NOTES ON THE FINE GOLD OF SNAKE RIVER, IDAHO.

By J. M. Hill.

INTRODUCTION.

The material contained in this paper is largely a compilation from various sources, but is in part based on the writer's examinations of gravels in the Fort Hall Bottoms, near Fort Hall, Bingham County, Idaho, and near Moran, Lincoln County, Wyo. Its presentation at this time is thought to be warranted by a constantly increasing demand for information concerning the occurrence and recovery of the fine gold of Snake River. This short paper will probably be supplemented as the result of further studies which the writer expects to make in the preparation of a report on the placer deposits of the United States. The larger work will require considerable time for its completion and, with the cooperation of the Bureau of Mines, will include much more detailed information on the technology of placer mining than would be possible for a geologist to incorporate in a report.

BIBLIOGRAPHY.

Much of the material in this paper has been obtained from the publications listed below, which should be consulted by anyone desiring more detailed information concerning the gravels of Snake River.

Bancroft, H. H., History of Washington, Idaho, and Montana: Works, vol. 31, 1890. Mentions (p. 233) discovery of gold in Caribou district and says (pp. 531–534) that though gold was known in the gravels of Snake River prior to 1871, it was not until that year that any attempt was made to extract the gold.

Bell, R. N., Dredging for fine gold in Idaho: Eng. and Min. Jour., vol. 72, pp. 241–242, 1902; Idaho Mine Inspector, Eighth Ann. Rept., pp. 112–117, 1906. Describes construction of dredge.

——— The origin of the fine gold of the Snake: Eng. and Min. Jour., vol. 73, pp. 143–144, 1902. Supports Turner's suggestion that the fine gold of the Snake was deposited from the waters of a Miocene lake, and describes gold as occurring in small flakes, many of them cup shaped and coated with silica, of which 1,000 to 2,000 are necessary to make 1 cent. The rich gravels occur near the surface or in thin lenses of cemented sand and gravel.

Bradley, F. H., U. S. Geol. Survey Terr. Sixth Ann. Rept., pp. 250–271, 1873. Describes exploration of the headwaters of Snake River along Henrys Fork and Teton River and in Jackson Hole and the southern part of Yellowstone Park. Mentions early placer operations in Jackson Hole.

DAY, D. T., and RICHARDS, R. H., Investigations of black sands from placer mines: U. S. Geol. Survey Bull. 285, pp. 150–163, 1906. Give preliminary results of tests made at Portland Exposition.

——— ——— Black sands of the Pacific slope: U. S. Geol. Survey Mineral Resources, 1905, pp. 1175–1258, 1906. Give final results of tests at Portland Exposition and show by tables the minerals contained in black sands. Give results of experiments on the separation of gold and platinum from such sands.

EGLESTON, THOMAS, The treatment of fine gold in the sands of Snake River, Idaho: Am. Inst. Min. Eng. Trans., vol. 18, pp. 597–609, 1889. Gives a very good description of the construction and operation of the burlap table machine.

IDAHO INSPECTOR OF MINES, Annual reports, 1899 to 1913. Notes on the occurrence and methods of working the fine auriferous gravels of Snake River.

IDDINGS, J. P., WEED, W. H., and HAGUE, ARNOLD, Geology of the Yellowstone National Park: U. S. Geol. Survey Mon. 32, pt. 2, pp. 184–189, 1899. Describe geology of the headwaters of Snake River and state that "It is quite likely that this gold [in Snake River and Pacific Creek] has in great part been derived from the conglomerate of the Pinyon (Eocene) formation."

IRVINE, C. B., Fine gold of Snake River: Min. World, vol. 29, p. 916, 1908. Notes fineness and high quality of Snake River gold, also its peculiar cupped flakes.

LINDGREN, WALDEMAR, The mining districts of the Idaho Basin and Boise Ridge, Idaho: U. S. Geol. Survey Eighteenth Ann. Rept., pt. 3, pp. 625–637, 1898. Discusses geology of lower Snake River valley and shows the existence of a Miocene [Eocene?] fresh-water lake in which the Payette formation was deposited. Considers that flows of basalt took place in Pliocene and Pleistocene time.

——— The gold belt of the Blue Mountains, Oreg.: U. S. Geol. Survey Twenty-second Ann. Rept., pt. 2, pp. 759–762, 1901. Mentions occurrence of gold in the gravels of Snake River between Idaho and Oregon and quotes W. H. Washburn at length on the distribution of gold.

MAGUIRE, DON, Snake River gold fields: Mines and Minerals, vol. 20, pp. 56–58, 1899. Notes that South Fork of Snake River is principal source of gold above Boise River, and estimates that gravels contain at least $2,000,000,000 in gold. Says that large operations have not as a rule proved successful, but that skim-bar miners average from $1 to $4 a day with rockers.

MINERAL RESOURCES OF THE UNITED STATES, published annually by U. S. Geol. Survey. The reports from 1902 to 1913 inclusive contain brief notes on the developments along Snake River and give production of gold from the various counties along the river's course.

POWELL, F., Gold dredging on Snake River in Idaho: Eng. and Min. Jour., vol. 70, pp. 395–396, 1900. Notes that highest gold content is confined to gravels for a few inches near the surface, and that tenor diminishes with depth. Describes the dredge used.

RUSSELL, I. C., Geology and water resources of the Snake River Plains of Idaho: U. S. Geol. Survey Bull. 199, 1902. Describes the geology of the lavas of the Snake River Plains between the Teton and Sawtooth mountains.

SCHULTZ, A. R., Gold developments in central Uinta County, Wyo., and at other points on Snake River: U. S. Geol. Survey Bull. 315, pp. 71–88, 1907. Describes occurrence of gold and methods of working gravels at the south end of Jackson Hole, Wyo., and other points on Snake River, particularly in that portion of the river between Minidoka and American Falls, which was partly submerged by the Minidoka reservoir.

——— Geology and geography of a portion of Lincoln County, Wyo.: U. S. Geol. Survey Bull. 543, pp. 122–129, 1914. Describes placer mines at Pine Bar and Davis diggings, at south end of Jackson Hole.

SCHULTZ, A. R., and RICHARDS, R. W., A geologic reconnaissance in southeastern Idaho: U. S. Geol. Survey Bull. 530, pp. 267–282, 1913. Describes lode and placer deposits of the Caribou district, in the southeastern part of Bonneville County, Idaho.

SHOCKLEY, J. H., The origin of the fine gold in Snake River, Idaho: Eng. and Min. Jour., vol. 73, pp. 280–281, 1902. From examination of gravels of Snake River in Jackson Hole decided that gold came for the most part from the breaking down of auriferous pyrite similar to that found in andesitic bowlders. Says that all gravels carry gold but that bars with most sand carry largest amount.

ST. JOHN, ORESTES, U. S. Geol. and Geog. Survey Terr. Eleventh Ann. Rept., pt. 1, pp. 321–474, 1883. Describes exploration of part of upper Snake River basin, the Caribou district, and notes placer workings in Snake River canyon that were worked in 1875.

WASHBURN, W. H., Gold in Snake River gravel bars: Min. and Sci. Press, vol. 81, p. 610, 1900. Notes that gold is most abundant at head ends of bars deposited along short or inner sides of curves, and that these bars are enriched by every flood of river; that the top layer of gravels is richest; and that bedrock concentration is not usual. Mentions the fact that above Boise River 1,200 colors are worth 1 cent, but below Boise River it takes only 900 colors to make 1 cent, also that the gold above the mouth of Boise River is worth from $17 to $19 an ounce, while below it runs from $14 to $16 an ounce.

HISTORY.

There is no mention of the existence of gold in the gravels of Snake River in any of the reports of early explorations in this country. Different parties of the United States Geological and Geographical Survey of the Territories, under F. V. Hayden, visited Snake River. In 1871 Bradley[1] visited the headwaters and reported that as early as 1862 prospectors were trying to extract gold from the gravels of Snake River in Jackson Hole. Bradley says:[2]

> A considerable excitement was stirred up a few years since by reported discoveries of placer gold in large quantities on the upper Snake, and many prospectors visited this region. A small hydraulic operation was undertaken near this point, but the gold was too fine and in too small quantities to pay, and the whole region was entirely abandoned after a few months. The coarse gold found on the lower part of the Snake appears to have entered the river below the canyon, which is still to the southward of us.
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> Two or three miles below the mouth of Salt River a small stream from the west (entering Snake River near the mouth of the canyon) was thick with mud from the Caribou gold washings.

In 1877 St. John[3] found "on the terraced interval [in the upper canyon of Snake River] indications of old placer workings which had been opened eight years ago [1875] by a party of miners associated with Jeff Stantiford, a well-known prospector and explorer of this region. The enterprise was, however, interfered with by the Indians,

[1] Bradley, F. H., Report of Snake River division: U. S. Geol. and Geog. Survey Terr. Sixth Ann. Rept., for 1871, pp. 190–250, 1872.

[2] Idem, pp. 266, 269.

[3] St. John, Orestes, U. S. Geol. and Geog. Survey Terr. Twelfth Ann. Rept., pt. 1, p. 196, 1883.

since when no organized mining operations have been resumed in this quarter."

According to Bancroft,[1] though flour gold was known to exist in considerable quantities in Snake River, it was not until 1871 that experiments were made toward its recovery. He says that paying quantities of gold were found—

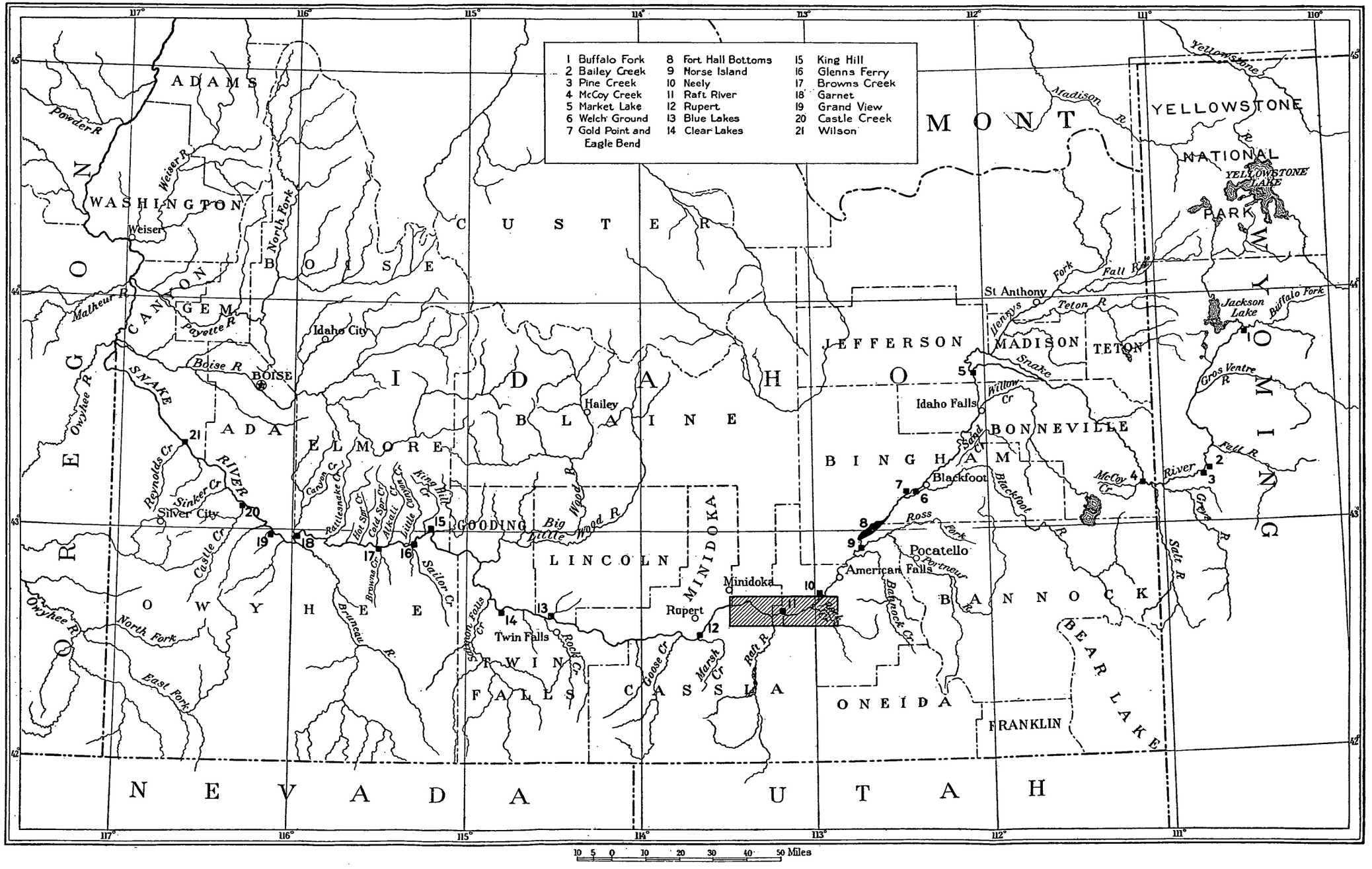
on the gravel bars in the vicinity of the Great Falls, at the mouth of Raft River, Henrys Ferry [between the mouths of Bruneau River and Castle Creek], and the mouth of Catherine Creek. * * * In 1871 and 1872 several mining camps or towns sprang up along the river. Thousands of ounces of gold dust of the very finest quality were taken from the gravels in their neighborhood in these two years. The placers, however, were quickly exhausted on the lower bars, the implements in use failing to save any but the coarsest particles. 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 appliances for mining them and saving the gold, which enabled operators to work the high bars which for hundreds of miles are gold bearing.

According to Bancroft, the cost of opening a claim was about $5,000 and the returns from $10 to $50 a day; $5,000 to $10,000 in gold could be won from an acre of ground by gold-saving machines and amalgamators. He proposes the use of long ditches to supply water for the placers, as well as for irrigation. He says that on the Idaho Snake River Gold Mining Co.'s land in Black Canyon some rich ground yielded $100 a day to the man working with rocker, copper plate, and some cyanide of potassium, while the average yield was $25 a day over 80 acres of gravel. The Lawrence & Holmes Co. claims, near Blackfoot, paid from $19 to $50 a day to the man. Lane & Co., near the mouth of Raft River, obtained $25 a day to the man, and Argyle & Co., near Fall Creek, $100 a day to the man. The best working seasons, according to Bancroft, are from the 1st of March till the middle of May, and from the 1st of September to the 1st of November.

For many years the gravels of Snake River have been intermittently worked at a large number of places, extending from Moran, Wyo. (Buffalo Fork), to the mouth of Boise River. (See Pl. VII.) None of the larger operations, so far as known, have met with marked financial success, though unquestionably some individuals have made a small amount of money.

Probably the most extensive workings on Snake River were in southern Idaho, in the vicinity of Rupert, Minidoka, and American Falls. Plate VIII (p. 278) shows the principal claims in this area, some of which were submerged in the reservoir formed by the building of the Minidoka dam.

[1] Bancroft, H. H., History of Washington, Idaho, and Montana: Works, vol. 31, pp. 529-535, 1890.



SKETCH MAP OF SOUTHERN IDAHO SHOWING MAIN TRIBUTARIES OF SNAKE RIVER AND PRINCIPAL LOCALITIES AT WHICH PLACER WORK HAS BEEN DONE.

SNAKE RIVER BASIN.

GENERAL FEATURES.

Snake River rises in Shoshone, Lewis, and Heart lakes, in the southern part of the Yellowstone National Park. It flows southward, through Jackson Lake and Jackson Hole, for about 100 miles. Its principal tributaries in this part of its course are Buffalo Fork and Gros Ventre River, which enter it from the east. A short distance south of Jackson Hole the stream turns west, and after passing the Idaho line its course changes to the northwest. (See Pl. VII.) Between Fall River and a point a short distance west of McCoy Creek the river flows through a canyon, and in this part of its course Greys River and Salt River enter it from the south. Near the boundary between Madison and Jefferson counties, Idaho, Snake River is joined by Henrys Fork, a tributary that heads near the Idaho, Montana, and Wyoming boundary line. The river here makes a sharp turn to the southwest and continues in this direction to Rock Creek, beyond the town of American Falls. In this part of its course it receives Willow Creek, Blackfoot and Portneuf rivers, and Bannock Creek from the east, but no streams enter it from the Snake River Plains, which border it on the west. From Rock Creek Snake River flows in a general westerly course to the mouth of Bruneau River, a considerable tributary from the south. From American Falls to Salmon Falls the Snake receives no large tributaries from the north, but on the south side there are a number of streams, among which are Rock Creek, Raft River, and Marsh, Goose, and Salmon Falls creeks. Big Wood River joins Snake River a short distance west of Gooding, and from that point westward the Snake, here intrenched in a deep, narrow canyon, receives more tributaries from the north, heading in the Sawtooth Mountains, than from the south. Beyond the mouth of Bruneau River Snake River turns northwestward and continues in that course to the Idaho line, which it reaches about 30 miles west of Boise. It forms the western boundary of Idaho as far north as Lewiston and from that point flows in a general westerly direction to Columbia River near Pasco, Wash.

From an inspection of Plate VII it will be seen that Snake River and its tributaries drain all of southern Idaho and portions of western Wyoming and northern Nevada. The area of the Snake River basin above the mouth of Rattlesnake Creek is 37,300 square miles.

WATER SUPPLY.

According to a recent Survey report [1]—

> Precipitation in the Snake River drainage area ranges from 6 or 8 inches in the valley to 50 inches at the head of many of the tributaries. In the higher altitudes the precipitation is practically all in the form of snow, but the snowfall in the lower

[1] U. S. Geol. Survey Water-Supply Paper 292, p. 287, 1913.

valleys below American Falls, Idaho, is comparatively light. * * * The temperature in these valleys ranges from 100° in the summer to 35° below zero in the winter.

The following tables showing the maximum, minimum, and mean discharge of Snake River at Moran, Wyo., and Blackfoot, Neely, and King Hill, Idaho, have been compiled from the Survey reports on the surface water supply of the North Pacific coast,[1] which give detailed information concerning the water resources of the Snake River basin:

Monthly discharge of Snake River at Moran, Wyo., and Blackfoot, Neely, and King Hill, Idaho.

Moran, Wyo.

[October, 1903, to September, 1911, inclusive.]

Month.	Discharge in second-feet.		
	Maximum.	Minimum.	Mean.
January [a]	1,070	374	654
February [b]	1,430	440	700
March	2,220	500	683
April	4,370	530	837
May	7,930	622	4,290
June	10,600	950	5,250
July	12,100	1,030	3,400
August	9,700	712	2,430
September	2,160	[c] 0	805
October	[c] 1,810	[c] 0	614
November	[d] 1,440	[e] 374	[d] 585
December	[d] 1,310	[e] 374	[d] 584

[a] Not including 1905 and 1907.
[b] Not including 1905.
[c] Not including 1910.
[d] Not including 1906.
[e] Not including 1906 and 1910.

Neely, Idaho.

[March, 1906, to September, 1911, inclusive.]

Month.	Discharge in second-feet.		
	Maximum.	Minimum.	Mean.
January	[a] 10,600	[b] 5,280	[c] 6,520
February [a]	12,800	5,270	6,460
March	15,600	4,140	7,540
April	29,900	5,460	11,000
May	33,000	10,500	19,000
June	41,100	6,130	25,600
July	37,200	3,470	14,100
August	13,900	2,220	5,930
September	11,100	3,450	6,070
October	8,870	4,270	6,480
November	13,200	5,050	7,030
December	[d] 7,590	[e] 5,320	6,650

[a] Not including 1910.
[b] Not including 1907, 1910, and 1911.
[c] Not including 1907 and 1910.
[d] Not including 1909.
[e] Not including 1908, 1909, and 1910.

Blackford, Idaho.

[June, 1910, to September, 1911, inclusive.]

Month.	Discharge in second-feet.		
	Maximum.	Minimum.	Mean.
January [a]	5,870	2,140	3,250
February [a]	7,270	2,270	3,870
March [a]	5,620	2,200	4,000
April [a]	9,450	3,610	4,960
May [a]	18,800	9,170	14,800
June	32,900	3,560	16,900
July	21,900	890	6,580
August	6,860	238	2,000
September	3,700	1,120	2,340
October [b]	2,900	1,570	2,430
November [b]	3,780	2,900	3,410
December [b]	3,870	2,270	3,230

[a] 1911 only. [b] 1910 only.

King Hill, Id aho.

[May, 1909, to September, 1911, inclusive.]

Month.	Discharge in second-feet.		
	Maximum.	Minimum.	Mean.
January	21,400	8,160	10,000
February	18,700	8,750	11,400
March	25,100	8,880	16,200
April	30,100	8,720	16,800
May	34,000	12,900	21,900
June	41,900	5,790	26,200
July	37,500	4,760	13,100
August	20,900	4,760	6,780
September	15,600	5,090	8,460
October	14,700	6,400	10,500
November	15,800	6,750	11,700
December	14,400	7,910	11,000

[1] U. S. Geol. Survey Water-Supply Papers 100, 135, 178, 214, 252, 272, 292, 312.

PLACER GRAVELS.

DISTRIBUTION.

The placer gold deposits along Snake River may be classed as stream placers and bench placers. The stream placers consist of bowlders, gravels, and sands that form bars, banks, fills, and shoals along the present streams. Many of these deposits are temporary and change more or less during every heavy storm. The bench placers are older stream deposits, at higher levels represented by terrace remnants.

At the mouth of Buffalo Fork (No. 1, Pl. VII) there are two distinct terraces 10 and 30 feet above the present channel. South of Jackson Hole examples of terrace formation are seen on both sides of Snake and Fall rivers, at wide points in the valley. At several places along Snake River above the canyon terraces occur 50 to 100 feet and even 200 feet above the river. The terraces slope gently toward the center of the valley and their slopes are strewn with waterworn rock fragments similar to the material found in the river bed. Many of the terraces along Fall River, extending back a quarter to half a mile from the present river channel, are paved with waterworn pebbles similar to the material found in the Snake River channel. Near the mouth of Fall River, where the stream cuts across two anticlines, gold was found in the sands accumulated near the water's edge. Whether gold occurs in the gravels farther up Fall River above the canyon and along its tributaries heading in the Gros Ventre Mountains is not known.

In the canyon between Greys River and McCoy Creek (No. 4, Pl. VII) there are several small gravel deposits both in the present channel and on rock-cut terraces.

At Market Lake (No. 5, Pl. VII), near the junction of Henrys Fork and Snake River, there are extensive bottoms. Terrace gravels about 15 feet above the present channel, as well as the gravels now at the stream level, have been worked in the past.

On both sides of Snake River near the mouth of Blackfoot River considerable gold has been won from terrace gravels on the Welch ground (No. 6) and the Gold Point and Eagle Bend ground (No. 7). On the Welch ground, east of the river, the gravel bank is 18 feet high, and no bedrock is exposed in the workings. It is said that a 75-foot well near the river cuts only gravels and sands. On the west side of the river the gravels, which rest upon basalt, range from a few inches to 12 feet in thickness. Several attempts to work the present stream gravels in this vicinity by the use of dredges and suction pumps have not been successful.

In the Fort Hall Bottoms and on Horse Island (Nos. 8 and 9, Pl. VII) some gold is won from "skim bar" diggings in the present

channel and from gravels occupying a terrace about 8 feet above the present level.

Between American Falls and the Minidoka dam there are a number of placer bars both in the stream channel and on terraces from 15 to 30 feet above the old water level. These bars have been productive, particularly Diamond Bar. As will be seen from an inspection of Plate VIII, part of the productive ground was submerged by the Minidoka reservoir. Between Burly and Milner there has been some placer work, but the backwaters from the Milner dam have submerged the bars, and no work has been done there recently.

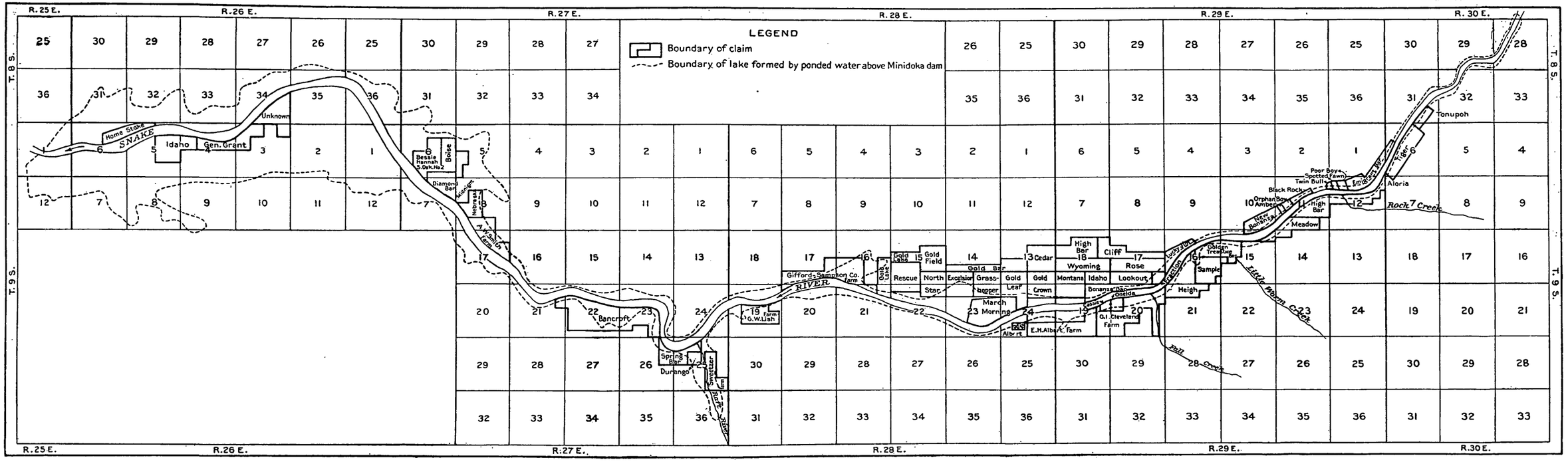
In the vicinity of Clear Lake and Blue Lake (Nos. 13 and 14, Pl. VII), north of Twin Falls, there are gold-bearing gravels, some of which are on terraces.

At King Hill and Glenns Ferry (Nos. 15 and 16) several attempts to dredge the present stream gravels have not proved financially successful. In the canyon between King Hill and Guffeys there are a number of bars that have been worked in the past. It is thought that most of these gravels are in the present stream channel, though little information is available concerning the operations on this part of Snake River.

CHARACTER.

The gravels of Snake River consist for the most part of white, cream-colored, and gray quartzite pebbles, with some pebbles of dark slates and a few of white quartz and red and gray flint. Pebbles of granular and fine-grained igneous rocks and schist occur in the Jackson Hole country and in less numbers along the lower part of the river. Small amounts of sandstone and limestone pebbles are found in the gravels below Gros Ventre River, and basalt pebbles are seen in the gravels below Henrys Fork. The sand accompanying the gravels is composed in the main of quartz grains and heavy minerals. In most places there are grains of a black sand that is light in weight and can be washed away from the heavy "black sands." This sand is apparently in part disintegrated basalt and in part volcanic glass lapilli. It is not found, so far as known, above Henrys Fork. The largest deposits of light-weight black sand are usually found beyond or on the downstream ends of the "skim bars."

The gravels are of two fairly distinct sizes and are more or less sorted. By far the greater in amount are the relatively coarse gravels, such as are most abundant in the present river channel. These are composed of well-worn ovoid to round pebbles, ranging in general from one-fourth inch to 4 inches in diameter and averaging 2 to 3 inches, but accompanied by a small percentage of larger bowlders and considerable light-colored sand. Lying in small lenses in the coarse gravels and on the tops of the high bars of the present Snake River channel are smaller deposits of fine gravels, whose peb-



MAP SHOWING LOCATION OF PLACER CLAIMS ALONG SNAKE RIVER IN THE VICINITY OF MINIDOKA, IDAHO.

bles range mostly from one-fourth to 1 inch in diameter, only a few pebbles reaching 2 inches. The fine gravels are everywhere mixed with a much larger quantity of heavy sands than the coarse gravels and carry more gold. These gravels are locally known as the "skim-bar" gravels. The terrace gravels contain lenses of fine gravels that are believed to be old skim-bar gravels. In some places they are cemented with a white to gray lime carbonate, but in others they are uncemented.

GOLD.

DISTRIBUTION.

Usually the soil covering the gravels is not gold bearing, though in the region of Minidoka and American Falls, according to Schultz,[1] "it was found that in general the values were concentrated in the bottom of the loam and the upper portion of the underlying gravels."

The gold is most often found in appreciable amounts in the gravels of the terrace and present stream deposits and is more abundant in the fine gravels, those averaging one-fourth to three-fourths of an inch in diameter, than in the coarser material.

The coarser gravels that are so widespread along the present channel of the Snake carry from a few to as many as 1,300 colors to the cubic yard. The gold is not equally distributed throughout the coarse gravels, either laterally or vertically. In fact, there seems to be a concentration of gold in the upper layers of the coarse gravels.

The most valuable gravels found along Snake River, comparable to skim-bar gravels, are much finer than the average material handled by the river. The pebbles range from one-fourth to 1 inch in size, but most of them are between one-fourth and three-fourths of an inch. With these gravels there is in all places a considerable quantity of black sand, a larger proportion than is found with the coarser gravels. The gold content of the skim-bar gravels is not equally distributed over the skim bar. The richest gravels are found in the outer edges of the bars, where the gravels "tail off," and to a depth of 6 to 8 inches only. The rich gravels consist of heavy particles carried, probably in suspension, by strong currents during high water and deposited at the edges of the higher bars, where eddies have retarded the currents or where the carrying capacity of the water is checked by the lessening of the depth of the channel. These relations will, perhaps, be better understood by reference to figure 16. All the material on the skim bars looks very much alike, and it is only by testing that the richest portions, those usually worked by the skim miners, can be determined. As will be seen from the sketch, the area of skim-bar gravels is small compared to the area of a bar.

[1] Schultz, A. R., Gold developments in central Uinta County, Wyo., and at other points on Snake River: U. S. Geol. Survey Bull. 315, p. 82, 1907.

Gold is present in the gravels found at various places on the high terraces. The gravels are essentially the same as the coarse gravels in the present river channel and carry as much gold. The lenses of fine gravel in the terraces, corresponding to the skim-bar gravels of the present stream, have been found to yield more gold than the coarse gravels. In some places where terrace gravels have been worked lime-cemented lenses that usually carry more gold than the average gravels have been found.

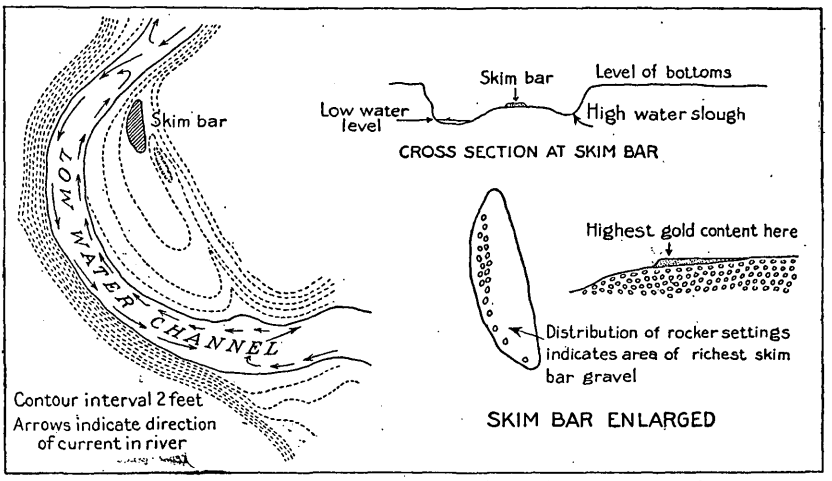


FIGURE 16.—Sketch showing relation of skim bar and distribution of gold in skim-bar gravels.

CHARACTER.

The Snake River gold is in minute particles, most of which are flat. The largest pieces are scarcely 0.01 inch in diameter, and the colors range from those of that size to some so small that the separate flakes can be distinguished only with a high-power microscope. The large flakes as a rule are somewhat cupped, apparently owing to the turning up of their edges by repeated knocks. This characteristic was noted in most of the colors separable by the eye. Most of the microscopic colors are flat, but some are rounded irregular grains.

Most of the gold has a bright-yellow color, but certain flakes appear red-brown in some lights. In part the color of the rusty gold appears to be due to a roughened surface, but some of the larger flakes of brown color have a thin coating of brown material that is probably iron hydroxide. Bell[1] reports that some of the gold is coated with a sugary incrustation of silica or other substance, which gives the flakes a light color.

The gold from Snake River is from 0.930 to 0. 951 fine and averages about 0.945, according to most reports. The particles are so small that it takes from 1,000 to 2,000 colors to be worth 1 cent.

[1] Bell, R. N., The origin of the fine gold of the Snake: Eng. and Min. Jour., vol. 73, pp. 143-144, 1902.

PRODUCTION.

It is impossible to ascertain the amount of gold obtained from the gravels of Snake River during the early years, as the figures for the output of Snake and Salmon or Boise rivers are combined in the reports of the Director of the Mint. Since 1902, according to statistics published by the United States Geological Survey, $149,315 in gold has been taken from Snake River above the mouth of Boise River. Of this recorded production, $29,658 was obtained from placers in Bingham County, $57,408 from Cassia County, $11,078 from Lincoln County, and $12,171 from Twin Falls County.

It is probable that these figures do not represent the total value of gold obtained from the gravels of Snake River, because of the great uncertainty as to the number of operators working these gravels. As is well known, much of the gold is obtained by rocking, and it is impossible to know of or hear from each person who may have worked the deposits for a few days or longer. It is thought that much of the gold obtained by these small operators is used to obtain supplies from merchants, and its source is lost sight of when the merchants turn it over to banks, assay offices, or the mint.

PLATINUM.

The experiments of David T. Day, then of the United States Geological Survey, at Portland, Oreg., on the heavy placer concentrates of the Pacific slope, to determine their value in other metals and minerals besides gold, included a number of samples of Snake River concentrates, nearly all of which yielded from a trace to an appreciable amount of platinum, but it is doubtful whether many of the results were obtained from representative samples. The platinum is probably too thinly scattered along this stream to be of much value, though it may be combined with the concentrates and have largely passed unnoticed.

Bell [1] reports that one sample of Snake River concentrates which yielded 0.018 ounce of platinum and several hundred dollars' worth of gold to the ton was obtained from a burlap table and probably represented a concentration of several thousand to one. A sample of concentrates taken from the same deposit, from which the free gold had been amalgamated, yielded only $3 in gold and a trace of platinum to the ton.

That platinum in metallic form is associated with the gold in the gravels can not be questioned, for although it can rarely be seen in panning it invariably shows in cleaning amalgam. In the operation of the Sweetzer-Burroughs dredge near Minidoka it was always observed at clean-up time as ashy gray metallic particles which

[1] Bell, R. N., Eighth annual report on the mining industry of Idaho, for 1907, p. 115.

floated when the amalgam was thinned with quicksilver for the purpose of separating foreign matter from the gold. A quarter of an ounce of clean platinum recovered in this manner is now in the possession of Lewis Sweetzer, of Rupert, Idaho. It is perfectly clean gray metal in scaly particles about as minute as those of gold.[1]

HEAVY MINERALS.

The results of the tests made by David T. Day on concentrates from placer gravels were published in 1906.[2] The following table, compiled from Day's report, shows the minerals he obtained from Snake River concentrates:

[1] Schultz, A. R., Gold developments in central Uinta County, Wyo., and at other points on Snake River: U. S. Geol. Survey Bull. 315, p. 38, 1907.

[2] U. S. Geol. Survey Bull. 285, pp. 150-164, 1906; U. S. Geol. Survey Mineral Resources, 1905, pp. 1175-1246, 1906.

Heavy minerals in concentrates from gravels of Snake River.

[Pounds per ton, except gold and platinum, which are stated in dollars per ton.]

Locality.	Magnetite.	Chromite.	Ilmenite.	Garnet.	Hematite.	Olivine.	Monazite.	Limonite.	Zircon.	Quartz.	Unclassified.	Gold.	Platinum.	Remarks.
Bingham County:														
Rich	48	.....	64	10	.....	.....	.....	.....	16	.....	1,878	$25.10	.....	65 pounds to the cubic yard of gravel.
Otis	70	.....	36	.....	.....	.....	.....	.....	50	1,536	310	1.24	.....	Concentration not known.
Rich	290	.....	90	38	.....	.....	.....	.....	.....	1,448	132	61.02	.....	1½ pounds to the yard of gravel, ground sluice.
Blackfoot	1,118	.....	616	50	.....	.....	.....	.....	150	14	50	674.26	.....	35 pounds to the ton of gravel.
Do	726	.....	436	356	[a]152	.....	.....	.....	174	36	120	73.38	.....	Concentration not known.
Sand of Snake River	688	.....	138	.....	.....	.....	.....	.....	Trace.	614	560	405.55	$5.40	Do.
Do	864	.....	664	.....	.....	.....	.....	.....	112	200	136	33.07	21.00	1½ pounds to the ton of tailings, ground sluice.
Do	888	.....	112	.....	.....	.....	.....	.....	160	840	.....	62.63	.....	1 pound to the yard of gravel.
Do	1,032	.....	80	.....	40	.....	Trace.	.....	80	.....	768	1,154.37	.....	Concentration not known.
Blaine County:														
Snake River near Wapi	72	.....	39	17	.....	11	.....	.....	8	1,317	533	.71	.....	Not concentrated.
Lincoln County:														
Minidoka	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	5.37	.....	Wilfley concentrates.
Minidoka, Snake River	1	.....	Trace.	Trace.	[b]Trace.	.....	.....	.....	Trace.	.....	.....	.08	.....	Natural sand.
Minidoka	2	.....	Trace.	Trace.	[b]Trace.	.....	.....	.....	Trace.	.....	.....	.10	.....	Do.
Do	4	.....	Trace.	2	[b]Trace.	.....	.....	Trace.	Trace.	.....	.....	.13	.....	Do.
Do	8	.....	4	4	.....	.....	.....	.....	.....	.....	.....	1.45	.....	Do.
Do	Trace.	.....	Trace.	Trace.	.....	.....	8	.....	Trace.	.....	.....	.41	.....	Diaspore; 66 pounds of apatite.
Shoshone	174	15	.....	80	.....	.....	26	.....	46	1,441	.....	26.33	.....	50 pounds a day.
Snake River near Milner	1,976	.....	.....	.....	.....	.....	.....	.....	.....	.....	24	.....	None.	
Do	.....	.....	16	500	.....	.....	.....	.....	152	152	1,130	9.51	.....	30 pounds to the ton after amalgamation.
Do	100	.....	.....	.....	.....	.....	.....	.....	.....	.....	1,900	39.89	.....	20 pounds a day.
Near Wapi	Trace.	.....	Trace.	.....	.....	.....	.....	.....	.....	1,784	215	$0.31		Natural sand.
Oneida County:														
American Falls	48	.....	24	.....	.....	.....	.....	.....	.....	1,538	390	114.20	.....	Taken from sluice box.
Do	14	.....	4	2	.....	6	.....	.....	.....	1,488	488	.62	.....	Natural sand.
Do	9	2	.....	8	.....	18	.....	.....	.....	1,335	628	Trace.	.....	Natural sand, old river channel.
Owyhee County:														
Enterprise	648	.....	.....	.....	.....	.....	.....	.....	.....	.....	[c]1,352	.....	.....	6 pounds to the yard.
Oreana	1,344	.....	280	312	.....	.....	.....	.....	56	.....	.....	.....	.....	1 pound to the yard.
Do	32	.....	1,472	40	.....	.....	56	.....	.....	340	80	2.19	.....	Concentration not given.
Sand of Snake River	51	.....	9	6	.....	4	.....	.....	2	1,432	493	1.12	.....	Natural sand.
Do	48	.....	7	4	.....	6	.....	.....	1	884	.....	.98	.....	Do.

[a] Titaniferous.

[b] Includes hematite.

[c] Includes a little garnet.

METHODS OF MINING.

Along the course of Snake River can be seen the wrecks of numerous attempts to extract the fine gold from the gravels. The remains of dredges are seen here and there, and many more have been removed. Countless "process machines" have been tried on Snake River, but so far as known without success. Most of these "machines" have depended on amalgamation, but many different methods have been used to get the quicksilver and gold into contact.

The rocker and sluices are still used, and a sluice of special type, known as the burlap table, used also on some of the dredges, has proved one of the best appliances for saving the fine gold. (See fig. 17.) In working with burlap tables the main sluice leading from the working (A, fig. 17) is set at any convenient grade. Near the lower end is a section with a perforated steel bottom (B, fig. 17), which allows the fine heavy sands and gold to drop through to sluices set at right angles to the line of the main sluice. The transverse sluices (C, fig. 17) are in reality launders which deliver the sands to a series of burlap tables (E, fig. 17). Each burlap table is from 16 to 30 feet long and 3 or 4 feet wide. It is usually set at a grade of 1 inch to 12 inches, but the grade needs to be adjusted to meet different conditions. Most tables are built with two drops at least. The pulp from the launder sluices is fed to the burlap tables through adjustable openings (D, fig. 17), so that it flows over the table in a thin, even sheet. The heavy sands and gold are caught by the rough surface of the burlap, and the light sands run to waste. In some places the tailings are rerun. In operation the tables are cleaned as often as necessary, by taking up the burlaps and washing them in tubs of clear water. These concentrates, together with those washed from the bottom of the tables, are either placed in a grinding pan or revolving barrel, for treatment with quicksilver and weak cyanide solution, or cleaned with a rocker. The latter method, while attaining somewhat better results than the simple rocking of the gravels, is not efficient. In some of the burlap tables the first section of the table—that nearest the launder sluice—has a silver-plated copper bottom coated with quicksilver, for amalgamating the gold. In figure 17 six tables are shown on each side of the main sluice. The number of tables varies with different conditions. In some places all the tables are on one side of the main sluice. In fact, each operator has his particular design of table and method of handling the gravel.

Both suction-pump and bucket dredges have been used for lifting the gravels. Probably the most successful dredging operation on the river was the Sweetzer-Burroughs dredge, which was operated

30 miles west of Minidoka. The first dredge [1] built by this company, in 1894, was of the suction type, but the company later built a bucket dredge [2] having a capacity of 2,000 cubic yards a day. The concentrates from burlap tables were amalgamated in barrels. It

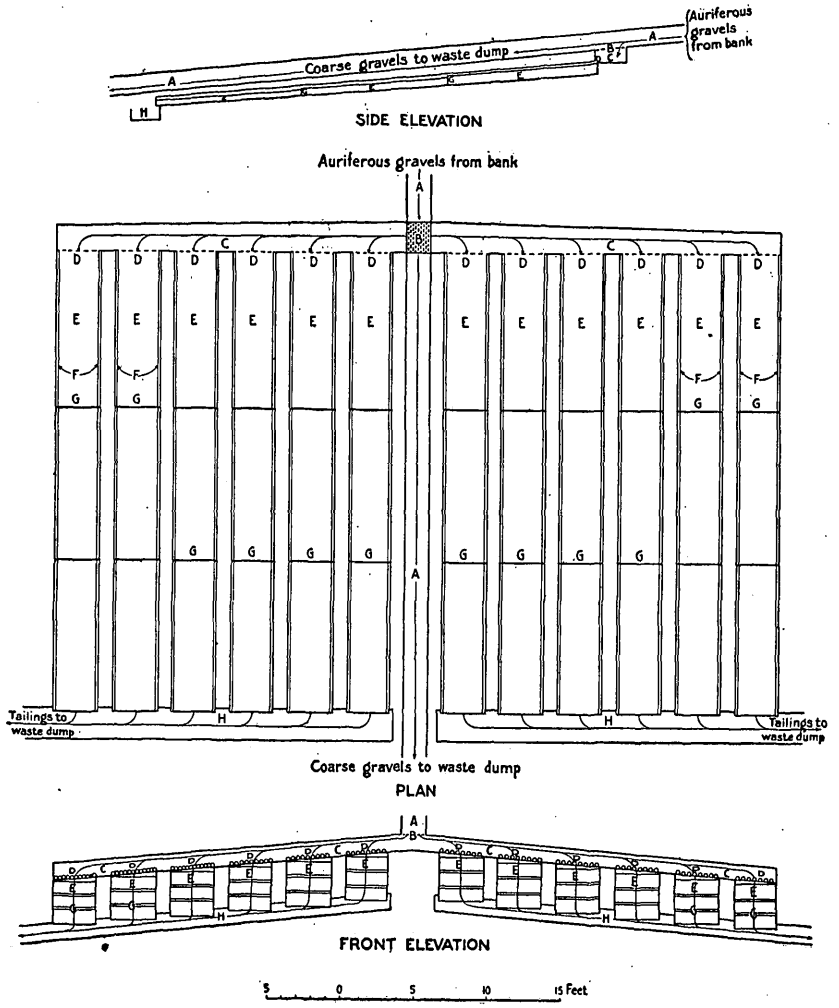


FIGURE 17.—Diagram of burlap table for saving fine gold.

is estimated that the cost of handling the gravels ranged from 4½ to 5½ cents a cubic yard.

Within the last few years experiments at cyaniding the gravels of Snake River, while not meeting with financial success, have at least showed that the method is not without some merit. At a plant located about 16 miles southwest of Blackfoot the gravels were

[1] Bell, R. N., Dredging for fine gold in Idaho: Idaho Inspector Mines Rept. for 1904, pp. 48–52, Min. and Sci. Press, vol. 94, pp. 542–543, 1907.

[2] Powell, F., Gold dredging on Snake River in Idaho: Eng. and Min. Jour., vol. 70, pp. 395–396, 1900.

screened through a $\frac{3}{16}$-inch mesh trommel. All the undersize was leached, and it is said that no difficulties were encountered in the leaching tanks.

TYPICAL LOCALITIES.

More detailed notes about some typical deposits of gravels are included in the hope that they may give a better understanding of the character of the deposits and the distribution of the gold. The numbers in parentheses refer to corresponding numbers on Plate VII.

BUFFALO FORK (No. 1).

Several placer claims were located along Snake River south of Buffalo Fork, at the north end of Jackson Hole, Lincoln County, Wyo., in 1905. These claims are between Elk and Moran post offices and cover low terraces on the east side of Snake River, in the southwest quarter of T. 45 N., R. 114 W., and the north half of T. 44 N., R. 114 W., of the sixth principal meridian.

In this locality there are two well-marked terraces above the present channel of Snake River. The first terrace is 10 feet and the second 30 feet above water level. The upper terrace is covered with 2 to 6 feet of sandy loam, which overlies 6 to 8 feet of gravel, which in turn rests upon a stratum of clay extending below the level of the lower terrace. In the sandy loam a color of gold is found here and there, but the gravels contain more gold. A series of tests of these gravels, made by the writer in 1908, show the average value of the gravels of the upper terrace to be less than 1 cent a yard, though in places, particularly just above the clay, the gravels carry more gold.

In the lower terrace gravels similar to those in the present channel are found throughout to the level of the river. They contain more gold to the yard than the gravels of the upper terrace, averaging about 2½ cents, but in places carrying as much as 5 cents a yard.

Skim bars, some of which have been worked, are present on the upper ends of the high-water bars in the present channel.

A small quantity of the gravel of the upper terrace has been worked by sluicing, and there are evidences of a little work having been done on the lower terrace and the skim bars.

BAILEY CREEK (No. 2).

The following notes are taken from papers by Schultz:[1]

The placer workings on the Davis claim are on a low terrace along the east side of Snake River, extending half a mile north from the mouth of Bailey Creek. They are in the vicinity of those opened by Stantiford in 1870. There are two distinct

[1] Schultz, A. R., Gold developments in central Uinta County, Wyo., and at other points on Snake River; U. S. Geol. Survey Bull. 315, pp. 77–78, 1907; Geology and geography of a portion of Lincoln County, Wyo.: U. S. Geol. Survey Bull. 543, pp. 124–127, 1914.

terraces here, and Mr. Davis is at present working parts of both. The very fine flour or flake gold occurs all through the gravel, but is much more abundant in some streaks than in others. Mr. Davis, who has been mining in Idaho for 40 years and has been working this bar for several years, makes the following statement concerning the gold placers:

"I always found, in working the high bars of the river, that they contain from one to two and sometimes three pay streaks, with fine gold scattered throughout the gravel both above and below the pay streaks. Most all of these high bars have streaks of pay. Sometimes in old eddies or whirlpools the deposits do not seem to have any regular pay streaks. The gold in these places seems to be deposited uniformly and the entire deposit pays well.

"The gold-bearing sand and gravel in my richest pay streak at the Davis diggings or Bailey Creek mining camp average from 3 to 7 feet in thickness and lie on a bed of white cement rock or clay. The gold in this pay streak runs from 9 cents to $3 per cubic yard. The average height of the bar or bank that is here worked is 20 feet. From the top of the lower pay streak to the top of this bank is a 13-foot sand and gravel bed which averages 3 cents to 25 cents in gold per cubic yard. The width of the pay streak is about 500 feet and extends beyond the limits of my workings, which are about 900 feet at this place. South of the 'machine' near the central ditch the pay streak is considerably wider. Six hundred feet north of the central ditch the gravel bank is 30 feet high, the pay streak wider, and the entire bank runs higher in gold values."

* * * * * * * *

One of the main pay streaks near the Snake River channel is from 4 to 6 inches thick and is overlain by 4 to 6 feet of gravel that contains much lower values in gold, and is in turn overlain by a nearly barren gravel bed 4 to 5 feet thick that extends to the surface. The rich pay streak, from 8 to 10 feet below the surface, makes it profitable to work the entire bank. On working back into the bank away from the river these seams are found to rise and a new pay streak about 6 feet thick and richer than the other one is encountered. The new pay streak drops slightly farther east and probably represents the deposits of an older channel of Snake River. The different placer mines and even parts of the same terrace vary considerably in the character of the deposits and arrangement of their beds.

Water for hydraulicking is brought in a ditch from a point some distance up Bailey Creek and is used to break down the gravel, wash out the gold and fine particles, and sluice through the flume (and burlap tables). Sometimes the gravel is shoveled into sluice boxes. Large bowlders are piled up in rows between the boxes so as to retain as much grade as possible and still work the lower pay streaks.

The gravel on these terraces, as shown by the workings for the last few years, runs from 3 cents to $3 a cubic yard. Pay streaks that run $2 to $3 a cubic yard are very thin and rare. The average aggregate run of the pay streaks and the comparatively barren gravel is 7 to 10 cents a cubic yard. Only one piece of coarse gold, said to be about half the size of a tenpenny nail, has thus far been found.

Four samples of black-sand concentrates collected by the writer [Mr. Schultz] from the Davis diggings were examined by David T. Day, who says:

"These samples consist largely of magnetite—No. 1, apparently not much concentrated, containing 1 ounce of magnetite to 4½ ounces of the original material. They are all rich in gold but contain no platinum. The percentage of gold was not determined, but they will all range from $30 to $100 a ton and probably more. This gold could easily be extracted by means of shaking tables of the Pinder, Wilfley, Woodbury, or Deister type, but it is doubtful whether very much can be taken out by other means, certainly not by sluice boxes, as you have probably already found."

Four additional samples of gold-bearing gravel at the Bailey Creek mining camp were furnished through the kindness of Mr. Davis. Concerning these samples Mr. Day reports:

"The samples of black sand collected from the Snake River gravel at Bailey Creek mining camp, Davis diggings, Lincoln County, Wyo., have been carefully tested and examined.

"Sample No. 5 (our No. 1133), reported 'to be an average sample of the pay streak from the bottom to the top, 20 feet in depth,' gave on assaying:

	Ounces per ton.
Gold	35.64
Silver	4.25
Platinum	None.

"Sample No. 6 (our No. 1134), reported to be 'concentrates of sample 5, from which all gold has been extracted by the churn process,' weighed 137 grams and was run over the Wetherill magnetic separator, giving the following results:

	Grams.
Magnetite	57
Ilmenite	48½
Garnet	12½
Garnet and olivine	5
Tailings (consisting of three-fourths zircon and one-fourth quartz)	19

"An assay gave the following results:

	Ounces per ton.
Gold	8.75
Silver	1.14

"Sample No. 7 (our No. 1135), 'concentrates from which gold has been taken out and concentrates buried for five years,' weighed 101 grams and was run over the Wetherill with the following results:

	Grams.
Magnetite	62
Ilmenite	28
Garnet	9
Olivine	5
Tailings (consisting principally of zircon with some garnet)	14

"An assay gave the following results:

	Ounces per ton.
Gold	29.98
Silver	1.15

"Sample No. 8 (our No. 1136) 'is a sample of pay streak showing gold content.' This gave on assaying:

	Ounces per ton.
Gold	107.41
Silver	10.56
Platinum	4.54"

PINE BAR (No. 3).

Schultz[1] gives the following information concerning Pine Bar:

The terrace at the mouth of Pine Creek, on the south fork of Snake River, has been worked * * * by Ivan L. Hoffer and L. M. Rosencrans. The terrace or old bar at this point is 1 mile long, one-twelfth to one-eighth mile wide, and from 40 to 50 feet above the water level of Snake River. * * *. Water for hydraulicking is brought from a point some distance up Pine Creek in a ditch across the bench. The water is used to break down the gravel, wash out the gold, and sluice through the flume. * * *

[1] Schultz, A. R., Gold developments in central Uinta County, Wyo., and at other points on Snake River: U. S. Geol. Survey Bull. 315, pp. 78–79, 1907; Geology and geography of a portion of Lincoln County, Wyo.: U. S. Geol. Survey Bull. 543, pp. 127–128, 1914.

Mr. Hoffer informed the writer that on this bar there is about 8 feet of overlying gravel that contains about 15 very fine colors to the cubic foot, followed by 32 feet of gold-bearing gravel to water level, without striking bedrock. So far only the upper 12 feet of this gold-bearing gravel, which is supposed to be better than that lower down, has been worked.

The following figures, furnished by Mr. Hoffer, give the run of gold in colors for the first 12 feet of gravel in two different places.

Colors of gold in upper gravel at Pine Bar diggings.

Depth in feet.	Colors per cubic foot.	
	A.	B.
1	7,200	6,300
2	23,400	3,600
3	8,100	16,200
4	106,200	11,700
5	8,100	11,700
6	22,500	4,500
7	3,600	5,400
8	17,100	900
	196,200	60,300

The tests were made on one-thirtieth cubic foot of gravel carefully measured and the results per cubic foot were obtained by multiplying these values by 30. About 1,000 to 1,200 colors make 1 cent value. Thus it will be observed that this 8 feet of gravel, both tests being averaged, yields from 12 to 14 cents a cubic yard. Including the upper 8 feet, the value for 16-foot depth averages about 7 cents a cubic yard. Working to a depth of 20 feet or more should slightly raise this value. In a few places small streaks running up to $2 a cubic yard have been cut. Most of these streaks occur on top of the gold gravel immediately below the overlying 8 feet of comparatively barren material.

WELCH GROUND AND GOLD POINT (Nos. 6 and 7).

At the Welch placer, about 1½ miles north of the mouth of Blackfoot River, Snake River has cut into a bank of gravel about 18 feet high, over which there is 2 to 4 feet of fertile sandy loam. The gravels contain gold throughout the depth exposed by the river cut, but those containing the most gold are usually cemented with lime and are composed of smaller pebbles than the great bulk of the gravels. The richer gravels occur in lenses and streaks irregularly distributed in the bank. This deposit is said to average about 40 cents a yard throughout. About 20 acres of gravel next to Snake River has been washed to depths varying from 4 to 12 feet. A ditch about 1,500 feet back from and parallel to the bank furnishes water. The gravels are caved by allowing the water to run out of the ditch through gates. The gold was caught in sluices and on burlap tables. This ground has not been worked for a number of years.

The placer gravels west of Snake River at Gold Point and Eagle Bend, which are from three-fourths to a mile above the mouth of Blackfoot River, rest upon basalt. They have been extensively

worked, but, so far as known, not in the last few years. At Gold Point the gravels are said to average 8 feet in depth and are reported to carry about 40 cents a yard throughout. It is said that very rich "dirt" was found in the crevices in the bedrock, and that some of the cemented gravels found in thin lenses carry as much as $2 a yard.

FORT HALL BOTTOMS (No. 8).

The Fort Hall Bottoms cover approximately 30,000 acres along Snake River in Bannock and Bingham counties, extending from Big Butte, at the junction of the Blackfoot and Snake, to the mouth of Portneuf River, a distance of 24 miles, and varying in width from one-fourth of a mile to 7 miles. They are reached from American Falls, Pocatello, Fort Hall Agency, or Blackfoot. At their eastern margin is a bluff which rises from 15 feet at the north end to 100 feet at the south end, to the level terrace upon which stand Fort Hall Agency and Pocatello. The bottoms have an average elevation of 8 to 10 feet above the normal water level of Snake River. Water stands from 2 feet below the surface at the north end of the bottoms to 9 feet below at the south end. This level is slightly higher than the normal water level of Snake River.

By far the most extensive material found on the surface of the Fort Hall Bottoms is a gray to black sandy loam that in some places contains considerable clay. Gravels occur at the surface in a few places, irregularly distributed over the bottoms. Usually the gravel bars do not cover much more than an acre, but here and there areas of several acres are underlain by gravel. There are more numerous and larger gravel bars within half a mile of the river than in any other part of the bottoms.

There is no doubt that gravels similar to those along the present channel of Snake River underlie all the Fort Hall Bottoms. The upper limit of the gravels varies considerably in different parts of the bottoms. In some places the gravels extend to the surface; in others the sandy loam extends as much as 2 feet below the level of the stream, or 12 feet below the surface.

From the distribution of the gravels on the bottoms away from the river it is thought that they are the tops of buried bars such as are now found along the present channel of the Snake, and from analogy it is thought that the rich gravels are of rather small extent, corresponding to the skim-bar gravels of the present stream.

Bedrock was not found anywhere in the Fort Hall Bottoms. In some places along the terrace east of the bottoms similar gravels rest on partly consolidated clayey sands that Mansfield [1] has referred to the older Quaternary. It seems possible that the bottoms may

[1] Mansfield, G. R., Geology and phosphate deposits of the Fort Hall Indian Reservation, Idaho: U. S. Geol. Survey Bull. (in preparation).

have been cut from similar material and that the partly consolidated Quaternary sands will be found to constitute the bedrock, rather than basalt. At many places west of this part of Snake River basalt flows form the banks. These flows are relatively thin, and it is the opinion of the writer that they originated in the plains west of Snake River and never extended much farther east than their present limit. It seems possible that the course of the Snake in this locality was in large part determined by a shallow depression between the edge of the basalt flow and the gravels and silts upon which the flow rested. In the wells of the high bench[1] in the vicinity of Fort Hall Agency, which reach below the level of the bottoms, nothing but unconsolidated or partly consolidated sand and gravel was encountered above a depth of 75 feet, but at that level there is a 10-foot bed of volcanic rock interbedded with gravels. This flow has a strong dip to the west and would probably be found at a considerable depth if it extends under the bottoms.

The gravels of the Fort Hall Bottoms average less than 1 cent to the yard in gold. The skim-bar gravels, which have been worked each year after high water, carry at least 65 cents a yard in fine gold and perhaps as much as $2 to $3 a yard. The skim bars, however, form a very minor part of the total amount of the gravels of the Fort Hall Bottoms.

HORSE ISLAND (No. 9).

On Horse Island, which is really a continuation of the Fort Hall Bottoms, considerable placer mining has been done in the past, but in recent years the gravels have not received much attention. The surface of this island is from 6 to 10 feet above the normal water level of Snake River. The soil is from 2 to 8 feet thick and rests upon gravels. The gravels that have been worked are near the surface and are for the most part coarse, though some skim-bar gravels are exposed in cuts.

Rockers were used in working most of these gravels, though some on the Elliott ground, at the north end of the island, were worked in a "machine." Horse-drawn scrapers were used to remove the soil and at the machine settings to bring the gravels from the pit to the sluice.

Apparently the pay gravels follow more or less well-defined lines or bars which have a somewhat crescentic shape and are the tops of old high-water bars such as are deposited in the present stream channel.

[1] Heroy, W. B., oral communication.

MINIDOKA.

According to Schultz [1]—

The Government dam at Minidoka has raised the water over an adjacent high terrace that represents an old river bed and contains some of the best values in fine gold along Snake River. This terrace is known as Diamond Bar, and the shallow water now covering it affords a pond with sufficient water to float a chain-bucket or suction dredge, either one of which is adapted for treating this ground. * * *

In May and June, 1906, before the water was ponded above the dam, some prospecting on these gravels was done by the United States Geological Survey. The land examined by L. G. Gillette and W. L. Walker consisted of certain claims along Snake River in Idaho which would be submerged when the lake formed by the dam at Minidoka was full. The claim farthest upstream that was examined was the Golden Treasure, about 25 miles above the dam. The bulk of the work was done in the neighborhood of the old placers in order to determine the value of the ground that was formerly considered profitable. It was found that the values were very irregularly distributed and in but few places equal to the claims made by those interested in the land. The prospecting was accomplished by means of test pits, panning, and sampling, the samples taken being shipped to Portland, Oreg., where they were treated and assayed by the Survey in connection with the black-sand investigation. * * * It was found that in general the values were concentrated in the bottom of the loam and the upper portion of the underlying gravels. The surface soil or sandy loam is common and ranges in thickness from 2 to 12 feet or more. The gold was everywhere of the finest flourlike particles, a large percentage of which would pass trhough a 150-mesh screen. The rocks are in general much smaller than a man's head, although in a few places rocks large enough to interfere with dredging or other mining operations were encountered. * * *

No other minerals of any commercial importance were found. No platinum or monazite was observed and only a trace of zircon. The richest sample contained only 4 pounds of magnetite per ton. These results indicate that the percussion type of machine can be used advantageously in separating the Snake River fine gold from the loam and gravels, especially after preliminary concentration in ordinary sluice boxes and shunting the concentrates onto the tables by means of undercurrents. In the 25-mile stretch examined by Messrs. Gillette and Walker mining work was carried on only at the Sample placer claim, owned by W. H. Philbrick, who employed one stream in his ground-sluicing operations.

NEELY (No. 10).

Schultz [2] gives the following description:

The gravels along Snake River in the vicinity [south and east] of Wapi, Idaho, have been worked by Dunn & Hand, all of their workings being on old high bars or terraces (part of which are now under water) along the present river channel. C. H. Hand states that the gold here is a very fine flake gold and amalgamates readily. The gold is scattered through the gravel but is usually best at the top of the beds. It occurs in heaviest particles in the oldest bars. The pay streaks run from a few inches to 6 or 7 feet in depth but in some places exceed 22 feet, at which depth the gold has run as high as 22 cents per cubic yard. Where bedrock lies at the shallow depths, say from 6 to 8 feet below the surface, the pay streak in some places rests on the bedrock. Occasionally two or more pay streaks are encountered, one on bedrock and the other higher in the gravels or near the top. It is, however, exceptional to find the

[1] Schultz, A. R., Gold developments in central Uinta County, Wyo., and at other points on Snake River: U. S. Geol. Survey Bull. 315, pp. 81–85, 1907.

[2] Idem., p. 86.

pay streak on bedrock. The bars in this locality are very extensive, amounting to hundreds of acres. Actual clean-up, by sluicing some thousand of yards, shows a value of a little more than 20 cents per cubic yard for some million of yards. Gravels of much higher grade occur at some places in thin seams. For a short distance these may run as high as several dollars per cubic yard. The above averages are, however, for gravels worked from 12 to 15 feet in depth and include both the gravels and the surface soil. Besides the gold, the gravels for the above depths carry about three-fourths of 1 per cent of black sand and other heavy minerals.

SOURCE OF THE GOLD.

There can be little question that the fine gold of the Snake was derived from the destruction of older auriferous deposits and not, as suggested by Turner,[1] by precipitation of the gold from the waters of a Miocene lake. That most of the gold above Boise River has come from the Teton, Gros Ventre, Salt River, and Caribou mountains is fairly well established, inasmuch as no gold has been found in Henrys Fork, Blackfoot River, or Portneuf River. It has long been known that in the upper part of Snake River, which heads in the Jackson Hole country, the gravels contain gold. The ultimate source of the gold is not yet definitely known. Some gold has undoubtedly reached the Snake from the Caribou district, of southeastern Bonneville County. The gold-bearing veins and gravels of this district were known as early as 1870 and reported by St. John[2] to be nearly vertical northwestward, trending lodes consisting of rotten ferruginous quartz. Schultz[3] visited the Caribou district in 1913 and reported that while there was considerable gravel in this region, there was only sufficient water to operate for three months each year.

Schultz[4] reports that gold occurs in Jurassic shales, limestones, and sandstones in the northern part of the Wyoming Range at Horse Creek. The sediments are slightly brecciated and contain numerous small calcite seams, and some of them show considerable pyrite. He also reports that fine gold occurs in the Aspen formation, of Upper Cretaceous age. Rocks of the same age are seen along Snake River east and north from Greys River and probably form a considerable part of the Gros Ventre Mountains.

The Teton Mountains, according to Bradley,[5] are composed of a pre-Cambrian core consisting of granite, schist, and gneiss, resting upon which are Paleozoic quartzites and limestones. He noted quartz veins in the granitic core but stated that in general they appear to be barren.

[1] Bell, R. N., The origin of the fine gold of Snake River: Eng. and Min. Jour., vol. 73, pp. 143–144, 1902.
[2] St. John, Orestes, U. S. Geol. and Geog. Survey Terr. Eleventh Ann. Rept., pt. 1, pp. 404–405, 1879.
[3] Schultz, A. R., and Richards, R. W., A geologic reconnaissance of southeastern Idaho: U. S. Geol. Survey Bull. 530, pp. 267–283, 1913.
[4] Schultz, A. R., Geology and geography of a portion of Lincoln County, Wyo.: U. S. Geol. Survey Bull. 543, pp. 121–122, 1914.
[5] Bradley, F. H., U. S. Geol. Survey Terr. Sixth Ann. Rept., pp. 250–271, 1873.

At the headwaters of Snake River, on Big Game Ridge, there are heavy beds of ferruginous conglomerates which have been named Pinyon conglomerate.[1] In speaking of this conglomerate the authors say:

> For many years gravels along Snake River and Pacific Creek in the neighborhood of Jackson Lake have been known to yield a slight amount of gold * * * but not in remunerative quantities. Evidences of gold may be found * * * in the streams coming down from the conglomerate. It is quite likely that this gold has in great part been derived from the conglomerate of the (Eocene) Pinyon formation.

Shockley,[2] who examined the gold gravels of the Jackson Hole country, came to the conclusion that the gold was derived from the decomposition of auriferous pyrite, which he found in bowlders of andesitic rocks.

CONCLUSION.

While it is true that practically all the gravels of the Snake River valley contain gold, it seems to be equally true that most of the deposits contain so little gold that they can not be called placers. There is little question that some small deposits contain sufficient gold to pay for extraction if it were possible to work them on a large scale, and it is probably true that a few relatively small gravel deposits contain sufficient gold to be worked at a profit by hand methods.

The problem of saving the fine gold is one which has received much attention. None of the methods so far tried has proved entirely efficient or commercially successful. Perhaps the solution of this problem may be in the direction of the cyanide process, though much experimenting must be done before a commercially profitable development of this sort can be hoped for.

Under the present conditions of distribution, character of the gold, and methods of its recovery, it seems very doubtful if any ventures of a size large enough to expect success can be commercially profitable.

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[1] Iddings, J. P., Weed, W. H., and Hague, Arnold, Geology of the Yellowstone National Park: U. S. Geol. Survey Mon. 32, pt. 2, pp. 184, 185, 189, and atlas, 1899.

[2] Shockley, J. H., The origin of the fine gold in Snake River, Idaho: Eng. and Min. Jour., vol. 73, pp. 280-281, 1902.