

BRITISH COLUMBIA DEPARTMENT OF MINES

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BULLETIN No. 1, 1933

PLACER-MINING IN BRITISH COLUMBIA

COMPILED BY

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*To the Hon. W. A. McKenzie,
Minister of Mines, Victoria, B.C.*

SIR,—I beg to submit herewith Bulletin No. 1, 1933, being a special compilation of information regarding Placer-mining in British Columbia.

Two previous issues of bulletins relating to placer-mining in the Province—one in 1930 and one near the close of 1931—have been exhausted, 8,000 copies in all having been distributed. The present bulletin has been printed in order to take care of many inquiries regarding methods of placer operation by the individual, favourable areas for prospecting, and general information regarding placer opportunities. The reports of the Resident Mining Engineers on their respective districts clearly indicate that many latent opportunities for the individual and the capitalist still exist in placer-mining.

In order to cover the cost of publication, it has been found necessary to make a charge of 25 cents a copy for this bulletin.

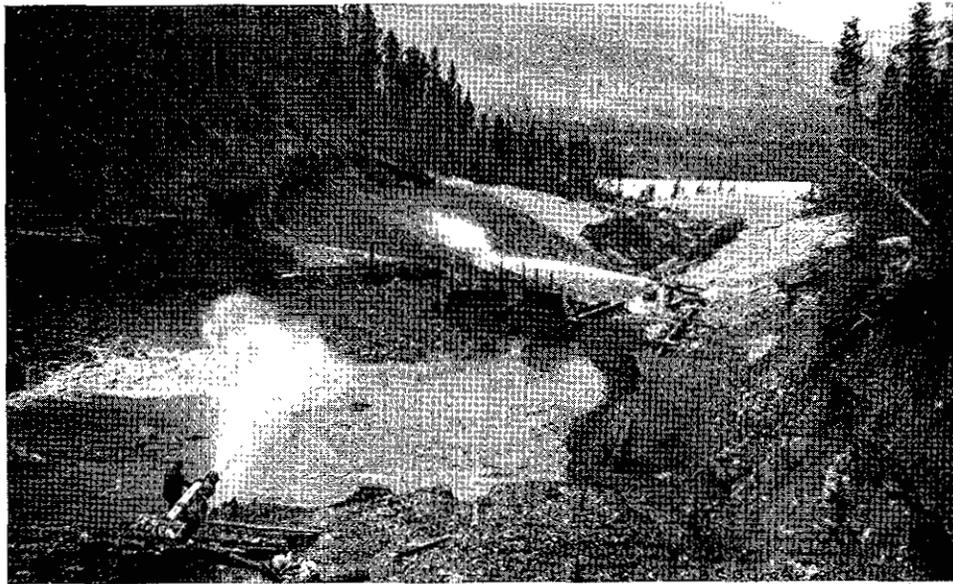
I am, Sir,
Yours faithfully,

JOHN D. GALLOWAY,
Provincial Mineralogist.

*Bureau of Mines,
Victoria, B.C., March 15th, 1933.*



PLACER-MINING IN 1863 ON WILLIAMS CREEK, CARIBOO.



MODERN HYDRAULIC GOLD-MINING, ATLIN.



INDIVIDUAL PLACER-GOLD MINING, QUESNEL.

PLACER-MINING IN BRITISH COLUMBIA.

GENERAL SUMMARY.

BY JOHN D. GALLOWAY, PROVINCIAL MINERALOGIST.

INTRODUCTION.

During 1932 much interest was shown in placer-mining. Prospecting has been particularly active, as many men, finding employment difficult to obtain, have scoured the hills with gold-pan and shovel in search of the yellow metal. Development of placer properties was vigorously prosecuted and productive hydraulics enjoyed a successful year.

Placer-prospecting was stimulated by the issuance by the Department of Mines of provisional free miners' certificates free of charge, which enabled the holders thereof to locate and record placer claims without cost. By the end of 1932 about 10,000 of these certificates were issued and many tried their luck at small-scale placer-mining. While many were unsuccessful, owing to being totally inexperienced, a fair percentage had a satisfactory season, making from \$1 to \$2 a day, and are being trained in this way for future years. Several new placer discoveries were reported, some of which promise to be of importance. Along the Fraser, Thompson, Similkameen, and other rivers, bars which have been unworked for years have again been attacked, and in the old placer camps many old diggings are being reworked.

Early in 1930, Bulletin No. 2, entitled "Placer-mining in British Columbia," was issued by the Department of Mines. This bulletin contained reports on special examinations of placer areas made in the field season of 1929, and in addition a general summary of placer-mining in the Province, including geological, historical, and statistical information regarding this branch of the mineral industry. Owing to the interest in placer-mining the demand for this bulletin soon exhausted the issue.

The bulletin was reissued as Bulletin No. 1, 1931, with some revision and addition of new material. This latter is now also out of print owing to the keen demand for such information. The present bulletin has been prepared in order to present briefly information on promising areas for placer-prospecting and methods of placer-mining. Much of the historical data and special reports contained in the previous bulletins has been deleted and the main material has been rewritten. Reports by the Resident Mining Engineers indicate clearly the many areas in the Province where opportunities exist for placer-mining of various kinds.

Although copies of the previous placer bulletins are not available for distribution, still they can be found in many libraries and mining offices in the Province. Those interested should have no difficulty, therefore, in seeing copies of Bulletin No. 2, 1930, and Bulletin No. 1, 1931. It is not intended that this bulletin on placer-mining will be reprinted in the Annual Report for 1932; it should therefore be preserved by those who desire a permanent file of the publications of the British Columbia Department of Mines.

PRODUCTION.

Measured by production, placer-mining has declined considerably in recent years. It is expected, however, that 1929 will mark the low point in the present cycle and that the trend will be upward in the future. The following table shows the output from 1858 to 1932:—

YIELD OF PLACER GOLD TO DATE.

1858	\$705,000	1877	\$1,608,182	1896	\$544,026	1915	\$770,000
1859	1,615,070	1878	1,275,204	1897	513,520	1916	580,500
1860	2,228,543	1879	1,290,058	1898	643,346	1917	496,000
1861	2,666,118	1880	1,013,827	1899	1,344,900	1918	320,000
1862	2,656,903	1881	1,046,737	1900	1,278,724	1919	286,500
1863	3,913,563	1882	954,085	1901	970,100	1920	221,600
1864	3,735,850	1883	794,252	1902	1,073,140	1921	233,200
1865	3,491,205	1884	736,165	1903	1,060,420	1922	364,800
1866	2,662,106	1885	713,738	1904	1,115,300	1923	420,000
1867	2,480,868	1886	903,651	1905	969,300	1924	420,750
1868	3,372,972	1887	693,709	1906	948,400	1925	280,092
1869	1,774,978	1888	616,731	1907	828,000	1926	355,503
1870	1,336,956	1889	588,923	1908	647,000	1927	156,247
1871	1,799,440	1890	490,435	1909	477,000	1928	143,208
1872	1,610,972	1891	429,811	1910	540,000	1929	118,711
1873	1,305,749	1892	399,526	1911	426,000	1930	152,235
1874	1,844,618	1893	356,131	1912	555,500	1931	291,992
1875	2,474,004	1894	405,516	1913	510,000	1932	346,800
1876	1,786,648	1895	481,683	1914	565,000		
				Total.....			\$79,227,741

It will be noted that the most important period was from 1858 to 1877, with the maximum production in 1863, with an output valued at nearly \$4,000,000. From 1875 to 1893 a steady decline ensued, and then the industry revived until 1904, when an output of \$1,115,300 was recorded. Since that time the output dwindled steadily until 1929 with a production of \$118,711. It is expected that the increased production in 1932 will be followed with a larger output in 1933.

Although production is relatively small, it should not be concluded that there is not much interest in the industry. Actually in the last five years much placer-mining has been carried on, but unfortunately in many instances without as yet very tangible production results. Much of this work has consisted of testing placer-ground, and in many instances the testing is not conclusive or completed. In a number of placer-fields of the Province plants for hydraulicking are being constructed, and some of these may be expected to be productive in the future. Much desultory small-scale work has been carried on, partly to recover gold and partly to prove up deposits of placer-gravels.

OUTPUT IN 1932.

The placer-gold production in 1932 was \$346,800, a substantial increase of 19 per cent. over the figure of \$291,992 recorded in 1931. The output from the larger operations was, in the aggregate, about the same as in the previous year, so that the winnings of individual and small-scale operations were considerably larger and more numerous than in 1931.

The following table shows the output of placer gold in 1932 by mining divisions, with district totals:—

PLACER-GOLD PRODUCTION IN 1932.

Districts and Divisions.	Ounces.	Value, \$.	DISTRICT TOTALS.	
			Ounces.	Value, \$.
North-western District (No. 1).....			8,401	144,347
Atlin.....	8,040	136,680		
Stikine.....	37	629		
Liard.....	357	6,069		
Skeena.....	36	612		
Queen Charlotte.....	18	306		
Bella Coola.....	3	51		
North-eastern District (No. 2).....			8,708	148,036
Cariboo.....	4,155	70,635		
Quesnel.....	3,338	56,746		
Omineca.....	627	10,659		
Peace River.....	588	9,996		
Central District (No. 3).....			689	11,713
Vernon.....	55	935		
Yale.....	224	3,808		
Ashcroft.....	128	2,176		
Kamloops.....	83	1,411		
Clinton.....	199	3,383		
Southern District (No. 4).....			452	7,684
Greenwood.....	180	3,060		
Osoyoos.....	2	34		
Similkameen.....	270	4,590		
Eastern District (No. 5).....			1,725	29,325
Fort Steele.....	543	9,231		
Golden.....	6	102		
Ainsworth.....	28	476		
Nelson.....	153	2,601		
Arrow Lake.....	4	68		
Trail Creek.....	7	119		
Revelstoke.....	908	15,436		
Lardeau.....	76	1,292		
Western District (No. 6).....			335	5,695
Alberni.....	1	17		
Clayoquot.....	18	306		
Victoria.....	2	34		
New Westminster.....	21	357		
Lillooet.....	293	4,981		
Totals.....	20,400	346,800	20,400	346,800

It is believed that this year substantially accurate figures of placer production have been obtained, although it is possible that some small lots of gold were secretly taken out of the country and no record of them obtained. The assistance rendered by branch banks and store-keepers throughout the Province, by making a voluntary monthly return of gold handled by them, either for transmission to branches of the Mint or taken in payment for supplies, has been and is of great help in obtaining a record of the output of placer gold. To these institutions and individuals the thanks of the Bureau of Mines is given.

GENERAL GEOLOGY OF BRITISH COLUMBIA PLACER-FIELDS.

While it may seem to be rather out of the question to generalize regarding the geological features of placer-fields which are many hundreds of miles apart, still there are certain conditions which pertain to all the placer areas of the Province; and a realization of these may be decidedly useful.

In the following geologic discussion, only a brief summary is given and in general reasons are not given for the conclusions reached or ideas advanced. In the aggregate there is an extensive literature on British Columbia placer deposits, which contains much of the evidence on which this summary is based.

It is noticeable that the important placer-fields of the Province lie along a broad zone stretching north-westerly from the International boundary-line up to Atlin and extending into Yukon Territory. This fact gave rise to an early theory of an immense "flow" of gold-bearing gravels or "wash" traversing the Province along this line; the theory, of course, was quite untenable and erroneous.

This grouping of the main placer areas along one zone was noticed by Dawson, who said:—

"While it may now be safely affirmed that gold is very generally distributed over the entire area of the Province of British Columbia, so much so that there is scarcely a stream of any importance in which at least 'colours' of gold may not be found, the enumeration of the principal discoveries of important mining districts show very clearly that most of these are situated along the system of mountains and high plateaus which comprises the Purcell, Selkirk, Columbia, and Cariboo ranges and their north-western continuations, lying to the south-west of the Rocky Mountain range properly so called, and parallel in direction with it. Of all the gold-producing districts that of Cariboo has proved the richest and the most continuously productive."

Physiographically the placer-fields are situated in the Central Belt of the Cordilleras of Canada. This Central Belt is comprised of the Columbia, Interior, Cassiar, and Yukon systems, which systems in turn include the Selkirk, Monashee, and Cariboo mountains and the Fraser, Nechako, and Yukon plateaus.

Generally speaking, the placer-fields of British Columbia occur in plateau areas where alpine mountains are absent. As a rule the topographic relief is not great, although in places the deep valleys of the Fraser plateau give an appearance of true mountainous topography. Even in the Selkirk and Cariboo mountains the placer-fields are found in topographic areas transitional between plateaus and typical mountain ranges.

Rocks of many varieties and formed over a considerable range in geologic age are found in the various placer-fields. In many of these areas a noticeable feature of the rock formation is the large number of quartz veins that are exposed. For the purpose of this discussion it is unnecessary to enumerate the types of rock formations occurring in the placer camps, but it is important to bear in mind that quartz veins are almost always present, varying in size from mere stringers up to ledges 100 feet in width. In some areas auriferous slates are mentioned by some writers, but these generally consist of slates containing small irregular quartz stringers, and it is in these that the gold occurs.

The most important period of mineralization in British Columbia was in Jura-Cretaceous times following the intrusion, or series of intrusions, of batholithic rocks expressed in the Coast range, Bulkley mountains, Cassiar-Omineca, Central, Nelson, and other batholiths and stocks which form a dominant feature of the geology of the Province. Another deeply concealed batholith is postulated as responsible for certain mineralization in the Cariboo district, which is believed to be much older than the widespread Jura-Cretaceous intrusives. The age of this Cariboo batholith is placed as pre-Mississippian, and it may be pre-Cambrian. It is important as occurring where the richest placer and lode deposits of the Cariboo are known.

It is believed that the quartz veins of the placer-fields stretching from South-east Kootenay to the Yukon were formed by these intrusive agencies. Although occurring in host rocks of a

wide variety, these quartz veins are characterized by the presence of small amounts of sulphides (in particular pyrite and arsenopyrite) which are in part gold-bearing. It is further believed that the erosion of these quartz veins and later concentration and reconcentration of the contained gold gave rise to the placer deposits. It follows, therefore, that in all cases of rich placer deposits the gold had a local origin, but that the fine gold (flour-gold) from this source had a widespread distribution throughout the gravels of the Province.

A long period of erosion took place in the late Cretaceous and Tertiary periods, and it is believed that extensive placer deposits were formed then in the stream-valleys. For a description of the processes by which the gold in the sulphides of the quartz veins was concentrated in the veins by solution, precipitation, and repetitions thereof, thereby deposited at the water-level, eroded and finally concentrated in the stream-gravels, the reader is referred to the convincing and elaborate discussion in the Report on the Barkerville Area, by Johnston and Uglov, Memoir 149, Geological Survey of Canada, 1926.

While this report is confined to the Barkerville area, it is believed that this is an excellent description of what has taken place in many placer-fields of the Province. Similar conditions are noticeable in East Kootenay, Granite Creek, Atlin, and other camps.

It is assumed that at the close of the Tertiary there were a number of rich and continuous placer deposits in the various fields of the Province. Then the Glacial age arrived and immediately much havoc was created with the placer deposits. In large part they were obliterated and the placer-gravels transported far and wide and the gold content so admixed with barren gravels as to make them of no economic value.

It is generally agreed that British Columbia was covered with a large ice-sheet, and that there was a recurrence of this condition at intervals, with interglacial periods between. It is also evident that in the Central Belt the ice-sheet was not particularly active, but was more or less stagnant, in contrast to the active glaciation that prevailed in the more rugged mountainous belts of the Province where glaciation was a potent force of erosion. With the exception of valley glaciers at the end of the Glacial age or in inter-Glacial periods, the great ice-sheet did not actively erode the rock formations of the Central Belt. To this is due the fact that there are bonanza placer-fields left and also explains (at least, in part) the virtual absence of important placer deposits in the Western Belt, where glaciation had a much greater erosive action. The Eastern Belt is also lacking in placer deposits, but this is probably due mainly to the lack of original gold mineralization in the rock formations.

Plenty of evidence is to be found in the Cariboo district to show that glaciation did not erode rock formations to any great extent, and in places there are remnants left of what undoubtedly are original Tertiary gravels. Glaciation, however, did profoundly affect the gravels of the area by eroding them in part, distributing them, and by means of glacial streams roughly re-sorting and partially concentrating them.

The writer would like to emphasize the point that the most important feature of placer geology in British Columbia is the effect of glaciation. It is the cause of many perplexities, and a lack of knowledge of glacial geology is the reason that so many ill-advised placer ventures have been attempted, with consequent financial failure.

It is recognized that all bonanza placer deposits in British Columbia were either in original Tertiary gravels or in gravels which represent a direct reconcentration by Glacial or post-Glacial streams of original Tertiary gravels.

Placers in British Columbia may be broadly divided into the following classes:—

(1.) Original Tertiary gravels. Only remnants and fragments of these are left and in following a Tertiary channel it may be cut off abruptly; this sudden termination is due to erosion by glaciation. They occur on bed-rock and are usually buried beneath glacial gravels. This is the "lead" gold of the old-timers.

(2.) Inter-Glacial gravel deposits. In many instances these gravels are deposited on a previously deposited glacial clay, but may occur on bed-rock. These are derived by interglacial stream-action concentrating glacial gravels robbed from original Tertiary channels.

(3.) Post-Glacial gravel deposits. The Pleistocene or Glacial epoch scattered enormous masses of gravels across the country and particularly in the main stream-channels. In the zones of original Tertiary placer deposits these glacial gravels contained more or less gold, but almost always the original placer-gravels were so diluted with extraneous material that the final depositions of glacial gravels were of no economic value as placer deposits. In this connection

it should be remembered that ice-erosion did not concentrate. In places these glacial gravels have been concentrated by post-Pleistocene stream-action, but as a rule these deposits are low grade, with the exception of bar deposits, which sometimes have rich shallow ground.

Variations of these three types occur, but in a broad general way this classification includes all placer deposits in the Province. In some cases ancient channels have been left stranded through diversion of the waters by glaciation, covered by glacial gravels, and later these ancient channels were robbed by recent stream-action giving rise to rich placers in the present streams. This was well exemplified by Keithley creek, Quesnel Division, and in part on Lightning creek.

Masses of Tertiary gravels with a rich gold content have apparently in places been plucked out by glaciation and deposited almost intact away from the original source and entirely surrounded by glacial gravels. This has been suggested as the explanation of the rich patch at Cedar creek, Cariboo Division.

Enough has been said to show that the dominant feature of British Columbia placer geology is glaciation and that much cautiousness must be used in assuming continuity of any placer deposit. Much futile work has been done on the assumption that a rich pay-streak in an ancient channel should continue for miles. The channels often do continue, but in many instances are barren of pay-gravels.

The Graham Island deposits are probably of type 3, but have been mainly concentrated in the present deposits by wave-action.

ANCIENT CHANNELS.

The history of every placer camp in British Columbia is filled with stories of ancient channels, and many channels are theorized running in all directions. While such theories are valuable if reasonably based on proper field evidence, undoubtedly they are responsible for much work that was in no way justified.

Throughout the important placer-fields of the Province the master-drainage in Tertiary times was probably very similar to what it is at present. Local drainage, however, has been profoundly altered in many instances. Many of the present streams have stranded channels in the benches which represent various positions of the stream from Present back to the Tertiary age. Depending on successive uplifts, rejuvenation of streams always results in different levels and stranded ancient channels. In many instances, however, the stranded channel is no more than a bench and as such not necessarily a likely place for coarse gold.

Glaciation undoubtedly reversed, altered, and changed the local drainage in many places, but did not materially affect the master-drainage of the country. Theories of ancient channels that parallel or diverge at slight angles from the present drainage are worthy of investigation and testing, but those ideas that postulate large channels, running at random across the country, should be dismissed as highly improbable.

Further work by W. A. Cockfield and J. T. Walker, of the Geological Survey of Canada, in the Cariboo Division was commenced in 1932. It is expected that this work will be steadily carried on until the important placer and lode area is completely geologically mapped. The value of this work is exemplified by the small Barkerville area mapped and examined by W. A. Johnston and W. L. Uglow. Their report—Memoir No. 149, Geological Survey of Canada, issued in 1926—contains much useful information on the placer and lode-gold deposits of the area, including an elaborate discussion of the origin of the placer deposits. The present work now under way will undoubtedly be useful in connection with studying ancient channels, and it is these ancient channels that provide the more important possibilities of further profitable placer deposits.

PLATINUM.

Metals of the Platinum group occur in sparing and irregular quantities in the placer-gravels of the Province. The most important area has been the Tulameen section of the Similkameen Division. The origin of this platinum is in a belt of peridotite rocks cut by the Tulameen river and its tributaries. In the gravels of this section there is a considerable content of black sand carrying varying amounts of fine gold and platinum which is difficult to recover by ordinary methods. An efficient and economical process for treating this black sand to recover these metals would probably make possible the profitable operation by hydraulicking or dredging of certain of these gravel-deposits which cannot be worked otherwise.

Platinum also occurs in the gravels of the Quesnel river and its tributaries, but very irregularly distributed. Similarly, small amounts have been detected in black-sand concentrates from gravels of the Fraser river. No appreciable production of platinum has ever been recorded from these localities. The Quesnel River gravels in many places, however, carry a high content of black sand and a proper treatment system might show values in fine gold and platinum in these sands which would pay to recover.

Small amounts of platinum also occur in Atlin Division and Graham island, but are not of great importance. Other Platinum group metals, such as iridium, osmium, and palladium, occur in small amounts associated with the platinum, especially in the Tulameen section.

EXPERIENCE FROM RESULTS OF PLACER-MINING IN BRITISH COLUMBIA.

By studying the record of placer-mining in British Columbia it is seen that in every camp some good pay-ground was first discovered, which was easily worked at a satisfactory profit. Later on, extensions of the shallow bonanza ground were explored with varying degrees of success.

As a rule, when costly plants were installed to work by drifting methods deep ground with heavy water-pressure, no success was attained. On the other hand, many successful hydraulic plants have been operated on ground too low grade for drifting, or in places where a rich pay-streak had been partially drifted out by the old-timers.

It is quite apparent that deep-drifting operations in many instances were unsuccessful because the pay-streak or "lead" of rich gold gravel ceased owing to various causes. Pay-streaks of coarse gold, which undoubtedly were of direct local origin, could not be expected to extend to any great distance from the source of gold: secondly, many of these pay-streaks terminate abruptly through the gravels being eroded by glaciation.

The whole history of placer-mining in British Columbia shows that, in the majority of instances, altogether inadequate testing of the ground was carried out before proceeding with installation of costly equipment and construction-work. In the early days testing of ground was primitive, and in the bonanza fields probably unnecessary. Later, testing was done by pits, shafts, and tunnels, and on the results of one favourable test extensive plans were frequently laid out and executed. In many cases far too much was assumed without thorough testing.

In later years the use of churn-drills—such as the Keystone and others—have been used to test placer-ground, but, owing to many prejudices, not as full use has been made of this excellent device as would be desirable. Drilling, if properly conducted, is the most economical and efficient method of testing placer-gravels. It gives information as to values, character of gravels and clays, and depth of bed-rock; but it only gives this information if the work is systematically carried out by experienced operators. The writer has knowledge of much testing of placer-ground in British Columbia which is entirely valueless so far as reliability of results is concerned; some of this was by drilling and some by other methods.

Without elaborating further, it is quite evident that the moral to be taken from the results obtained from much money spent on unsuccessful placer enterprises in British Columbia is that careful and adequate testing of the ground is essential before assuming that any ground will pay to work. In some instances it is argued that the cost of drilling the ground would be as great as installing a hydraulic plant, and that if a reasonable assumption can be made that the ground carries pay-gravel, then the plant should be installed without testing. Such cases are extremely rare, and as a rule ground can be tested for a small percentage of the cost of plant and equipment to work it.

FUTURE POSSIBILITIES.

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 through ice-erosion, 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 which cannot be profitably handled by present methods.

If further detail geologic work is done in the various placer areas, particularly in the Central Belt, it seems probable that many interesting possibilities will be brought to light and capital will be encouraged to test out various gravel-deposits now unknown.

METHODS OF WORKING.

Practically every method of working has been used in the placer-fields of British Columbia. The early miners in each camp started with pans and rockers; and this was followed by deep-drifting methods, the pay-gravels being washed in sluice-boxes. The old-timers of the Cariboo did wonderful work in deep-drifting operations; Cornish pumps and water-wheels were used to handle the water and ground heavy with slum and water-pressure was successfully handled. In the Cariboo after 1864 many elaborate deep-drifting enterprises were commenced to mine continuations of channels worked by the old-timers. It was assumed that with more modern machinery areas unprofitable to the old-timer would pay to operate, but practically none of these projects have been successful.

Later, hydraulic operations were commenced and in recent years the bulk of the placer production of the Province has come from hydraulic operations. Variations of ordinary hydraulic practice have been used, including hydraulic elevators and the so-called "pump-hydraulic." This latter system is used where water is scarce and the water is caught in dams below the operation and pumped back to be used again under a pressure-head; it is a costly and generally inefficient system, only suitable for rich shallow ground. Some excellent hydraulic systems have been installed in the Province, particularly in the Cariboo, Quesnel, Liard, and Atlin Divisions.

Dredging has been tried in several places, but nearly all the dredges have been of poor design or a new unproven invention that proved unsuitable for the work. Probably the only really modern dredge installed in the Province was the one at Antler creek, Cariboo Division, operated by the Kafue Copper Development Company. Mechanically this dredge was successful, but the operation unfortunately was not a financial success. This dredge has now been scrapped and the machinery shipped out of the country.

Variations of dredging, such as steam-shovels, gas-shovels, and drag-line scrapers, have also been used to dig placer-gravels. Generally, every available device has been used in attempting to exploit the latent wealth of the placer deposits of the Province.

ELEMENTARY PLACER-MINING METHODS.

BY A. M. RICHMOND, ASSISTANT RESIDENT MINING ENGINEER.

INTRODUCTION.

Only a few of the large number of inexperienced newcomers who were attracted to the possibilities of small-scale placer-mining along the many known gold-bearing streams of British Columbia during the summer of 1932 had any knowledge of the conditions they would meet in their summer's work; a few of them prepared themselves beforehand by studying all the available information on where and how to prospect, how to work placer-gold deposits, and, as far as their finances permitted, provided themselves with what equipment they believed would best suit the conditions and places they planned to prospect. Unfortunately, however, the majority of those venturing forth were not so equipped and they found themselves badly handicapped by their lack of knowledge of even the most elementary methods of prospecting for, and the mining of, placer-gold deposits.

Information is presented in other sections of this bulletin by the Resident Mining Engineers describing favourable areas in the Province for placer-prospecting. The notes which follow have been compiled from various sources (listed in the bibliography) to provide the amateur small-scale placer-miner with non-technical descriptions on such subjects as: Prospecting for placer gold; testing of placer-gold deposits; simple methods of recovering gold from placer deposits with the aid of the gold-pan, rockers, long-toms, and sluices; methods of constructing rockers, sluices, and riffles; the use of mercury for the amalgamation of fine gold and the recovery of the gold from the resulting amalgam by retorting; the value of black sands and the recovery of precious metals from the black sands. The notes are primarily for the novice, and while brief descriptions have been included to give the principles of hydraulic mining, drifting, and gold-dredging, it will be appreciated that drift-mining should only be undertaken by experienced placer-miners, and that hydraulic mining and gold-dredging require large initial expenditures of capital for their proper inception and should only be undertaken on the advice of an experienced placer engineer after a thorough examination of the deposit has shown it to have commercial possibilities. For those who are interested in studying further detail than is considered necessary for this elementary treatise the many publications listed in the bibliography will be found helpful. Most of them can be referred to in any well-equipped public library, or may be purchased at small cost.

PLACER DEPOSITS.

Placers are deposits of sand, gravel, or other alluvial material which contain particles of valuable minerals in workable quantities. In addition to the occurrence of gold in placers, other valuable minerals such as platinum, cassiterite (tin ore), silver, copper, rubies, and diamonds may also be found in placers.

There are two general types of placer deposits: (1) Residual placers and (2) transported or alluvial placers. In both types the source of the gold was originally in lode or vein deposits in the solid rock, the gold being eventually freed from its enclosing rock by the action of the elements (changes in temperature, frost, rain, wind, chemical actions) gradually decomposing and partially removing some of the rock by mechanical means or in solution. In the case of residual placer deposits, which are comparatively unimportant as a source of placer gold, the gold and much of the decomposed vein-rock is left in approximately its original location.

Transported placers, also derived by the weathering of lode and vein deposits of gold, result from the removal of the decomposed gold-bearing rock by natural agencies, principally running water, and the further crushing and breaking of the rock during the period of travel by the action of solution and abrasion, which in turn is followed by the sorting action of the moving water which carries away the lighter and finer material and permits the deposition of the heavier materials, including the gold and black sands, at places in the stream where the velocity (speed) of the moving water is reduced. The largest and heaviest pieces will obviously be deposited first, or nearest their origin in the lode or vein, while the lighter and finer material will frequently be carried long distances. Due to the different amounts of water which will flow in any stream during the course of many seasons, the gold, black sands, and rock material deposited in the stream-bed will be re-sorted and worked over many times until finally the gold, black sand, and other heavy particles of metal work down through the gravel and become concentrated at or near bed-rock of the creek-bottom. After the gold reaches bed-rock, or a clay or hard-pan false bed-rock, it may be moved slowly down-stream until it lodges in crevices, cracks, or other irregular openings in the bed-rock.

There is no fixed rule as to where gold is apt to occur in the stream-bed, as the velocity of the stream is not the same at all points and the gold is naturally dropped by the water to the stream-bottom when the velocity of the water is not sufficient to carry it along. At the time of formation of transported placer deposits, water was necessarily present, but later disturbances, geological changes and erosion, changes in the stream-course, or changes in the climate may have caused the stream to flow in a different location or to dry up, thus leaving the placer deposit high up on the bank of a stream or in a dry location.

Streams are often found to have a bed of clay or hard-pan on or above the true bed-rock. This layer of clay is known as a false bed-rock and it may have a marked effect on the distribution of the gold in the placer. Clay and hard-pan form impervious beds on which the deposition

of gold may take place, and while they act as concentrating horizons in the stream-bed it does not mean that gold will not be found below them on lower horizons, for the gold might have been deposited lower down in the stream-bed before the clay and hard-pan beds were formed.

To distinguish between the many types of transported placers the following are some of the terms used to describe the most commonly encountered types:—

Creek Placers.—These are gravel-deposits found in the beds and intermediate flood-plains of small streams. They are generally shallow and have been the most productive of high-grade placer gold, the gold generally being concentrated on or just above bed-rock. If the bed-rock is badly broken or decomposed the gold will be found in the cracks and crevices, and it will be found necessary to dig down into the bed-rock to make a good recovery of the gold values.

Culch Placers.—This type of placer is similar to the creek placer, except that the stream is usually intermittent in its flow or has been dried up altogether.

River-bar Placers.—When bars of gold-bearing sand or gravel have been formed along the sides and in the centre of the larger streams and rivers they are known as river-bar placers. The gold is often distributed throughout the bar and is generally fine as compared to the coarser gold found in the creek placers. Bar placers are generally low grade, but occasionally very rich bars are found.

Bench Placers.—Gravel-deposits of gold-bearing material in old (ancient) stream-channels and flood-plains which stand 50 to several hundred feet above the present stream or river level are called bench placers and represent the remnants of stream-beds which existed in the earlier stages of the stream-development.

Lake-bed Placers.—Placers formed in the beds of present or ancient lakes formed by landslides or glacial dams across the gold-concentrating stream.

Sea-beach Placers.—Placers reconcentrated from the sea-coast gravels by the action of the waves along the sea-shore.

MINERALS ASSOCIATED WITH PLACER GOLD.

Placer gold nearly always occurs in association with "black sands," the black sand being composed principally of grains of magnetite (magnetic iron oxide) and varying amounts of hematite (non-magnetic iron oxide), ilmenite (titanium iron oxide), and pyrite (iron sulphide), etc.

The specific gravity or density of placer gold is fifteen to nineteen times that of water, varying somewhat owing to different percentages of silver usually found alloyed with it. Magnetite has a density of five, so that placer gold is three to four times as heavy as magnetite, the chief constituent of the black sands. Quartz, the commonest rock found in association with gold, is only one-sixth to one-seventh as heavy as gold, and during the transportation and sorting of the placer-forming material the quartz grains and grains of other light minerals and rocks are carried away while the gold, black sand, and other heavy minerals are dropped and, due to their weight and the sorting action of the stream, sift down between the boulders and larger pebbles until they come to rest on the bed-rock. Likewise, in panning or in other methods of artificial separation of the gold from the placer-gravels, the black sands and heavy minerals will remain longest with the gold and will be the last to be separated therefrom.

With a little experience and practice, gold is readily distinguished from other minerals, the ones which are usually the most deceiving being iron pyrite (fool's gold) and bronze or golden-coloured mica. Pyrite is brittle and is readily broken by crushing, whereas gold is malleable, and when it is hammered it simply flattens out into thin flakes without breaking. Mica is easily distinguished from gold by its light weight and the fact that when it is hammered it breaks into white-coloured flakes.

SIZE OF GOLD PARTICLES IN PLACERS.

Placer gold is of all sizes, from large nuggets weighing several ounces (occasionally pounds) to minute specks known as "colours." It usually occurs in flattened and rounded grains, and when it is found as angular and occasionally crystallized particles, nearness to the primary source of the gold is indicated. Gold retained on a 10-mesh screen (openings $\frac{1}{15}$ inch square, approximately) is called coarse gold. Medium-sized gold varies from $\frac{1}{15}$ to $\frac{1}{30}$ inch in diameter, while fine gold from $\frac{1}{30}$ down to $\frac{1}{70}$ inch in diameter will average about 2,200 colours to the ounce, each colour being worth about $\frac{3}{4}$ cent. Very fine gold will average about 40,000

colours to the ounce, while flour-gold, or colours, readily visible in gold panning, will be so small that it will take over 1,000,000 of them to make an ounce of gold (575 colours to the cent).

PROSPECTING FOR PLACER GOLD.

Since streams and their tributaries are the principal agencies in the formation of placer deposits, the first search for placer gold is generally made along the stream-beds, on the stream-bars, and the tributary gulches in areas that are known to be favourable for placer deposits (*see* the various recommendations of the Resident Mining Engineers). Even though the valuable deposits of placer-ground may be located up on the benches of the stream, the presence of gold will almost invariably be indicated by showings obtained in test-panning done along the stream below.

In prospecting along a stream the prospector should pan the gravel at many points, selecting particularly such places as show evidences of concentration of the minerals by the presence of black sands. Also, since the gold and heavy minerals will ordinarily be found concentrated on bed-rock, the placer prospector should carefully investigate all exposures of bed-rock along and in the stream, especially those depressions wherein minerals might easily be caught. Test-pits to bed-rock on the bars and banks of the stream are also recommended in examining any areas which respond to preliminary stream-panning. The results of panning tests are noted, preferably on a rough map or sketch prepared by the prospector, and if a section shows a better concentration in one or two points the prospector should give some attention to the sinking of test-pits and prospecting on the slopes above the stream-bank in an effort to find the best areas.

The gold-pan is an indispensable tool in prospecting in either a large or small way. It is a circular dish, commonly made of sheet iron, with sloping sides, and varies from 10 to 18 inches in diameter, with a depth of 2½ to 3 inches. The pan should be light, but stiff enough to withstand hard usage, and the inner surface should be smooth, bright, and kept free from grease and rust. Pans made of copper or with a copper bottom are sometimes used for panning, because the copper may be coated with quicksilver (mercury) and used to amalgamate fine gold which is often otherwise lost in panning. Fig. 1 shows a gold-pan of the ordinary type which can be purchased for about 75 cents at most hardware stores.

Panning.—The operation known as panning will be described here, because it is essential that a practical knowledge of how to pan be known before placer-ground can be properly tested. The material to be panned or tested is dumped into the pan, filling it about two-thirds full. The operation of panning is simple, but requires a knack only developed by practice, and is difficult to describe clearly by words alone. The pan of material is held under the water and is mixed and kneaded with the hands, breaking the lumps of clay and other easily broken material. If the pan is held in running water, some of the lightest and finest material will immediately wash away. The rocks and pebbles are washed and picked out and discarded, and after all the lumps of soft material are broken up to free any gold which may be trapped in them, the regular panning operation is begun. The pan is 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 as the pan is held slightly tilted away from the operator. The motion of the pan serves to concentrate the gold and heavy minerals around the edge of the bottom of the pan, and the washing-away of the light material is facilitated by alternately raising and lowering the far edge or lip of the pan above and below the surface of the water. The pan should occasionally be lifted entirely from the water and shaken vigorously with the usual circular motion to concentrate the gold and heavy sands and to bring the pebbles and fine light material to the top. This material may be scraped off the lip of the pan with the thumb, thus hastening the operation of panning. Panning is continued until only the gold and heaviest minerals remain in the pan. Towards the end of the operation it may be well to finish panning in a tub of water instead of in the stream, since any gold that may inadvertently be carried away may be recovered later by panning the contents of the tub. The final product is dried and the magnetic black sand is separated with a magnet of the ordinary horseshoe type. The coarse gold can be easily picked out piece by piece and the fine gold may be recovered by amalgamation with quicksilver, or with care by blowing away the sands from the gold with the aid of a small straw.

Experienced placer-miners will pan about 100 pans in ten hours, the exact number depending on the coarseness of the gold, the amount of clayey and cemented gravels panned, and the skill

of the individual panner. The ordinary gold-pan holds about 265 cubic inches of gravel on the average, or 176 pans of gravel will correspond approximately to 1 yard of gravel in place. A good man with a pan will handle about $\frac{1}{2}$ to $\frac{3}{4}$ 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 gravel in this day.

Testing of Placer-ground.—In small-scale work or hand-work, prospecting, testing, and actual mining, whether by panning, rocking, or sluicing, are usually all done at the same time. That is to say, the deposit is prospected as it is being mined, and the work is shifted from place to place according to the disclosures made during the progress of the work. The results of pan samples are used as a guide in working the small property.

For large deposits of low-grade gravels which can only be worked profitably by mechanical means involving large capital expenditures, a thorough preliminary prospecting and testing of the deposit is required. This is done by means of test-pits and drill-holes, depending on the characteristics of the deposit. After the average values, yardage, and distribution of the gold have been determined with accuracy, the following things must be considered before planning the actual methods of gold-recovery: The thickness of the gravel; the depth of overburden; the topography of the country; the nature of the bed-rock; the conditions governing the disposal of the washed gravels; the water-supply available; the character of the gravels, whether cemented, bouldery, or otherwise; the methods available for excavating, transporting, washing, and recovering the gold; as well as the local transportation and climatic conditions. The three most important items are the extent and value of the deposit, the presence of adequate supplies of water, and tailings-disposal room on a gravity-grade.

PLACER-MINING METHODS.

Placer-mining is conducted by both underground and open-cut mining methods, the underground placer-mining being called "drift-mining" and employed for the mining of buried placer deposits. The open-cut methods of placer-mining may best be classified according to the equipment used, as follows:—

- (1.) Hand methods: (a) Panning; (b) rocking; (c) long-toms; (d) sluicing, including ground-sluicing and booming.
- (2.) Power methods in conjunction with sluicing: (e) Drag-scraping; (f) hydraulic mining; (g) power-shovelling; (h) gold-dredging.
- (3.) Dry placer-mining.

Placer-mining in principle implies the excavation or digging of the gravel, the transportation of the gravel to the equipment which disintegrates and washes it, and the removal of the waste tailings, followed by the recovery of the heavy minerals caught in the gold- or mineral-catching riffles.

The power methods of placer-mining all employ sluicing in some form for the recovery of the gold, the chief distinction between the power and hand methods coming in the methods and equipment used for excavating and conveying the gravels to the sluices. The sluices are the same in principle in each case, and as this report is concerned primarily with hand methods of placer-mining which may be used by the man with limited capital, only a brief reference will be made to the various methods of power working.

Hand methods of working are useful for small-scale operations on deposits of fairly high-grade gravel which are of shallow depth and covered with not more than a very shallow covering of barren material.

Panning.—The limitations of panning as regards the amount and grade of the material which can be profitably handled have already been indicated under the notes on how to pan. It is slow, laborious, back-breaking work which requires plenty of perseverance, but since the only tools used are a pick, shovel, and pan, it is often the poor man's favourite method of working.

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.

ELEMENTARY PLACER EQUIPMENT.

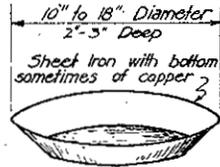
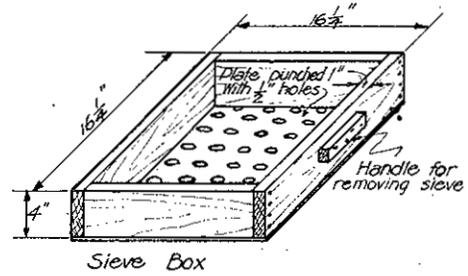


Figure 1. Gold Pan.



Sieve Box

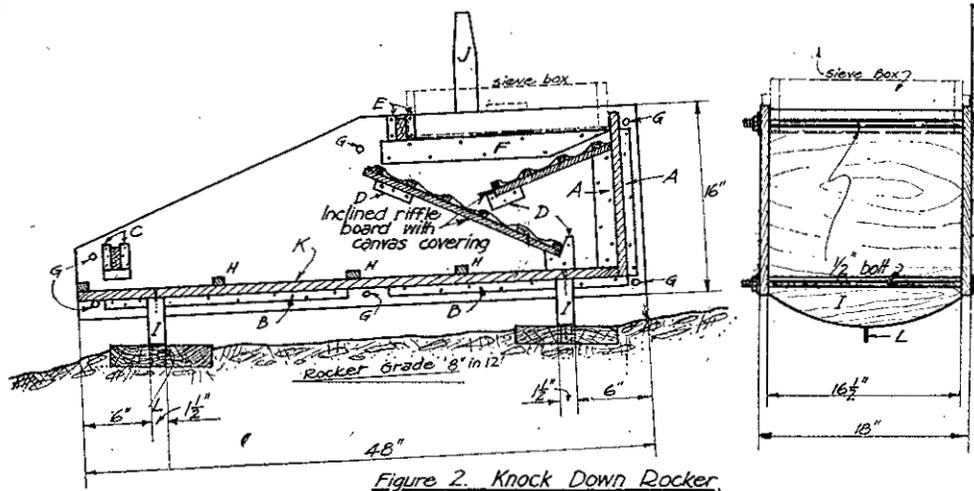


Figure 2. Knock Down Rocker
(After Eng'g Min Journal)

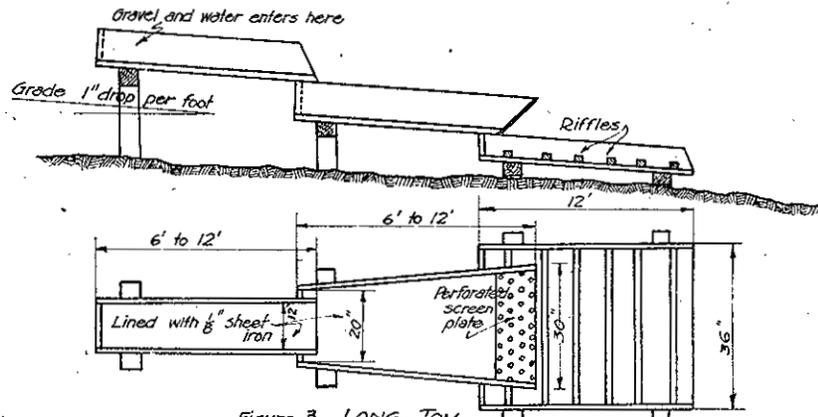


Figure 3. LONG TOM
(After Staley)

With Report by A.M. Richmond,
Asst. Cos. Eng., Victoria, B.C. 1933
B.C. Bureau of Mines.

TYPES OF SLUICE BOX & RIFFLES.

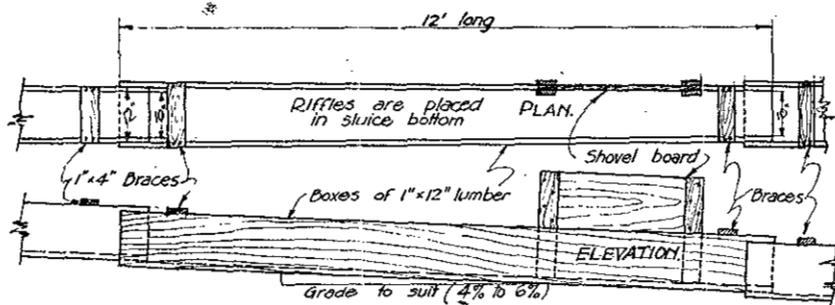


Figure 4. EXAMPLE OF SMALL SLUICE.

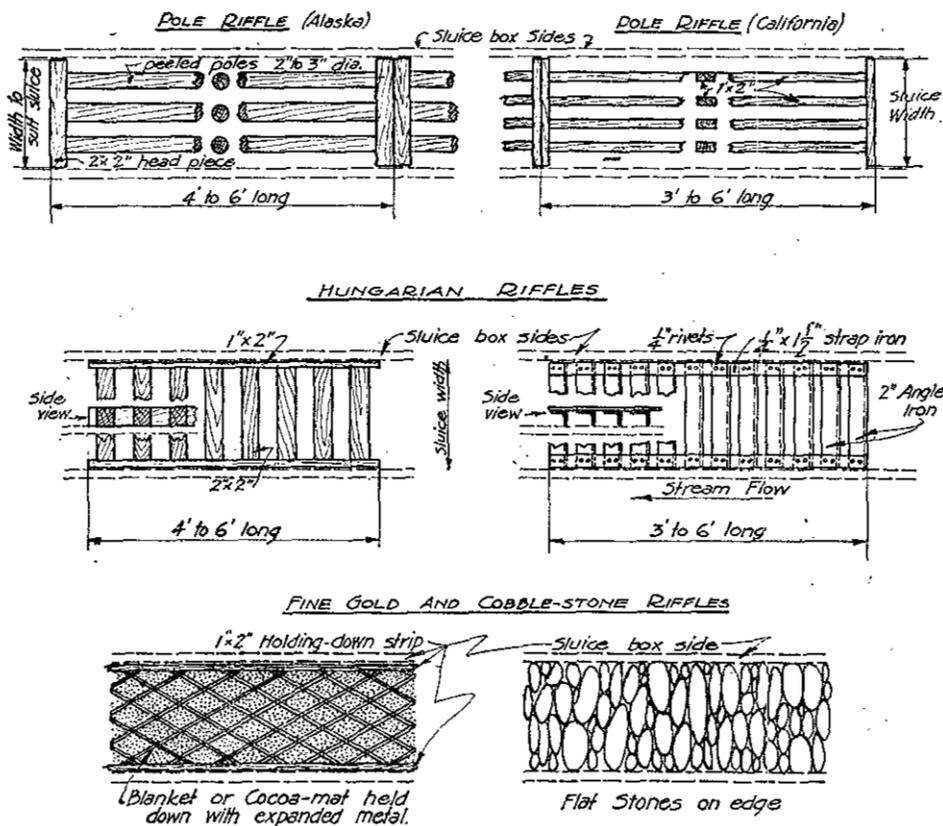


Figure 5 RIFFLES.

With report of A.M. Richmond,
Ass't. Res. Eng. Victoria, B.C., 1933.
B.C. Bureau of Mines.

A.M.R.

Fig. 2 is a sketch of a rocker 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 $\frac{1}{2}$ -inch tie-bolts.
- H. Wooden riffles $\frac{3}{4}$ 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 $\frac{3}{4}$ inch thick.
- L. Spikes which project $1\frac{1}{2}$ 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 $\frac{1}{2}$ -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 $\frac{1}{2}$ -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-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 tom, 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. Fig. 3 illustrates the usual type of long-tom, and as the sketch 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 Fig. 4, 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 or iron bars and 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 sketch (Fig. 5). 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-slucing as it does to do the same work in a box sluice. Very often ground-slucing 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-slucing 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-slucing 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-slucing 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. Brief mention is made here of the four power methods of mining previously mentioned.

Drag-scrappers.—The gravel is moved to the sluices with scrapers operated by a double-drum hoisting-engine through a suitable arrangement of snatch-blocks and movable tail-pulleys.

Hydraulic Mining.—Hydraulic mining is the name given to the method whereby water under high pressure is employed to break down the gravel bank and move it into the sluice-boxes. The water is conveyed through pressure pipe-lines to "giants," or nozzles, through which the water is directed against the gravels. This method requires an ample supply of water under a good pressure-head, a good natural bed-rock slope, and ample room for the dumping of tailings.

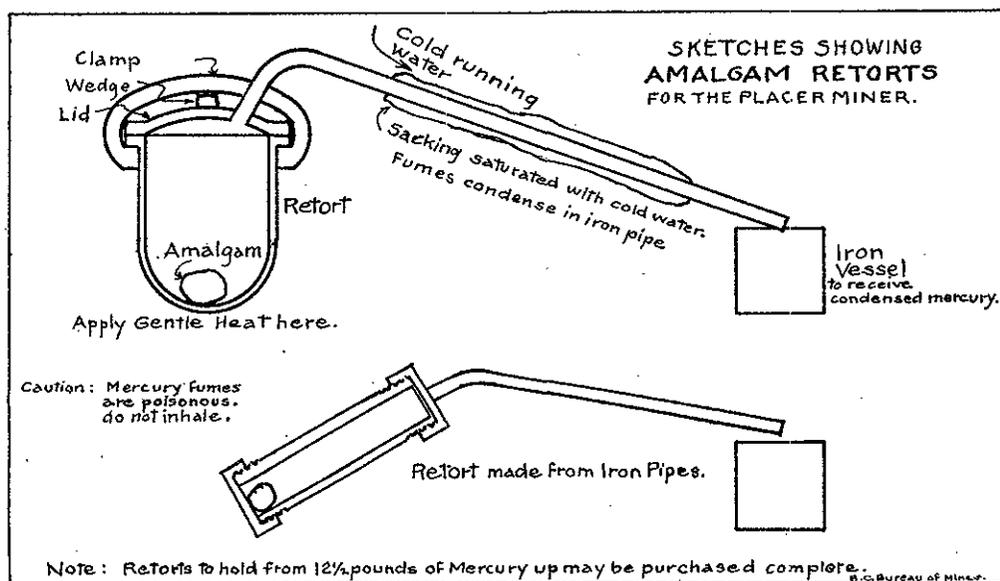
Power-shovelling.—Steam-shovels, gasoline-shovels, and bucket excavators are used for mining the gravels, which are conveyed to the sluice-boxes by cars running on rails or by motor-trucks.

Gold-dredging.—Dredging is usually employed for mining wide gravel-deposits where the surface and bed-rock are flat. The excavating and gold-recovering machinery are mounted on a dredge or float and the gravels are excavated by an endless chain of heavy buckets which deliver their load to the washing equipment. The gold is recovered in sluices and undercurrents and the tailings are stacked behind the dredge by means of a conveyor-belt. The dredge floats in a pond made by the excavation of the gravel being filled with water, the level of the water being kept up to counteract seepage and evaporation losses.

Use of Mercury or Quicksilver in Placer-mining.—Mercury has the power of absorbing gold into itself and it is used a great deal in the larger placer-mining operations. It can be placed on the apron of the rocker or in the sections of the sluice-boxes from 36 to 60 feet from the head of the sluice, and it will collect the fine gold which is clean and free from rust. The sluices and rockers should be well built to prevent loss of mercury by leakage.

If mercury has been used, the amalgam (the combination of the gold and the mercury) formed is softened with an excess of mercury and the mixture stirred, permitting the base material to rise to the top of the liquid, whence it can be skimmed. The excess mercury is then removed from the amalgam by squeezing it through a chamois-skin or a strong close-woven cloth.

The small balls of amalgam obtained by the hand-miner after squeezing out the excess mercury are generally placed on a shovel and held over the fire to drive off the balance of the mercury. Care should be taken not to breathe the fumes that are driven off, as they are poisonous. For amalgam retorting on a larger scale the reader is referred to articles listed in the bibliography.



Black Sands and the Recovery of Values therefrom.—The material taken from the riffles of the rocker or sluices is composed of the coarse gold, fine gold, and a variety of black sands and heavy minerals, some of which have already been mentioned. The coarse gold is easily picked out with the fingers or a pair of tweezers, after which the sand is dried and the magnetic iron is removed with a magnet. If a piece of paper or handkerchief is used to cover the end of the magnet while the magnetite is being picked out of the black sand, much time will be saved in removing the magnetite from the magnet. The remaining minerals, including the fine gold, in the form of a heavy sand residue, should be spread, a small quantity at a time, on a sheet of white paper, and by using a thin straw and carefully blowing away the sand grains it will be found possible to get a very clean concentrate of gold. The gold is placed in a pouch and is ready for sale. Chamois or heavy leather makes a good pouch. The average value of placer gold in British Columbia is about \$17 per ounce.

The above method is the one ordinarily used by the small miner, but very often it is believed by the prospector that a large amount of gold and platinum is tied up in his black sand in such a way that ordinary separation methods are of little use in saving the precious minerals. Very often it is true that gold may be present in a black-sand concentrate in the rusty or oxidized state. Sometimes it is even intimately a part of some of the iron minerals present, but, more often than not, the amount of gold actually tied up in a black-sand concentrate does not pay for the trouble and cost of recovering it.

There are several methods of removing this fine gold from the concentrate, and one or two of the simplest methods will be described for the guidance of the hand-worker, or small-scale placer-miner. The first thing which should be done is, of course, to carefully sample the black-sand concentrate and have it assayed for gold by a reliable assayer, and if the sands actually do show the presence of appreciable gold values they should be saved until sufficient is accumulated for either a shipment to an accredited treatment plant or for treatment in a simple home-made plant by barrel-amalgamation methods.

Barrel amalgamation is a comparatively simple process and does not require elaborate or expensive equipment. In the larger plants the barrel consists of a small batch ball-mill fitted with a door for charging and cleaning out. A small barrel for the individual miner can be made from a 5-gallon oil-drum or a wooden wine-flask, to which paddles can be attached, and by fixing trunnions to each end the barrel can be made to revolve by the current of water in the sluice-box. Even a mortar and pestle can be profitably used to grind the black sand with mercury and water in small lots of sand. The charge of black sand, the amount depending on the size that can be conveniently handled in the drum available, is placed in the barrel with water and mercury and rotated for an hour or more if found necessary, after which it is dumped into a tray which overflows into a tub, long-tom, rocker, or sluice-box. A hose is turned into the tray and the sand washed away from the mercury. The mercury is then drawn off through a plug-hole in the bottom of the tray and squeezed through a chamois-skin to separate the amalgam, which is subsequently retorted.

If much rusty gold is mixed with the black sand it may pay to introduce a number of pebbles to assist in the grinding action which takes place in the rotating drum. Also the use of from 3 to 5 lb. of lye or soda-ash per ton of black sand will help in dissolving any grease or dirt on the gold, while the addition of a solution of sodium cyanide of 0.25-per-cent. strength will remove most of the rust from the gold. Cyanide dissolves the gold slowly and some of the fine gold will naturally be lost in the solutions. A safe means of using sodium cyanide, which is a very poisonous chemical, is to make up a solution of 1 oz. of 98-per-cent. cyanide to $\frac{1}{2}$ gallon of water, and then use about $\frac{1}{2}$ teacupful of this solution further diluted with 10 gallons of water. It may be found necessary to considerably increase the period of amalgamation over the time of one hour previously mentioned, but as the treatment of each black sand is a problem of its own, except for the simple principles involved, experience will teach those willing to learn, and teach them very quickly.

Table concentration of black sand is sometimes used in large installations, or where there is plenty of sand available for treatment to provide for a steady plant operation, but it is too expensive an operation for the small man, and incidentally not as efficient as the barrel-amalgamation methods above described.

Recoveries of 99.9 per cent. of the gold in a black-sand sample have been obtained in the laboratories of the Mines Branch, Ottawa, by the use of barrel-amalgamation methods.

Platinum.—Platinum occurring in placer-gravels is in general somewhat more difficult to recover than placer gold. Coarse platinum is readily recovered by the same methods as coarse gold, but, as a rule, platinum occurs as fine particles associated with and recovered in the black sand in the sluice-boxes. This fine platinum cannot be amalgamated as fine gold, although a partial recovery is possible with the use of sodium amalgam.

By careful panning-down of the black sand, the use of the magnet, and blowing, fine platinum can be separated from the black sand and fine gold. Some platinum is slightly magnetic, however, and care must be taken in attempting to take out waste magnetic material by this method.

Crude platinum is easily marketable and black sand, if sufficiently rich to stand transportation, can be shipped away for treatment. Gold Savers, Limited, 940 Station Street, Vancouver, B.C., owners of the patented Lorentsen machine, advertise that black sand will be accepted for

treatment with recovery and payment for the gold and platinum contents. It is also reported that Johnson, Matthey & Company, Limited, 73-82 Hatton Garden, London, E.C. 1, besides purchasing crude platinum, will purchase black-sand concentrates.

The placer-miner should always have black-sand concentrates from his sluice-boxes tested for gold and platinum, as, at least in some instances, this material by careful reconcentration may be of decided value. Particularly in the Tulameen district, it is known that black sand frequently contains fine platinum. The recovery of this metal from the concentrates may in some instances make possible the profitable operation of a placer property that otherwise would not pay.

It is reported that there are more than 7,000 patented gold-saving devices and machines for saving fine and flour gold and platinum, and while most of the machines are little more than ideas, some of the machines have been built and tried out with more or less success under certain conditions, while a few have proved their worth and are being manufactured on a commercial scale. For detailed information on this phase of placer-mining the reader is referred to an excellent summary issued by the State Mineralogist, Division of Mines, California, in the No. 2 issue, Vol. 28, Mining in California, April, 1932.

Several gold-saving machines are on the market in British Columbia and are reported to have met with some success. As no tests have been conducted by the Department of Mines on these machines, no official comment on the merits of the respective machines can be made at the present time.

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

REPORT BY JOSEPH T. MANDY, RESIDENT MINING ENGINEER (HEADQUARTERS, PRINCE RUPERT).

INTRODUCTION.

The objective of this report is mainly to indicate promising areas for placer-gold prospecting and opportunities for expansion of placer operations. Detailed descriptions of operating mines, geologic and topographic features, transportation, etc., will be found in former reports and in the forthcoming Annual Report for 1932, and have consequently been omitted here.

QUEEN CHARLOTTE MINING DIVISION.

GRAHAM ISLAND SECTION.

Black-sand Beach Deposits.

Interest in the possible profitable recovery of gold from the beach-sand concentrates of the east coast has increased very materially. These deposits are described in the Annual Reports for 1929 and 1930 and in Bulletin No. 2, 1930, and Bulletin No. 1, 1931. Considered from the standpoint of individual operations, the character of the material is such that the proposition is not recommended to "greenhorns." However, with ability for continuous work, applied study of the peculiarities of the deposits, and application of details of methods suitable to the recovery of the gold in these deposits, it would be possible for individuals to earn expenses or small wages. It would seem that large-scale operations would be dependent for success, not upon the spasmodic superficial deposition of the high-grade streaks and patches, but upon a sufficient yardage of low-grade, permanently-situated, formerly-deposited sands and the application of a suitable method of concentration and gold-extraction. Such deposits would take the form of buried black-sand concentrate-lenses interbedded with layers of non-pay grey sands, the whole making up a sufficient grade for profitable treatment by the method selected.

The beach and bordering bluffs consist of Pleistocene to Recent superficial deposits of unconsolidated to semi-consolidated sands, clays, sandy clays, gravels, and conglomerates. The basal formation is a blue-grey glacial clay. The black-sand deposits have a lenticular and varying distribution along the base of the bordering bluffs, and have been derived from disintegration of the material constituting these and its reconcentration by wave and possibly wind action.

Concentrate-lenses from 1 to over 6 inches thick are distributed in sections up to 300 or 400 feet long and 40 to 50 feet wide, extending from the base of the bluffs through the high-water drift-log fringe and down the gently sloping beach. The richest lenses are about 5 feet wide and 10 to 50 feet long. A typical characteristic of the deposits is a marked gradation from concentrated magnetite black sand in the upper or high-water fringe, through brownish-red and pink garnetiferous sand, into greenish epidote or peridotite sand, and then into the yellow-sand strip down to the low-tide breaking surf. Although in some of the black-sand patches, particularly those collected behind drift-logs, some fine colours of gold could be recognized with the naked eye or with the aid of the magnifying-glass after gently scraping away the top layer of the damp sand, no free gold was actually recognized in the pinkish garnet or greenish epidote section. In all cases where gold could be recognized, the colours are characteristically fine, probably from 60 to over 100 colours constituting 1 cent.

The best area is apparently a stretch about 3 miles in length locally known as "Bull Swamp," situated about 5 miles south of Cape Fife, commencing at about 1 mile south of Martel creek and extending to the vicinity of Frank Gagner's location, known as Lake creek (about 4 miles south of Martel creek). In this section several small ravines representing the eroded beds of small creeks are noted. These creeks, dependent upon the rainfall for their water-supply and cutting down to the basal clay on the beach, offer an additional means for reconcentration or natural sluicing of the already formed lenses, and in one of them, from which a small amount of water was trickling in veinings across the beach, numerous fine specks of gold could be readily seen.

Methods of Recovery.—Concentration followed by amalgamation in specially constructed machines has heretofore been the most popular method. The flotation process may prove to be successful in the extraction of the fine or flour-gold occurring in these sand-deposits. In this respect the Resident Engineer has been in recent correspondence with A. W. Fahrenwald, Professor of Metallurgy and Ore Dressing, School of Mines, University of Idaho, who has carried out exhaustive experiments in this connection. Regarding the treatment of these sands, Professor Fahrenwald states: "Rather a large number of placer and black-sand samples have come to this laboratory and have been tested for flotation. We have had very good results. Small gold particles float readily, and I have no doubt that the material in which you are interested would respond satisfactorily to the flotation process. It is, of course, a matter of economics. From considerable study of the problem and calculations that I have made, I believe any sand running 50 cents or more a yard can be handled at a profit by the flotation process." One apparent difficulty in connection with gold-recovery from these deposits is the scarcity of water, particularly during the drier summer season.

The hand method that has so far given best results is shovelling into sluice-boxes with the recovery-box carried at a steep grade, say about 18 inches to the 12-foot box, so as not to allow the riffles to become clogged with heavy magnetite, and the gold-saving boxes lined with blankets into which narrow and shallow cleat-riffles are sewn. A combination with this of trap or plate amalgamation might be useful for increased recovery. The necessary grade of the recovery-box would have to be determined by experimentation and panning of the tailings. The sands would be shovelled into a sluice-box without riffles, ahead of the recovery-box. This facilitates an even feed to the recovery-box. By this method probably from 50 to 60 per cent. of the gold values in the sand, and also platinum, could be recovered. It is not known that long-toms have been tried on the Graham Island beaches, but it would seem that this method, using a steep gradient and amalgam-plates, might be applicable to the richer patches. Recovery in rockers adapted to the peculiarities of the sand should also be possible from the rich patches. It is estimated that one man could handle about 3 cubic yards of sand per ten-hour shift in a long-tom or rocker. In considering hand operations by individuals on these beach-sand concentrations, it must be stressed the nature of these deposits would necessitate more or less intermittent operation on small rich lenses with the best periods occurring after storms.

Gold Beach Mines, Ltd.—It is understood that this company has absorbed the assets of the Gold Star Mines, Limited, operating at Cape Fife. During the 1932 season, Norman H. Terry carried out a three-month series of tests on the beach sands in the neighbourhood of Cape Fife. This consisted of test-pitting in an extensive stretch of sands above high-tide mark and the treatment of this material in a Lorentsen centrifugal force amalgamator. In these tests 102 cubic yards of sand are stated by Mr. Terry to have yielded \$291, or \$2.84 per cubic yard. Mr. Terry estimates that much of the yellow sand also contained pay values. It is stated that within a radius of 1,000 feet of the present site there is estimated 54,000 cubic yards of workable sand. The company proposes setting up a plant to treat 500 cubic yards a day. Concentration, magnetic separation, and an amalgamating-machine will be used.

During 1932 the late Frank Gagner, an experienced Yukon miner, operated intermittently about 4 miles south of Martel creek and made expenses by hand-slucing. Several other individuals have also worked during 1932. On Blue Jacket creek, Masset inlet, two men, at first totally inexperienced, are recovering fair wages by shovelling into sluices.

SKEENA MINING DIVISION.

This Division lies within the Pacific-slope area of intense glaciation and consequently does not hold much promise for the discovery of placer-gold deposits. Whereas colours of fine gold can generally be obtained in remnants of morainal deposits, conditions for reconcentration of these to any appreciable extent do not appear to have been generally favourable. An area, giving evidence of creek concentration from morainal deposits, occurs on the north-east side of Kitsumgallum lake. Here Douglas creek has been worked by individuals for several years. Other creeks in this area that should be prospected for similar deposits include Maroon creek, Wesach (Hall) creek, and Clear creek. Several old drainage-troughs, now drift-filled and recognizable only as dry gulches, occurring along the slope from Couture mountain to the main valley north of Kitsumgallum lake, should also be prospected.

DOUGLAS CREEK.

This creek flows into the head of Kitsumgallum lake near Rosswood at elevation 480 feet. It occupies a generally north-easterly-striking trough about $7\frac{1}{2}$ miles in length from elevation 480 feet to about 3,000 feet, and is fed by isolated small glaciers and several small tributaries, particularly on the south side, draining the northerly slopes of Goat mountain.

During 1932 twenty-eight individuals were working on the creek. Recoveries varied from promising indications in the gravels above bed-rock to expenses or wages where sluicing is carried out on or near bed-rock. On some sections of the creek small remnants of old-channel ground occur on low bench and bar sections, necessitating drainage-ditch construction. In other sections the best values are found on bed-rock in the present creek-bed and necessitate the construction of wooden flumes for the fluming of the creek-water. The shallowest ground to bed-rock is around the central section of the creek; the area around the mouth and towards the head being comparatively deep.

As an indication of what can be accomplished on this creek by hard, systematic, and applied work, the operation of Mr. and Mrs. Nightwine on their leases in the canyon section at altitude 1,000 feet, about 3 miles from the mouth, is an example. These leases have been operated for several years, and during the last two years clean-ups every two days have varied from about \$3 to about \$50 during the work periods, or an average of about \$14 for the two days' shovelling. The biggest nugget discovered on these leases was valued at \$10.13, and several \$1 to \$2 nuggets have been recovered. The total recovery for 1931 amounted to over \$1,000. It is estimated on this operation that two men can shovel from 2 to 3 cubic yards of gravel a day after moving and squaring away the boulders. To handle the largest boulders a geared double-handled hand-winch is used. Included in the equipment is an ingeniously constructed water-driven sawmill.

NASS RIVER MINING DIVISION.

This Division lies within the Pacific-slope area of intense glaciation and consequently does not hold much promise for the discovery of placer-gold deposits. During the 1932 season some prospecting for placer gold was carried out in the Cranberry River drainage area.

PORTLAND CANAL MINING DIVISION.

During the 1932 season two prospecting-parties penetrated the headwaters of the Bell Irving river and claim to have found sufficient encouragement to warrant further investigation. One party returned to the area with 4 tons of supplies transported by pack-horses, with the intention of remaining all winter. Sections of the Unuk River trough have also been found to contain gold-bearing gravels, but so far nothing of importance has been discovered. During 1932 T. J. McQuillan and two men, of Ketchikan, prospected on Sulphurets creek and also on the South fork of the Unuk river. On Sulphurets creek these prospectors report "old-timers'" workings and also the discovery of some coarse gold.

STIKINE MINING DIVISION.

The area in this Division favourable for the discovery of placer gold lies in the commencement of the upland plateau east of the Coast range. This is the drainage-basin of the Stikine river and its numerous tributaries. The Stikine Division generally has been intensely affected by glacial erosion. It is consequently not generally favourable for the discovery of placer-gold deposits. It represents, however, a gradation from the intensely glaciated Coast range into the Interior plateau and as such possesses proportionately more favourable placer-gold aspects.

Remnants of old river and creek channels may occur, as well as comparatively extensive areas of inter- and post-Glacial reconcentrations, giving opportunities for the discovery of placer-gold values amenable to individual sluicing, hydraulicking, and dredging operations. On the Stikine, near Telegraph Creek, there are occurrences of lava-buried gravels which would be worth prospecting. 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. Possibly some of this gold may originate from the latter rivers and they are consequently worth prospecting.

BARRINGTON RIVER.

Barrington river, a north tributary of the Chutine river, offers a likely section for prospecting both for individual operations and for possible dredging-ground of extent around its headwaters. The possible dredging-ground extends from about the upper end of the canyon to above Lake creek in the headwaters area.

Individual Workings.—During 1932 seven individuals carried on rocking and sluicing in the lower section of Barrington river between the mouth and the canyon for about 2 miles, making recoveries of \$2 to \$6 a day. The ground worked consists of about 12 inches of gravel occurring above a clay bed-rock along the banks of the river and down to which the river has cut its channel. In some patches this can be easily worked with up to a maximum of about 4 feet of stripping along a narrow strip of the bank. At low water, shallow bars on this clay bed-rock form good "sniping" ground. This condition should be found in places for a considerable distance up Barrington river, offering very likely "sniping" ground.

Dredging.—Dredging by the Barrington Company was attempted during the 1932 season. This ground and installation is described in the 1931 Annual Report and further details are also included in the 1932 Annual Report. During the 1932 season the dredge installed in the

preceding year was put into operation. Boulder conditions were more acute than had been expected and operations ceased after about thirty days' digging, with no recovery. This more or less obsolete dredge design is not adapted to efficiently dig this type of ground. Alterations and modifications may permit the dredge to work more efficiently.

LIARD MINING DIVISION.

This Division lies in the elevated Interior Plateau area draining to the Arctic ocean. From a placer-gold aspect it possesses the generally favourable features that are characteristic of this upland area. The area is reached via Wrangell and the Stikine river to Telegraph Creek, and thence via automobile to Dease lake, whence the various sections are accessible by trail or small boats with outboard motors. In the 1931 Annual Report there is a detailed description of transportation and of the McDame Creek area.

Considering the extensive area of auriferous country in the Cassiar region, it would appear that, apart from the immediate vicinity of the well-known productive creeks, the country has been very imperfectly prospected and that a great part of the area has been merely run over in search of rich diggings. It is not improbable that other rich creeks may be discovered and that there should be appreciable areas of low-grade deposits.

McDame's Post is a central point where supplies can be obtained. From here a large area of promising territory can be easily reached by river or trail. Likely sections include the McDame Creek area, Spring creek and tributaries about 25 miles below McDame's Post, and French creek about 25 miles below Spring creek. In the Spring-French Creek section, Rosella, Patterson, and Dennis creeks are mentioned in an old report by G. M. Dawson as having yielded about \$6 a day in the early eighties. The headwaters area and many side-creeks of the Muddy and Little Muddy rivers are also recommended.

DEASE CREEK.

During 1932 hydraulicking operations were continued on Dease creek by the Cassiar Hydraulic Mines, Limited, but the clean-up of 173 oz. of gold was disappointing. Drilling in 1930 of similar ground towards the mouth of the creek by the Dease Creek Mines Corporation indicated pay values. Some gold discovery was also made by individuals in the upper section of this creek.

GOLD PAN CREEK.

A. M. Vickary has continued working his ground on Gold Pan creek and recovered about 100 oz. of gold. Several other individuals continued their operations on this creek, all making some gold-recovery.

THIBERT CREEK.

On this creek the Mosquito Creek Hydraulic Association continued preparatory operations and some ground-slucing, making a recovery of 51 oz. of gold.

LITTLE MUDDY RIVER.

In this section Messrs. Faulkner, Black, and several others have been active in preparatory work with some coarse-gold recovery on a promising new discovery made towards the end of 1931. Several other individuals have also been getting promising indications from prospecting in this area during the season.

MCDAME CREEK.

Energetic prospecting was continued on the *Viking*, *Centreville Hydraulic*, *Princess Edith*, and *Buccaneer* leases by G. A. Brown and associates, of Victoria. Recovery of indicative gold values have been obtained. On Quartz creek D. Wing carried out preparatory work for the extension of his hydraulicking operations. In this section there is an extensive area of ground that warrants prospecting.

ATLIN MINING DIVISION.

The important placer-gold area of this Division lies east of the Coast range and in the elevated Interior plateau. There is an extensive territory in this Division favourable for the occurrence of placer-gold deposits. Although the chance for discovery of bonanza deposits cannot be said to be exhausted, future production will in the main come from hydraulicking and dredging, the mining of lower-grade gravels by individuals, the expansion of drifting operations

to a more systematic and larger yardage basis to include low-grade gravels, and the application of modern equipment. In the old Atlin section such opportunities still exist. Contiguous to this section towards the Yukon boundary there is also an extensive favourable area in which little detailed prospecting has been done. A reconnaissance by the Resident Engineer into the Tatshenshini River section has also indicated an extensive promising new area. Placer operations by companies and individuals have been exceptionally active, and increasing interest is evinced not only in the presently worked creeks in the older areas, but in virgin territory.

It is quite possible that present activities will result in large-scale drift-mining operations involving the introduction of a long-wall retreating system of mining, the inclusion of low-grade gravels in individual operations, the introduction of modern power equipment, and a possible lowering of mining costs. Hydraulic operations in contiguous areas and the introduction of dredging with modern equipment may also materialize.

Opportunities in this section include:—

SPRUCE CREEK.

- (1.) Extension of drifting operations in the central area.
- (2.) Drilling and pitting to verify the possible extension of the "yellow run" up Dominion creek.
- (3.) Extension of drainage-tunnel facilities from the central area up Dominion creek to facilitate drift-mining on the deeply buried bed-rock of this area.
- (4.) Possible "pay" for hydraulic operations in interglacial concentrations in the Dominion Creek trough.
- (5.) The possible continuation of the deeply buried "Blue Run" through the central area on up to the upper area on the right or north side of the known "Yellow Run" and at a slightly lower elevation.
- (6.) Exploration of possible dredging-ground in the upper Spruce Creek area.
- (7.) A possible lateral channel to, and on the south side of, the "Yellow Channel," as indicated in recent workings in the Mathews operation.
- (8.) Location of the deeply buried old channel under the high bench in the lower Spruce area.
- (9.) A possible gold-run between Little Spruce creek and Pine creek at about Stephendyke.
- (10.) Individual "sniping" operations on old clayey tailings in Spruce creek.

McKEE CREEK.

The development and mining of the deeply buried old channel on the right bank of this creek.

O'DONNELL RIVER.

- (1.) Possible hydraulic operation.
- (2.) Extension of drift-mining operations to include lower-grade gravel.
- (3.) Penetration by drift-mining to the deeply buried old-channel extension on the right bank above Nathan Murphy's workings.
- (4.) Prospecting and exploration of the upper tributary area of this trough.

PINE CREEK.

Perhaps the most constructive development during 1932 in the Atlin section, and one which might have far-reaching results in the future, is what appears to be the location of the continuation of "Gold Run." This has resulted from the hydraulic carried out during 1932 by Fred Helm and Company of five men working on a lay from Walter Rassmussen, of Atlin, on bench leases on the left bank of Pine creek, about 1 mile below the bridge. At the time of examination the face of the pit in these workings showed a top layer of 10 feet of interstratified interglacial gravel, sand, and clay. Below this is coarse unstratified glacial gravel with boulders, then about 30 inches of hard-pan and coarse wash-gravel on bed-rock. Up to the time of examination at the end of July clean-ups of 40, 60, 142, and 190 oz. of gold were being made about every two weeks, with a reported production at the close of the season of about \$25,000.

Drilling Pine Creek valley on the north side between the bridge and Surprise lake is recommended. Exploration of Trond gulch, skirting Munro mountain towards Fourth of July creek, is also suggested.

BIRCH CREEK.

The creek-bed is shallow ground varying from 7 to 8 feet in depth. At present some virgin patches remain on the east side that may repay shovelling. It is also reported some gold still remains on bed-rock under the old tailings. Towards the creek-mouth on the Joe Yonaites lease a comparatively fair-sized area of virgin ground remains. This is at present being prospected by Joe Yonaites. If this ground proves to contain values, and as the tailings-ground above is all loose gravel requiring a minimum pressure to move it, it is suggested that the whole of the creek-bed from the Yonaites lease to the bench, a distance of about 2 miles, may repay hydraulicizing, for which a good water-supply is available during spring and early summer.

It is also suggested that the old channel, which appears to swing across the creek-bed and under the bench of the west side about 2 miles up, should be prospected for by drifting under the high bank. To carry out this work efficiently a good opportunity exists for its conduct in combination with a drainage-tunnel. The fact that in the old operations the best values were found below Plum creek, which flows into Birch creek on its west side, suggests that Plum creek may have cut across the old channel somewhere in the high-bench area on the west side of Birch creek. Striking south from this point on Plum creek, the old channel appears to have conformed to the present bed of Birch creek on the old hydraulicized ground, and at approximately the Yonaites lease to have swung into the east bank, where, towards the mouth, rim-rock sloping west again swung it into the present location of Birch creek.

RUBY CREEK.

Good coarse-gold values are being hydraulicized from this creek, and also drift-mined from the lava-buried gravels of the old channel. Good "pay" has been struck in the most northerly drifting operations, and it is logical to conclude that this condition will continue for an appreciable distance up-stream under the lava beyond the present worked ground. To work the upper area efficiently, however, particularly under the increasing thickness of lava, it would seem that a bed-rock drainage-tunnel would be necessary. This would conveniently commence from about the Tornquist operation, and with incline shaft connections at intervals through the up-stream lava-ground affording adequate ventilation, the opportunity would be presented of opening up an appreciable length of very likely ground towards the upper reaches of the creek. It is also suggested that in prospecting the lava-buried old-channel area of Ruby creek the chance for appreciable subsidiary channels lateral to the main channel should not be overlooked. The discovery of these would entail crosscutting at right angles to the present known old channel. It would seem that the lava-buried gravels of upper Ruby creek have not yet been exploited to the full.

On the east bank above McKay, Johnson, and Morrison, and about 3 miles up-stream from Surprise lake, Arno Krumbiegel is sinking a shaft through lava in an attempt to reach bed-rock and the old channel. A hoist and pump was installed during 1932. It is estimated that at this locality the lava may be over 100 feet thick. At the nearest working below there is about 30 feet thickness of gravel between the lava and bed-rock. When bed-rock is attained, crosscutting may have to be carried out to locate the old channel.

OTTER CREEK.

Hydraulicizing by the Compagnie Française des Mines d'Or du Canada has uncovered interglacial reconcentration layers of appreciable thickness and extent in the glacial debris, containing pay values. In the pit at the time of examination a thickness of 25 feet of such material composed of stratified coarse gravel and boulders with interstratified streaks of sand and clay, with fairly coarse gold, was being piped. It is estimated this material would grade about 50 cents to the cubic yard, and the whole pit, including barren stripping, about 23 cents to the cubic yard. In this section there is the possibility for the occurrence of this type of deposit in a wide area. In moving 170,000 cubic yards of gravel in 1931 it is estimated that total costs amounted to about 9 cents per cubic yard, with between 7 to 8 cents per cubic yard for actual hydraulicizing.

CRACKER CREEK.

The attitude of the granite-rim at the top end of the canyon indicates the possibility of an old channel behind and south-easterly of this rim, skirting and possibly paralleling the canyon-rock on that side. At the top end of the canyon an old drainage-tunnel was excavated in an

attempt to crosscut towards the presumed old channel. At the lower or north-easterly end of the canyon three men working on a lay from Paul Eggert, of Atlin, are continuing an old tunnel located on the right bank in an attempt to tap the old channel south of the canyon. Over 400 feet of tunnelling has been carried out and the ground appears worth thorough prospecting.

LINCOLN CREEK.

This creek flows into Gladys lake (elevation 2,915 feet) on the south side and on old maps is referred to as Munro creek. Some prospecting by shafts and tunnelling carried out at intervals between 1910 and 1919 disclosed promising possibilities for an appreciable hydraulic operation. The ground is worthy of intensive exploration with this objective in view. An extensive drainage area to Vance lake at the head feeds Lincoln creek and an exceptional water-supply and efficient head for extensive hydraulic operations is available. In the event of sufficient values being proved it is computed that efficient hydraulic operations could be carried on for four or five months of the year. The creek is accessible by road and trail or by aeroplane to Vance lake.

CONSOLATION CREEK.

This creek rises in a low divide (3,300 feet) between Fourth of July creek and Gladys Lake drainage-basin and flows into the north-westerly end of Gladys lake. Upper Consolation creek for a distance of about 7 miles to about opposite Boyd creek, on the Surprise Lake side, occupies a flat gradient in a wide drift-filled valley flanked by morainal and eskar topography. It is possible that this section, which has been partially planated, may contain low gold values in inter- or post-glacial concentrations which may be amenable to dredging. It is recommended that this section of the creek be investigated to this end.

VOLCANIC CREEK.

This creek flows into the northerly end of Fourth of July creek from the west. Some indications of gold values have been found by tunnelling and pitting. As this creek heads into the divide to Ruby creek, it is quite possible that the lava-flow which features the latter creek may also extend into Volcanic creek. Whether this has covered and preserved an old creek-channel, as is the case in Ruby creek, is still to be determined.

TATSHENSHINI RIVER SECTION.

The following is a condensed description of this section: During 1932 a general reconnaissance of the section lying between Rainy Hollow and the Yukon boundary, including the headwaters of the Kelsall and Tatshenshini rivers, was carried out by the Resident Engineer. The objective of this journey was Squaw creek, which rises in British Columbia and flows into the Tatshenshini river in Yukon Territory. In this reconnaissance, practically entirely through virgin territory, geological conditions indicating a very likely prospecting area for lode and placer gold as well as base metals were noted.

The section is accessible from Haines, Alaska, whence there is a motor-road for 42 miles to Pleasant Camp, on the Alaska-British Columbia boundary, at elevation of 840 feet. From Pleasant Camp an old wagon-road in bad condition leads up the Klehini River valley for about 11 miles to Rainy Hollow Cabin at elevation 1,700 feet. From the cabin the old *Maid of Erin* wagon-road is followed to about the old tunnel on the *Victoria* claim at elevation 2,700 feet, whence the valley of Inspector (Jarvis) creek is followed to the crest of the St. Elias Range divide at about Trout lakes, elevation 4,000 feet. From the *Victoria* tunnel to Squaw creek there is no well-marked trail, but occasionally sections of the old Dalton trail or scattered recent hoof-marks of pack-trains can be picked up. From Rainy Hollow the route follows Inspector creek, skirts the eastern side of Goose lakes (source of Stonehouse creek), crosses Stonehouse creek at the western edge of the Interior plateau at elevation 3,500 feet, and follows Nadahini creek to the headwaters of the Kelsall river. The low divide to the headwaters of the Tatshenshini river is then crossed at elevation 3,150 feet and Mansfield creek is followed to the crossing of the Tatshenshini river at elevation 3,000 feet. From the west side of this river the old Dalton trail is followed for about 1½ miles. Here the route to Squaw creek branches off to the west and skirts the south-west slope of a high peak lying between it and Talbot Creek canyon. It then descends to the headwaters section of Talbot creek, which is crossed at altitude 4,025 feet, and the North branch followed to the divide to Squaw creek at

altitude 5,025 feet. Squaw creek is descended for about 4 miles to F. Muncaster's (Deputy Mining Recorder) cabin at altitude 2,900 feet and about $\frac{1}{2}$ mile south of the Yukon boundary. From the range to Squaw creek is about 60 miles through open timberless country, which could be negotiated for practically the whole distance by a tractor.

From Skagway to Haines a boat plies twice a week. Between Haines and Pleasant Camp, Erik Oslund, of Haines, Alaska, conducts an automobile freighting service. Passenger-cars cost about \$15 between these two points and the freighting charge quoted is 1 cent per pound. Erik Oslund also owns two horses and for limited loads arrangements for the use of these from Pleasant Camp could possibly be made at a cost of about \$5 per day per horse and \$6 per day for packer and guide. F. Muncaster, of Squaw creek, operates a pack-train, and it is understood that packing charges from Pleasant Camp to Squaw creek are about 20 cents per pound. The Kane Bros., Klukshu Indians, also operate a pack-train into Squaw creek, and it is possible that connections with this at Pleasant Camp could be made. It is, however, suggested that those planning to go into the area communicate with Erik Oslund, Haines, Alaska, who may possibly be able to make all arrangements and give information regarding seasonal snow and weather conditions. Operations may be carried on from May to the end of September.

An alternative route is via the White Pass & Yukon Railway from Skagway to Whitehorse, thence via Champagne, the Dezadeash river, Unahini river, and Dalton Post to Squaw creek, a total distance of about 150 miles. The route via Haines is, however, recommended as providing accessibility through an extensive promising area in British Columbia. From Vancouver to Squaw creek a cost of between \$75 and \$100 per man would be entailed.

Geologically, the elevated plateau is featured by granitic stocks and bosses intrusive into Palaeozoic sediments and volcanics. Creeks occupying a trough contiguous to these granitic stock and boss contact-areas should be thoroughly prospected for placer gold. Squaw creek, the trough of the upper part of which occupies such a contact-area, has been found to be gold-bearing, and it is suggested that creeks such as Stanley creek and those in the vicinity of the Parton river be prospected in detail.

Erosional conditions of the wide valleys with their flat gradients and meandering streams suggest the occurrence of low-grade placer-gold values which might be amenable to dredging. Such areas are quite extensive in this section. Placer-gold values in these would result from inter- and post-glacial concentrations of gold on a clay bed-rock. Geologic evidence points to the section as being a very likely area for detailed prospecting by individuals and for initial exploratory operations by large financial interests.

SQUAW CREEK.

This creek is about 8 miles long and flows into the Tatshenshini river on the south side. The lower half of the creek is in Yukon Territory and the upper section is in British Columbia. The creek rises in the divide to Talbot creek at altitude 5,025 feet and flows with a comparatively steep gradient in a north-westerly direction. The headwaters are fed by a North and South fork and the stream contains an appreciable volume of water. The upper part of the main trough lies practically on the contact between a granitic stock on the north-east and the Palaeozoic rocks of the south-west and entire lower section.

The creek is featured by heavy wash and excessively large boulders, particularly in the upper section. In the outwash area extending westerly from about the Yukon boundary across the Squaw Creek trough and towards the lower Tatshenshini river, excessively large boulders are not quite so prominent, and it is quite possible that this section would contain placer-gold values resultant from inter- and post-glacial concentration that would be amenable to hydraulicking. With the exception of a small part of the bench area on the east side of the creek contiguous to the Yukon boundary, this outwash area is entirely unprospected.

Coarse gold was discovered in Squaw creek in 1927 by Paddy Duncan, a Klukshu Indian, and, with the exception of Mr. and Mrs. Muncaster and a few whites who came in during 1932, has been mined in a comparatively haphazard manner practically entirely by Indians. The largest nugget found on the creek was valued at \$216, found on No. 4 above "Discovery" in 1931. During 1932 the largest nugget reported up to the end of August was one valued at \$130 from No. 3 above "Discovery." During this season several from \$20 to \$75 in value were also found. Amongst the Indian miners there is much competition in the discovery of big nuggets and methodical mining suffers accordingly.

The rock composing the creek-bed is generally soft and schistose, in places featured by wide gouge-zones and many pyritized quartz veins, and is fairly well weathered, making a condition that would be conducive to the penetration of placer gold. In former operations it is understood that the bed-rock was left practically intact, but during 1932 attention has been directed to the possibility of gold being retained in this, and from 1 to 2 feet of bed-rock is now being cleaned up. In former operations the competition for big nuggets also resulted in the covering of possibly good ground with boulder-piles and tailings from indiscriminate cutting and pitting. In panning the clean-ups the Indian miners generally pay little attention to the saving of fine gold in the black sand, which is panned out into the creek, leaving only the coarse nuggets in the pan. In this way much of the fine gold is lost.

When gold was first discovered the creek was staked by Indians practically from its mouth to its source. At the time of examination about the middle of August, 1932, however, it was only being worked from No. 1 below "Discovery" to No. 6 above. It was understood that Nos. 7 and 8 above "Discovery" were at that time being held and that a half-mile lease, including No. 9 to No. 20 above, was applied for on June 9th. It would be noted that from the boundary to the North fork is about thirty-two claim-lengths, including "Discovery" claim. No ground is held on either the North or South forks. Discovery claim is located about three-quarters of a mile above the Yukon boundary.

During the examination, fifteen Indian men, four Indian women, six white men, and two white women were on the creek. Daily clean-ups have varied from about \$5 to \$20 per man; with two or three men working, some daily clean-ups up to \$60 and \$70 for the outfit have been made. The depth of gravel to bed-rock varies from about 8 feet on No. 1 below "Discovery" to about 4 feet at No. 6 above. Down-stream from No. 1 below to the canyon in Yukon Territory depth to bed-rock increases as the morainal outwash area extending to the west is crossed. Up-stream from about No. 7 above "Discovery" depth to bed-rock also increases. From No. 1 above "Discovery" towards the source the creek occupies a comparatively narrow trough varying from about 80 to 300 feet at its base between the confining rims. Narrow strips of low benches or bars, 20 to 100 feet wide, skirt the creek-bed at intervals along either bank. As most of the work has been confined to the creek-bed itself, the majority of these bars are still unprospected. The wide bar and outwash area extending across the creek-trough towards the west, just above the Yukon boundary, has already been referred to. It is also suggested that both the North and South forks should receive attention. Around the mouth of the South fork there is much quartz float in evidence.

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

REPORT BY DOUGLAS LAY, RESIDENT MINING ENGINEER (HEADQUARTERS, HAZELTON).

INTRODUCTION.

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

The three batholiths of Jura-Cretaceous age which cross this district—namely, the Coast Range, Central, and Cassiar-Omineca—have all originated placer deposits. In addition to these, in a region lying partly in the Cariboo and partly in the Quesnel Mining Division, there is a concealed and deep-seated batholith of pre-Mississippian age, which has originated the richest placer deposits of these Mining Divisions. It should, however, be understood that in these Mining Divisions there are many other valuable placer deposits which have originated from 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 paths of the batholiths mentioned is one of the most important of the considerations which the prospector must bear in mind.

These 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 erode the pre-existent placer deposit. They are unobscured by either the effects of glaciation or by the fact that there exist many other forms of placer occurrence besides those of local origin, such as river-bar and bench deposits and others, which are all to be regarded as re-sorted placers, and secondary not only in mode of origin, but in most cases in importance.

OMINECA MINING DIVISION.

Three batholiths cross this Mining Division—the Coast Range on the extreme western boundary; the Central, extending from the North-west arm of Tatla lake through the region at the south end of Babine lake and of Fraser lake, and continuing its south-east trend through the Cariboo and Quesnel Mining Divisions; and the Cassiar-Omineca batholith, extending from the McConnell Creek region through the Manson section across the McLeod river, and continuing south-east into the north-eastern portion of the Cariboo 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 portion, in the Manson section.
- (3.) In the northern portion, 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 portion, 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.

(1.) SKEENA SECTION.

Placer deposits of local origin occur within the region immediately adjacent to the Skeena river between Lorne and Kleanza creeks, but activities mainly focus on the two creeks mentioned. This region illustrates the fact that even in a portion of the Province immediately adjacent to the Coast range, exposed to the maximum effects of glaciation, remnants of placer deposits of local origin may yet survive owing to local protective features preventing alpine glaciation, and to the fact that creek-valleys lie transverse to the path followed by the large valley glaciers.

Both Lorne and Kleanza creeks are the most deeply incised of any placer creeks in the district, and run on or close to bed-rock. In the valleys of both occur buried pre-Glacial channel segments at different points, and near the mouth of each an extensive ancient channel segment lies buried. That on Lorne creek known as "Dry Hill" is fully described in the 1930 Annual Report, and that on Kleanza creek is described in the forthcoming 1932 Annual Report. The latter is largely unprobed and both these merit investigation.

Efforts of individuals are mainly directed to Lorne creek to the recovery of placer from the bed of the creek, and to some extent from buried ancient channel segments. This creek flows on a steep gradient over bed-rock at all points practically, and constitutes the most striking example known of the fact that even in a canyon-like gorge, incised in unriffled bed-rock, coarse gold by reason of its high specific gravity resists with remarkable obstinacy the tendency to move it exerted by a torrential stream. Gold from Lorne and Kleanza creeks is fairly coarse, and one 1½-oz. nugget has been obtained on Lorne creek. Various bars on the Skeena river from Hazelton down-stream engage the attention of individuals during each season.

Portion recommended for Prospecting.—Local prospectors only are advised to prospect the wide valley which lies at the head of the North fork of Lorne creek on the divide between this creek and Douglas creek, also tributary draws and creeks in this valley. There are also quite possibly several points on Lorne creek and its tributaries at which buried pre-Glacial channel segments warrant prospecting.

(2.) MANSON SECTION.

This section is fully described in "Placer-mining in British Columbia," Bulletin No. 1, 1931, which, although out of print, can be found in many libraries. Very considerable promise is offered to interested capital, and detailed investigation of many possibilities is warranted. No

pre-Glacial gravels have been noted in the region, which has been subjected to glacial disturbance rather than erosion, and coarse gold is found on bed-rock. A marked revival of activity has taken place within the past two years, which is likely to be still further stimulated by the fact that a motor-road from Fort St. James to this section seems likely to reach completion in the near future. This road last year, as the result of the efforts of the Consolidated Mining and Smelting Company, aided by the Department of Mines, had reached a point 20 miles north of the Nation river.

This section has not been visited since 1931, but the following is a résumé of activities of 1932: Germansen Placers, Limited, after completing an extensive programme of construction, commenced hydraulic operations at the end of the season; the Consolidated Mining and Smelting Company of Canada, Limited, had a large force of men on the road-construction mentioned above, and in hauling over the road as completed a Sauerman slack-line plant for installation on its property on Slate creek; the Chinese operators on Vital creek are reported to have had a successful season; J. Warren commenced further investigation of the buried ancient channel of Tom creek; and new discoveries were reported on Steele's gulch, a tributary of Kenny creek, by natives, and on Manson creek by S. Rosetti.

Portion recommended for Prospecting.—The extreme western portion of this section, namely that portion lying west of Silver creek, and between the Fall river and Kenny creek merits close prospecting. Also prospectors might note that discoveries so far have been in the extreme western and eastern portions. Between Germansen creek and Silver creek the area should be worth investigation.

Generally speaking placer deposits in this section are more deeply buried under glacial drift than is the case in the Cariboo and Quesnel Mining Divisions, and for this reason inexperienced prospectors are under a severe handicap in this region.

(3.) NORTHERN PORTION OF OMINECA MINING DIVISION.

Activities in this region focus mainly on McConnell creek (which was last year the cause of considerable excitement, and as to which Bulletin No. 2, 1932, "McConnell Creek Placer Area," gives full information) and on Jimmay creek. Placer occurrence is also reported at a point some 50 miles north-west of McConnell creek on a tributary of the Finlay river flowing eastward, and on the Fox and Kwadacha rivers.

On a tributary of Jimmay creek, tributary of the Osilinka river, Frank Martin, of Hazelton, and associates were engaged in prospecting all last season and report hopeful results, and have this year already commenced preparations to transport equipment to this creek by aeroplane, while landing can be effected on skis. This creek was originally discovered many years ago by J. May, after whom it was named.

With regard to possibilities in this portion of the Omineca Mining Division, it is important for prospectors to note that it lies close to the centre of dispersion of the Cordilleran ice-sheet, in the path of the large valley glaciers which constituted the drainage-tongues of the ice-sheet, and which are highly destructive agents of placer deposits. While placer deposits are formed in mountainous country, such topography does not lend itself to the formation of the richer placer deposits. While it does not by any means follow that good deposits of placer of local origin are not to be found in this area, it is certain that the appraisal of placer possibilities in this region calls for a more extensive knowledge of placer occurrence, and the possible effect thereon of glaciation, than at any other point of the district, and the prospector is handicapped in many ways.

(4.) McLEOD RIVER AREA.

This region may be reached either by trail from Fort St. James or by motor-boat from Summit lake. Activities centre on a region close to the Fort St. James-Fort McLeod trail, about 14 miles distant by trail from Fort McLeod. The latter is distant 66 miles by the water route from Summit lake. Only skilled rivermen should attempt the water route.

Interesting discoveries of placer were made last year on the McLeod river and Little McLeod river, and the amount of metals of the Platinum group accompanying the gold was a very noteworthy feature. The mode of occurrence exhibited is that of shallow deposits on low-lying rock benches. The placer is in part of local origin, and in part results from reconcentration of glacial drift of probably closely-local origin. This area is situated on the Nechako plateau in the path of the Cassiar-Omineca batholith which outcrops in this region. Values seem to range

from \$1 and upwards per cubic yard. Good values, shallow overlie, and absence of any great number of large boulders make this region attractive from the "poor man's" standpoint, and it also offers possibilities of large-scale operation. Space does not permit of further details herein, but a full account of this area will appear in the 1932 Annual Report.

Prospecting is recommended north-westwards from the McLeod river towards Mount Milligan. The direction of the batholith being south-eastwards, it follows that any creeks flowing at right angles, or nearly so, to this should receive close investigation. It is quite possible also that the region south-east of McLeod river merits attention; the Crooked river would seem to flow close to the east edge of the path of the batholith, but it is possible that the latter may be found somewhat east of the Crooked river at southerly points.

An account of individual occurrences of placer such as Rainbow creek ("Placer-mining in British Columbia," Bulletin No. 1, 1931), Dog creek (Annual Report for 1931), and Bob creek (Annual Report for 1928) will not be repeated herein, as they are dealt with fully in the publications indicated.

In the Dome Mountain region, distant 26 miles from Telkwa, occur a number of gold-quartz veins, which received considerable attention some years ago, and which are now being developed by W. R. Wilson & Sons at the *Free Gold* group. The discovery of placer has never been reported in this region, but its occurrence seems quite possible, and prospecting of creeks in this region by local prospectors only is advised.

PEACE RIVER MINING DIVISION.

No placer deposits of local origin are known to occur in this Mining Division, concentrations being entirely in the form of bar and bench deposits, which still engage the attention of individual operators. For further particulars reference is invited to "Placer-mining in British Columbia," Bulletin No. 1, 1931, page 89.

CARIBOO MINING DIVISION.

Great diversity in the modes of occurrence is exemplified by the placer deposits of the Cariboo and Quesnel Mining Divisions, but they fall naturally into two broad classes:—

- (1.) Those which result from veins of pre-Mississippian age.
- (2.) Those which result from veins of Jura-Cretaceous age.

In the first class are to be included the richest deposits of these Mining Divisions, with the single exception of Cedar creek. Deposits of this class have naturally, in view of their richness, borne the brunt of attack, but they are not yet completely exhausted, and remnants of much potential value yet remain. These deposits originate from the erosion of gold-bearing veins formed by a concealed batholith underlying the region between Cariboo lake and that to the north-west, including within it Stanley and Barkerville. Deposits of the second class originate mainly from mineralization caused by the Central batholith outcropping at various points in its path between Boss mountain in the Quesnel Mining Division and Hixon creek in the Cariboo Mining Division. A few only, such as Skaret creek and Goat river, probably result from the Cassiar-Omineca batholith, which is mainly deeply concealed, although not entirely so, in the Cariboo Mining Division, and does not underlie the Quesnel Mining Division.

It is desired to express the view that the placer deposits of these Mining Divisions, so far from being exhausted, offer great opportunities to capital under skilled direction. Space does not permit of particularizing properties herein, but perusal of the Annual Reports, which is earnestly invited, will disclose wherein individual opportunities lie. Further, it is desired to add that these properties are not situated at some remote point, but most of them can be reached by car from any point of the highway.

PRINCE GEORGE SECTION.

Interesting new discoveries of the year 1932 are those on Skaret creek (medium coarse gold on true bed-rock); on the North fork of Hixon creek (coarse gold on false bed-rock); and on Terry creek (fairly coarse gold on false bed-rock).

The placer deposits of Hixon creek and adjacent region warrant a greater measure of investigation than they have received in the immediate past. A section of indicated promise is that extending from Hixon creek south-eastwards towards Ahbau lake, and close prospecting of this region is advised. A south-easterly-trending belt of highly altered schistose rocks,

containing many quartz veins, exists in this region, and quite possibly has an important bearing on placer occurrence. On Terry creek, at the canyon, a clearly defined valley on the north side of the creek trends in the direction of Hixon creek, which merits close prospecting.

Attention is especially directed to the fact that in this region, where creeks occupy rocky gorge-like channels, such are probably post-Glacial, and a buried portion of the pre-Glacial channel may exist in one of the banks of the creek in such regions.

A matter of interest in this section is the possibility of the existence of the up-stream continuation of the Tertiary Fraser River channel segment exposed at the *Tertiary* mine in the Cottonwood canyon. D. D. Fraser and associates have carried out much investigation of this matter at their property on Canyon creek close to the highway. It might be mentioned that a few miles north of this, on the west side of the Fraser river opposite Woodpecker, is exposed a former channel at a point considerably above the river. (Refer to 1930 Annual Report.)

AHBAU LAKE SECTION.

Interest in this region revived following discovery by G. F. Taylor of promising ground on Ahbau creek just below Hay lake. Further investigation is required to fully appraise possibilities, but the nature of the ground lends itself to drag-line operation. This ground lies only about 5 to 15 feet above bed-rock, and gold occurs partly on false bed-rock, partly on bed-rock. On Alder gulch, flowing into Hay lake from the west, much deeper ground was apparently encountered by earlier workings, so that there may be a buried channel in this region. A small hydraulic plant was installed on Murray creek, flowing into Ahbau creek about 1½ miles below Hay lake, by P. Jorgensen and associates. Further investigation of this region is warranted, and prospecting is advised north-west of this towards Terry creek and south-east towards Beaver pass. Generally speaking, it may be said that the region north of the Cottonwood river and west of the Willow river merits close scrutiny.

BARKERVILLE SECTION.

(This section comprises the area lying between Cottonwood and Barkerville and includes all properties therein.)

This section has been subjected to more thorough prospecting than any other, in view of the fact that it was the scene of the earliest excitement in the sixties and contained most of the bonanza placer deposits of the Cariboo. Nevertheless, recent discoveries, notably that of G. S. Gagen on Gagen creek, tributary of Lightning creek, indicate that possibilities still exist for the experienced prospector. Recent activities in Beaver pass indicate the advisability of close prospecting from this point north-westwards towards Ahbau lake. There is also evidence of channels trending across Lightning creek at some points between Cottonwood and Wingdam.

There is a great deal of fairly large-scale activity in progress at different points, and at many of the smaller hydraulics interesting possibilities are indicated. In this class the bed-rock and placer geology and other features of the *Trehouse* hydraulic on Cunningham creek, and of the *Last Chance* on Last Chance creek, attach importance to the detailed investigation of these properties to determine if larger-scale enterprise is justified.

Among the many interesting possibilities, determinable only by further investigation, is the "high run" in Downey pass on the property of D. McIntyre and W. E. Thompson, described in the 1931 Annual Report, and the possibility of an extension of the *Thistle* gold-run at 8-Mile lake to Shepherd creek.

ACTIVITIES IN CARIBOO MINING DIVISION DURING 1932.

A brief résumé of activities in 1932 follows, but those interested are referred to the forthcoming Annual Report for 1932 for greater details.

Great activity was general throughout this Mining Division. Among the larger operators may be mentioned: Lowhee Mining Company, Limited, on Lowhee creek; New Waverly Hydraulic Mining Company, Limited, on Grouse creek; and Consolidated Gold Alluvials of B.C., Limited, on Lightning creek. This latter is the property formerly controlled by the Lightning Creek Gold Gravels and Drainage Company, Limited; full information regarding it can be secured by writing to the Department of Mines. A large number of the small hydraulic operators carried on work and promising results were secured in several instances. New activities of promise developed in the vicinity of Ahbau lake and in Beaver pass.

Among new enterprises may be mentioned those of: Guyet Placers, Limited, at the *Guyet* mine on Antler creek; French Creek Hydraulic Placers, Limited, on French creek; Slade-Cariboo Gold Placers, Limited, at the property of W. C. Slade, Mosquito creek, tributary of Lightning creek; C. W. Moore and associates on the new discovery made by G. S. Gagen on Gagen creek, tributary of Lightning creek; and C. H. and J. A. McDonald on Leases 2061 and 2062 on Swift river (drilled in 1922; see Annual Report for 1924 under "Gold Dredging Syndicate, Limited").

Among the more promising of the new discoveries are: That of G. S. Gagen, of Cottonwood, of well-worn fairly coarse gold on a rock bench on Gagen creek, tributary of Lightning creek; that of A. Nani, of Hixon, of coarse gold on false bed-rock on the North fork of Hixon creek in the region where the likelihood of a buried ancient channel was indicated in the 1931 Annual Report; that of coarse gold on false bed-rock on Terry creek by G. Lahti on ground owned by F. German and the discoverer; and that of P. Skaret, of Prince George, on Skaret creek, tributary of Tabor creek, about 6 miles east of Prince George.

Many bars and benches on the Fraser river engaged the attention of a large number of individuals, whose efforts were greatly hampered by the high water prevailing during a large part of the season.

QUESNEL MINING DIVISION.

Remarkable features of this Mining Division are the very extensive buried ancient river systems exemplified by the ancient channels of (a) the Fraser river, (b) the Quesnel river and both its North fork and South fork, and (c) the Horsefly river. Where exposed the gravels of the Tertiary Fraser river are cemented, but with the ancient channel systems of the North and South fork of the Quesnel river are concerned the largest hydraulic enterprises of the district. Of recent years but little activity has transpired in connection with the buried ancient Horsefly River drainage system, but recent developments evince decided promise and augur well for the future. These buried ancient river systems apparently have large-scale possibilities and merit the closest scrutiny. It is possible that in cases where methods of straight hydraulicking are inapplicable a combination of hydraulicking and drag-line methods will prove adaptable, and in some cases the latter method only possibly. For particulars of: (a) Refer to Annual Reports for 1926 and 1932; (b) refer to Annual Reports for 1930, 1931, and 1932; (c) refer to Annual Reports for 1931 and 1932.

QUESNEL SECTION.

Interest in this section focuses chiefly in the various bars and benches of the Fraser and Quesnel rivers, which annually engage the attention of a large number of individuals, and in the buried ancient channel segments of the Quesnel river from Drummond flat down-stream (see Annual Reports for 1930 and 1931).

A buried Tertiary channel of the Fraser river is cut by the present river in the Cottonwood canyon, and segments lie buried in both the east bank (*Tertiary* mine) and in the west bank (*Canyon* mine). The former is described in the 1926 Annual Report and the latter in the 1932 Annual Report. It is entirely a reasonable anticipation that this channel will be richer where the Fraser river crosses the path of the Central batholith in the more immediate vicinity of Hixon creek, if the channel exists at that point. Some work has been done by D. D. Fraser at the last-mentioned point, including some Keystone-drilling, and the results are stated by him to have been encouraging. Both the *Tertiary* and *Canyon* mines are at present inoperative, although a certain amount of work was done last year by S. R. Craft, and some further investigation seems warranted.

LIKELY SECTION.

Apart from a few individual operations, interest in this section focuses on the buried ancient channels of the South and North forks of the Quesnel river, with which are concerned the hydraulic operations of Moorehead Mines, Limited, *Bullion* mine (Hireen Placers, Limited), and the C. and S. Mining Company, Limited; in Cedar creek and a possible extension of this old channel; and in the hydraulic operations on Poquette creek recently started by B. Boe. The buried ancient channel system of Black Bear and Spanish creeks is also of much interest, but at present the object of individual effort only.

The possibility of a continuation of the rich Cedar Creek channel (with which latter the operations of B. Boe have been concerned for some years past), either north-west or south-east of the point of this discovery, is one of much interest, in view of the many facts which indicate

the local origin of the gold. E. A. Bradley, after much field-study and investigation, has formed the entirely rational hypothesis that the buried ancient channel of the South fork of the Quesnel river is the north-west or down-stream continuation of this old channel. He has therefore commenced to sink a shaft, after Keystone-drilling, in the ancient South Fork channel, which lies buried on the south side of the present river, and of Quesnel lake just opposite Likely. This property is known as the *Little Joe* mine.

B. Boe is investigating possible local extensions of the Cedar Creek run, but the possibility of finding an extension in a south-easterly direction would seem to merit close prospecting. The grade of the bed-rock in the vicinity of B. Boe's operations is about 3 per cent., and this fact should be borne in mind in considering any possible extension. Should the channel exist in the region of Cedar Creek meadows, it is likely to be on the western slopes of the valley, as was indicated by W. A. Johnston in his original report. It would seem that search to be successful should be thorough, bearing in mind that a shaft sunk from the surface within a few feet of the "Second Nugget Patch" failed to disclose the latter.

The region on the east side of the North fork of the Quesnel river between Sailor creek and the falls on the river would seem to merit prospecting, in view of the fact that a buried channel of the river exists in the left bank of the latter in this region, and watercourses or gulches that cross it are likely to contain a false bed-rock concentration. The region of the falls should be closely examined.

There is evidence of a buried high channel of the North fork trending south-westwards from the south end of Cariboo lake in the direction of Quesnel Forks. A close examination of the region of Kangaroo and Maud creeks would seem merited, as such might disclose that these creeks cut the channel mentioned.

KEITHLEY SECTION.

Placer deposits in this section lie north-west of Cariboo lake, and originate presumably from the concealed pre-Mississippian batholith, previously referred to in this report, as extending from the region of Cariboo lake north-west through Stanley and Barkerville. Such deposits comprise Keithley Creek drainage system, Nigger and Harvey creeks, and at present engage the attention of Placer Engineers, Limited, and a number of individual operators. These deposits evince considerable potential importance. Interesting discoveries were made during the year by W. Hamilton and associates on Nigger creek and by H. Curtis on Harvey creek.

HORSEFLY SECTION.

The feature of this section is the very extensive buried Tertiary Horsefly River drainage system, of which detailed accounts will be found in the 1931 and 1932 Annual Reports. Upon a correct deciphering of this drainage system depends the explanation of the modes of placer occurrence exemplified.

This section differs from any other placer section within this district in that it was not subjected to any late Tertiary uplift, and a process of prolonged erosion and peneplanation has proceeded with the minimum of interruption. One such interruption in early Tertiary times is evidenced by a high channel (about 600 feet above the present Horsefly river) cut by Black creek and its East fork, due to differential uplift, and causing the river to rejuvenate immediately south of its former position.

Very gratifying developments took place during the year at the property of R. N. Campbell and associates on Antoine creek, under option to G. F. Baird, which give every indication of assuming commercial proportions in the near future. A discovery by G. Kuchan of fairly coarse gold on false bed-rock in the bed of the Horsefly river, about half a mile below "Hobson's Horsefly" mine, made during the year, clearly calls for investigation.

This section offers a field for much detailed investigation at several points, which perusal of the Annual Reports for 1931 and 1932 will render evident.

ACTIVITIES IN THE QUESNEL MINING DIVISION DURING 1932.

Limitations of space preclude other than the following brief résumé. For detailed accounts those interested are referred to the 1932 Annual Report. Activity was general throughout this Mining Division. Among the larger operations may be mentioned those of: Moorehead Mines, Limited, near Hydraulic; Hireen Placers, Limited, at the *Bullion* mine; B. Boe on Cedar creek; and Placer Engineers, Limited, on 4-Mile creek, near Keithley. New enterprises inaugurated during the year were those of: C. and S. Mining Company, Limited, on the property of the

Moose Syndicate, North fork of the Quesnel river (see 1931 Annual Report). This company employed upwards of seventy-five men during the season in installing a hydraulic plant and commenced piping at the close of the season. Small-scale operations were carried on by Ruby Gold Mines, Limited, on the North fork of the Quesnel river; by B. Boe on Poquette creek; by E. A. Bradley on the south side of the South fork of the Quesnel river, half a mile from Likely; and by G. F. Baird on the property of R. N. Campbell and associates on Antoine creek in the Horsefly section.

Among new discoveries may be mentioned: That of fairly coarse gold on Nigger creek (known locally as Pine creek) by W. Hamilton and associates, of Likely; that of H. Curtis, of Williams Lake, on Harvey creek; and that of George Kuchan, of Horsefly, of fairly coarse gold in the bed of the Horsefly river, about half a mile down-stream from "Hobson's Horsefly" mine. B. Boe has purchased the property of H. Curtis on Harvey creek and is making preparation to haul in equipment to this property.

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

REPORT BY PHILIP B. FREELAND, RESIDENT MINING ENGINEER (HEADQUARTERS, PENTICTON).

INTRODUCTION.

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 (magnetic or chromite), and although his full report is not yet available, 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.

Full reports on placer-mining will appear in the Annual Report for 1932, and detailed information can be obtained from the Resident Mining Engineer.

GRAND FORKS MINING DIVISION.

There is no production reported from this Division, but 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; Sander 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.

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 average \$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. The other channels occur on Leases No. 51, No. 58, No. 73, and No. 55. There are plenty of similar opportunities for finding gold on Jolly creek, McKinney creek, and the lower reaches of Rock creek.

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 and there is a run of gold going on at the present time.

OSOYOOS MINING DIVISION.

Likely prospecting areas embrace any creeks, wet or dry, draining the free gold in quartz area between the Okanagan and Similkameen rivers on the east and west and Osoyoos lake and Twin lakes on the north and south. The Similkameen river contains much fine gold in the surface gravels from Hedley to the International boundary-line, but bed-rock workings have never been reported.

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.

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.

New finds of gold on the bed-rock gravels under glacial moraines at Hefley 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 intense prospecting; even the old dry creek-beds. The bars of the Thompson river are also worth consideration.

CLINTON MINING DIVISION.

A new discovery of gold was made this year 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.

On the *Crows Bar* property work on the benches was discontinued and a suction-pump and sluice-boxes installed on a scow on the Fraser river with the idea of sucking gold from the bottom gravels. When examined only light colours had been obtained.

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.

NICOLA MINING DIVISION.

Production from this Division has been practically negligible for some time. This year gold and platinum prospects are reported from the junction of Spius (Petit) creek and the Nicola river, where extensive gravel flats are in evidence; also in the neighbourhood of Nicola lake. Moore creek, which traverses the Stump Lake section, where gold-quartz veins are mined, suggests a likely prospecting area.

EASTERN MINERAL SURVEY DISTRICT (No. 5).

REPORT BY B. T. O'GRADY, RESIDENT MINING ENGINEER (HEADQUARTERS, NELSON).

INTRODUCTION.

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 portions 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.

Valuable information concerning placer-gold deposits in the vicinity of Cranbrook is contained in the report by C. E. Cairnes to be published in the Summary Report for 1932, Geological Survey of Canada, and, with the courtesy of the Director, to be reproduced in the Report of the Minister of Mines for 1932. The notes submitted are in part complementary to the Cairnes report, which deals with an area west of the Kootenay river and within a 25-mile radius of Cranbrook. Placer-mining in the Fort Steele Division, chiefly of a testing and preliminary nature, was more active than for some years past. In addition to the claims taken up by individuals under provisional free miners' certificates, 172 new creek leases were issued, in connection with most of which some activity occurred. These included 132 creek leases,

thirty bench leases, and ten dredging leases. The 1932 stakings cover areas on Fish Lake creek, St. Mary river, Perry creek, Valley creek, Kootenay river, Wild Horse creek, Boulder creek, Maus creek, Skookumchuck river, Moyie river, Palmer Bar, Nigger, and Weaver creeks. For the location of these streams and the general geology of the area the reader is referred to Geological Survey Map 147A, "Cranbrook, Kootenay District, British Columbia." 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 that bed-rock conditions should be more fully investigated.
- (8.) Wild Horse Creek valley and delta.

PERRY AND VALLEY CREEKS.

The past season witnessed a considerable amount of development-work carried out on these creeks.

Perry Creek Syndicate.—Near Old Town some sixteen men were employed by G. M. Bell and associates, who installed compressor and hoisting equipment. Preliminary testing included three holes sunk to bed-rock with a Keystone drill. Results being encouraging, this was followed by the sinking of a shaft 100 feet in the rim-rock, with a 95-foot drift under the stream-bed. This work was practically completed at the end of the season and production is expected to be made in 1933.

Grady Leases.—A start was made late in the fall by T. B. Grady, of Vancouver, in connection with five adjoining creek and bench leases, situated 1½ miles above Old Town, which were acquired on a lease and option basis from A. Hurry, J. Leask, and associates, of Cranbrook. A long tunnel is being driven to prove the ground with a view to hydraulicking, for which equipment already on the property includes three monitors.

McDonald Leases.—On Valley creek, near where it joins Perry creek, Dan McDonald, M. P. Johnson, and R. V. Price have been drifting in connection with their creek leases.

FISH LAKE CREEK.

Following the discovery of placer gold on this creek early in the spring of 1932 by M. Brandvold and C. Hornlund, of Cranbrook, the whole valley for 3 miles has been staked as claims, creek and bench leases from Fish lake to Palmer Bar creek. Substantial recoveries, including fairly coarse gold, were made from the discovery claim, situated on the eastern side of the valley half a mile southerly from Fish lake, and for the three months ended August 31st the bank records showed these prospectors cashed in on the average from 2 to 3 oz. per week, the approximate total amount received at the bank being 41 oz. The upper end of Fish Lake creek is now conveniently reached by road westerly from Cranbrook and the lower end is connected by road and trail from Lumberton.

Audrey-Melrose Leases.—Southerly from Fish lake twenty bench leases and one creek lease were staked on behalf of G. M. Bell and associates, of Calgary, and some preliminary testing was made of the bench-gravels. Results encourage the expectation that a small operation will be initiated during the coming season. A comprehensive report on the gold occurrences was made in September by W. V. Smitheringale.

PALMER BAR CREEK.

Golden Star.—On this bench lease, held by G. A. Ness, adjoining the road 2 miles from Lumberton, new activity was initiated late in the season by G. V. Cady, representing a syndicate of Nelson men. Several weeks were spent in construction of camp and plant, followed by hydraulicking for a short period prior to the freeze-up. It is planned to resume this operation in the spring.

Moodie Leases.—A large area along Palmer Bar creek, north-westerly from its junction with the Moyie river, was taken up as bench and creek leases by F. R. Moodie and associates, of Calgary, and preliminary testing was carried out at several points.

MOYIE RIVER AND WEAVER CREEK.

Nystrand Lease.—On the Moyie river, below Weaver creek, W. Nystrand and S. A. Nogalski constructed a boom-gate of large dimensions to dam the river and boom the old hydraulic tailings from the channel below. Two such contrivances were previously constructed by Nogalski on Weaver creek and used with some success. The main object in this case was to lower the present creek to allow of a tunnel being driven into an old channel, in which five shafts had been sunk, proving, it is claimed, good values.

WILD HORSE CREEK AREA.

Placer-gold extraction began in the sixties and accurate records covering the early years are not available. The total production of the creek, mostly from a length of 3 or 4 miles, is variously estimated at from \$5,000,000 to \$20,000,000. A large production at least is certain, much of it at a time when this locality was remote from transportation and expenses were extraordinarily high. The available geological data indicate that in pre-Placial times the valley of Wild Horse creek was partially filled with water-worn gravel, containing a concentration on bed-rock of well-rounded placer gold derived largely from the valley of Boulder creek, a tributary from the east. Wild Horse glacier scoured this valley fairly clean and removed most of the gold. Coincidentally the character of the valley was changed to a pronounced U-shape, its rock walls were worn off smooth, and all decomposed rock removed therefrom. According to this theory, another abundant supply of broken rock, sand, and mud with placer gold was released on the retreat of the ice. It was this debris, subsequently worked over and roughly assorted by the glacial streams, which filled Wild Horse Creek valley with bouldery gravel up to a level of about 300 feet above that of the present stream. During the filling of the old valley in this manner, placer gold would have been to some extent deposited with a tendency to gravitate towards bed-rock. The lack of pronounced stratification and assortment of these gravels is taken to indicate that a complete concentration of gold on bed-rock in the glacial channel is not to be expected, and that some of it will be found distributed through the heavier parts of the gravel generally. Geological evidence all tends to the conclusion that the post-Glacial stream pursued a different course from the present stream, and that as a result portions of the old gravel-filled glacial stream escaped re-excavation. It has been shown that the present stream crosses the abandoned channel of the glacial stream in a few places, where the values have been removed. At other points the gold content of the old channel has been removed by hydraulicking and ground-slucing operations. Attention of late has been directed to the remaining undisturbed sections of the old channel, as in the case of the ground controlled by the Wild Horse Gold Mining Syndicate, where the present stream is considered to be about 100 feet below that of the glacial stream-bed.

Wild Horse Gold Mining Syndicate.—Hydraulicking with one giant was carried on for a short period on the western side of the creek by this syndicate, which holds bench leases extending along both banks for a distance of about 2 miles above Brewery creek. In addition to hydraulicking carried on intermittently since 1924, past operations under the management of W. A. Drayton, of Fort Steele, include a large aggregate amount of shaft-sinking and tunnelling to explore for old channels. A considerable amount of information should thereby be available to direct future efforts.

J. R. Finlay Leases.—On the delta of Wild Horse creek, adjoining the Kootenay river, some sixteen holes were sunk with a Keystone drill by J. R. Finlay and associates, of Medicine Hat, to test the ground with a view to dredging. Subsequently important dredging operators of California became interested in the undertaking and a preliminary inspection of conditions was made in December by their representatives. Plans definitely consummated include a systematic testing with two Keystone drills to be undertaken as soon as local conditions permit. G. L. Holmes, placer-dredging engineer, of San Francisco, is expected to accompany the drilling crews.

Activities on Wild Horse creek above the canyon included shaft-sinking and drifting by J. F. White, of Fort Steele, to test the bed-rock on his creek lease; and minor efforts of numerous individual miners, including Chinamen, at various points along the valley.

On Boulder creek, three-quarters of a mile up-stream from Wild Horse creek, A. Suran and sons worked their *Violet* creek leases with some success, coarse nuggets up to \$27 in value having been recovered, according to report. When the locality was visited in August, work was in progress on a deep trench to divert the stream and work the bed-rock gravels, below which a rich concentration of gold was found. This condition seems to be restricted to a limited amount of original material which, due to local structural conditions, escaped the intense glaciation which scoured this valley at other points. Below Suran's ground the creek was staked to Wild Horse creek and minor activities were being conducted at several points by groups of individuals, including the G. R. Leask lease at the lower end. Adjoining Suran's creek lease to the south, a tunnel was being driven on the *Lucky Jim* bench lease (W. A. Drayton holdings) and sluice-boxes installed.

MAUS CREEK.

On this creek, which parallels the course of Wild Horse creek to the south-east, G. M. Bell and associates, of Calgary, financed exploration on creek leases in which they are interested. Under the supervision of W. Thomson, a shaft was sunk 96 feet to bed-rock and drifting was commenced. This was discontinued when the cold weather interfered. A water-wheel was installed, with which the shaft is to be dewatered early in the spring and further work carried on.

MISCELLANEOUS.

There were also numerous minor activities by individuals and partnerships in the district adjacent to Cranbrook. Production by seven prospectors on Bull river aggregated about 37 oz. The largest amounts reported were from Fish Lake creek, Boulder and Wild Horse creeks. While the total combined production of the Fort Steele Division is not yet very important, the encouraging results obtained in some cases, and preparations being made for future production, indicate that this class of mining cannot be overlooked in any estimate of the mineral potentialities of the area.

REVELSTOKE MINING DIVISION.

In this Division the more important placer deposits have been found in the Big-Bend district, chiefly in French, McCulloch, and Camp creeks, all tributaries of Goldstream river. The lower reaches of this river, Smith creek, and Carnes creek have also yielded some gold. The total production from the Big Bend, where placer-mining commenced in the sixties, is not known, but it is believed to amount to several million dollars. As reference has been made to the local geology and conditions of the gold occurrences in previous Placer-mining Bulletins, only recent developments will be mentioned herein. In addition to claims acquired under provisional licences, some twenty leases are held in the Big Bend area.

French Creek Development Co.—Hydraulic operations were continued by this company on French creek and clean-ups for the season are reported to have aggregated \$13,125. This gold, much of it quite coarse, was derived from a section of old channel which has apparently terminated where it joins old workings at its upper end. The company's holdings are quite extensive, however, and if this particular deposit is exhausted a considerable area remains to be tested.

Coughlan Leases.—A new operation was initiated on Camp creek in connection with six leases acquired by J. B. Coughlan and associates, of Calgary. Testing operations are reported to have been successful, approximately \$2,000 in gold having been extracted from a comparatively small area. It is understood that a limited liability company is to be incorporated, to be known as the "Camp Creek Gold Mining Company."

Other streams actively prospected or worked by individuals include McCulloch creek, Smith creek, and Goldstream. On McCulloch creek intermittent work has been carried on for some years by C. M. Williams and D. Fulmore, of Revelstoke. In this operation boulders, varying in weight from a few pounds up to 40 or 50 tons, are the chief difficulty, necessitating the expenditure of much time, labour, and powder. Wherever unworked bed-rock can be exposed, however, good values in coarse gold can be expected.

On Isaac creek, south of Revelstoke, a proposed new undertaking has just been reported by N. E. De Mers, of Montreal. A dredging lease is said to have been acquired on Isaac creek adjoining the Columbia river, and at the time of writing, materials are being shipped from the East for an experimental, continuous bucket-type dredge to handle from 500 to 800 cubic yards

of gravel in 24 hours, power to be provided by a 65-horse-power gasoline-motor. Some preliminary testing of the gravels was done in former years with, it is claimed, encouraging results.

NELSON MINING DIVISION.

The areas worked in former years attracted the most attention, such as Forty-nine creek, the Pend d'Oreille and its tributaries, including the Salmo river; Rover creek and Hall creek. In addition, prospecting activities took place at widely separated localities, including Falls creek west of Nelson and Goat river. Mechanical equipment was used in a few cases. No production of much importance has been reported.

Cabinet and Edith.—A considerable amount of work was accomplished on these leases on Hall creek by E. Brasch, of Procter, and S. McDonald and associates, of Nelson, in connection with ground-slucing operations. A drag-line outfit and caterpillar were used.

Pothole.—This lease on Forty-nine creek, held by H. W. Robertson, of Nelson, was actively worked by M. J. Sweeney at the upper end of the ground; and by G. H. Keefer and H. Watson, of Vancouver, at the lower end. Work done includes surface excavation, tunnelling, and ground-slucing.

On Falls creek, G. Hyde, of Winnipeg, representing the Cann Mining Syndicate, is testing the ground (bench lease) with a Crown placer-machine of 120-cubic-yards capacity in 24 hours, operated by a gas-engine.

LARDEAU MINING DIVISION.

Individuals and syndicates prospected and worked the Lardeau river for seasonal periods at several points above Trout lake.

Selkirk Mines, Ltd.—At 10-Mile, near the confluence of Gainer creek, camp buildings were erected and a substantial amount of work done by the Selkirk Mines, Limited, a private company of Vancouver, which took over the holdings and leases of the Ganor Creek Gold Washing Syndicate. The creek was diverted into a flume of large dimensions to give access to bed-rock, where, however, no values of importance had been found when the property was visited towards the end of August. It was then understood that the benches adjacent to the creek were to be investigated.

Big Boulder.—On this creek lease, at the mouth of the canyon $1\frac{1}{2}$ miles above Trout Lake, work was carried on by J. McEwan, of Nelson, and associates during the first few months of 1932. Construction of a dam and 16- by 4-foot flume were completed in January. Trouble developed from leakage in the flume and the dam was carried out at high water. Before this the creek-gravels, up to 17 feet deep, were tested by pits sunk at several points over a length of about 1,500 feet. Encouraging results are reported and it is planned to resume work on a more efficient basis when adequate financing is obtained.

WINDERMERE MINING DIVISION.

Recent stakings on Dutch creek, all below the intersection of its North branch, include seventeen claims recorded under provisional free miners' certificates and eighteen creek leases, including those in which J. L. McKay, of Lake Windermere, is interested. George Bagley, of Vancouver, tested the gravels at various points, but no permanent activity has materialized as yet.

GOLDEN MINING DIVISION.

A revival of interest took place on Canyon creek, south of Golden, where R. M. Six and associates have been actively developing a creek lease and three creek claims, but production has not yet been reported. In the same vicinity some work was done by holders of provisional free miners' certificates, no claims being recorded by them. On Quartz creek, north-west of Golden, minor activity occurred in connection with the *Ophir* bench lease, held by C. P. Price.

AINSWORTH MINING DIVISION.

In this Division the actively prospected areas include the Lardeau river below Goldhill, Howser pass adjacent to this stream, lower Cascade creek, Hall creek near its junction with the upper Duncan river, and Fry creek. The ground worked was all taken up as placer claims and no production of importance is known to have been made.

ARROW LAKE MINING DIVISION.

Placer-mining was limited to small activities by individuals on Barnes creek and its tributaries.

WESTERN MINERAL SURVEY DISTRICT (No. 6).

REPORT BY GEORGE A. CLOTHIER, RESIDENT MINING ENGINEER (HEADQUARTERS, WORKMEN'S COMPENSATION BUILDING, VANCOUVER).

This branch of mining is of minor importance on Vancouver island and the Mainland coast. Lilloet Mining Division, east of the Coast range, contains the Bridge River area and a portion of the Fraser river, and consequently holds important potentialities in placer-mining, essentially in the larger operations of hydraulicking, dredging, and other methods, where large yardages are handled. There is not much encouragement for the hand placer-miner anywhere within this district. I again warn the "amateur" against paying cash to the "placer-lease bootlegger" for the privilege of working his ground.

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.

This year Leech river has been tried out from its mouth to the forks with very little success. The main operation has been that of E. Butterworth, of Victoria, and associates, who last year installed a small hydraulicking plant under the supervision of J. S. Macdonald. A cut was made from the river through a gravel bank on the east side to rim-rock, which was followed until what was believed to be an old channel was encountered about 30 feet higher than the present river-bed. The old channel appears to be 50 feet between rims and about 7 feet deep, of partially cemented gravel showing in places fairly coarse gold. There is about 10 feet of loose barren gravel above to the surface which will be a heavy dilution, and the channel-gravel will therefore have to carry pretty fair values to be profitable. A considerable yardage will have to be sluiced to prove its importance.

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 and contained in the black sand, and consequently is hard to recover. An amateur has no chance, and even with expert handling the returns are small.

MAINLAND.

There is no placer-mining of any description on the Mainland coast.

NEW WESTMINSTER MINING DIVISION.

Government office statistics for the year show that some thirty placer claims were recorded in this Division, of which twenty-six were staked on the Alouette river below the B.C. Electric dam, and the remainder along the Fraser river. The Alouette River claims were investigated early in the season, but the results were so discouraging that little further was done.

LILLOET MINING DIVISION.

Placer-mining in this Division is confined mainly to a portion of the Fraser river and tributary creeks and the main Bridge river and tributaries.

Extensive individual mining has been carried on throughout the Division this year: On McGillivray creek, flowing into Anderson lake from the north-west; on Cayoosh creek, emptying into Seton river just west of Lilloet; on the Fraser river; on the main Bridge river and its South fork (Hurley river); and on Tyaughton creek, a tributary of Bridge river; and with very few exceptions only living wages have been made. The Division therefore cannot be recommended as holding many inducements for individual placer-mining. It is, however, a very attractive field for larger operations, and a number of installations are under way from which there is every reason to expect profitable returns. It must be emphasized that the prime reason for failures in such undertakings is due to inadequate testing of the ground before the installation of the plant. A comparatively small preliminary expenditure for drilling or a pilot

plant would obviate this. Several pumping plants for furnishing water for sluicing the higher ground have been put in along the Fraser and more are planned for next season.

On Bridge river the Lower Bridge River Placers, Limited, with a capitalization of 2,000,000 shares of 50 cents per share par value, has installed an hydraulicking plant on its leases situated below 7-Mile creek, about 12 miles up from Lillooet. The company owns sixteen river leases and six bench leases.

Water was obtained from 7-Mile creek by ditch and pipe-line giving a 400-foot head of water at the monitors. Sluicing was started late in July on the bench-ground, but encountered bed-rock and cemented gravel conditions which necessitated changing the sluice-boxes. By the time the necessary changes were made the water-supply was inadequate for efficient work and operations were closed until the spring. The indicated gold values of over \$1 per yard in this ground gives this property a very promising outlook.

There are several placer leases and claims held above this at the "Horseshoe bend," about 20 miles from Lillooet. I am informed that a drag-line scraper outfit will be installed next season on one of the leases.

On Marshall creek, a tributary of Bridge river from the north, about a mile above Rex-mount on the main highway, a plant was about completed this year by Miller Bob, Bob Colvin, and Robt. Warren, the owners of two leases. This ground has been operated for a number of years with a small hydraulicking plant, giving fair gold returns. The new plant is something new in this district, consisting of a dam fitted with an automatic gate which holds and releases the water when the dam is full, thus giving "booming" conditions for washing the gravel down to the sluices. A light monitor is used at the head of the sluice to facilitate the movement of the gravel into the boxes. By means of "shears" the rush of water is diverted or confined in channels as desired, and by this means the full width of the river-bed, several hundred feet, is worked at very low cost. The owners state that the lower half-mile lease can be worked from this dam. The known gold content of the gravels from former years' operations marks this as a probably successful proposition.

On Tyaughton creek there are two larger operations and a number of individual claims.

W. Gorelli owns some ground below the Tyaughton Creek Gold Placers holdings that is worth investigation. He has driven a couple of tunnels on bed-rock on a bench about 30 feet above the present river, from which he gets good gold values in places. Further work on this ground might show sufficient yardage of pay-gravel to justify a large plant.

The Tyaughton Creek Gold Placers, Limited, owns three leases below Liza creek, or about 4 miles up Tyaughton creek from the main road. The company is capitalized at 125,000 shares of \$1 par value, with its head office now at 118 Vancouver Block, Vancouver. This year the company acquired the hydraulicking plant used on McGillivray creek a number of years ago. To get this plant to the property from the main road required the construction of about 7 miles of trail. As the plant was being delivered the old ditch-line, 3,700 feet long, was cleaned out, enlarged and repaired, and the pipe-line laid, putting the water from Liza creek down to the monitor at the creek with about 165 feet head. A few weeks' work in the spring will complete this plant as the material is all on the ground. There is ample gravel in the benches which the company states has been sampled sufficiently to expect satisfactory returns. Working conditions are favourable, and with the early completion of the plant the merits of the property should be demonstrated early in the summer of this year.

About 2 miles above this, two creek leases owned by Grant White, of Bridge River, and Vancouver associates have been developed this year to the production stage, though not enough gravel was worked this fall before the freeze-up to fully prove the value of the ground. The work consisted of diverting Tyaughton creek to permit the working of the river-bed for a distance of 200 feet or more. This necessitated digging several hundred feet of ditch from 6 to 8 feet deep of sufficient size to carry the entire creek-flow and the building of a wing-dam to divert the river into the ditch. The creek-water will be used for sluicing. The exposed creek-bed will be worked by drag-line scraper which has been installed. Cemented gravel in the river-bed prevented the moving of very much gravel, but I am informed that sufficient sluicing was done and gold recovered to indicate very favourable chances when work is resumed next year.

The headwaters of Tyaughton creek, Yalakom river, French Bar creek, and Churn creek should be a very favourable area for both placer- and lode-gold prospecting. The area is reached by trail up French Bar creek from the Fraser river.

The Cadwallader Syndicate Placers, Limited, of Vancouver, has a creek and a bench lease on Cadwallader creek just below the Bralorne mine. Under the supervision of Horace Fraser, a drag-line scraper on a 45-foot boom was installed this year. It is of heavy construction, capable of handling boulders of several tons weight. The estimated gravel yardage is 350,000 yards, with an indicated value, from Mr. Fraser's sampling, of about \$1 per cubic yard.

A metal flume carries water from the intake up the river to the sluice-box set on a 3-per-cent. grade. A movable grizzly dumps into the sluice-box, the oversize going into the creek. Some 7,000 yards of gravel were moved this season from a cut 400 feet long along the bank of the creek. Unfortunately a bed of clay was entered at the lower end of the cut where it was about 2 feet thick, but had increased to about 12 feet thick at the upper end. The top gravel gave some gold, but under the clay is a loose barren gravel to bed-rock about 10 feet. The results of the season's work were therefore not very encouraging; however, shafts will be sunk to bed-rock above the pit and the results will determine future work.

PLACER-MINING IN BRITISH COLUMBIA.

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

Placer-mining is governed by the "Placer-mining Act." Important amendments to this Statute were passed at the 1933 session of the Legislative Assembly. Those engaged in this form of mining, and those proposing to take it up, would be well advised to note carefully the provisions both of the parent Act and the changes made this year. As to these alterations, it is well to bear in mind that the most radical—namely, those relating to the method of location and applications for placer-mining leases—*do not become effective until July 1st, 1933.*

In order to encourage and facilitate placer-mining, having regard for the prevailing lack of employment, the "Provisional Free Miners' Certificates (Placer) Act" was introduced to the Legislative Assembly in 1932 by the Minister of Mines and was approved. Its possibilities as a measure for the relief of unemployment were broadened in 1933 by an important amendment. Particulars of this Statute will be found on page 55.

It may be said generally that the mining laws of British Columbia, both lode and placer mining, are liberal in their nature and can compare favourably with those of any other part of the world.

Further particulars as to procedure in respect of staking, recording, etc., are contained in the appended synopsis. It must be understood, however, that no attempt is made here to cover the details of the placer-mining law of the Province. Any person who plans a prospecting-trip and proposes locating and taking up placer-mining ground is advised to read carefully the provisions of the Statutes referred to and to be guided by the same.

The following synopsis will give the miner or intending investor a general knowledge of the scope and requirements of the laws affecting placer-mining in the Province:—

FREE MINERS' CERTIFICATES.

Any person over the age of eighteen, and any joint-stock company, 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. To a joint-stock company having a capital of \$100,000, or less, the fee for a year is \$50; if capitalized beyond this, the fee is \$100.

The free miners' certificates all expire at midnight on May 31st in each year. 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, or upon any other lands on which the right to so enter is not specially reserved, and to prospect for minerals, locate claims, and mine.

A free miner is not entitled to hold more than 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. He may acquire others by purchase.

In the event of a free miner allowing his certificate to lapse, his mining property reverts to the Crown, 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 by amendment to the "Placer-mining Act" and the "Mineral Act" passed at the 1933 session of the Legislative Assembly. 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 and in that of a company \$300.

It is not necessary for a shareholder, as such, in an incorporated mining company to be the holder of a free miner's certificate.

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 discoveries, viz.:—

“ 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. It should be noted that under the amendments of 1933 already referred to the definition of “legal post” has been enlarged to include a “cairn of stones not less than 4 feet in height and not less than 1 foot in diameter 4 feet above the ground.”

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 ten miles of the office of the Mining Recorder by the most direct means of travel. One additional day shall be allowed for every ten 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 recorded before the expiration of the record or rerecord.

A placer claim must be worked by the owners, 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.

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, and does not obtain a special free miner's certificate within six months of the date of the lapse, the title of his associates is not prejudiced, but his interest reverts to the remaining co-owners.

LEASES.

Leases of unoccupied Crown lands may be granted by the Gold Commissioner of the district after location has been made by placing a legal post at each corner of the ground applied for. The locator shall post "a notice on the post nearest to the placer claims then being worked in the immediate locality (if any), and within thirty days thereafter shall also post a notice on the office of the Mining Recorder." This notice must state the name of the applicant, the location of the ground to be acquired, the quantity of ground, and the term for which the lease is to be applied for. Within thirty days an application, in duplicate, with a plan of the ground on the back, must be made in writing to the Gold Commissioner, and the application must contain the name of each applicant, the number of each applicant's free miner's certificate, the locality of the ground, the quantity of ground, and the term of the lease desired. A sum of \$20 must accompany the application, which is returned if the application is not granted. The term of leases must not exceed twenty years. The extent of ground covered by leases must not be in excess of the following: Creek leases, on creek or river, half a mile; bench leases, 80 acres; for dredging leases, 5 miles; precious-stone diggings, 10 acres.

Under the "Placer-mining Act" the annual rental and amount to be expended annually on development-work on all leases is as follows:—

Bench lease, annual rental, \$25; annual development-work, \$250.

Creek lease, annual rental, \$37.50; annual development-work, \$250.

Dredging lease, annual rental per mile, \$25; annual development-work per mile, \$1,000.

It is further provided that all development-work must be recorded with the Mining Recorder during the current year, similarly as is done with a mineral claim, and in default of such record being made the lease becomes automatically forfeited.

Leases may be "grouped" and annual development-work performed on one or more of the leases for the whole group. Excess work may be recorded three years in advance. Payment in cash of like amount to the development-work requirements may be made in lieu of such development-work.

NEW FORM OF LEASE.

EFFECTIVE JULY 1ST, 1933.

Amendments to the "Placer-mining Act," effective July 1st of this year, will eliminate the "creek" and the "bench" lease, and substitute for them a single form of lease approximately 80 acres in extent. It will be staked 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, will be permitted. Where a straight line is followed two posts only will be 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 new leasehold will be 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.

It is of such importance that the amendment with reference to the staking of the new form of placer-mining lease should be clearly understood that the reproduction here of that section of the Act dealing with it is justified. It follows:—

“21. Said chapter 169 is amended by inserting therein the following as section 105A:—

“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.

“(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.

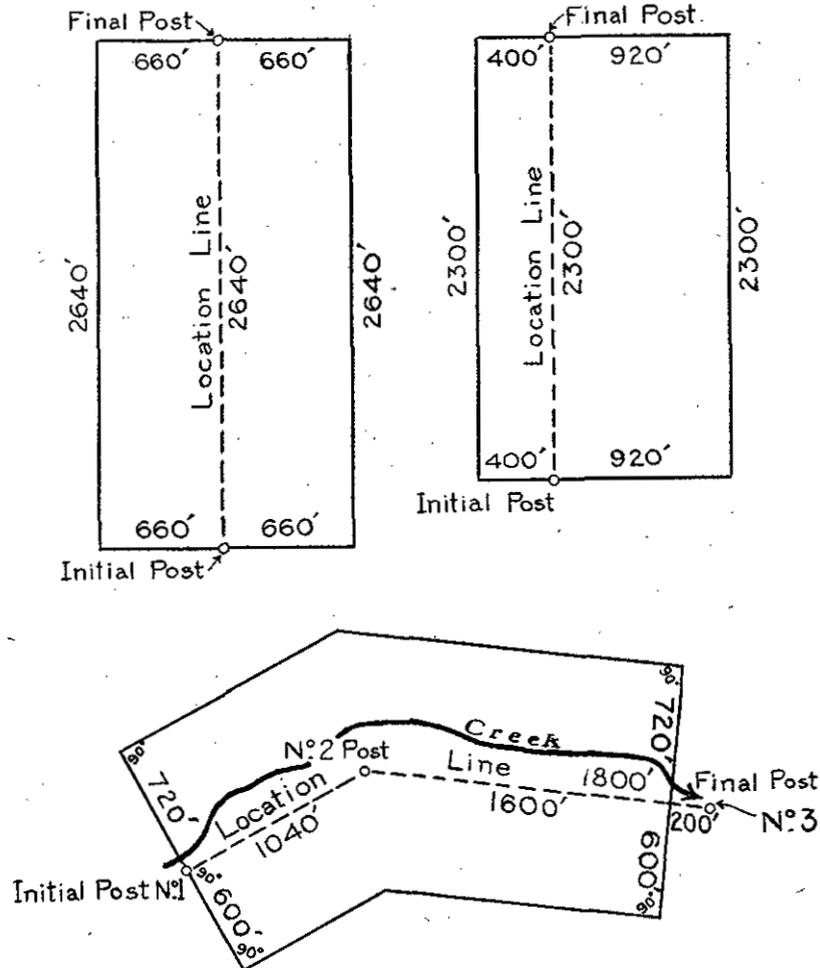
“(6.) The location and area of the placer leasehold shall be determined by establishing its end lines running from or through the initial post and from or through the final post, at right angles to the course of the location-line at those posts, respectively; and by establishing its side-line parallel 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. It is further provided that there will be one rental fee of \$30 per annum, which takes the place of the fees of \$25 for bench leases and \$37.50 per annum for creek leases issued under the Act at this time. The terms of the Statute as to the amount of assessment-work

required each year have not been altered; nor has the penalty of forfeiture of the leasehold if the rental is not paid and assessment-work done and recorded on or before the anniversary date of the lease. The holders of existing leaseholds may, on application, bring themselves under the terms of the new leaseholds as to rental, etc., by making application to the Gold Commissioner for the mining division in which the property is situated.

EXAMPLES OF VARIOUS METHODS OF LAYING OUT PLACER LEASEHOLDS.

Showing Areas secured with Location-lines of Various Lengths.



Dredging leases on rivers for 5 miles below low-water mark will continue to be granted. Section 122 of the Act has been amended to establish 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.

"MINES DEVELOPMENT ACT."

When it is shown to the satisfaction of the Minister of Mines that the possibilities of a mining property are such as to warrant the expenditure of public moneys, the Minister of Mines may authorize the expenditure of so much of the public money as may be required for the construction, reconstruction, or repair of trails, roads, and bridges to facilitate the operation and development of placer claims.

Furthermore, the Minister of Mines may authorize the expenditure of public money towards the building or repairing of trails and bridges in or to any mineral district for the purpose of facilitating the exploration of the mineral resources of the district. If such roads, trails, or bridges have been built by any person or company having mining interests in the district, the Minister of Mines may refund to such persons a portion not exceeding 50 per cent. of the cost of such construction.

“MINERAL SURVEY AND DEVELOPMENT ACT, 1929.”

PART I.—MINERAL SURVEY.

This Act divides the Province into six Mineral Survey Districts, to each of which district a Resident Mining Engineer, with such assistants as necessary, has been appointed, who shall devote his whole time to the carrying-out of the provisions of this Act and shall report to the Minister of Mines.

PART II.—AID TO PROSPECTORS.

The Resident Engineer in each district shall aid the prospectors, etc., therein by such advice, information, and directions as may be of assistance to them; by examining and testing samples of mineral and advising as to the same; by reporting as to such trails, roads, and bridges as may be desirable for the development of the mineral resources, with the approximate cost thereof.

The Minister may provide from time to time at suitable places short courses of instruction in practical geology and mineralogy.

PART III.—PROTECTION OF WAGE-EARNERS.

1. Every person giving or making a working bond or lease, with or without any option for sale, of any mining property shall insert therein a provision that during the currency of the bond or lease all free miners and wage-earners employed on or about the mining property shall be paid their wages semi-monthly, and shall demand and receive a letter, to be procured by the holder of the bond or lease from a Gold Commissioner or Government Agent or Mining Recorder, stating that security for such wages has been given pursuant to this section, otherwise the person giving or making the bond or lease shall be under personal liability to pay all such wages.

2. Every person taking a right or option to work or purchase any mining property shall furnish to the nearest Gold Commissioner, or Government Agent, or Mining Recorder adequate security from time to time for the payment semi-monthly of wages of all free miners and wage-earners employed on or about the mining property, on the terms that every such security shall be forthwith realized and payment of wages made upon any default; and every Gold Commissioner, Government Agent, and Mining Recorder shall have full power and authority to realize upon the security lodged with him so as to make payment of any wages in default, and shall make payment thereof up to the amount realized.

PART IV.—PROTECTION OF INVESTORS.

Each Resident Engineer shall, upon receiving notice of any advertised or solicited sale of shares in any company or in any claim or mine or mineral property whatsoever, upon statements or terms not in accordance with actual facts and conditions, notify the Minister of Mines, who, upon investigation, may, if found necessary, give such notice, either personal or public, as may be necessary to prevent any injury to investors; and every notice given under this section by the Minister of Mines shall be absolutely privileged.

“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 satisfactory 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 certificates, 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.

For more detailed information the reader is referred to the complete "Placer-mining Act," and the other Acts dealt with in their complete form, which may be obtained from any Mining Recorder and from the King's Printer, Victoria.

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