C. E. Ricketts

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AUGUST 1938

UNITED STATES
DEPARTMENT OF THE INTERIOR
HAROLD L. ICKES, SECRETARY

BUREAU OF MINES
JOHN W. FINCH, DIRECTOR

INFORMATION CIRCULAR

RECONNAISSANCE OF PLACER MINING IN BOISE COUNTY, IDAHO

BY

O. H. METZGER

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RECONNAISSANCE OF PLACER MINING IN BOISE COUNTY, IDAHO[1]

By O. H. Metzger[2]

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ILLUSTRATIONS

INTRODUCTION

This is one of a series of papers on placer mining in the western United States. The author has endeavored to give a general outline of the available placer deposits in Boise County, Idaho, together with a description of current practices and the recovery costs of the principal producers. The paper is based on a field examination by the author in May and June 1937.

Boise County (fig. 1) is in the southwestern part of Idaho. It has a maximum length of 60 miles, a maximum width of 42 miles, and an area of approximately 1,600 square miles.

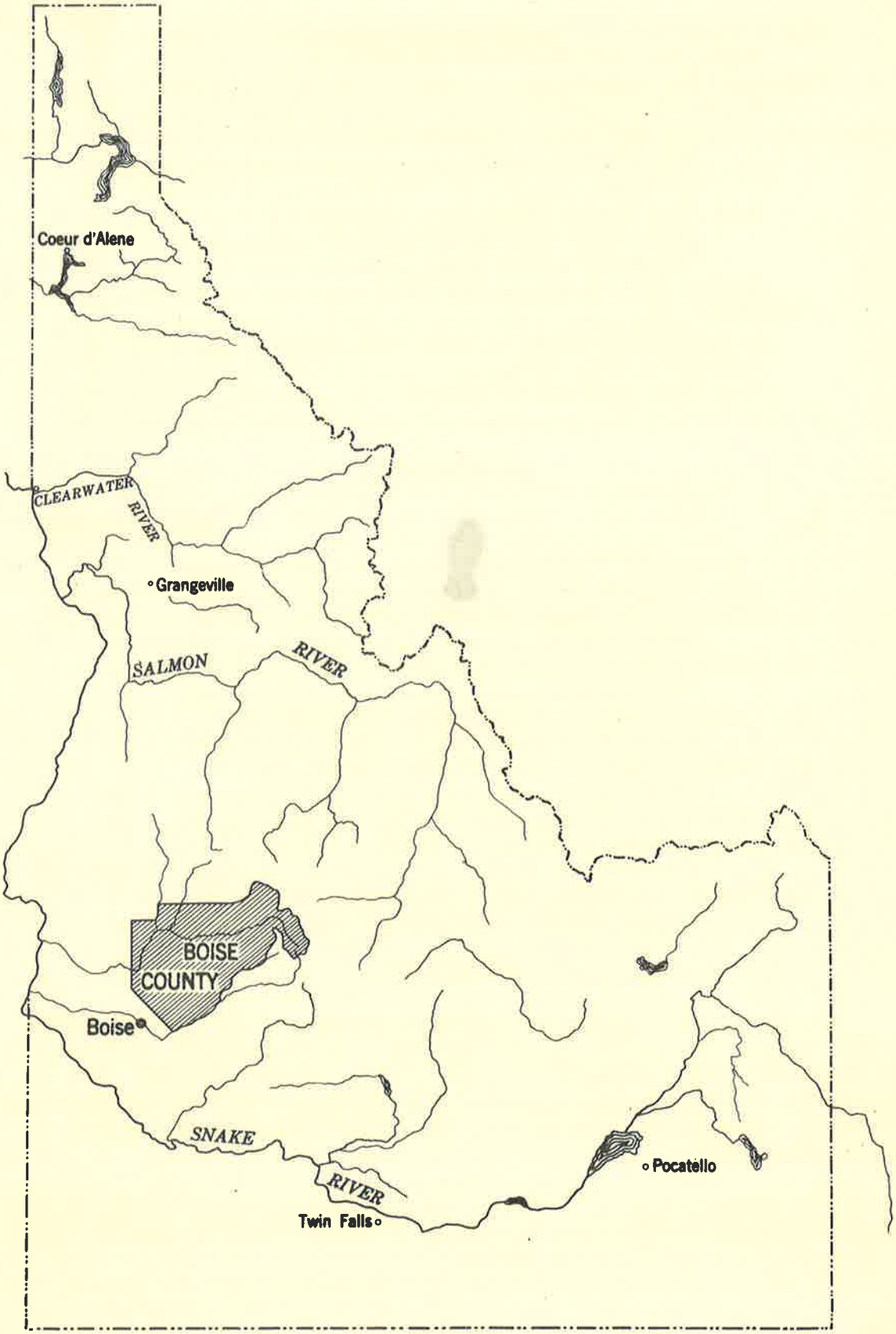


Figure 1.—Key map to Boise County, Idaho.

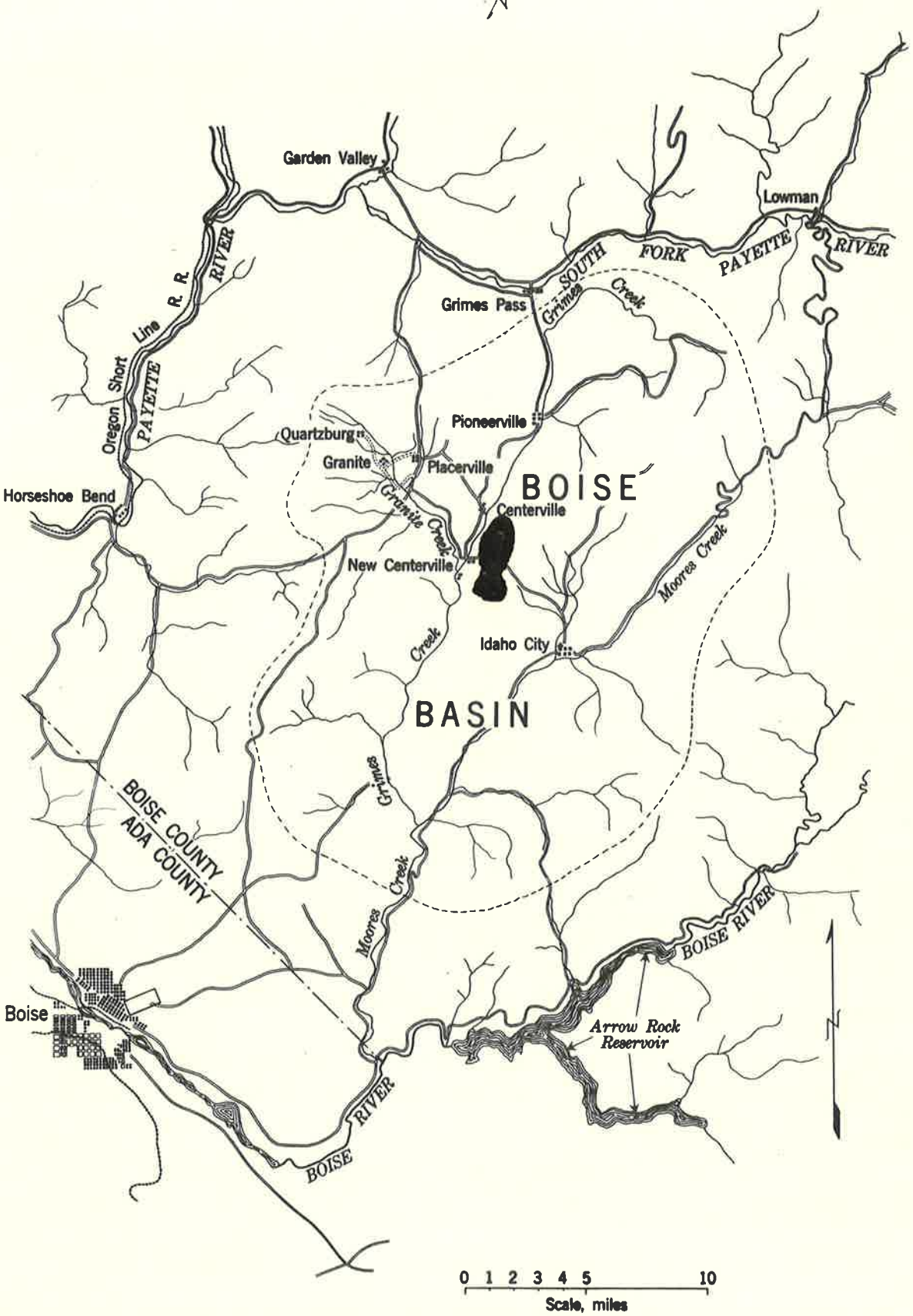
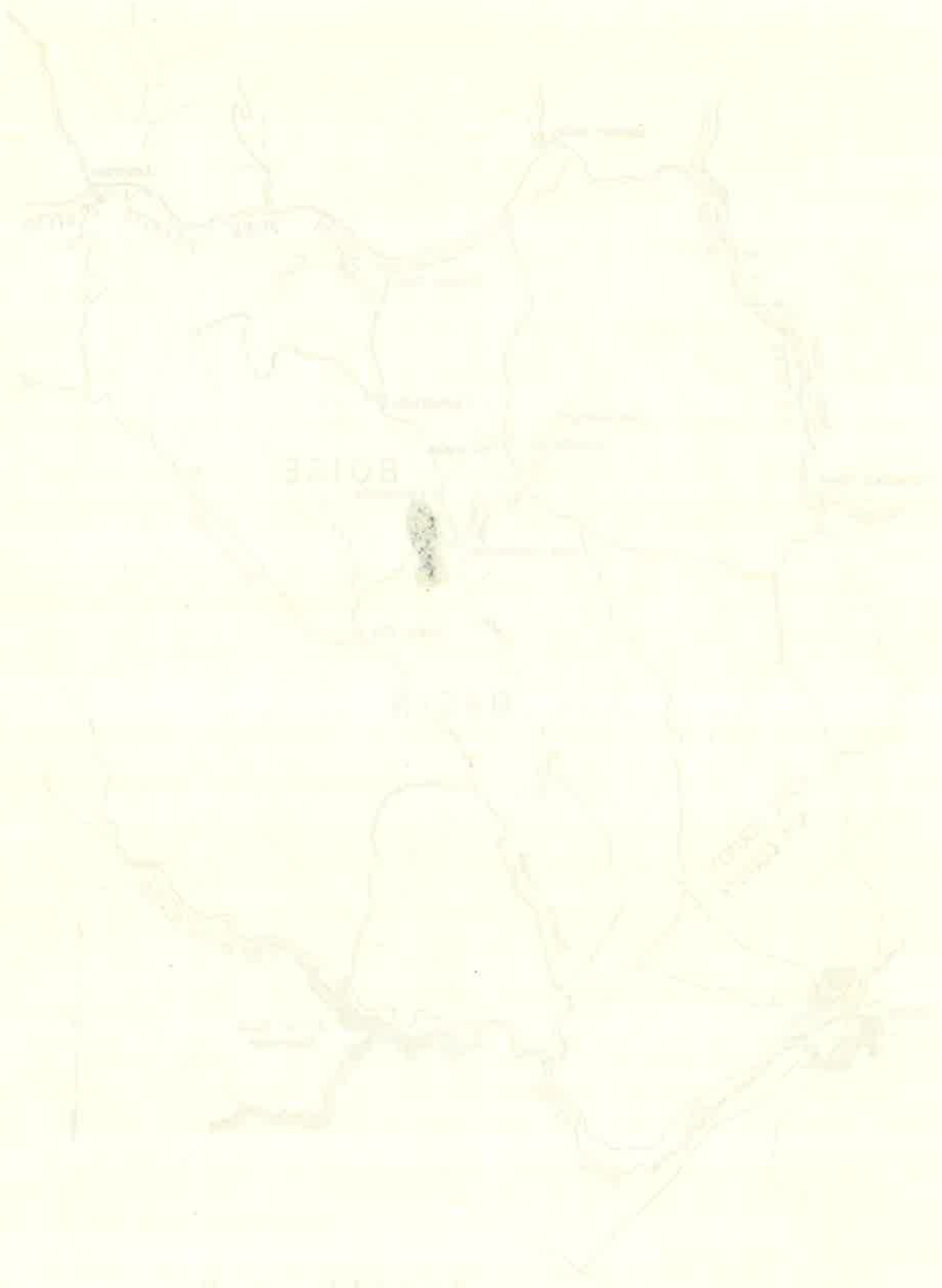


Figure 2.—Map of Boise Basin and surrounding country. (From Forest Service map of Boise National Forest.)



Boise Basin (fig. 2), in the northwestern part of the county, is the principal gold-producing area and has contributed 90 to 95 percent of the total gold production. The villages of Idaho City, Centerville, Pioneerville, Placerville, and Quartzburg are the principal mining centers and have an aggregate population of about 750. Idaho City, with a population of 187, is the county seat.

ACKNOWLEDGMENTS

The author wishes to acknowledge his indebtedness to all of the operators in the Boise Basin section and to a number of pioneers who supplied valuable historical data. References to published articles are made throughout the text.

HISTORY

The first discoveries of placer gold in Boise Basin were made by prospectors from Walla Walla, Wash., in 1862; by the end of the year, the inevitable gold rush was well under way. The first lode location, the Gold Hill mine, was made by P. J. Fairchild near Quartzburg in 1864. The Elk Horn mine on Elk Creek was located a little later.

The first mining was done by hand methods in the gold-bearing gravels of the creek bottoms. Inasmuch as there were no Federal mining laws at that time, locations were made according to local regulations that were drawn up by the miners. According to these regulations, each miner was permitted three claims or three locations. The first was known as a creek claim; it extended along the creek bottom for 200 feet and between the first outcrops of bedrock on each side of the creek channel. The second claim, known as a bar claim, extended for a distance of 200 feet, parallel to the creek claim and between the first and second outcrops of bedrock. The third, known as a face claim, extended for a distance of 200 feet parallel to the first two, and between the second outcrop of bedrock and the summit of the nearest watershed. The edges, at right angles to the creek, of the three claims had to be in a straight line, and the bar claim and the face claim had to be on the same side of the creek. The ground on the opposite side of the creek, not included in the creek claim, was open to location by other parties.

This method of locating placer ground was very satisfactory as conditions existed in the 1860's. Mining organizations were small, consisting of 3 to 10 men, and almost all work was done by hand in the rich surface deposits. Virtually all of the creek bottoms of Boise Basin that contained valuable placer deposits were located by this method prior to 1870. Locations that were made according to these regulations were recognized by the State and Federal courts for many years. However, nearly all of the land that is now held as mining claims was later relocated according to the mining laws of 1872. Virtually all of the more desirable creek claims were taken up during the first two years after the first discoveries were made.

Local regulations not only stipulated how placer ground could be located, but they also specified how the ground could be worked. A miner was not permitted to dump tailings on ground that did not belong to him, and he could not work a bar claim or a face claim until his creek claim had been mined. The object of this regulation was to provide an orderly procedure of working out the creek deposits before they were covered by tailings from the bar placers high up. The regulations did not accomplish their full purpose, and in many cases they complicated operations for small operators. The first operations consisted of hand shoveling into sluice boxes. This method of mining was very inefficient, and much of the material had to be handled a number of times because of the regulation concerning dumping. There was no means of handling seepage water from the creek channels, and hence it was impossible to work the creek gravels to a depth of more than 6 to 8 feet. All gold below this depth was left intact and is today the object of nearly all dredging operations in the basin. After several years, most of the rich surface deposits were worked out, and white labor became too expensive to work the lower-grade bar deposits. In about 1870 Chinese labor was imported. In some cases the Chinese worked for white mine owners, but for the most part they leased the ground they worked or acquired ground of their own. It is said that leasing to a Chinese amounted to almost the same as a sale, as they were very close and skillful miners and once they started working a piece of ground they did not leave it until it was completely mined out.

The first hydraulic mine was started at Bishop's Hill above Placerville in 1864. This method of mining was introduced from California; most of the early operators were professional California miners. The high gravels of the district are well adapted to hydraulic mining, as they are high above the creek beds and the bedrock has a sufficient slope to provide satisfactory disposal for the tailings.

The first dredge in the district was built near Placerville on Wolf Creek about 1898. Shortly after, two more were built on Grimes Creek in the vicinity of Centerville. The Placerville dredge started working on ground that was used as a dump for a hydraulic mine and after a few months of unsuccessful operation was shut down and abandoned. The two dredges on Grimes Creek operated intermittently for about 7 years. The general procedure was to work during the spring, summer, and fall and shut down during the most severe months of the winter.

In 1908 or 1909, a small dredge was built on Moores Creek just below Idaho City. After operating for several years it was dismantled and the more valuable machinery was moved away.

About 1910 a large dredge was built about half a mile below Idaho City. Apparently this was unsuccessful, as it operated for only a short time and was then abandoned.

In 1908, the W. H. Estabrook dredge was built on Elk Creek about a half mile above Idaho City. This is reputed to have been the largest dredge in the world at that time. The boat was built entirely of native Ponderosa

pine. Timbers 24 inches square and over 75 feet long were sawed from logs procured at a great cost and hauled a distance of more than 25 miles by teams.

The dredge worked down Elk Creek to the confluence with Moores Creek, and thence down Moores Creek to about the present site of Hot Springs. At this point it was turned around and worked up Moores Creek to 2-1/2 or 3 miles above Idaho City. It operated in all a little more than 5 years. The maximum amount of gravel handled in any month was 162,000 cubic yards. Buckets of 13-cubic-foot capacity were first used. Later on, these were replaced by 18-cubic-foot buckets, which in turn were replaced by buckets of 21-cubic-foot capacity. The 21-cubic-foot buckets were too large and were never entirely satisfactory.

The gravels above Idaho City on Moores Creek became gradually lower grade, and the dredge finally ceased operating about 1917. One morning about 3 years later, the caretaker went out to shovel snow from the deck and the roof and built a fire on the roof to keep warm. He failed to extinguish the fire when he left the dredge, and the next morning it was burned to the ground.

Electric power was used on all of the early dredges. The first power plant for this purpose was a hydroelectric plant on Grimes Creek about half way between Centerville and the confluence of Grimes and Moores Creeks.

PRODUCTION

The placer production history of Boise Basin has followed the same general pattern as that of other western placer-mining districts. The greatest annual output was during the years that immediately followed the first discoveries when hand methods were used. Table 1 shows the annual productions from 1863 to 1936. The figures from 1863 to 1900 were taken from Lindgren.3/ The rest of the figures are from Mineral Resources of the United States and the Mineral Yearbooks from 1900 to 1937. The large increase in placer-gold production in 1936 was due chiefly to large dredging operations on Moores Creek, Grimes Creek, and Granite Creek in Boise Basin. The lode-gold production was made chiefly by the Talache Mines, Inc., and the Come-Back Mining Co., both of Boise Basin.

3/ Lindgren, Waldemar, Mining Districts of Idaho Basin and Boise Ridge, Idaho: Extracts from the 18th Annual Report, Geol. Survey.

TABLE 1. - Gold production, Boise Basin, 1863-1936

Year	Lode	Placer	Total	Year	Lode	Placer	Total
1863			$3,000,000	1900	-	-	$368,682
1864			4,000,000	1901	-	-	374,243
1865			5,000,000	1902	-	-	340,692
1866			5,000,000	1903	$25,398	$130,309	155,707
1867			4,300,000	1904	90,290	204,594	294,884
1868			4,300,000	1905	20,858	131,287	152,145
1869			3,000,000	1906	91,332	137,692	229,024
1870			2,700,000	1907	69,066	166,210	235,276
1871			2,000,000	1908	81,499	117,808	199,307
1872			1,000,000	1909	72,539	143,492	216,031
1873			800,000	1910	69,767	129,663	199,430
1874			700,000	1911	87,697	265,767	353,464
1875			600,000	1912	52,513	449,764	502,277
1876			600,000	1913	90,177	529,893	620,070
1877			500,000	1914	128,535	472,692	601,227
1878			500,000	1915	171,866	383,259	555,125
1879			400,000	1916	174,889	295,171	470,060
1880			300,000	1917	179,146	38,340	217,486
1881			300,000	1918	175,255	51,538	226,793
1882			290,000	1919	412,843	5,607	418,450
1883			565,000	1920	264,201	1,594	265,795
1884			400,000	1921	245,469	10,625	256,094
1885			619,000	1922	140,391	8,393	148,784
1886			390,000	1923	84,330	10,398	94,728
1887			502,200	1924	74,010	2,539	76,549
1888			283,000	1925	34,851	11,635	46,486
1889			274,000	1926	44,586	37,191	81,777
1890			320,000	1927	95,080	57,169	152,249
1891			356,700	1928	190,513	42,894	233,407
1892			376,400	1929	206,668	53,086	259,754
1893			280,800	1930	217,729	50,200	267,929
1894			327,800	1931	183,979	22,576	206,555
1895			339,000	1932	26,272	28,216	54,488
1896			326,000	1933	31,176	35,729	66,905
1897			233,054	1934	150,103	177,207	327,310
1898			206,884	1935	290,500	177,207	467,707
1899			393,902	1936	325,101	433,531	758,632
					1/4,598,629	1/4,813,276	55,979,262

1/ 1903 to 1936.

RAILROADS

Boise, in Ada County, is the nearest city to Boise County and the principal railroad center. During the summer months some rail shipments are handled at Horse Shoe Bend in the western part of Boise County on the Oregon Short Line RR. The highways leading to this point, however, are closed during the greater part of the late fall and winter, during which time all shipments must be made via Boise. Freight rates on $100 concentrates from Boise and Horse Shoe Bend to Salt Lake City are $6.50 a ton.

HIGHWAYS

Route 15 is a paved highway crossing the western part of the County from south to north. It follows along the Payette River from Horse Shoe Bend to the South Fork of the Payette River. From this point it follows along the North Fork of the Payette River. A graded road in fair condition follows the South Fork of the Payette from its confluence with the Payette River in the western part of the County up to Bonneville in the eastern part.

The highway from Boise to Idaho City, a distance of 42 miles, has been paved recently. Graded and graveled roads extend from Idaho City, Centerville, and Placerville to almost every part of Boise Basin. Most of these roads are maintained by the United States Forest Service and are generally passable except when blocked by snow. Aside from the paved road from Idaho City to Boise, the principal highways leading from Boise Basin are the Horse Shoe Bend road from Placerville to Horse Shoe Bend on the Payette River, the Grimes Pass road from Pioneerville over Grimes Pass to the Grimes Pass power plant, and the Lowman Pass road from Idaho City over Lowman Pass to the town of Lowman on the South Payette River. All three of these roads are closed by snow during the winter months.

Trucking Rates

Trucking rates have not been definitely established. Concentrates were hauled from Quartzburg to Horse Shoe Bend, a distance of 18 miles, for $2.50 a ton in the summer of 1937. General freight from Boise to Idaho City, a distance of 42 miles, was hauled at a rate equivalent to $6 a ton before the road was paved. It is probable that this has been lowered since the road has been paved.

TIMBER

Almost all of Boise County is covered with a dense growth of Ponderosa pine and Douglas fir. Most of the area has been cut over by the Boise Payette Lumber Co., and much of the timber is second growth. The second-growth timber is for the most part too small for saw logs but is satisfactory for mining and some classes of light construction work. Round timber up to 10 inches in diameter can be obtained almost anywhere in Boise Basin within one fourth mile to a mile of where it is to be used. This class of timber is delivered at the mines by contract cutters for as little as 7 cents per linear foot.

In June 1937 three sawmills were operating in Boise, one at Placerville, one about 1-1/2 miles west of Pioneerville, and one on Elk Creek about 4 miles above Idaho City. Dimension lumber sold for $20 a thousand board feet at the mills, or $22 delivered at the mines. Finished lumber sold for $45 a thousand board feet at the mills.

POWER

Power is supplied to the mine operators of Boise Basin by the Grimes Pass hydroelectric plant on the South Fort of the Payette River about 5 miles due north of Pioneerville.

The plant consists of two turbogenerators, each of 900 kv-a capacity. A plant consisting of a 375-kv-a generator direct-connected to a 390-horsepower 8-cylinder Diesel engine is used to take care of heavy loads during the late fall and winter months, when the South Fork of the Payette River is low.

Current is generated at 2,300 volts and stepped up to 20,000 volts for transmission over a 3-phase line from the plant to Pioneerville, Centerville, and Idaho City. A 3-phase, 20,000-volt branch line runs from Centerville to the Placerville and Quartzburg areas.

The power company offers a number of power schedules designed to meet the specific needs of the various classes of service required in Boise Basin. Schedules that are applicable only to the more important classes of operations follow.

Schedule B-1. Available to customers for milling and underground mining operations requiring 150 kilowatts or more.

Demand: $2 per kilowatt per month for the highest 15 minutes.

Secondary demand: $2 per kilowatt per month for all hoist motors.

Energy charge: $0.0125 for the first 50,000 kw.-hr.
.0070 for the next 50,000 kw.-hr.
.0050 for all over 100,000 kw.-hr.

Schedule B-2. Available to customers using power for milling and underground mining operations requiring 10 to 300 kilowatts. For small operators.

Demand: $2.50 per kilowatt per month for the highest 15 minutes.

Secondary demand: $2.50 per kilowatt per month for all hoist motors.

Energy charge: $0.040 for the first 30 kw.-hr.
.030 for the next 30 kw.-hr.
.020 for the next 30 kw.-hr.
.010 for all over 90 kw.-hr.

Schedule B-4. Available to customers for dredging or continuous pumping operations requiring 100 kilowatts or more.

Demand: $3 per horsepower for the highest 15 minutes.

Secondary demand: $1 per horsepower for all hoist motors.

Energy charge: $0.002 per kw.-hr., no sliding scale.

Schedule C-1. Available to customers for mining development work only. As soon as the mine goes into production the customer must change to another schedule.

Demand: $1 per horsepower per month for a minimum of 150 horsepower.

Secondary demand: None.

Energy charge: $0.0125 for the first 50,000 kw.-hr.
.0070 for the next 50,000 kw.-hr.
.0050 for all over 100,000 kw.-hr.

A discount of 1/2 of 1 percent on the gross monthly bill is made for every 1-percent improvement of the power factor above 80. A similar penalty is imposed for every 1 percent that the power factor falls below 80. This discount, or penalty, is applicable to all schedules.

No additional charges are made when it becomes necessary to operate the Diesel plant. Power customers pay the same rates for lighting as for power and are not limited to any definite lighting load.

CLIMATE[4/]

Boise County lies between parallels 43°35' and 44°20' N. latitude. At the southern end the altitude is from 2,300 to 3,000 feet. The winters in this part of the county are mild. Temperatures below zero occur rarely and snow lies on the ground for only a few days during the winter. The summers are hot and humid; temperatures of 100° F. are common in June, July and August. From June to September, inclusive, the monthly precipitation is less than 1 inch; for the remainder of the year it ranges from 1.1 to 1.9 inches, the greatest being in January. The average annual precipitation for a period of 63 years was 13.4 inches.

The central part of the county, which includes most of the placer-mining area, consists of a plateau, much of which is over 4,000 feet above sea level. The climate of this section is quite severe, being characterized by cool summers and cold winters. Snowfall is heavy. Many of the roads over the high passes are closed to traffic from December to May. Temperatures of -20° F. and lower are common during December, January, and February. Dredging is generally discontinued for a month to 6 weeks during the coldest weather, but occasionally a dredge is operated throughout the winter.

4/ U. S. Department of Agriculture Weather Bureau, Climatic Summary of the United States; Sec. 6 - Southern Idaho.

The run-off generally begins early in April. By April 15 the water in the creeks is usually high enough for hydraulicking. The greatest run-off is probably during May. By June 1 the high water starts going down, and by July 4 most hydraulicking is discontinued.

The following table shows the monthly and annual precipitation and snowfall at Idaho City, elevation 4,000 feet.

Month	Precipitation, inches (Average for 37 years)	Snowfall, inches (Average for 24 years)
January	3.05	25.7
February	3.05	20.4
March	2.13	12.2
April	1.46	3.8
May	1.59	0.4
June	.83	T
July	.40	.0
August	.52	.0
September	.77	T
October	1.41	.2
November	3.04	9.0
December	3.07	22.0
Total	21.32	93.7

TOPOGRAPHY

The southeastern part of Boise County lies in the valley of the North Fork of the Boise River at an altitude of 2,300 to 3,000 feet. The broad valley of the Payette River crosses a part of the western end of the county. This river flows south from its confluence with the North Fork to the town of Horse Shoe Bend and then turns abruptly to the west, flowing out of the county and into the Snake River.

The central, western, and northern parts of the county are a high plateau ranging in altitude from 4,000 to 5,000 feet; some of the highest mountains rise 7,500 to 8,000 feet above sea level. The plateau is cut by the canyon of the South Fork of the Payette River extending east - west for about 40 miles and ranging in depth from 2,000 to 3,000 feet.

Boise Basin occupies the valleys and tributaries of Granite and Grimes Creeks and the head waters of Moores Creek. The area forms a depression surrounded on the north, east, and west by high mountains. The Boise Range on the west rises abruptly from the vicinity of Quartzburg to an altitude of 7,000 to 8,000 feet. On the north is the watershed between the Boise and the Payette Rivers. This ridge is comparatively low in the vicinity of Grimes Pass, but farther to the east it attains an altitude of 7,500 feet. On the east is the watershed between Moores Creek and the North Fork of the Boise River.

GEOLOGY

General

The rocks in the southern and western parts of the county consist mostly of granites and basalt flows. The plateau that forms the central, western, and northern parts of the county consists mostly of granite intruded in many places by porphyry dikes.

The geology of Boise Basin has been described by Lindgren[5/]. The country rock consists of granite intruded by porphyry dikes. A large belt in the northwest section of the area (fig. 6) is intruded by a series of these dikes. It ranges in width from a few hundred feet to a mile, and bears N. 60° E. from a point 2 miles southwest of Quartzburg. Many of the more important underground mines of the district were developed on lodes in the vicinity of this intruded belt. The lodes roughly parallel the intrusion in dip and strike. Some of them are in the porphyry dikes and some at or near the contact of the porphyry and the granite, while others are in the granite north of the intruded belt but never more than one-fourth to one-half mile from the porphyry contact. Another important lode area lies about 5 miles to the northeast of Idaho City, near the summit between Elk Creek and Moores Creek. These lodes bear roughly N. 60° E. and dip to the south at 45° to 60°. A number of lode mines have been developed in this area, but on the whole it has not been as productive as the Quartzburg belt.

Sedimentary beds consisting of sandstone and clay occur in the vicinity of Idaho City. From their even and regular stratification it is inferred that they are the remains of fresh-water lake deposits. They are older than any of the placer deposits, as they form the bedrock of many of the creek as well as the bench placers. In many places the beds have been eroded before the gold-bearing gravels were deposited on them, forming an irregular bedrock that slopes toward the creek bottoms at about 10°. They do not outcrop in the valley of Grimes Creek or Granite Creek but form the bedrock of many of the placers in that vicinity.

Placer Deposits

Gravel deposits containing gold occur along the streams in nearly every part of Boise County. In only a few places, however, are the deposits rich enough in gold to be of economic value, and on the basis of production the Boise Basin area is the only one of economic importance. In 1936, placer-gold production was reported from nine districts. The total production was 12,387 fine ounces - 12,336 ounces was from Boise Basin and 51 ounces from all of the other districts.

Lindgren described the gravels of Boise Basin.[6/] Stream gravels and high-level gravels occur extensively along the creeks and tributaries in all parts of the area; basalt-covered gravels extend along lower Moores Creek for a distance of about 10 miles.

5/ Lindgren, Waldemar, Mining Districts of the Idaho Basin and Boise Ridge, Idaho: Extracts from 18th Annual Report, Geol. Survey.

6/ Work cited.

Stream Gravels

The stream gravels that occupy the creek bottoms are the most recent and were formed, in part at least, from the breaking down and erosion of bench gravels. Most of the stream deposits of importance have been worked by hand methods to a depth of 6 to 8 feet; in many places, the remaining gravel is buried to a depth of many feet by hydraulic tailings from bench placers. The virgin ground was 20 to 30 feet deep.

Most of the dredging operations of the past and present are on creek placers formerly worked by hand, then covered by later tailings. In some places the gold is concentrated on the bedrock, while in others it is distributed more uniformly in the material.

High-Level Gravels

Lindgren1/ distinguishes between two types of high-level gravels - Neocene stream gravels and the more recent bench gravels.

Neocene stream gravels. - The Neocene stream gravels occupied the ancient stream beds of nearly all of the valleys in Boise Basin. Subsequent erosion removed great areas, and the remaining parts appear as irregular patches in the vicinity of Idaho City, Pioneerville, and Placerville. In several places they lie on the granite bedrock 150 to 200 feet above the creek bottoms, entirely detached from the more recent deposits. They were formed at a time when the creek beds were at a much higher elevation than during the formation of the other gravel deposits.

In general, the Neocene gravels are thicker and more firmly consolidated than later deposits. In many places they consist of successive layers of gravel, clay, and sandstone (fig. 8). A deposit of this class on the east side of Elk Creek, about one-half mile above Idaho City, has a maximum thickness of nearly 200 feet. A hydraulic mine in this deposit has been the most consistent producer of placer gold in Boise Basin, with an output of $24,000 to $50,000 annually over a period of 50 years.

Recent bench gravels. - The more recent bench gravels are similar in many respects to the Neocene deposits, the essential differences being that they are thinner and not as firmly consolidated. Moreover, the later deposits have been eroded much less extensively and extend more regularly along the creek valleys.

Residual gravels. - Another class of deposits, one that has become of considerable importance since Lindgren's report was published, is the type of residual deposits that occurs in the small gulches and depressions in many parts of Boise Basin. Such deposits are characterized by slightly round to sharply angular rock fragments mixed with top soil and are generally much thinner than the bench gravels. They generally are less than 10 feet in depth but in places range up to 20 feet. Deposits of this type have been

1/ Work cited.

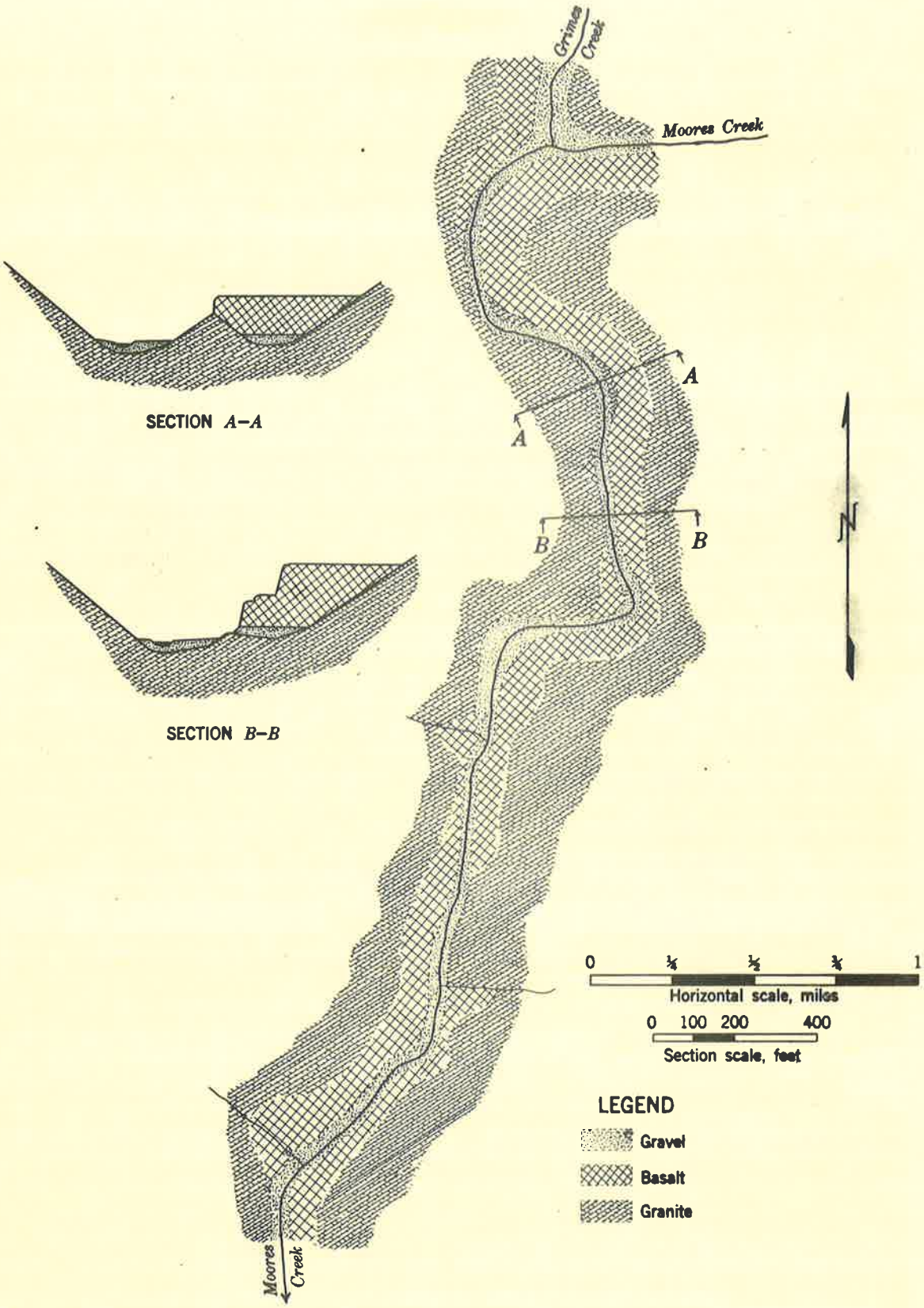
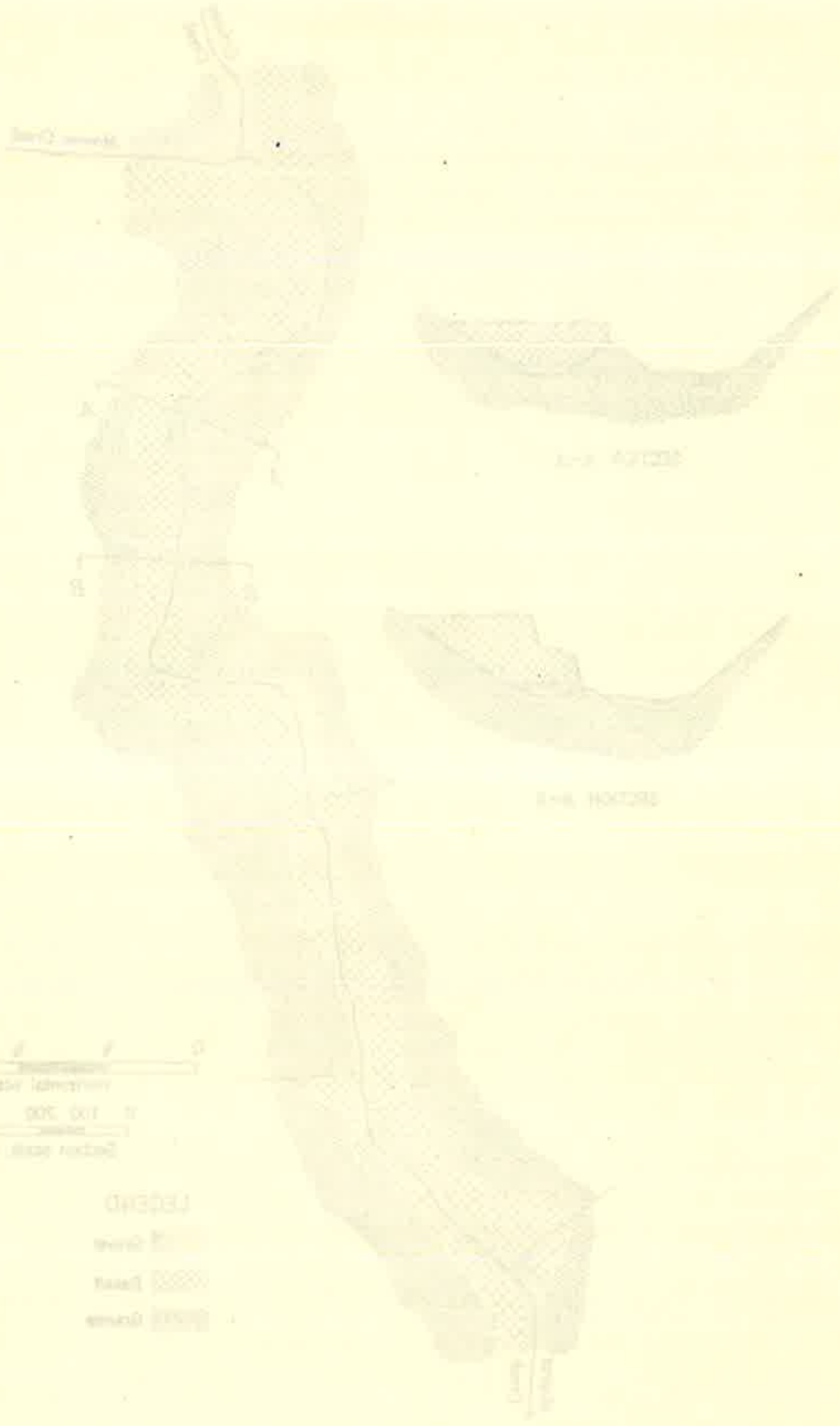


Figure 3.—Part of the basalt-covered gravels of Moores Creek.



worked quite extensively on Muddy Creek west of Pioneerville (fig. 5) and to a smaller extent on the Monazite placer (fig. 4). Because of the general lack of knowledge concerning their location and extent, no attempt was made to show the gold-bearing residual gravels on the maps.

That this type of deposit is mineral bearing was determined definitely in the contest before the Land Office between the Centerville Mine & Milling Co. and the Boise Payette Lumber Co. over lands embraced in the Monazite placer. This contest began in 1911 but was not definitely settled until 1919 or 1920. In 1918, the Commissioner of the General Land Office, Washington, D. C., appointed an investigating commission to test the deposits of the Monazite placer thoroughly and to determine its value as mineral land. The findings of this commission[8/] indicated a total of 1,932,000 yards of material available for placer-mining operations. Of this, 818,000 yards is overburden that will have to be stripped, and 1,114,000 yards is gravel having a value of 77 cents a yard with gold at $20.67 an ounce. Commercial deposits were found to be limited largely to the material in the gulches, where they ranged in depth from 2 to 10 feet and averaged 7 feet.

Basalt-Covered Gravels

A basalt lava flow covered the ancient channel of lower Moores Creek from about the confluence of this stream with Granite Creek to the Boise River, a distance of about 10 miles (fig. 3). The lava is 500 feet to one-fourth mile wide and 50 to 150 feet deep. It filled the ancient stream valley and forced Moores Creek to cut a new channel, which it now occupies.

As the granite country rock was less resistant to erosion than the basalt, the new channel followed one or the other contact between the granite and lava for most of the distance. Granite forms one wall of Moores Creek Canyon and Basalt the other, except where ancient tributaries joined the main stream; here both walls are basalt. In finding a new channel the creek had either to cut through the basalt filling the tributary or through that filling the valley of the main stream. The new channel cuts across the basalt filling Grimes Creek at its confluence with Moores Creek, across the main channel of Moores Creek from west to east 2-1/2 miles below Grimes Creek, where a tributary comes in from the west, and across the main channel from east to west a little farther down, where a tributary comes in from the east.

Moores Creek has cut to a depth of 12 to 40 feet below the bottom of the ancient stream bed, thus exposing the granite bedrock of the ancient gravels as well as the gravels themselves and the basalt above. The best exposures are where the present channel crosses the ancient one. Most of the exposures, however, are near the edges of the ancient channel where the gravel deposits are thin. Except in mine workings, the bottom of the ancient stream bed where the gravel is thickest is seldom, if ever, exposed, having been covered by talus from the basalt cliffs above.

8/ Unpublished report filed in the Land Office, Washington, D. C.

These ancient gravels have been the least exploited of any of the gold-bearing deposits of Boise Basin. They were worked to a small extent about 20 years ago, but no appreciable yardage was removed. In the summer of 1937, three or four men were mining some of the ancient gravel by hand; the only equipment used was picks, shovels, and wheelbarrows. The production from this source is almost negligible.

On each side of Moores Creek a number of adits expose the gravel from the granite bedrock to the basalt above. The most extensive accessible workings are 14-1/2 miles below Idaho City on the west side of the creek. These workings consist of 400 to 500 feet of adits and drifts and a worked-out area of several thousand square feet. Other accessible adits are short and have been worked to only a very small extent. The coarse material was left in the old workings for back filling.

The gravel is very loose and can be easily broken down with a hand pick. In four drifts where samples were taken the thickness ranges from about 4 to 12 feet, the average being 6 to 8 feet. It is possible that the average thickness of the deposits is greater than this, as many of the drifts in which the thickness was observed are near the edge of the ancient channel, where the deposits are comparatively thin. In many places the largest boulders are 6 to 8 inches in diameter, while in others boulders up to 12 and 15 inches constitute over 5 percent of the total volume of the gravel.

It is difficult, if not impossible, to get an estimate on the richness of these deposits from past or present operations. Operators of the past are either dead or cannot be found, and the present operators have not done enough work or kept enough data to be informed. Samples weighing 25 to 50 pounds were taken from some of the accessible drifts. The results obtained by panning these samples and amalgamating the pannings are as follows:

Sample	Location	Description	Value, 1/ cents per cubic yard
1	Drift 12 miles below Idaho City, east side of creek. Sampled 20 feet from portal.	6 feet of gravel above bedrock. Total thickness of gravel, 12 feet.	32
2	Drift 14 miles below Idaho City, east side of creek, sampled 100 feet from portal.	3 feet of gravel above bedrock. Total thickness, 6 feet.	37
2a	Do.	2-1/2 feet of sand above gravel.	16
3	Drift 14.5 miles below Idaho City, west side of creek. Sampled 20 feet from portal.	3 feet of gravel from basalt down. Total thickness, 6 feet.	58
4	Drift 16.5 miles below Idaho City, east side of creek. Sampled 10 feet from portal.	7 feet of gravel from 2 feet above bedrock to basalt roof. Total thickness, 9 feet.	13

1/ Assuming 3,000 pounds per cubic yard; gold at $35 per ounce.

These samples indicate that the gravels sampled contain gold from the basalt covering to the granite bedrock. No bedrock material was included in the samples nor was any attempt made to get a sample representing gravel from bedrock only.

Abandoned attempts at drift mining and the few samples taken indicate that the covered gravels are too low-grade for profitable exploitation by standard drift-mining methods, at least with gold at the old price of $20.67 per ounce.

As far as could be observed, the natural conditions are very favorable for low drift-mining costs provided adequate drainage can be obtained without pumping. The basalt covering the gravels is strong and apparently would stand well over areas customarily held open in drift mining; hence, little timbering would be needed. As the gravel is easy-digging and easy-washing, the cheapest methods of handling it could be followed. The most unfavorable factor is that, as indicated by available data, the slope of bedrock upstream is not sufficient for fluming the gravel. A number of old timers of the district suggested that a combination of hydraulic and mechanical methods could be used. The coarse material could be screened out and used for back filling and the minus 1/2- to 3/4-inch sands pumped to the surface and washed in standard sluices. The oversize could be handled with a scraper and portable electric hoist. Development would consist of a drift the full length of the deposit to be worked. A retreating method of mining would be followed.

To be successful any kind of operation would have to follow plans based upon a careful geological study of the ground. Many of the drifts driven made by the old timers were started in the gravel exposures near the edge of the ancient channel and follow the granite bedrock on a down grade toward the center of the channel. Drainage under such conditions is impracticable, and the adits are useless for anything except sampling. Drifts started in the bottom of the ancient stream bed, where the new channel crosses the old, could be used as working adits and would also provide an adequate means for drainage.

There are not enough data available to give even a rough idea of the yardage available in these deposits. Large portions were eroded at the crossing of the new and old channels. In other places they have been almost entirely preserved by the basalt covering for distances of 1-1/2 to 2 miles along the canyon. It is possible a geophysical survey could be used in mapping the ancient stream bed and determining the thickness of the gravel where it is not exposed. Such a survey, if successful, might provide a means for making estimates upon which to base proposed operations.

Monazite Sands

Monazite sands occur in all of the gold-bearing gravels in Boise Basin. Monazite contains thorium, cerium, lanthanum, neodymium, praseodymium, yttrium, and erbium. It is of commercial value principally because of thorium, which is used in the manufacture of incandescent lamps.

The monazite sands of Boise Basin are too low in thoria (ThO_2) to be marketable at present prices. Prices quoted in the Engineering and Mining Journal during 1936 ranged from $60 to $75 a ton for monazite sands containing a minimum of 6 percent thoria. Monazite concentrates from Boise Basin gravels contain from 4.5 to 5 percent thoria.

The only attempt to produce monazite concentrates in Boise Basin was made during the World War by the Centerville Mine & Milling Co. of Boise in its plant at the Monazite placer. The plant has since been destroyed by fire. The tailings from hydraulic operations were run over a grizzly that rejected everything over one-fourth inch. The undersize from the grizzly was screened to minus-6 mesh. The minus-6 mesh material was run over concentrating tables that produced several grades of concentrate ranging in grade from 10 to 45 percent monazite. These concentrates were dried and then run through electromagnetic and electrostatic machines to remove the magnetite, ilmenite, garnet, and other material that could not be removed by gravity concentration.

Concentrates containing 95 percent monazite and 4.94 percent thoria were produced by this method. It was estimated that the value of the thorium content of most of the gold-bearing gravels in Boise Basin ranged from 1 to 4 cents a yard at the prices that prevailed in 1918 and 1919. It was impossible, however, to produce concentrates having a high enough thorium content to be marketable. From this it is apparent that monazite sands in Boise Basin have no commercial value at present. Future possibilities depend upon the demand for thorium and the rare earths.

PLACER RESOURCES OF BOISE BASIN

Moores Creek and Tributaries

Stream Gravels

Stream gravels occur along Moores Creek from its confluence with the Boise River about 20 miles below Idaho City to within a few miles of its source about 10 miles above Idaho City. The deposits, however, are not continuous. The lower 15 miles of the stream are in a canyon that in many places is too narrow for the deposition and formation of placer deposits. The deposits along this section of the river are narrow and in many places too rocky to be worked by any other than hand methods. At several places, attempts have been made at working them by sinking shafts to the bedrock and drift-mining from the bottom of the shafts. These attempts have seldom if ever been successful, first because of the great number of large boulders encountered and, second, because of the excessive cost of handling seepage water from the creek.

The upper 4 or 5 miles of the canyon is a little wider than the lower end, and in a number of places the creek bottom ranges in width from 100 to 300 feet. The total yardage of the deposits in this part of the canyon, however, is quite limited and the deposits are irregular and not continuous. These deposits are too small to be mined successfully by a bucket-line dredge; some of them might be worked profitably by a dragline and floating plant.

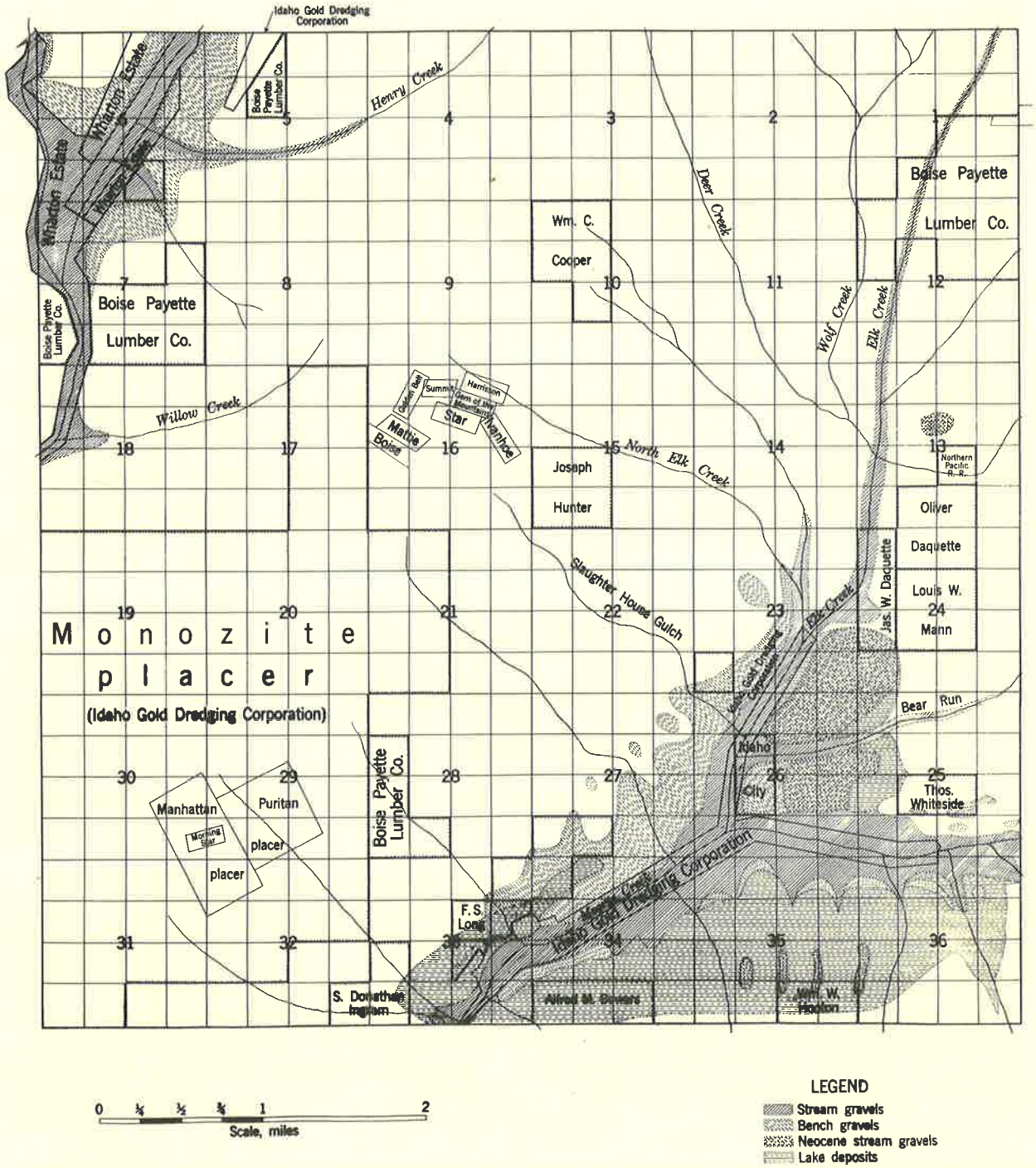


Figure 4.—Gravel deposits of upper Moores Creek and tributaries, T. 6 N., R. 5 E., Boise base and meridian (after Lindgren).

The basalt-covered placers along this section of Moores Creek have been described already.

From the upper end of the canyon to about 3 miles above Idaho City (fig. 4) the width of the creek bottom is 300 to 800 feet, except for one short stretch below Warm Springs where it is less than 100 feet. All of the stream gravels along this section of the creek had been worked by hand methods prior to 1900, and since then a considerable portion has been reworked by dredges. From 1912 to 1917, the Estabrook dredge worked from Warm Springs to about 2 miles above Idaho City. The amount of dredging ground left undredged on Moores Creek is very small. For the past 3 years, the Moores Creek dredge of the Idaho Gold Dredging Corporation has been working below Warm Springs. Above Idaho City, a small acreage of doubtful value was left unworked by the Estabrook dredge. This dredge was stopped because the gold content of the gravel became too low to permit operating at a profit. The advance in the price of gold from $20.67 to $35 per ounce changes the picture somewhat, but it is doubtful if the amount of recoverable gold is sufficient to justify the expense of building a dredge or dragline plant of any kind.

The last 5 to 6 miles of Moores Creek is in a canyon. The creek bottom in this canyon was worked over by hand methods many years ago.

High-Level Gravels

All of the bench placer deposits in the vicinity of Idaho City on Moores Creek have been worked except several small patches on the south side just south of Idaho City. The Antonson Mining Co. of Seattle, Wash., conducted a small hydraulic operation on these deposits in 1936 and 1937. Data furnished by the company indicate an average value of 20 to 25 cents a yard for all of the material handled in the spring and summer of 1937. Several miles above Idaho City, on the west side of Elk Creek, are other bench deposits that have not been completely worked. In the spring of 1937 a leasing company was working two small giants on these deposits.

The Neocene channel gravels are the only important remaining deposits in the immediate vicinity of Idaho City and upper Moores Creek. Just east of Idaho City, south of Bear Run (fig. 3) they have been nearly worked out by hydraulic methods. On the north side of Bear Run, however, a considerable yardage remains unworked. This part of the deposit is being depleted at the rate of 150,000 to 200,000 cubic yards a year by the hydraulic operations of the Gold Hill placer mines. Reserves easily accessible at the south end of the deposit where it is deepest are sufficient for several years' operations at the present rate of depletion. As indicated by seasonal clean-ups, the average of all material handled is above 16 cents per cubic yard. A considerable yardage has been left on the west side of the deposit where it is comparatively thin - 25 to 50 feet; this part of the deposit has a greater percentage of clay, sandstone, and overburden than the thicker parts. As a result of these conditions, operating difficulties are increased to a point where it is doubtful if it could be worked profitably by the present methods.

Elk Creek

Stream Gravels

Elk Creek (fig. 4) flows into Moores Creek at Idaho City. The stream gravels at the lower end were worked by hand methods by the old timers. In 1911 and 1912, they were re-worked by the Estabrook dredge. The upper end of the creek is too narrow for dredging, but it has all been worked by hand or by hydraulicking.

Slaughter House Creek, North Elk Creek, Deer Creek, Wolf Creek, and most of the other tributaries of Elk Creek contain some stream gravel deposits, but they have been worked over quite thoroughly by the early miners.

Grimes Creek

Grimes Creek flows into Moores Creek about 9 miles below Idaho City. The lower 10 miles is in a canyon in which there are a few small stream gravel deposits. Little or no placer mining has been done along this section of the river in recent years. Some of the more desirable deposits were worked by hand methods in the early days by both American and Chinese miners.

Stream Gravels

From about 2 miles below New Centerville to Grimes Pass (fig. 5) the stream placers range in width from a few hundred feet to over 2,500 feet. Nearly all of this section of the stream was worked by hand methods from the surface to the water level prior to 1900. From 1898 until 1905, a considerable portion of the creek bottom in the vicinity of Old Centerville was re-worked by dredges. In recent years, very extensive dredging operations have been conducted on the worked-over stream gravels in the vicinity of New Centerville, Pioneerville, and Grimes Pass. Descriptions of these operations are given later.

From Grimes Pass to Summit Flat the creek is in a precipitous country unfavorable for the formation of placer deposits. At Summit Flat, conditions are more favorable and stream gravels occur along the creek from about half a mile below the Mammoth mine to about 1-1/2 miles above. They are continuous for nearly the whole distance and range in width from 50 feet at the narrowest places to nearly 1,500 feet at the widest; the average is between 350 and 400 feet. The depth of the gravel in most places is 8 to 10 feet, with 2 to 3 feet of top soil. In places the top soil is as much as 10 feet deep. In the narrow places, there are a great many large boulders, but where the creek bottom is wide there is a comparatively small amount of material more than 1 foot in diameter. This is one of the few stream deposits in Boise Basin that has not been all worked over by hand methods. Aside from a small area that was worked by the Chinese about 1/2 mile above the Mammoth mine, the deposits are entirely virgin.

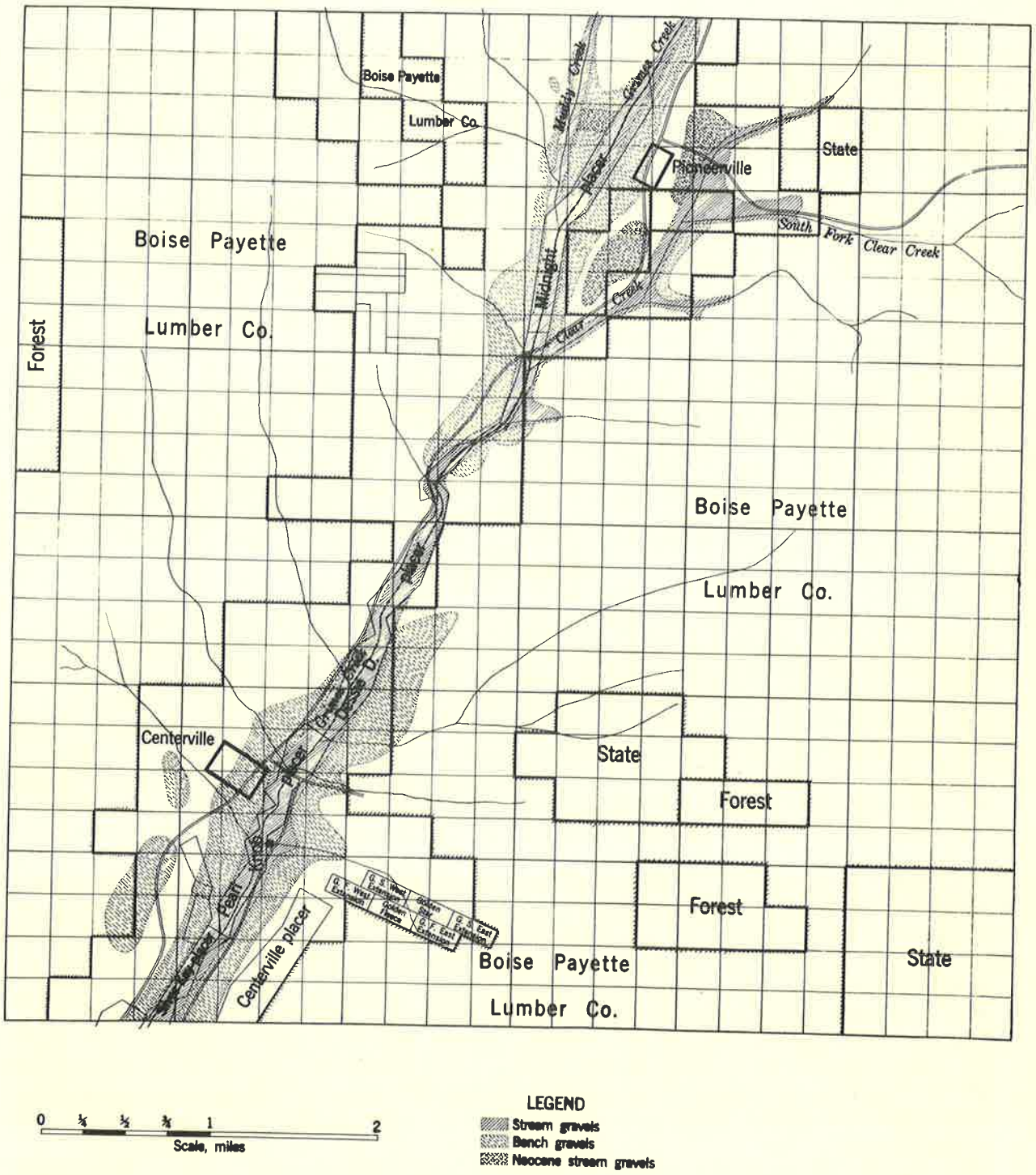


Figure 5.—Gravel deposits along Grimes Creek in the vicinity of Centerville and Pioneerville, T. 7 N., R. 5 E., Boise base and meridian (after Lindgren).

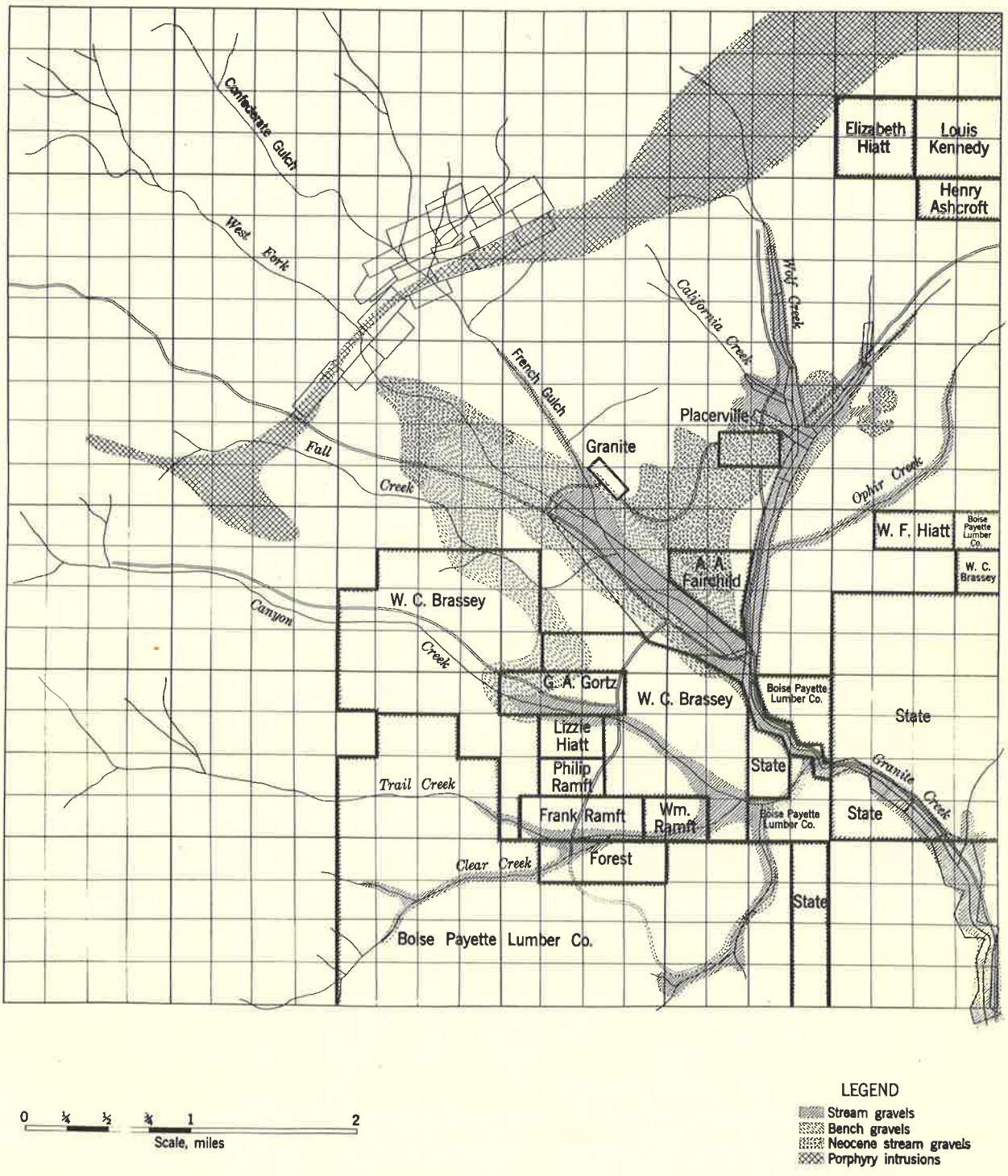


Figure 6.—Gravel deposits along Granite Creek and tributaries, T. 7 N., R. 4 E., Boise base and meridian (after Lindgren).

Natural conditions appear favorable for the occurrence of placer gold. Several gold-bearing veins, including the Mammoth, are in the drainage area, and drainage conditions are favorable for the retention of the gold. Some testing has been done and it is reported by the owner that gravel of commercial grade was indicated in many places.

There is enough water at all times for dredging. Hydraulicking is not practicable because the grade of the creek is too flat for the disposal of tailings. The most unfavorable feature is the severe climate during the winter months. The altitude at Summit Flat is 7,000 feet. It would probably be difficult to operate more than 6 to 7 months during the year.

Virtually all of the favorable placer ground on Summit Flat is held by location by J. D. Smith of Idaho City.

High Gravels

The bench and the Neocene stream gravels along Grimes Creek were worked extensively many years ago. Some unworked deposits of this class, however, remain on Muddy Creek on the property of Antonio Pancho, north of Centerville. There are some extensive unworked residual deposits on the property of Homer Granger just west of Centerville.

Granite Creek and Tributaries

Stream Gravels

Granite Creek flows into Grimes Creek about 1/2 mile below New Centerville (fig. 6). The stream gravels of value along Granite Creek, like the stream placers in most other parts of Boise Basin, have been worked by hand methods. Quite extensive deposits of these worked-over gravels occur along Granite Creek from its confluence with Grimes Creek to within a short distance of its source, a total distance of about 6 miles.

Wolf Creek, Ophir Creek, and Boyles Gulch, tributaries to Granite Creek from the north, have been worked by hand methods. Some dredging was done along Wolf Creek in the vicinity of Placerville as early as 1898.

Virtually all of the ground along Granite Creek and Wolf Creek is owned and has been tested by the Fisher & Baumhoff Co. of Centerville and Warren, Idaho. This company has been dredging on upper Granite Creek for the past year and a half. Extensive gravel deposits occur along Clear Creek, Trail Creek, and Canyon Creek, tributaries from the west. It is said that testing along these creeks showed very discouraging results. None of them have ever been placered.

High Gravels

The Neocene stream gravels and the bench placers along Granite Creek and Wolf Creek (fig. 5) have been worked to a much less extent than high gravels in other parts of Boise Basin. Considerable areas in the vicinity

of Placerville and Granite have been hydraulicked. The Neocene stream gravels of upper Fall Creek were dredged successfully until the ancient stream gradient became so steep that it was impossible to hold water in the dredge pond. A dragline plant was started recently by H. F. English & Co. on the bench-gravel deposits of Grassy Flat, southwest of the town of Granite. The Gold Hill Placer Mines Co. has been conducting a successful hydraulic operation for a number of years on the Neocene stream gravels just west of the town of Placerville.

It is possible that 50 percent or more of the total original yardage of these deposits remains unworked. The most important of the unworked areas are probably at the head of Fall Creek and in the vicinity south of Placerville and southeast of Granite. Aside from the two operations noted above, there were no others on these deposits in 1937. Lack of enough ditches, pipe lines, and other equipment seems to be the reason why they are not being worked more extensively. Most of the acreage is held by individuals who lack the financial means for building adequate systems for hydraulic mining.

PLACER RESOURCES OF DISTRICTS OTHER THAN BOISE BASIN

Mining districts in the county, other than the Boise Basin, that reported gold production from placer mines in 1936 are the Banner, Bogus Basin, Dry Buck Creek, Garden Valley, Highland, Miller Creek, Payette River, and South Fork Payette River. Of these, the only ones with a production of any consequence are the Garden Valley district on the middle fork of the Payette River, and the South Fork Payette River district on the South Fork of the Payette River from the Saw Tooth Lodge to the confluence of the South and Middle Forks of the Payette River.

The production of the Garden Valley district in 1936 was 31.80 fine ounces, which came from seven placer mines. The production of the South Fork Payette River district in 1936 was 14.20 ounces, which came from 6 mines.

South Fork Payette River District

The deposits on the South Fork of the Payette River are mostly bench gravels from 25 to 75 feet above the stream level. Above Lowman are some quite extensive deposits of this type, but they are very rocky and it is said they are very low-grade. Most of the placer operations along the river are below Lowman. The tendency of the miners is to work as much as possible along the edges or rims of the benches where the gravel is thin. This would indicate a concentration of gold on bedrock; operations are generally unprofitable in the thick parts of the deposits where large amounts of very low-grade material must be handled.

About a mile below Lowman and 35 to 50 feet above the stream level is a bench deposit that was hydraulicked a number of years ago. The worked-out area is 40 to 50 feet wide and about 100 feet long. The gravel at the

workings is 6 to 8 feet deep with a large percentage of boulders larger than 1 foot in diameter. Operations were stopped where the gravel became thicker.

The George Russel placer is about 10 miles below Lowman on the south side of the river. It is about 50 feet above the stream level; the gravel at the workings is from 10 to 15 feet thick. The mine has had a small production for the past several years. Hydraulic and ground-sluicing methods are used. One man works single-handed with a fire hose fitted with a small nozzle.

The Horseshoe placer is 3 miles below the Grimes Pass power plant on the north side of the river. It is owned by W. T. Birdwell, of Grimes Pass, who operated it for the past 4 years. Mining methods consist of ground-sluicing and hand-shoveling into sluice boxes. The water supply is from Nelson Creek, which furnishes enough for about 2 months' operations in the spring. Total production for the past 4 years was 25 fine ounces, or an average of 6.25 ounces a year.

PLACER-MINING OPERATIONS

Fisher and Baumhoff

The property is in the vicinity of Centerville and Placerville, on Grimes Creek, Granite Creek, and Wolf Creek. It includes all of the claims of the Wharton Estate (figs. 3, 4, and 5), which cover about 7-1/2 miles of creek placers along Grimes, Granite, and Wolf Creeks. The claims are all patented and are owned by the company.

Operations in June 1937 were conducted with two dredges - one on Grimes Creek about a mile north of its confluence with Granite Creek, and one on Granite Creek about a mile southeast of the village of Granite. The dredge on Grimes Creek known as the Centerville dredge has been in operation for about 2 years. The Granite Creek dredge has been in operation since late in July 1936.

Granite Creek Dredge

The Granite Creek dredge was brought into Boise Basin from Warren, Idaho, where it had been in operation for about 3 years. It was delivered near its present location on Granite Creek early in July 1936. Twenty-one days were required to reassemble the various parts, and by the end of July it was in operation.

The gravel in Granite Creek, where the dredge is operating, is 20 to 25 feet deep and averages about 23 feet. The bedrock consists of moderately hard clay. Most of the gold is concentrated in 3 to 5 feet of gravel on bedrock; 80 to 85 percent of the material consists of sand and fine gravel less than 1/2 inch in size. The only coarse gravel is the 3 to 5 feet on the bottom, which contains the gold. The largest material consists of 6- to 8-inch boulders.

The dredge is working up the north side of Granite Creek Valley and is dredging about one-half of the width of the stream placer. The south half is left to be dredged when the dredge works down the creek. The total width of the creek placer is from 700 to 1,000 feet, making a width of 350 to 500 feet to be dredged each way. The normal capacity is 2,500 cubic yards in three 8-hour shifts.

The bank on the south side of the dredge pond is built up as required by a caterpillar tractor equipped with a blade. There is little or no brush and timber to be cleared away as the dredge advances.

The hull of the dredge is steel. Two spuds are used - a timber one for making the step ahead and a steel one for dredging. The bucket ladder consists of 84 buckets of 2-1/2-cubic-feet capacity each and is operated at a speed of 28 buckets per minute. The trommel is 5 feet in diameter by 28 feet long with 3/8-inch perforations. The tailings stacker is 60 feet long. The ladder cable is 3/4 inch in diameter; 3/4-inch cable is used for mooring the bow and 5/8-inch for the stern.

The dredge normally makes a 3-foot step ahead and a sweep of 75 feet. From 1 to 1-1/2 feet of bedrock is excavated. The gold-saving equipment consists of jigs and sluice boxes with Hungarian riffles. Very little gold, however, is recovered in the riffles. (At the time the data were gathered on this operation no riffle clean-ups had been made. Any concentrates that may be recovered from the riffles will presumably be treated in the amalgam barrel.) The flow sheet is shown in figure 7.

The undersize from the trommel is divided into two parts by a distributor; each of these parts goes to a separate unit of four 42- by 42-inch Pan-American jigs.

The concentrates from the two units are combined and go to another unit consisting of two 18- by 18-inch Pan-American jigs. The tails go over a set of riffles 16 inches wide and 40 feet long and thence to a sand trap. The sand from the sand trap is elevated by a bucket elevator to the tailings stacker and the fines go directly into the dredge pond.

The concentrates from the two-jig unit are treated in a 1-1/2- by 4-foot continuous-type amalgamating barrel. The tails are run over the riffles. The tails from the amalgamating barrel are run over a fourth unit consisting of two 12- by 12-inch Pan-American jigs. The tails from these jigs are discharged into the tailings pond. The concentrates are collected in a bucket and periodically dumped back into the amalgamating barrel. Mercury is added by an automatic mercury feeder at the head end of the amalgamating barrel.

The 42- by 42-inch jigs are operated by a cam and an eccentric. All of the smaller jigs are operated by water motors.

The amalgam is taken from the amalgam barrel while the dredge is in operation. This requires from 15 to 20 minutes. During this interval the

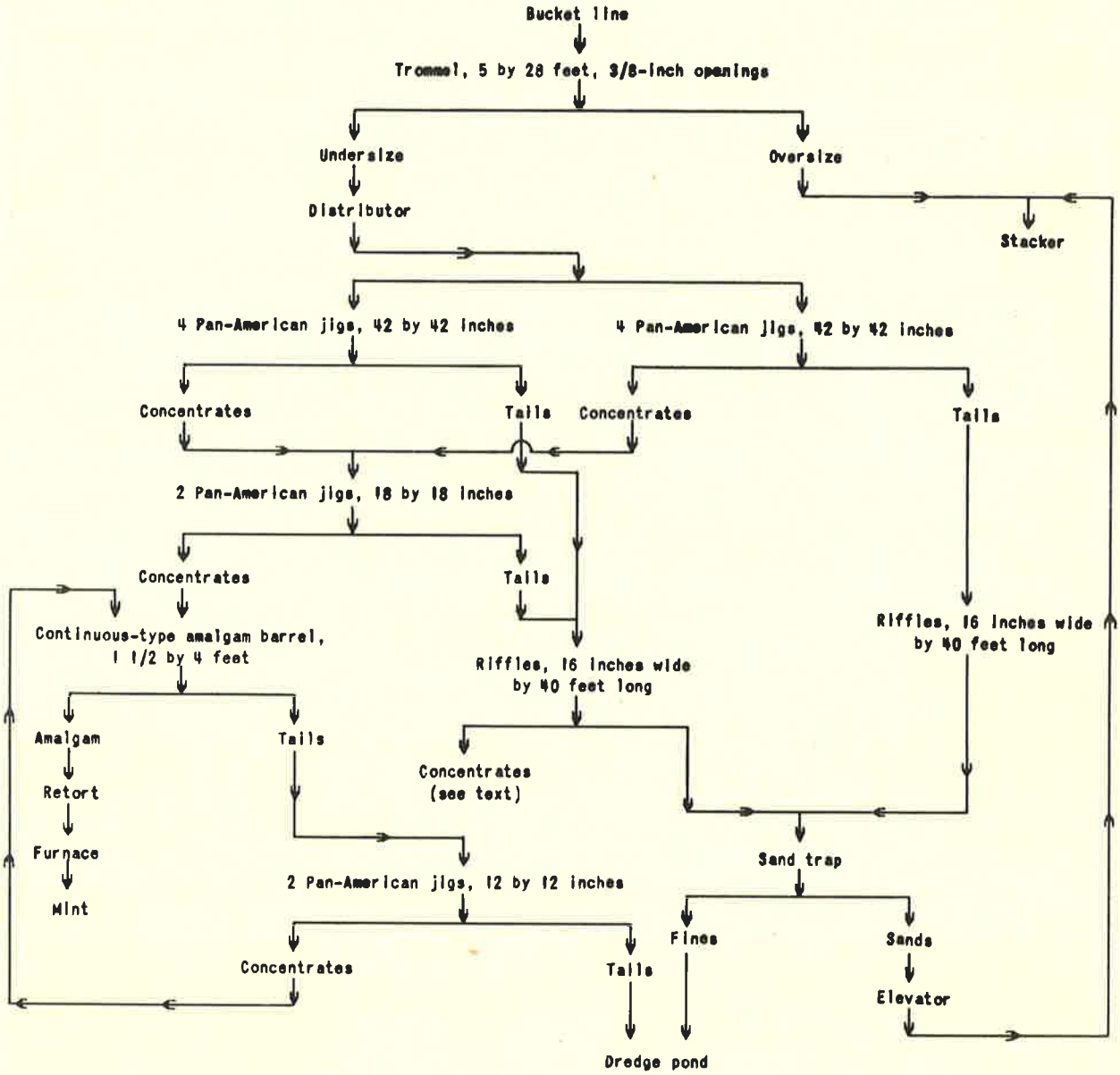


Figure 7.- Flow sheet, Granite Creek dredge of Fisher & Baumhoff Co., Centerville, Idaho.

concentrate from the 18- by 18-inch jigs is collected in buckets and dumped into the amalgam barrel as soon as it is cleaned and ready to begin operating.

The dredge is operated three 8-hour shifts a day. The payroll is as follows: 1 dredgemaster, salary; 3 oilers, $5.00; 3 winchmen, $6.25; 1 shoreman, $5.25. The shoreman changes the mooring cables and operates the caterpillar tractor.

Power is purchased from the Grimes Pass Power Co. Current is delivered at 20,000 volts and stepped down to 440 volts for the motors and 110 volts for lighting. The power transformers are on shore and the lighting transformers on the boat. The connected horsepower is as follows:

	Horsepower
Bucket line	50
High-pressure pump	40
Low-pressure pump	25
Small pump	2
Trommel	15
Winches	10
All jigs	10
Amalgamator	1-1/2
Welder	4
Sand elevators	6
Total	163-1/2

Centerville Dredge

The Centerville dredge is operating under conditions very similar to those at the Granite Creek dredge. The depth and character of the gravel are virtually the same, but the bedrock is granite instead of clay. About 1 foot of the bedrock is excavated whenever possible, but sometimes it is so hard that only a few inches can be taken. The dredge is working upstream across the entire creek bottom, a width of 800 to 1,000 feet. This makes it unnecessary to use a tractor for building up a dam for the dredge pond as in the case of the Granite Creek dredge.

The dredge has been in operation about 2 years. It was manufactured by the Yuba Manufacturing Co. of San Francisco and assembled near Centerville by the Olson Manufacturing Co. of Boise, Idaho. It is of all-steel construction. The bucket line consists of 79 six-foot buckets operated at a speed of 22 per minute. The dredge was designed for a higher bucket speed but in operation it had to be retarded because of insufficient jig capacity. A 7/8-inch cable is used on the ladder; a 7/8-inch cable for mooring the bow and a 3/4-inch cable for the stern. The dredge takes a 6-foot cut and makes a sweep of about 100 feet. Two steel spuds are used, one for making the step ahead and one for dredging. The rated capacity is 6,000 cubic yards in 24 hours. In June 1937 it was operating at a capacity of 4,500 cubic yards.

The flow sheet is almost identical with that of the Granite Creek dredge (fig. 7), the only difference being that the Centerville dredge has greater riffle area. There are six rows of 30-inch by 12-foot riffles and one row of 30-inch by 30-foot on each side. Present plans call for the addition of more jigs, so that the dredge can be operated at full capacity.

The payroll for the three 8-hour shifts is as follows: 1 dredgemaster, salary; 3 winchmen, $6.25; 6 oilers, $5.00; 1 mechanic, $6.50; 2 extras, $6.00. The extras help with repair jobs on the dredge and do odd jobs on shore.

Power is purchased from the Grimes Pass Power Co. The current is stepped down from 20,000 to 2,100 volts by a set of transformers on shore and from 2,100 to 440 and 220 volts by a set of transformers on the dredge. The connected load on the dredge is as follows:

	Horsepower
Bucket line	100
High-pressure pump	60
Low-pressure pump	50
Trommel	30
Winch	20
Stacker	15
Jigs	20
Amalgamator	5
Welder	20
Sand elevators	10
Total	320

An electrician and a manager are the only men employed besides the regular dredge crews. The bookkeeping and clerical work is done by the electrician.

Costs

Costs and operating data for both dredges for 1936 are shown in the following tables:

	Center-ville dredge	Grimes Creek dredge[1/]
Total cubic yards excavated	1,596,000	170,000
Gross weight of bullion recovered[2/] troy ounces	7,828.92	689.80
Net weight of bullion recovered[3/] do.	7,822.00	689.38
Gold do.	6,087.63	573.90
Silver do.	1,463.38	101.54
Value of gold	$213,066.28	$20,087.66
Value of silver	1,134.29	78.76
Mint charges	874.33	82.29
Total net value	213,326.24	20,084.13
Total gross value	214,200.57	20,166.42

1/ Operated only 4 months in 1936.
2/ Weight of bullion before being melted at the mint.
3/ Weight of bullion after being melted at the mint.

Direct operating costs

Account	Centerville dredge, 1,596,000 cubic yards		Granite Creek dredge 1/ 170,000 cubic yards	
	Amount	Per cubic yard	Amount	Per cubic yard
Accident compensation insurance	$678.57	$0.00043	$329.18	$0.00193
Wages	21,948.86	.01374	9,795.85	.05755
Supplies	8,721.68	.00546	2,119.93	.01247
Replacements and repairs	17,804.45	.01118	1,269.97	.00746
Electric power	12,025.80	.00754	1,095.27	.00645
Transportation and express	1,876.06	.00118	2,827.08	.01664
Unemployment insurance	233.71	.00014	94.08	.00055
Depreciation on dredge	16,300.37	.01021	2,322.29	.01366
Depreciation on automobile	192.77	.00012	70.56	.00041
Depreciation on caterpillar	1,334.50	.00084	296.38	.00174
Depreciation on power line	--	--	7.63	.00005
Depletion	32,130.09	.02008	3,024.96	.01778
Total	113,236.86	.07092	23,253.18	.13669
Net profit	99,500.04	.06235	--	--
Loss	--	--	3,224.24	.01895

1/ Includes cost of transportation from Warren and erecting at Placerville.

General and overhead costs, both dredges.
Total cubic yards dredged, 1,766,000.

Account	Amount	Cost per cubic yard
Management and supervision	$4,800.00	$0.00273
Leveling	895.86	.00051
Assaying	3.00	--
Insurance	130.00	.00007
Telephone and telegraph	.76	--
Licenses and taxes	1,627.21	.00092
Legal and auditing expenses	922.50	.00052
Miscellaneous	260.95	.00015
Total	8,640.28	.00490

Gold Hill Placer Mines

Idaho City Unit

The property of the Gold Hill Placer Mines at Idaho City consists of sixteen 20-acre claims held by location in sec. 23, 24, 25, and 26 in T. 6 N., R. 5 E., Boise B. & M. (fig. 8). The claims cover the greater part of the unworked Neocene stream gravels north of Bear Run Creek and extend south and partly cover the bench gravels on the south side of the creek.

The deposits are the deepest and most extensive of any of the remaining bench or Neocene stream gravels in Boise Basin. They consist of alternate strata of gravel clay and sandstone (fig. 8), with a total thickness of more than 150 feet along the west side of the pits. The clay and some of the sandstone are very hard when freshly broken. Large pieces that will not go through the sluice boxes must be drilled and blasted. On the east side of the property the deposits are much thinner, being 25 to 50 feet thick at the east side of the workings. Operations apparently are uneconomical where the thickness is less than 35 to 45 feet, as considerable yardage is left unworked on the east side. The bedrock is of clay and slopes west toward Elk Creek at about 15 feet in a hundred at the upper or east side and about 8 feet in a hundred at the lower or west side of the workings.

Water rights consist of 2,700 miner's inches from Moores Creek and 2,300 miner's inches from Elk Creek. Water from Moores Creek is taken through 8 miles of open ditch and two 40-inch siphons 2,700 and 3,000 feet long, respectively. Water from Elk Creek is taken through 10 miles of open ditch. The water from the two streams is combined at the penstock about 5,000 feet northeast of the workings. The head is about 225 feet at the upper part of the workings and about 325 feet at the lower part. From the penstock the water runs through two 20-inch pipes to a header within about 1,000 feet of the workings. From here it runs through three 18-inch pipes to the valves, from which it is distributed to the monitors through 15-inch pipes (fig. 8). A maximum of about 4,000 miner's inches is used. The normal amount is around 3,000 miner's inches. At the end of the season, the amount available is much less than this.

Figure 8 shows the general arrangement of monitors, sluice boxes, tailings pond, and rock piles. Three monitors are used in each pit. The pits are worked alternately, piping being done in one while the large pieces of clay and large boulders are being drilled and blasted in the other.

Four- or 5-inch nozzles are used on the monitors, depending on the amount of water available. Pressure at the giants is maintained at 90 to 110 pounds per square inch. Greater pressure than this is possible at the lower pit, but the equipment is old and will not stand a pressure of much more than 110 pounds. Normally, about 1,000 miner's inches are used at each giant. At the end of the season, when the water supply is low, only two giants are operated in each pit. Enough data are not available for

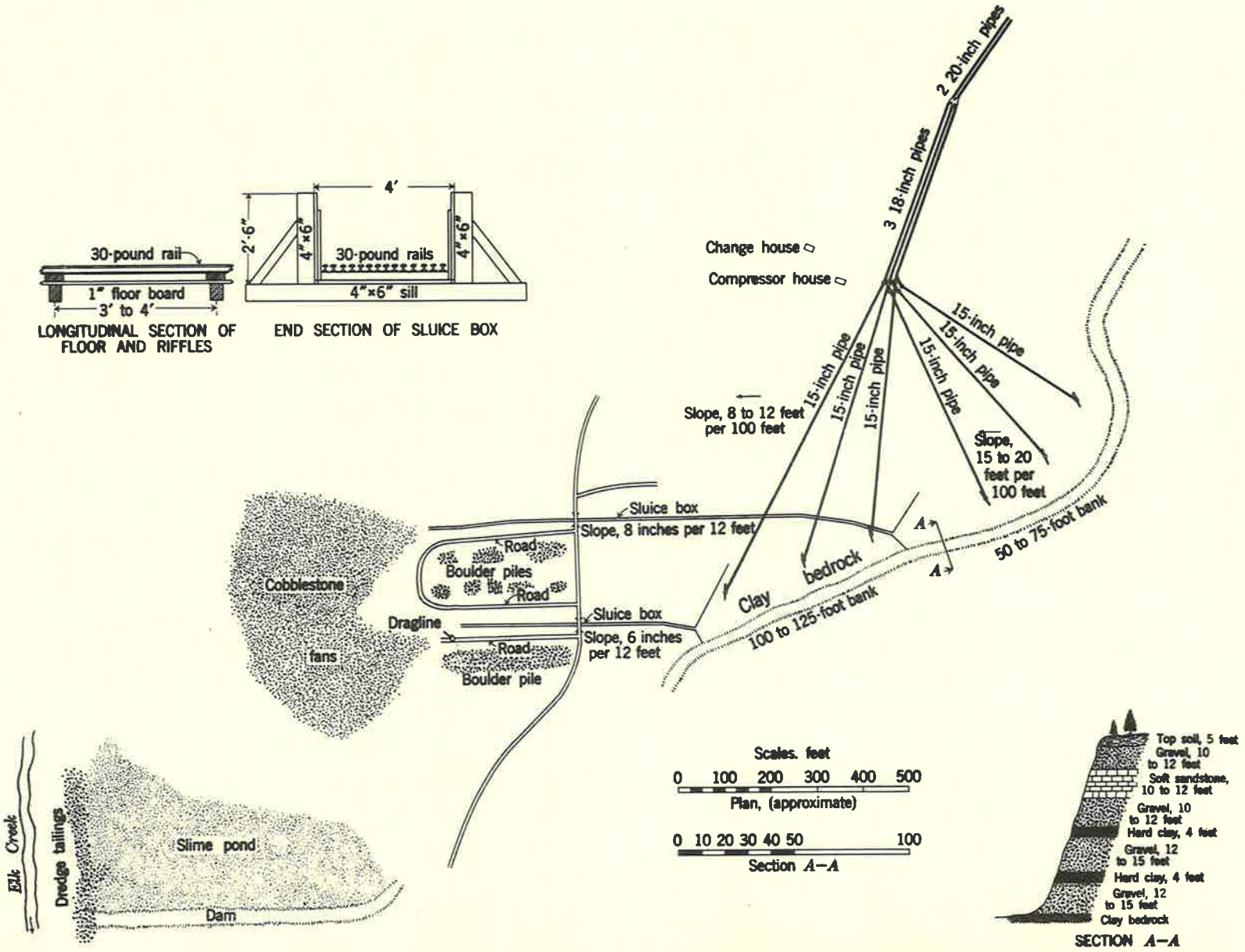


Figure 8.—Plan of hydraulic mine of the Gold Hill placer mines.

accurately determining the duty of water. However, it is stated that with the normal amount of 3,000 miner's inches, a maximum of 6,000 yards of material can be excavated and sluiced in 24 hours. The average amount treated is probably around 4,500 to 5,500 yards, which would make a duty of 1.5 to 1.75 cubic yards per miner's inch in 24 hours. The material is tightly consolidated and difficult to cut except along the west side, where it was drift-mined by the old timers. The duty of water at this part of the workings is much greater than at the east side, where there has been no drift mining.

Sluice boxes (fig. 8) are 12 feet long by 3 feet deep by 3 feet 7 inches wide (inside measurements). The sluice from the upper pit is placed at a grade of 8 inches in 12 feet and the one from the lower pit at a grade of 6 inches in 12 feet. Riffles consist of 4- by 6-inch crosspieces spaced at 2 to 3 feet and covered by 30-pound rails with the flanges down. Mercury is added at the first three boxes of each sluice at the rate of 3 to 5 ounces each day.

Accumulations of large boulders are cleared away from the ends of the sluices with a 1-yard gasoline-operated dragline. Slimes and sands are impounded by a dam built across Elk Creek Valley about 1,000 feet south of the sluice boxes. This dam is built up by the dragline as required. Most of the sands and slimes settle on the east side of the valley. The water filters through old dredge tailings on the west side of the valley before running into Elk Creek. The dragline is kept operating three shifts a day at the dam and at the end of the sluices.

Air-operated jackhammer drills are used for drilling large rocks and boulders. Air for drilling is supplied by a portable Gardner-Denver 120-cubic-foot air compressor operated by a gasoline engine.

In 1937, piping began on April 26 and continued until a few days after July 1. From 30 to 35 men are required for operating three shifts a day. During the latter part of June the payroll was as follows:

Labor classification	No.	Rate	Amount
Pipers	9	{3 at $5.00 6 at 4.50}	$42.00
Drillers	2	4.50	9.00
Powdermen	1	4.50	4.50
Ditch walkers	4	4.00	16.00
Flume men	6	4.00	24.00
Dragline operators	3	6.00	18.00
Blacksmiths	1	4.75	4.75
Electricians and mechanics .	1	5.00	5.00
Rock men	6	4.00	24.00
Foremen	1	7.00	7.00
	34		154.25

The flume men keep the sluices from becoming congested with large rocks. The rock men help extend the sluices, repair roads, and do other miscellaneous jobs.

After the piping season, several men are kept on to clean bedrock and make the cleanup from the sluice boxes. Beginning in September, about 15 men are put back to work at cleaning the ditches and making the necessary repairs and changes for the next season's operations. This job requires from 60 to 90 days.

Unfortunately, costs for this operation were not available. The largest single item of expense is the labor costs during the piping season. This can be quite closely estimated from the payroll. There are other important costs, however, that cannot be estimated and on which no information was available. The principal of these are the labor costs of cleaning and repairing ditches, labor costs of making clean-up, and costs of supplies such as gasoline, fuel oil, explosives, and lumber.

The clean-up in 1937 was 900 fine ounces. About 200,000 yards of material was run through the sluice boxes, making a recovered value of 15.75 cents per yard.

Placerville Unit

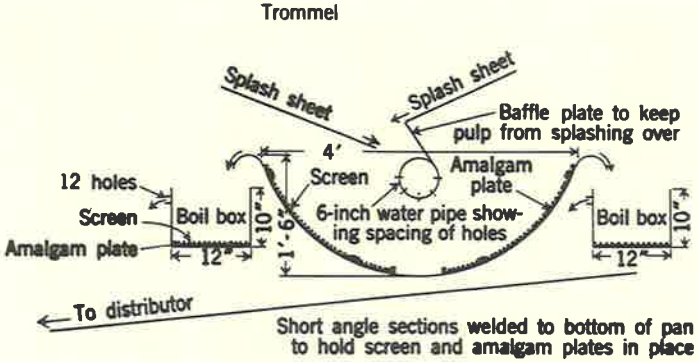
This property consists of several unpatented claims about a mile southeast of the town of Placerville (fig. 5). The water supply is from Granite Creek and West Fork. Nine miles of ditch and 3,000 feet of 15-inch pipe constitute the water supply system. The head at the workings is from 70 to 75 feet.

The workings are in Neocene stream gravels from 20 to 35 feet in depth. The bedrock is quite flat. In the east part of the pit it consists of clay and in the west part of granite. The gravel is loosely consolidated and can be cut with a jet of water under a comparatively low head.

The workings consist of a pit about 400 feet long by about 150 feet wide. They are served by two sluice boxes - one on the east and one on the west end of the pit. In 1937, only the one on the west end of the pit was used. Deep channels are cut in the bedrock to provide enough grade for washing the material from the working face to the sluice boxes. These channels were made by first blasting and then piping out the loose material with giants.

Sluice boxes are 32 inches wide by 24 inches deep and are set at a grade of 6 to 8 inches in 12 feet. Mercury is added at the head of the sluice at the rate of about 0.75 pound every 3 days.

Two giants are used when there is enough water. For about half of the 1937 season there was enough water for only one giant with a 4-inch nozzle. When one giant is used, operations are carried on with 7 men - three on day shift, two on afternoon, and two on night shift. The day shift moves



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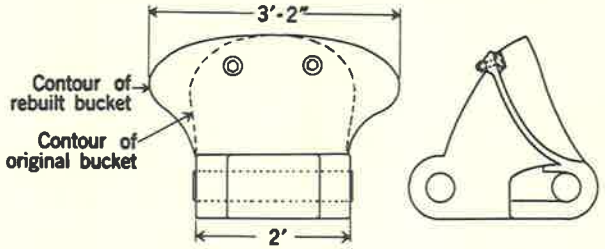
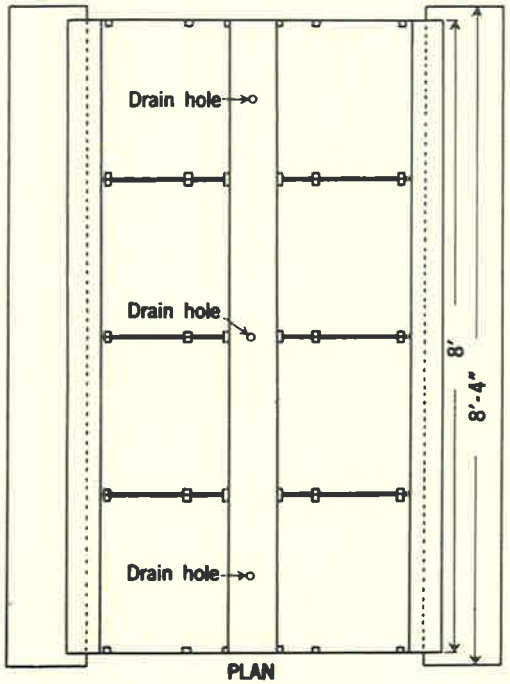


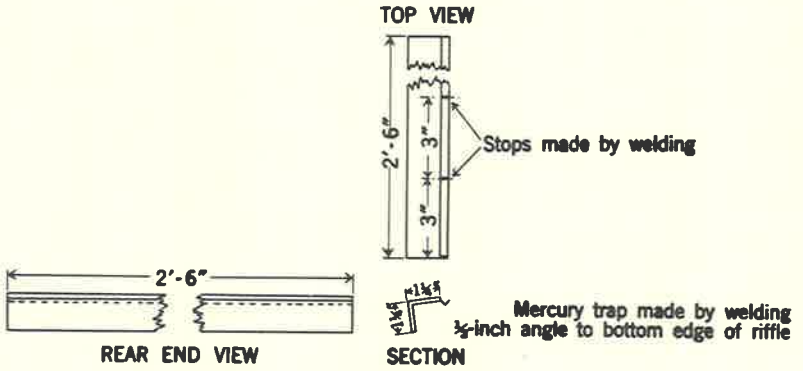
REAR END VIEW SIDE VIEW

GENERAL VIEWS OF REBUILT BUCKET



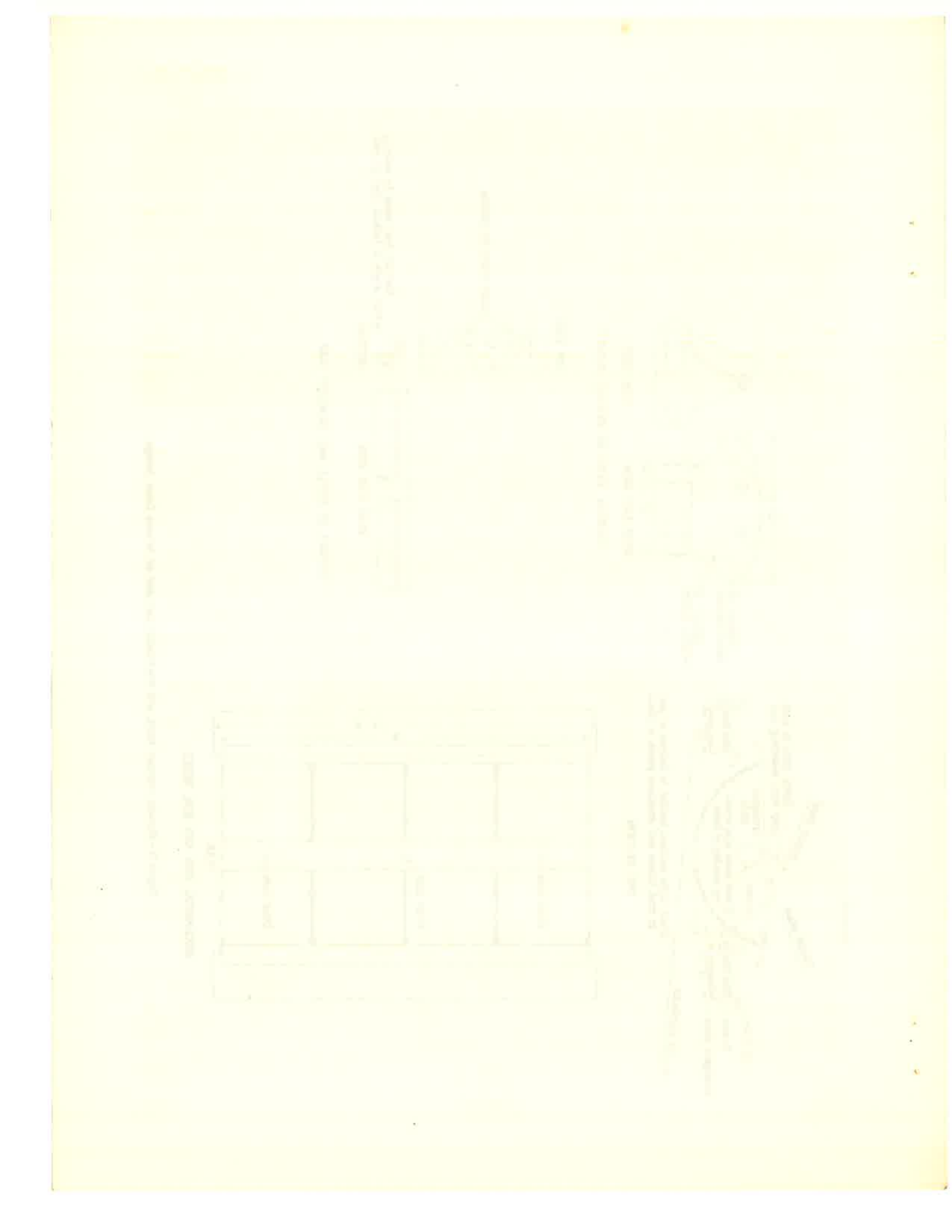
PLAN

MECHANICAL PAN AND BOIL BOXES



DETAILS OF RIFFLE AND MERCURY TRAP

Figure 9.—Buckets, mercury traps, and mechanical pan used on Moores Creek dredge.



the giants and makes the necessary lighting arrangements for the afternoon and night shift. Boulders are piled by hand.

Moores Creek Dredging Co.

The property on which the Moores Creek Dredging Co. is operating consists of 640 acres of patented and 140 acres of unpatented land extending along Moores Creek from about 3 miles below Warm Springs to about 2 miles above Idaho City. There is also a 40-acre tract on Elk Creek. All of the ground is held under lease and option. One dredge has been working for the past 3 years on Moores Creek just below Warm Springs.

The creek bottom where the dredge was operating in 1937 is 300 to 700 feet wide and averages around 400 feet. The depth of the gravel ranges from 7 to 18 feet. In the narrowest canyons there are a great many boulders 2 feet in diameter or larger. In the wider parts of the creek bottom, however, there are very few boulders of this size, and only 15 to 20 as large as 1 foot in diameter are found in a day's dredging. The bedrock is decomposed granite and in most places is quite soft. Nearly all of the ground above Warm Springs was worked by hand methods many years ago and was later dredged. Below Warm Springs, where the dredge is working, the ground was worked over by hand methods only. Much of the gold is in the form of amalgam that was lost by the old timers. It is distributed quite uniformly from the surface to bedrock. The ground is covered by a moderately heavy growth of brush and second-growth timber. The dredge is operating upstream and is dredging the full width of the creek bottom. Operating time averages about 23 hours a day.

A steel spud is used for dredging and one of timber for making the step ahead. The spud lines and the stern cables are 3/4-inch; the ladder line and the bow cables 7/8-inch. Normally, a 6-foot cut is taken with a 75-foot sweep. The dredge is capable of making a sweep of 125 feet, but in shallow ground 75 feet is more satisfactory.

The dredge is of timber construction. The bucket line consists of 68 eight-foot buckets operated at a speed of 19 per minute. The actual operating capacity of the dredge is 5,000 cubic yards a day. The buckets originally had a capacity of 5 cubic feet. Later, they were redesigned by the dredgemaster, J. D. Smith of Idaho City, and the capacity increased to 8 cubic feet. The bodies of the redesigned buckets are the same as those of the original buckets from which they were built, but the lips extend 7 inches beyond the ends of the pins (fig. 9). The purpose of the new design is to eliminate wear on the lower tumbler when crowding into the bank in making a cut. The gravel from the buckets goes through a 20- by 6-foot trommel with 3/8-inch perforations, except the last section, which has 1/2-inch holes. The undersize from the trommel goes into a mechanically operated rocking pan 8 feet long by 4 feet wide by 18 inches deep (fig. 9). The pan is rocked by a cam and lever arrangement at a rate of 60 oscillations per minute. The motion is about 2-1/2 inches.

The overflow or discharge from the rocker pan goes into two boil boxes 1 foot wide by 10 inches deep by 8 feet 4 inches long. From the boil boxes the material goes over a 6- by 8-1/2-foot sheet into a distributor with riffles and then to twelve 30-inch by 40-foot sluices (6 on each side) with Hungarian riffles. Water is added at the trommel and the rocker pan; mercury at the rocker pan and the head of the riffles at the rate of 6 to 8 pounds a day.

Each side of the bottom of the rocker pan is provided with four amalgam plates over which are screens held in place by short sections of angle irons welded to the bottom of the pan (fig. 9). Water is added at the rocker pan through a 6-inch pipe perforated with five lines of 1/2-inch holes spaced about 1 foot apart. An eighth-inch space is left at the bottom of the pan between the two sets of amalgam plates. A number of holes in this space provide a means of draining excess water from the pan when making the clean-up.

The riffles in the distributor are 1-1/4- by 8-inch; those in sluices are 1-1/4- by 30-inch. About every fourth riffle is provided with a mercury trap made by welding a 1/4-inch angle to the under side of the top of the riffle (fig. 9). These traps are made with stops every 3 inches to prevent the mercury from running out when the dredge rocks.

Clean-ups are made every two weeks. Each clean-up requires a little less than a shift. About 70 percent of the total recovery is made at the rocker pan.

Electric power is purchased from the Grimes Pass Power Co. Connected horsepower is as follows:

	Horsepower
Bucket line	150
High-pressure pumps	50
Low-pressure pumps	40
Winch	35
Slacker	20
Welder	15
Trommel screen	35
Total	345

Labor required to operate the dredge three shifts a day is as follows:

1 dredgemaster	Salary	
Winchmen	3 at 75 cents per hour	$18.00
Oilers	6 at 55 cents per hour	26.40
Shoremen	1 at 50 cents per hour	4.00
Shoremen	1 at 62-1/2 cents per hour.	5.00
Total		53.40

Grimes Co.

The Grimes Co. has a bond and lease on several placer claims covering the stream placer deposits on Grimes Creek in the vicinity of Pioneerville.

General conditions along this part of Grimes Creek are much the same as at New Centerville, where the Centerville dredge is operating. The creek bottom ranges in width from about 300 to 600 feet. The gravel is about 20 feet deep, with a very small percentage of large material. Available dredging ground is more limited than at the other dredges in the area. Much of the adjacent ground to the south has already been dredged, and to the north the gravel is too shallow for operation of a bucket-line dredge.

Dredging has been conducted during the greater part of 1936 and 1937. The dredge is of the bucket-line type, with a capacity of about 2,000 yards a day.

H. F. England & Co.

During the summer and fall of 1937, H. F. England & Co. of Oroville, Calif., built two dragline washing plants in Boise Basin - one on Grimes Creek above Pioneerville and one on a tributary of Fall Creek west of the town of Granite.

Above Pioneerville, where the smaller of the two plants is operated, the stream gravels are 75 to 100 feet wide and 6 to 8 feet deep, with very little overburden. A comparatively heavy growth of brush and second-growth evergreen was cleared with a Diesel caterpillar tractor equipped with a blade. The deposits were worked by hand by the old timers, which probably accounts for the small amount of overburden.

The washing plant is built on steel pontoons. It consists of a 4-foot-diameter trommel built in four sections and perforated with 3/8-inch holes; and tables are lined with carpets and metal lath. All machinery is driven from a line shaft by a Diesel engine.

Excavating is done with a 1-yard dragline operated with Diesel power. Very little stripping has been necessary since operations began. At the lower end of the property where the operations began, there were comparatively few boulders over 1 foot in diameter. At the upper end, however, where the plant was working in October 1937, there were considerably more boulders than farther down.

In 3 months the plant advanced about 1 mile up Grimes Creek and excavated and treated 75,000 to 85,000 yards of material.

The Fall Creek plant is operating on a south tributary to Fall Creek west of the twon of Granite. According to Lindgren, the deposits in this vicinity are bench placers and Neocene stream placers (fig. 5). Similar deposits at the head of Fall Creek were successfully dredged with a bucketline dredge by E. F. Blain a number of years ago.

The gravel is about 15 feet deep and is covered with 5 feet of top soil that is stripped and piled at the sides; it is more firmly consolidated than the stream gravels of the area and has proved to be more difficult to excavate. The ground is covered with a moderately heavy growth of brush, which is cleared away with a Diesel-powered caterpillar tractor.

The washing plant is erected on six 8- by 36- by 3-1/2-foot steel pontoons. The pontoons were built at the property from 3/16-inch sheet steel. The trommel is 35 feet long by 5 feet in diameter and perforated with 3/8-inch holes. It is built in ten 3-foot sections, each section having the perforations spaced differently to give an even distribution of the material on the tables. There are 10 tables on each side, lined with Brussels carpet under expanded metal. Hungarian riffles were tried when the plant was first built but were found less satisfactory than the carpet and expanded metal. Boulders up to 3 feet in diameter are rejected at a grizzly and dumped over the side by a mechanism especially designed for that purpose.

Power is furnished by a Diesel electric generating plant installed on the boat. The plant consists of a 100-kilowatt generator powered by a 160-horsepower caterpillar Diesel engine. An individual motor is used for operating each unit. The motor rating for each unit is as follows:

	Horsepower
Trommel	30
10-inch centrifugal pump	50
5-inch centrifugal pump	15
Stacker	15
Sand elevators	5
Rock chute mechanism	3
Total	118

Excavating is done with a 3-yard Diesel-powered dragline with a 65-foot boom. When operating at maximum speed it can deliver around 6 yards of material to the hopper every 50 seconds. Actual operating capacity, however, averages about 75 yards an hour. Mr. England thought that this might be greatly increased as soon as a more definite routine could be developed in operating.

The labor required to operate the plant three shifts a day is as follows: 3 dragline operators, 3 washing-plant operators, 3 oilers, 2 shoremen, 1 dredgemaster. The shoremen do the clearing and other miscellaneous jobs.

At the time of the visit in October 1937, the plant had been in operation about 2 weeks. Metallurgical and cost data were not available.

Antonson Mining Co.

The property of the Antonson Mining Co. is on the south side of Moores Creek just south of Idaho City. The workings are in the irregular bench

placer deposits that border on the stream gravels on the south side of Moores Creek (fig. 3). The thickness of the gravel at the workings ranges from 10 to 25 feet. The bedrock is clay that slopes steeply toward Moores Creek.

In 1936, several miles of old ditch were repaired and about 400 feet of flume was built. Piping operations began in April 1937. Two giants with 3-inch nozzles were operated during the greater part of the season, which was cut short in June because of the lack of enough water supply. Several thousand yards of material were treated.

Lightfoot Proposed Ditches

In the spring and summer of 1937, E. Lightfoot and associates had completed preliminary plans for building ditches, flumes, and tunnels for taking water from the head of Grimes Creek and from some of the tributaries of Granite and Wolf Creeks for hydraulicking in the vicinity of Pioneerville, Centerville, Placerville, and Granite. The purpose of the project was to buy, lease, and operate placer properties and to lease water to small operators.

From Grimes Creek to Muddy Creek the ditch is to follow the grade line of the old Wilson ditch, built in 1870 but since demolished. From Muddy Creek to Ophir Creek the grade line of the old Robinson ditch is to be followed, and from Ophir Creek to Placerville the Reed ditch will be used. Grimes Creek is the principal source of supply, but Muddy Creek and Ophir Creek also furnish appreciable amounts, especially during the run-off season. The flow of Grimes Creek at the ditch head gate is 300 to 400 miner's inches during August and September when the water is lowest, and up to 2,000 to 2,500 miner's inches during the flood season.

In October 1937 the flume at Grimes Pass was rebuilt, and several miles of ditch were completed. From the head of the ditch on Grimes Creek to Ophir Creek is about 20 miles along the ditch lines of the Wilson and Robinson ditches. From 2,500 to 3,500 feet of additional flumes will have to be rebuilt, and three tunnels, 200, 300, and 400 feet long, will have to be reopened before the project is completed.

This project would serve a large acreage of bench, residual, and Neocene stream gravels in the Grimes Creek and Granite Creek Basins, and if completed it would probably bring many small properties into production that had been idle for many years. There are many deposits above the ditches and some below that could not be worked economically because of the lack of a sufficient head.

CONCLUSION

Boise Basin is the most productive placer-mining area of Idaho, and with the exception of the Florence district in Idaho County it has probably been the most thoroughly exploited. Of the $56,000,000 total gold production of Boise County, it is safe to say that at least $52,000,000 was from the placer and lode mines of Boise Basin. There is no record of lode-mine production

prior to 1903. From that time to the present, however, the production from this source has been $4,598,000. The total value of all the gold produced by lode mines from the first discoveries in 1863 to the present is probably not more than $7,000,000. From this it appears that at least $45,000,000 was produced from placering operations in Boise Basin.

The placer-mining area of Boise Basin is relatively small, over 75 percent being included in three townships. Most of the larger and easily accessible deposits were worked many years ago. Suitable ground for large-scale dredging operations consists mostly of stream deposits that were worked imperfectly by hand methods by the old timers. Nearly all of this class of ground is owned or controlled by three large companies and will be depleted in 2 to 5 years. A few virgin stream deposits suitable for dragline plants or small dredges are still available. The small irregular deposits along lower Moores Creek might possibly be worked successfully with a dragline plant. The deposits on Summit Flat along upper Gaines Creek seem to have commercial possibilities and could probably be worked with a small bucket dredge.

High-level gravels have been less thoroughly worked than the stream deposits of the area. Unworked deposits of this class suitable for hydraulicking are available in the vicinity of Centerville, Pioneerville, and Placerville. They are mostly on land that is patented or held by location by small interests, but could probably be obtained on a leasing basis.

From most of the deposits being hydraulicked at present, it appears that the high-level gravels run from 10 to 20 cents a cubic yard and some as high as 25 cents a cubic yard. There is a large enough water supply in the creeks for conducting operations 2-1/2 to 3 months a year. Lack of sufficient capital for buildings, ditches, flumes, and pipe lines seems to be the principal reason why many of the small properties are idle.

The basalt-covered gravels of lower Moores Creek might be said to have commercial possibilities. There is little precedent, however, upon which to base conclusions as to their economic potentialities. Deposits of this same general type have been worked intensively in California9/. The California deposits are much higher grade than the Moores Creek deposits and therefore cannot be used as a basis for comparison. Operating conditions, however, are more favorable on Moores Creek.

The Garden Valley, South Fork Payette River, and other placer-mining districts of Boise County seem to hold little promise of ever developing into centers of large production. The deposits in these districts are, for the most part, small, low-grade, and scattered.

The most favorable outlook for the future of the county lies in Boise Basin and depends upon the development of better hydraulicking practice and a more extended use of small dredges and dragline plants.

9/ Gardner, E. D., and Johnson, C. H., Placer Mining in the Western United States. Part III. Dredging and Other Forms of Mechanical Handling of Gravel and Drift Mining: Inf. Circ. 6788, Bureau of Mines, 1935, 81 pp.

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