screen plate
30"
36"
LONG TOM.
(After Staley)

Fig. 1.

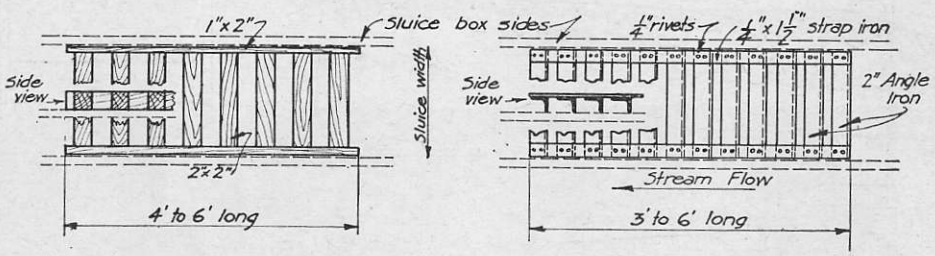
TYPES OF SLUICE BOX & RIFFLES.



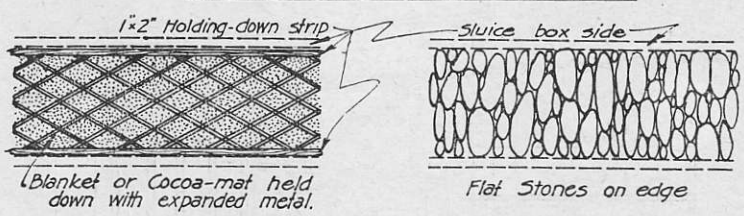
EXAMPLE OF SMALL SLUICE.



HUNGARIAN RIFFLES



FINE GOLD AND COBBLE-STONE RIFFLES



RIFFLES.

Fig. 2.

supply, and many individuals have shown much ingenuity in constructing semi-automatic water-driven features into working their rockers.

When the heavy sands build up behind the riffles to the level of the top of the riffle, gold particles are likely to be washed over and lost, and it is therefore necessary to keep an eye on the riffles and clean up the sands before they build up too high. After the sand and the clay have been washed away and the water coming through the sieve is clear, the contents of the sieve, consisting of pebbles too large to pass through the screen openings, are examined for large nuggets that may be present and then discarded. The sieve is then filled again with fresh gravel and the rocking continued.

To clean up, the inside riffles are removed and rinsed off in a tub or pail of water, while the sands from behind the riffles in the bottom of the rocker are cleaned out as often as may be necessary. These concentrates are further cleaned by panning, and sometimes use is made of mercury for cleaning up the very fine gold.

The rocker is not very efficient, but the prospector can handle several times as much gravel in a day with it as by panning, and it can be used in areas where water is not plentiful by carefully conserving the water in pits dug for the purpose, the water being used over and over again.

Long-toms.—The tome, or long-tom, is sometimes used in place of the rocker, but where running water and suitable grades prevail the use of a simple sluice is just as effective and requires less labour. The usual type of long-tom is illustrated and as the sketch (Fig. 1) is fully dimensioned and explained by letters no further description will be given here.

The gravel is shovelled into the tom, or flume section, where the material is washed through the screen and the larger rocks are forked out and discarded. When the riffles become filled, the material caught behind them is cleaned up and panned as in the clean-up of the rocker. Ordinarily two men are required, one shovelling in and the other operating the tom, but sometimes as many as four men are used, two shovelling in the gravel, one forking out the large stones, and the fourth shovelling away the waste tailings coming off from the lower end of the long-tom. The average duty per man is from 3 to 5 cubic yards of gravel per ten-hour shift, depending on the condition of the gravel, etc. For successful long-tom operation a good supply of running water is essential. The drops between the boxes serve to break up the lumps of clay which may be contained in the gravel.

Sluicing.—There are many variations of sluicing, some of which are described herein, but it depends for its success upon a plentiful supply of water, and it is most easily conducted where the bed-rock has a good natural slope of at least 4 to 5 per cent. grade or more. Where a favourable grade is not available it becomes necessary to adopt some mechanical means of handling the gravels in order to operate at all efficiently.

For the simpler methods of sluicing, the sluice-boxes are made of rough lumber, very often from lumber which has been whipsawed or hewn from the tree by the prospector. The sluices, of which examples are shown in the sketches (Fig. 2), are made up in sections varying from 12 to 16 feet in length, with a width of 10 to 18 inches and a depth of 8 to 12 inches. Boards 1½ inches thick are commonly used, and for hand operations a sluice-box 12 feet long, 12 inches wide (inside measurement), and 8 inches deep is of practical use. One end of the box can be made narrower than the other, so that they may be telescoped and thus simply joined together.

The gravel to be washed is generally introduced to the sluice through a head-box equipped with a grizzly (bar-screen) made of poles, iron bars, or pipe. The spacing of the grizzly-bars will depend on the size of the gravel, and where fine gravel is to be washed it is preferable to use a perforated screen, or even to do without a grizzly, picking out the large boulders as they may be encountered, by hand.

Riffles, which are used for stopping the escape of the gold down and out of the sluice, are of many types, a few of which are shown in the sketches (Fig. 2). They may be constructed of wooden poles, wooden blocks, angle-iron, cobblestones, etc., and they may run the length of the sluice-box or across it. Pole riffles are common because they are easily obtained and do a very good job in separating coarse gold. Where much fine gold is obtained, riffles made of carpet, blanket-cloth, cocoa-matting, or burlap and held down by small wooden cross-riffles or expanded metal lath are often used. Fine material containing fine gold usually requires shallow, wide sluices set on a comparatively steep grade, while coarse material requires a narrow, deep sluice.

The length of sluices employed should be sufficient to disintegrate the gravel and free the gold, and for loose gravels this is accomplished in from 100 to 300 feet. For crude shovelling-in work from three to six boxes are commonly used (36 to 72 feet), and it is customary to keep lengthening the sluice just so long as the yield from the lower boxes exceeds the cost of installing and operating them. Short sluices fitted with drops and undercurrents are often more efficient than long sluices without them. A drop is simply a vertical fall between two sections of the sluice, and an undercurrent is a wide sluice set on a heavy grade to one side and below the main sluice, which is fed with the fine sands and gravels through an appropriate screen or grizzly placed in the bottom of the sluice. An undercurrent is of value for the recovery of fine gold, and should be placed some distance from the head or intake end of the sluicing system. For small operations the use of an undercurrent is a refinement rather than a necessity.

Some of the simple variations of sluicing are:—

Ground-sluicing.—In ground-sluicing, a stream, or a portion of it, is diverted to flow against or over a bank of placer-gravel, eroding it away and washing it to and through the sluice-boxes. It is a very useful method of working where plenty of water is available and the bed-rock has a good natural slope and smoothness. It requires about six times as much water for ground-sluicing as it does to do the same work in a box sluice. Very often ground-sluicing will wash away only the lighter and barren gravels, leaving behind the heavy gravels and pay-dirt, which must then be handled by "shovelling-in" methods, or by handling the gravel in cars, with scrapers or other mechanical means. Sometimes the spring floods can be used to remove much of the lighter material by ground-sluicing and the remaining material can then be handled by shovel during the low-water seasons. About 20 to 30 yards per day per man can be moved by this method of working under favourable conditions.

Booming.—Booming is the name given to the variation of ground-sluicing in which water is accumulated in dams and released at intervals by hand or automatically operated gates; the water rushes or "booms" down the cut, carrying the material with it.

Shovelling-in.—"Shovelling-in" is adapted to rich placer-gravels up to 6 or 8 feet in depth, or to gravel which has been partially concentrated by ground-sluicing or booming. It consists of hand-shovelling the gravel into sluices, cleaning up the bed-rock, picking out the boulders and stacking them to one side, disposing of the fine tailings or waste gravels from the sluices, cleaning up the riffles, and recovering the gold from the riffle concentrates.

Favourable conditions include a bed-rock slope as steep as or, preferably, steeper than the desired grade for the sluices, plenty of room for the disposal of the tailings, lots of water at all times, and a surface and bed-rock contour which can be drained so that the shovellers will not be working in water.

Sluices are generally set on a grade of 6 inches to the 12-foot box-sluice section, and where the bed-rock grades are not steep enough it becomes necessary to elevate the sluices on a trestle to get the necessary grade for washing. An average day's work for a man shovelling-in is about 7 to 8 yards under average conditions. From 6 to 8 feet is the maximum height for shovelling into elevated sluices.

Water is supplied to the head of the sluice by a pipe, ditch, or a flume, and about 1.3 to 3 cubic yards of gravel per 24 hours can be handled with a flow of 1 cubic foot of water per minute, or about 3,600 to 8,300 gallons of water are required for handling 1 yard.

Clean-up.—Sluices may be cleaned up every few days or only once in a season, depending on the richness of the pay-dirt. Generally the first two or three sections of the sluice should be cleaned up every two weeks, sometimes oftener. Clear water is run through the sluice until it is cleaned of any gravel, and then, starting at the head end of the sluice, the riffles are removed section by section while a small stream of water is kept running in the sluice to wash any of the lighter material remaining to the sections below. The gold, heavy sands, and amalgam (if quicksilver has been used) are scraped up and placed in buckets and afterwards cleaned in the usual manner with the use of the gold-pan.

Variations of Shovelling-in.—Shovelling-in may be done by moving the sluice to keep it close to the bank and, as the bank is cut away, moving the sluice over accordingly. In other cases where this would be expensive and result in delays while moving, or where the slope of the bed-rock would not permit this, the sluice is constructed in a semi-permanent manner and located centrally with respect to the area to be worked, and the excavated gravel is brought to

the sluice by wheelbarrows, scrapers, or cars. If the sluice has to be located on such a grade and at such a height as would prevent shovelling-in, use can be made of inclined skipways.

Power methods of placer-mining are used where the deposits are low grade, where they are covered with thick overburden, or where the slope of the bed-rock is not suited to hand-working methods.

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 and will be described under that heading.

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. 3.) 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, 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.

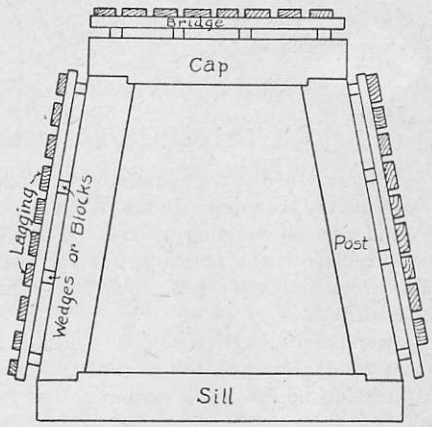


Fig. 3.

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.

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.

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.

* 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.

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 or bronco. 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 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.

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 paraffined 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.

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

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
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

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.

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

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	2.40
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.	60.00
Mosquito-net (for bed)	2.75
Candles, per dozen	.20

OTHER EQUIPMENT AND SUPPLIES.

Rifles, 30/30 carbine	$60.00
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	3.50–6.50
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 yds.	.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.	.26
Flour, per sack	1.65
Hardtack, per lb.	.15
Milk, dried (5-lb. tins)	3.10
Sugar, granulated, per sack	1.20
Sugar, brown, per lb.	.06
Salt, per lb.	.02
Mustard, ¼ lb.	.16
Pepper (black), ¼ lb.	.10
Cinnamon, ¼ lb.	.12
Yeast (Royal), per pkt.	.07
Chocolate (hard, sweet), per lb.	.20
Tea, per lb.	.40
Coffee, per lb.	.31
Butter (canned) (2-lb. tins), per tin	.78
Eggs (dried), 8-oz. tin	.83
Cheese (mild), per lb.	.18
Beef cubes, per tin	.23
Apples (dried), per lb.	.15
Figs (black cooking), 3 lb.	.25
Apricots (dried), per lb.	.22
Prunes (30-40's), 2 lb.	.25
Raisins (seedless), per lb.	.10
Potatoes (desiccated) (5-lb. tins), per lb.	.50
Onions, 10 lb.	.25
Rice (Jap), per lb.	.06
Barley, per lb.	.06
Beans (small white), per lb.	.05
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	1.25
Baking-soda (1's), per pkt.	.11
Tomatoes (canned) (2½'s), per tin	.10
Beans (canned), per tin	.10
Honey, 5-lb. tins, per tin	.55
Jam, strawberry, 4-lb. tins	.55
Syrup, 10-lb. tin	.70
Corned beef, 2 for	.25
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.

Under the "Placer-mining Act," a free miner may locate one placer claim or leasehold in his own name and one placer claim or leasehold for each of two free miners for whom he acts as agent, on any separate creek, river-bed, bar or dry diggings. Other placer claims or leaseholds may be acquired by purchase.

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 by the interpretation clause its scope is defined as "the mining of any natural stratum or bed of earth, gravel, or cement mined for gold or other precious minerals or stones." Placer claims are of four classes, as follows:—

"'Creek diggings': any mine in the bed of any stream or ravine:

"'Bar diggings': any mine between high- and low-water marks on a river, lake, or other large body of water:

"'Dry diggings': any mine over which water never extends:

"'Precious-stone diggings': any deposit of precious stones, whether in veins, beds, or gravel deposits."

The following provisions as to extent of the various classes of claims are made by the Act:—

"In 'creek diggings' a claim shall be two hundred and fifty feet long, measured in the direction of the general course of the stream, and shall extend in width one thousand feet, measured from the general course of the stream five hundred feet on either side of the centre thereof:

"In 'bar diggings' a claim shall be:—

"(*a.*) A piece of land not exceeding two hundred and fifty feet square on any bar which is covered at high water; or

"(*b.*) A strip of land two hundred and fifty feet long at high-water mark, and in width extending from high-water mark to extreme low-water mark:

"In 'dry diggings' a claim shall be two hundred and fifty feet square."

The following provision is made for new discoveries of placer-mining ground:—

"If any free miner, or party of free miners, discovers a new locality for the prosecution of placer-mining and such discovery be established to the satisfaction of the Gold Commissioner, placer claims of the following sizes shall be allowed to such discoverers, namely:—

" To one discoverer, one claim..... 600 feet in length;

" To a party of two discoverers, two claims amounting together to .....1,000 feet in length;

" And to each member of a party beyond two in number, a claim of the ordinary size only.

" The width of such claims shall be the same as ordinary placer claims of the same class: Provided that where a discovery claim has been established in any locality no further discovery shall be allowed within five miles therefrom, measured along the watercourses."

Every placer claim shall be as nearly as possible rectangular in form, and marked by four legal posts at the corners thereof, firmly fixed in the ground. On each of such posts shall be written the name of the locator, the number and date of issue of his free miner's certificate, the date of the location, and the name given to the claim. In timbered localities boundary-lines of a placer claim shall be blazed so that the posts can be distinctly seen, underbrush cut, and the locator shall also erect legal posts not more than 125 feet apart on all boundary-lines. In localities where there is no timber or underbrush, monuments of earth and rock, not less than 2 feet high and 2 feet in diameter at base, may be erected in lieu of the last-mentioned legal posts, but not in the case of the four legal posts marking the corners of the claim.

A placer claim must be recorded in the office of the Mining Recorder for the mining division within which the same is situate, within fifteen days after the location thereof, if located within 10 miles of the office of the Mining Recorder by the most direct means of travel. One additional day shall be allowed for every 10 miles additional or fraction thereof. The number of days shall be counted inclusive of the days upon which such location was made, but exclusive of the day of application for record. The application for such record shall be under oath and in the form set out in the Schedule to the Act. A claim which shall not have been recorded within the prescribed period shall be deemed to have been abandoned.

To hold a placer claim for more than one year it must be rerecorded before the expiration of the record or rerecord.

A placer claim must be worked by the owner, or some one on his behalf, continuously, as far as practicable, during working-hours. If work is discontinued for a period of seventy-two hours, except during the close season, lay-over, leave of absence, sickness, or for some other reason to the satisfaction of the Gold Commissioner, the claim is deemed abandoned.

Lay-overs are declared by the Gold Commissioner upon proof being given to him that the supply of water is insufficient to work the claim. Under similar circumstances he has also the power to declare a close season, by notice in writing and published in the Gazette, for all or any claims in his district. Tunnel and drain licences are also granted by him on the person applying giving security for any damage that may arise. Grants of right-of-way for the construction of tunnels or drains across other claims are also granted on payment of a fee of $25, the owner of the claims crossed having the right for tolls, etc., on the tunnel or drain which may be constructed. These tolls, however, are, so far as the amount goes, under the discretion of the Gold Commissioner.

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 permit 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.

Leases of unoccupied Crown lands approximately 80 acres in extent may be granted by the Gold Commissioner of the district after location has been made by staking along a " location-line " not more than one-half a mile (2,640 feet) in length. In this line one bend, or change of direction, is permitted. Where a straight line is followed two posts only are necessary—namely, an " initial post " and a " final post." Where there is a change of direction a legal post must be placed to mark the point of the said change. The leasehold is allowed

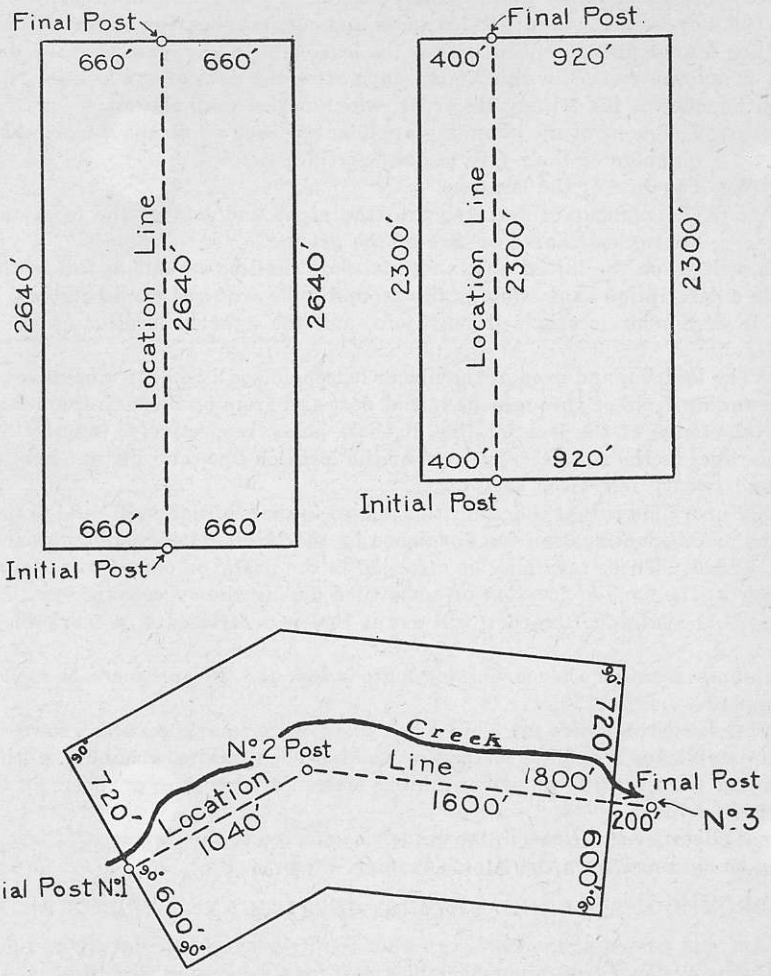
a width not in excess of one-quarter mile (1,320 feet), and the locator, both on his "initial post" and in his notice of intention to apply, which is posted at the office of the Mining Recorder, is required to state how many feet are included in the location to the right and how many feet to the left of the location-line.

That section of the Act dealing with the staking of placer-mining leases follows:—

"105A. (1.) For the purpose of locating a placer leasehold, a line to be known as the 'location-line' shall be marked on the ground by placing a legal post at each end, one post to be known as the 'Initial Post' and the other as the 'Final Post.' The direction of the location-line may change at not more than one point throughout its length, and an intermediate legal post shall be placed at the point at which the direction changes. The total length of the location-line, following its change of direction (if any), shall not exceed two thousand six hundred and forty feet.

EXAMPLES OF VARIOUS METHODS OF LAYING OUT PLACER LEASEHOLDS.

Showing Areas secured with Location-lines of Various Lengths.



"(2.) Upon the initial post and the final post shall be written the words 'Initial Post' and 'Final Post' respectively, together with the name of the locator and the date of the location. On the initial post shall also be written the approximate compass-bearing of the final post, and a statement of the number of feet of the leasehold lying on the right and on the

left of the location-line, as viewed from the initial post, not exceeding in the aggregate a width of thirteen hundred and twenty feet, thus: 'Direction of Final Post, , feet of this claim lie on the right and feet on the left of the location-line.' In addition to the foregoing, where there is a change of direction in the location-line as marked on the ground, the number '1' shall be written on the initial post; the number '2' shall be written on the intermediate post; and the number '3' shall be written on the final post. There also shall be affixed to the initial post a notice to the following effect, namely: 'Application will be made under the "Placer-mining Act" for a lease of the ground within this location.'

"(3.) The location-line shall at the time of location be marked between the legal posts throughout its length so that it can be distinctly seen; in a timbered locality, by blazing trees and cutting underbrush, and in a locality where there is neither timber nor underbrush, by placing legal posts or monuments of earth or stones not less than two feet high and not less than two feet in diameter at the base, so that the location-line can be distinctly seen.

"(4.) Where, from the nature or shape of the surface of the ground, it is impracticable to mark the location-line of a leasehold as provided by this section, the leasehold may be located by placing legal posts as witness-posts, as near as possible to the location-line, and writing on each witness-post the distance and compass-bearing of some designated point on the location-line from the witness-post; and the distances and compass-bearing so written on the witness-posts shall be set out in the application for the lease and in any lease granted thereon.

"(5.) The locator shall, within thirty days after the date of the location, post a notice in Form 1 in the office of the Mining Recorder, which notice shall set out:—

"(*a*.) The name of the intending applicant or each applicant if more than one, and the numbers of their free miners' certificates:

"(*b*.) The date of the location:

"(*c*.) The number of feet lying to the right and left of the location-line, and the approximate area or size of the ground.

The words written on the initial post and final post shall be set out in full in the notice; and as accurate a description as possible of the ground to be acquired shall be given, having special reference to any prior locations it may join, and the general locality of the ground to be acquired.

"(6.) The location and area of the placer leasehold shall be determined by establishing its end lines running from or through the initial post and from or through the final post, at right angles to the course of the location-line at those posts, respectively; and by establishing its side-line parallel to the course or courses of the location-line, and distant one thousand three hundred and twenty feet from each other."

Another provision is that there must be affixed to the "initial post" and to the "final post" a numbered metal identification tag furnished by the Mining Recorder with each free miner's certificate issued. These tags may be attached to the posts, or placed in a container within a cairn, either at the time of location or some time during the succeeding year, but must be so placed before the Mining Recorder will grant the first certificate of work in respect of the leasehold.

The annual rental on a placer-mining lease is $30, and the amount to be expended annually on development-work is $250.

Dredging leases on rivers for 5 miles below low-water mark are also granted. Section 122 of the Act establishes a definite method of staking such mining ground. Authority also has been given for the granting of placer-mining leases for dredging purposes in locations other than has been defined.

For more detailed information the reader is referred to the complete "Placer-mining Act," which may be obtained from the King's Printer, Victoria, B.C.

PROVISIONAL FREE MINERS' CERTIFICATES (PLACER) ACT.

This Act was passed at the 1932 session of the Provincial Legislature and provides for the issuance of "provisional free miners' certificates" for the locating, recording, representing, and working of placer claims of a size, and according to the terms, and in the manner set out in Parts II. and III. of the "Placer-mining Act." Any person over 18 years of age who has resided in the Province continuously for a period of not less than six months prior to date of his application may, on application accompanied by a statutory declaration or other satis-

factory evidence as to his age and period of residence in the Province, obtain from any Gold Commissioner or Mining Recorder a provisional free miner's certificate. No fees are payable in respect of such certificate, and it abolishes the fees payable in respect of the recording or rerecording of placer claims, but no record or rerecord of a claim shall be granted for a longer period than one year without the payment of fees. It should be pointed out that the provisional free miner's certificate does not carry the privileges of an ordinary free miner's certificate as to the staking and working of placer-mining leases or mineral claims.

An amendment passed at the 1933 session of the Legislative Assembly gives the Lieutenant-Governor in Council, as a means of unemployment relief, power to make provision for the establishment, equipment, maintenance, and operation of one or more placer training camps at suitable locations, at which unemployed persons who hold provisional free miners' certificates and are British subjects may acquire knowledge and training in the art of placer-mining and may be afforded gainful work in the recovery of minerals by placer-mining. Reserves for the location of such camps shall not exceed one mile in length by one-half a mile in width, and the right is given to enter into agreements with private holders under the Act for the development of their ground by means of unemployment relief camps.

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