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FINE GOLD OF SNAKE RIVER AND LOWER SALMON RIVER, IDAHO

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INTRODUCTION

Snake River

Historically, the presence of gold along the Snake River was among the first discoveries in the State. A determined effort toward mining through this area apparently was not undertaken until the Seventies. Bancroft[1] remarks, in discussing the sections around what was known as the Great Falls of the Snake, mouth of Raft River, Henrys Ferry (just above Castle Creek) and Catherine Creek:

> "Thousands of ounces of gold dust of the very finest quality were taken from the gravel in this neighborhood in these two years (1871-1872).....The higher bars were unprospected and the camps abandoned. But about 1879 there was a revival of interest in the Snake River placers, and an improvement in the appliances for mining them and saving the gold, which enabled operators to work the high bars which for hundreds of miles are gold-bearing. In many places they lift themselves directly from the water's edge, ten, twenty, a hundred, or two hundred feet, and then recede in a slope more or less elevated. At other points they form a succession of terraces, level at the top, varying from a few hundred feet to a mile or more in width.....
>
> "The deposits were of various depths, the upper beds being from 25 to 50 feet deep, and lying on a hard-pan of pseudomorphous rock from a few inches to three feet in thickness, beneath which is another deposit generally richer than the first. Or, in some places, the hard-pan is represented by a soft cement, found at a depth of from three to nine feet....."

The Snake River sands and gravels are not gold bearing only in Idaho. Almost from its source in Wyoming to the state line, mining operations have at various times been in progress[2]. The deposits continue from where the river leaves the State at Lewiston until its junction with the Columbia in Washington.

Something over 800 miles of the Snake River's 1,051 miles lie in Idaho. Only where it bounds Washington, Adams, Idaho, and Nez Perce counties have the activities been meager. This is the canyon of the Snake River. The ruggedness and inaccessibility of this region is probably responsible. Even so, reports from time to time indicate that a few hardy individuals have produced gold from this difficult stretch of the River.

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[1] References at the end of the Pamphlet.

The size of Snake River gold particles has been the contributing cause of difficulties in past operations. Hite[3] has determined that these particles are so small as to require 3,000 - 4,000 of them to have a value of one cent (gold, $35.00 per ounce). Some particles are so fine that several million are necessary to have a value of one cent. Still there is found an appreciable quantity of coarser particles and occasional nuggets. A very small amount of platinum usually accompanies the gold.

With the present meager information available, attempts to estimate the yardage and average grade will prove very deceiving. Scattered throughout the literature are estimates. They run from a trace to several dollars per yard. Unfortunately, no mention is made of the yardage to which these values should apply. There seems to be no doubt that many small pockets and thin layers, especially after high water, may be found running $2.00 or more. The yardage on the other hand is small. Various bars in the river are continually being replenished with values after each high-water season. Average values and the amount of material to be expected have not been determined for the extensive areas making up the permanent low and high benches. It is entirely likely that many gold-bearing areas extend considerable distances back from the present River channel into the ancient Snake River plains, north of the present channel.

The following table gives some very incomplete information on values.[4] (The county boundaries were not the same in 1905 as at present; therefore, some of the locations mentioned are now in other counties.)

Location	Gold, Cents Per Ton	
Bannock County		
Pocatello	37	
Pocatello	50	
Blaine County		
Near Wapi	71	
Near Wapi	31	(gold and platinum)
Lincoln County		
Minidoka	8	
Minidoka	10	
Minidoka	13	
Minidoka	145	
Minidoka	41	
Oneida County		
American Falls	62	
American Falls	Trace	(old river channel)
Unknown Location	112	
Unknown Location	98	

The above data are at the old price of $20.67 for gold. Information received during the past ten years is very similar insofar as the lack of uniformity is concerned. Values are reported as running from a trace to several dollars.[5] The usual value is 20 to 50 cents per cubic yard. The area accompanying these values is not known.

The following table[6] indicates what may be expected when concentrating the natural river sand.

Location	Dollars per Ton of Black Sand Concentrate Gold	Platinum	Remarks
Bingham County			
Rich	25.10		
Rich	61.02		
Blackfoot	674.26		
Blackfoot	73.38		
Snake River	405.55	5.40	
Snake River	33.07	21.00	
Snake River	62.63		
Snake River	1,154.37		
Idaho County			
Salmon River - Camp Howard District, near Whitebird	411.54		
District, near Whitebird	223.24		
Lincoln County			
Minidoka	5.37		Wilfley Table Conc.
Cassia County			
Near Milner	9.51		
Near Milner	37.89		
Nez Perce County			
Salmon River	234.34		
Oneida County			
American Falls	114.20		Sluice Box Conc.

Salmon River

Mining along the lower reaches of Salmon River dates from shortly after the discovery of gold at Pierce in 1860. While there has been more or less sniping from Shoup on down the River, the bulk of the production has apparently come from the so-called Salmon River placers - Riggins to somewhat north of Whitebird.

According to Lorain and Metzger[7] the gold is very fine and care must be exercised in saving it. There are bars in and close to the River, near River level benches, and higher bench deposits.[8]

PRODUCTION

Very unsatisfactory records were kept on the production of the area under consideration, and this is equally true of both the Snake and the Salmon. During the past twenty years a fair record is available; previous to, say, 1920 we know only that considerable gold was recovered but not its amount. The difficulty is that the river production was not recorded separately from other sources in the counties through which these rivers flow. Consequently, we have nothing to go on but what the local resident near the river has to tell. This is a handicap in the case of both rivers. But in the instance of the Salmon, it makes impossible even an approximate estimate. Idaho County has been one of the leading gold producers of the State. The relatively small amount from the Snake and Salmon Rivers simply is not known, being completely lost in the 2,176,550 ounce total.[9] Government publications have shown from

time to time a small production, enough to warrant a more detailed investigation than has been made in the past. The following table[9] gives a general idea of the Snake River production.

Snake River Production

County	Production, Ounces	Remarks
Ada	2,139*	Impossible to say; 1% of total recorded data taken
Adams	830	Impossible to say; 1% of total recorded data taken
Bannock	4,200	
Bingham	24,240	
Bonneville	2,864	
Canyon	623*	Impossible to say; 1% of total taken
Cassia	22,000	A little vein gold in recent years; by far the greater part must be Snake River gold
Gooding	273	
Elmore	759*	Impossible to say; 0.2% of total taken
Idaho	500*	Impossible to say; very insignificant compared to total
Jefferson	18	
Jerome	1,736	
Lincoln	14,124	From 1895 to date, probably all Snake River; before then impossible to say
Madison	0	Has been some, but have no idea as to amount
Minidoka	133	
Nez Perce	17	Impossible to say; half of output since 1911 taken; probably much higher than shown
Oneida	17,039	Some doubt as to whether this is all Snake River
Owyhee	3,521*	Impossible to say; equivalent of Ada, Canyon, and Elmore taken
Payette	10	
Power	1,446	
Twin Falls	2,347	
Washington	813*	Impossible to say; 5% of total taken
Total	99,632	

The data in the above table and also the information on production and locations to follow are from the following sources.

Director of the Mint Reports
Production of Gold and Silver in United States,
1881, 1882, 1883, 1884, 1885

United States Geological Survey
Mineral Resources

United States Bureau of Mines
Mineral Yearbook

* If these are left out, the total becomes 91,277 ounces. There would be no reason for doing so; there is a definite record since the Seventies of production from these counties. Only the amount is in doubt.

EXTENT OF DEPOSITS

Snake River

There are two, broad, general areas which may be considered in connection with the Snake River gold. One of these is in the realm of speculation; but because of its possibilities, it certainly cannot be ignored.

Plate I shows the course of the Snake in Idaho. The extent is over 800 miles. As may be seen on this map, the greater part of the River has produced more or less gold. The difficulty in the past has not been in finding colors so much as has been the economic mining of the material and the saving of the extremely fine (flour) gold particles. In the past insufficient investigation has been made of the extent of deposits before a mining method or a milling method was decided upon. The success of future operations will depend upon careful sampling and yardage determination, and then the proper mining and metallurgical treatment worked out. Nearly all past writers on this subject agree that most of the failures have been the very large operations. Small operators with low overhead investment in equipment were more successful.

The speculative, but possibly real future, area is that lying between the present channel and the beginning of the mountainous country to the north. Many thousands of years ago the present Snake River plains were in the process of being formed. A gradual downwarping or settling of the southern part of the mountainous region was taking place. The ancient channels were lowered by the downwarping, and the drainage pattern slowly changed. The influx of the Columbia River basalt has buried the older channels under varying thicknesses of lava. These ancient streams very likely were gold bearing. The drainage from the north and from the east (the present source of the Snake River gold) could have supplied the metal.

The Thousand Springs, as seen from the highway northwest of Buhl, may be an indication of these ancient channels. Big Lost River, Little Lost River, and Birch Creek all disappear into the sands of eastern Butte County. Many hold the opinion that this is the source of the Thousand Springs. Be that as it may, there is justification for assuming the presence of ancient, buried channels under the basalt. The literature from time to time mentions flour gold from sources as far away as Shoshone (over 20 miles north of Snake River). Of interest is the question "Were these ancient streams gold bearing during their early history"? And if there are old buried channels, do they contain sufficient values to pay after penetrating the basalt covering? Exploratory work will have to be done before these questions can be answered.

How best may this be done? One possibility immediately suggests itself: geophysical prospecting. Churn drilling of the favorable areas would follow.

Of the various geophysical methods available, the magnetic and the resistivity should prove adaptable. North-south traverses should be run. The resistivity survey would show the presence of buried channels. Because of the magnetic black sand in the river deposits, the magnetic method would show a magnetic high when crossing buried channels. There might be difficulties encountered with the magnetic method because of the magnetic content of the basalt. Careful work should obviate most of such trouble. When the above surveys indicate buried channels, a drill hole would be sunk just the same as in any other placer drilling operation. A survey of this kind should, incidentally, show the best places in which to drill water wells.

Salmon River

The country traversed by the lower Salmon River is shown on Plate I. As a matter of fact, more or less gold has been found along the entire course of the main Salmon. The portion shown on the plate is of particular interest in this study because the gold and the mode of occurrence closely resemble that of the Snake River. The gold cannot exactly be called flour gold, but it is, however, very fine. Its purity is 850 fine or less, whereas that of the Snake is usually higher than 850, averaging about 950. A little platinum is also found in these deposits. Deposits occur as bars in and along the River (during high water there is considerable reconcentrating of the gold); gravel deposits just above River level; and higher bench deposits. The higher bench deposits have received very little attention.

AREAS OF PAST PRODUCTION

The following table indicates points at which gold, in varying amounts, has been found. Some have been rather prolific producers; in others the output has been small. Lack of values has not always been responsible for small production; poor mining and, in many instances, the recovery process have been at fault. In some cases, the towns named are many miles from the river. Usually, the mining has been conducted on the river, the town named being the nearest point of habitation. There is some indication, however, that areas back from the river have produced. Lack of information prevents a definite statement that in all circumstances the area named is on the river. Nor are the towns mentioned always in the county under which they are listed. The nearest town may be in a county other than the one in which the deposit is located.

County	Town, Bar, or Point of Interest
Ada	8 miles above Henrys Ferry (just above Castle Creek); Grandview, near Melba; junction of Boise River with Snake River
Adams	6 miles from Homestead, Oregon, on Snake
Bingham	Blackfoot, near Blackfoot River; Woodworth Bar, Buena Vista Bar, Martin Bar, Gold Point, Welch, Eagle Bend, Aberdeen, Sterling, Pingree, Moreland, Rich
Blaine	Wapi
Bonneville	Idaho Falls, McCoy Creek, Heise
Canyon	Melba, Wilder
Cassia	Most of River, Raft River, Shoshone Canyon, Burley, Milner, Fall Creek
Elmore	Glenns Ferry, 3 miles south of King Hill; King Hill, Mountain Home, Hammett, Bruneau
Gooding	Clear Lake, Hagerman, Salmon Falls, Boulder Hill
Idaho	Riggins, Slate Creek, Whitebird, Lucile, Boles, Keuterville, Snake River (point unknown)
Jefferson	Roberts (Market Lake), Heise
Jerome	Jerome, Hazelton, Eden, Murtaugh, Hansen, Blue Lake, Good Luck
Lewis	Salmon River
Lincoln	Shoshone (this is 20 miles from the River)
Minidoka	Rupert, Minidoka (the best ground along the River is reputed to have been near Minidoka before the Minidoka Dam was built)

County	Town, Bar, or Point of Interest
Nez Perce	On Snake River near Lewiston and Clarkston, Washington; on Salmon River
Owyhee	Reynolds Creek, junction of Owyhee River and Snake River, Givens Springs, Castle Creek, Bruneau River, Oreana, Wilson, Garnet, Glenns Ferry, Meadow Creek, Sailor Creek, Murphy, Melba, Homesdale
Payette	Payette
Power	American Falls, Aberdeen, Neeley, Bonanza Bar, Wapi
Twin Falls	Twin Falls - Klondyke, Bonanza, and Homedale Bars; Buhl, Kimberly, Hansen, Salmon Falls, Murtaugh
Washington	East of Cuprum, 8 miles below Weiser at Olds Ferry, Sturgill Creek

MINING

From available information it would appear that every conceivable kind of apparatus has been tried - bucket dredges, suction dredges, dragline scrapers, dragline shovels, picks, shovels, and wheelbarrows, etc. With the exception of one instance, there is no record of the economic success of any of the large-scale ventures.

In 1902 a report[10] was written on the Sweetser-Burroughs Dredge. This operation was successful to the extent of paying two $10,000 dividends. This dredge was of the suction type with a 10-inch diameter intake. The hull was 30 X 90 feet and drew three feet of water. Bell states that the actual daily capacity was 2,500 cubic yards. He gives the cost (apparently for 1902, which includes all charges) as 4 1/2 cents per cubic yard. The material handled ran 10-20 cents per cubic yard. This operation proceeded so successfully that a second dredge was built. This time a conventional bucket dredge was selected. The capacity was 2,000 yards per day over a twenty-months' period. The bucket dredge did not prove profitable.

The numerous investigators of Snake River gold deposits are all unanimous in stating that, at least up to the time of their investigation, the small operation alone has paid a profit[11]. An exception is the Sweetser-Burroughs Suction Dredge (more scientifically known as the Hydraulic dredge). No information concerning the dragline operation of the late 1930's and early 1940's is at hand, so it is not known how successful such operations may have been. A very considerable quantity of gold was produced during this period.

The small operator has conducted his work without having to invest in expensive power-driven equipment. He used pick, shovel, and wheelbarrow, some hydraulicking and horse-drawn scraper. Simple burlap-lined sluice boxes and tables were used for recovery. In smaller operations a pan or rocker has been used.

To date the small-scale operation appears to have been the most successful. The bulk of known deposits would seem to average 10-30 cents, or maybe even as low as 5 cents, per cubic yard. To handle such material profitably requires an extensive yardage. No unnecessary costs can be incurred for equipment. Where its use is feasible, the suction dredge would seem to be the indicated choice for large amounts of gravel. In the case of deposits that

may be mined dry, or semiwet, some type of dragline excavator should be considered. Gardner and Allsman[12] present information which indicates that dragline excavating costs would run about 5 cents per cubic yard. Total costs would be about 12 cents for floating treatment plants and several cents more for stationary plants. Both of these costs would depend to a considerable extent on the yardage handled. At the time of this report, the cost of dragline operations seems to be materially decreasing.

The application of one of the various types of dragline excavators with either a floating or stationary treatment plant should receive serious consideration. The success of such applications with gradually decreasing costs was becoming very apparent up to the cessation of gold mining during the war. Dragline installations have a low first cost, are relatively easy to move (this is especially desirable where the area is made up of separated deposits), and are adaptable to irregular conditions. They do not penetrate bedrock well, nor have they, in the past, recovered as high a percentage of the gold as does a dredge. This latter drawback is, to a certain extent, being overcome by properly designing the digging equipment. On the other hand, there is considerable evidence indicating that little of the Snake River deposits carry values on bedrock. This, of course, should be determined by testing in each case.

When more than a few yards per day is contemplated, either mechanical or electrical power, or a combination of the two, must be considered. The selection must be based on a very careful investigation; a difference of several cents per yard may mean failure.

The following table, from Gardner and Allsman[13], gives a general idea as to what may be expected.

Comparative Cost of Power Plants, 125-hp. Dragline and 85-hp. on Boat

	Cost of Power Plant	Operating Cost for 2 Years	Salvage Value at End of 2 Years	Net Cost At End of 2 Years' Operation
1. Direct Electric Power	$4,214	$14,790	$1,685	$17,318
2. Diesel Engines, both Shovel and Boat	9,100	7,644	3,480	13,264
3. Diesel Shovel, Diesel Electric on Boat	12,192	6,475	4,800	13,867
4. Gasoline Engines, both Shovel and Boat	2,900	23,275	1,000	25,175
5. Diesel Shovel, Electric Power Purchased for Boat	7,912	12,950	2,240	18,622

Under the conditions for which the above information was compiled, the choice lies definitely between (2) and (3). Number (3) would prove the most convenient.

The comparative net costs would depend almost entirely on the relative cost of purchased power as compared to the cost of gasoline and fuel oil.

When purchased power is cheap and fuel oil is cheap, there might be little choice from the cost standpoint. From an operating standpoint, fully electrified operations are most convenient.

A few more words should be added concerning suction dredges. Arguments have waged for years on this subject[14]. Where this type of dredge has been given a fair trial, it does not appear to have been beaten by the bucket type. The installation cost is usually very much less.

In the past there have been four leading objections to the suction dredge: (1) it could not dig and clean bedrock; (2) it would not "suck" up the gold; (3) there was excessive wear on the pump; and (4) the intake jammed with rock and debris. With the modern cutter and well-designed centrifugal pump, the first objection can be disposed of. One has only to consider the enormous harbor and flood control operations and bridge pier construction being accomplished throughout the country. It is doubtful if the ordinary bucket dredge can dig any better than a properly designed cutter. Too many large boulders will interfere with the suction dredge, but they also cause trouble with the bucket dredge. Centrifugal pumps handling boulders up to several feet in diameter are not uncommon.

In the past 8-, 10-, or 12-inch diameter intakes have been used. Only failure could be expected with such undersized openings. The modern alloy steel, rubber-lined pump has proved very adaptable to handling all types of dredging material other than placer mining. Proper investigation and research will undoubtedly show the applicability of the hydraulic dredge to gold operations.

The Calumet and Hecla Consolidated Copper Company[15] has been for years removing material from Torch Lake with a 20-inch suction pump dredge. The capacity is 10,000 cubic yards per day. To quote the author, "All the rubbish of the stamp mills and the adjacent towns was deposited on top of these sand banks; and although this rubbish does not constitute a large percentage of the total weight, it amounts to thousands of tons of every conceivable kind and size of material, and any plan for reworking of the sand had to take into account a mixture of ashes, hoop iron, wire cable, launder plates, and submerged logs. After 14 years of operation, the suction dredge originally chosen has been in commission without at any time having had serious difficulty in operation."

As for the second objection, its fallacy can easily be demonstrated in the laboratory. True, we might experience some difficulty in picking up chunks of gold. The deposits on which the present-day dredge operates contain fine to flour gold. When sand, gravel, and large boulders can be drawn into the pump, fine gold has no alternative but to follow.

The Minidoka reservoir has been mentioned as ideal for dredging operations. Some of the best ground along the river was here before the dam was built.

TREATMENT AND RECOVERY OF GOLD

Experience has shown that the gold occurring in Snake River is not difficult to recover. Very simple equipment has been successfully used. The

Sweetser-Burroughs dredge contained burlap-covered tables. The successful small-scale operations also used burlap or similar covering or expanded metal lath or punched steel plates.

The leading objection to burlap tables would probably be the large total area needed to accommodate the great yardage necessary. About 7 to 10 square feet of area is needed for one cubic yard of gravel per hour. Better than 90% recovery is consistently claimed for burlap tables.

A more modern and less bulky arrangement would be coarse-sand flotation. The recovery here closely approaches 100 per cent[16]. A problem is involved in classifying the sands and thickening the pulp. Before undertaking the use of flotation, an experienced ore dressing engineer should be consulted. Flotation deserves consideration for cleaning black sand concentrates derived from sluice boxes or tables. It might be desirable to ship black sand concentrate directly to the smelter.

One of the most important steps in the treatment of placer sand is incorrectly handled or even entirely overlooked. This is the necessity for putting the mine-run material through a trommel. This is not so important in many small-scale hand methods. With large-scale work, in ground containing large pieces of gravel, clay seams, and partly cemented patches, it is very necessary that the correct type of trommel be selected. Experience indicates that the circular revolving type is superior to the flat shaking type. Several size reductions may be required. Where clay balls show a tendency to form, disintegrating chains may have to be strung in the trommel to break up the clay. Plenty of water under moderate pressure must be continually played on the inside of the trommel.

The undersize from the trommel passes to the burlap tables, amalgamation plates, or flotation cells. Oversize is recovered by some convenient method.

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IDAHO BUREAU OF MINES AND GEOLOGY

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Pamphlet 72

PLACER GOLD DEPOSITS OF SNAKE RIVER AND LOWER SALMON RIVER, IDAHO

Moscow, Idaho June, 1945

Compiled and Drawn by W.W Staley

(Base Map from "Mining Districts of Idaho" by C.P. Ross, Idaho Bureau of Mines and Geology, Pamphlet 57, 1941)

10 5 0 10 20 30 40

Miles

——— Canals

Location where gold has been found