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G. M. BUTLER, *Director*

ARIZONA GOLD PLACERS AND PLACERING

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BULLETINS AVAILABLE

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106. A Geological Reconnaissance of the Tucson and Amole Mountains, by Olaf P. Jenkins and Eldred D. Wilson.

120. Gold and Copper Deposits Near Payson, Ariz., by Carl Lausen and Eldred D. Wilson.

122. Quicksilver (Mercury) Resources of Arizona, by Carl Lausen and E. D. Gardner.

123. Geology and Ore Deposits of the Courtland-Gleeson Region, by Eldred D. Wilson.

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(The following voluminous, beautifully illustrated Bulletin is sold for $1.00.)

119. A Resumé of the Geology of Arizona, by N. H. Darton.

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PREFACE

The first publication of the Arizona Bureau of Mines on Arizona Gold Placers was written by Mr. M. A. Allen, then geologist with the Bureau, and appeared in 1922 as Bulletin 118. It was mainly a compilation of data already in print, but scattered and difficult to find. It proved to be popular, and all copies printed were distributed in four years. Mr. E. D. Wilson was then commissioned to rewrite the bulletin, completely, adding what new data could be obtained. Assisted by Mr. W. R. Hoffman in the field, and further aided by the advice and suggestions of Dr. Carl Lausen, then geologist with the Bureau, Mr. Wilson completed his work in the summer of 1927, and a large edition was published at once as Bulletin 124. Conditions with which everyone is familiar have aroused so much interest in gold that the demand for Bulletin 124 has been extremely heavy, and the supply was exhausted before June first of this year. This new bulletin has been prepared to meet the demand for information on Arizona gold placers which shows no sign of abating.

Part I of this bulletin is a reprint of Bulletin 124 excepting that the information is brought up to date, greater emphasis is placed on the present condition of each of the more important fields, and some details are added concerning the areas that appear to be especially promising. Mr. J. B. Tenney made the necessary field investigations and added these new facts.

Parts II to VII inclusive were presented to over two hundred persons who attended a short course for gold prospectors which was given at the University of Arizona on May 16 and 17, 1932. They were so well received that they have been included in this bulletin in the hope that others may find them useful.

Excepting for very recent work, which has disclosed no new facts of significance and has resulted in the finding of no new placer ground, it is, unfortunately, true that, in spite of diligent efforts to gather all the information available, the description of Arizona placer fields is incomplete and otherwise unsatisfactory. It could, however, hardly be otherwise. The pioneer prospectors and miners were too busy overcoming obstacles, struggling against hardships, and celebrating occasional periods of good fortune to write about their experiences, even if able to do so. Few authentic records of many of the earlier camps exist. Such statistics as are available are often far from reliable, and it requires good judgment to separate the true from the false.

Anyone who secures a copy of this bulletin with the idea of obtaining therefrom such data as will enable him to engage profitably in placer mining in Arizona should remember that gold placers are usually the first deposits found and exhausted in every region. Prospecting for placer gold is not expensive, and a deposit once found can be worked with little capital unless dredging is necessary. Even hydraulic operations (which are not described in this bulletin because it is doubtful if any deposits that can be worked satisfactorily in this way exist where the requisite water is available), do not ordinarily require the expenditure of any considerable sum for equipment unless the water must be piped or flumed a long distance. Because placer gold can be easily and cheaply recovered where water is available, it is not likely that unworked ground of fairly good grade remains along streams which flow for several months a year, at least. People attempting to do placering in such districts must, therefore, ordinarily be satisfied to work ground where the difficulties encountered, such as the prevalence of huge boulders, were too great, or the grade of the gravel was too low to attract the old-timers. Hundreds of people are, however, trying to earn wages on such ground now.

Although there is undoubtedly much placer gold in the so-called "desert" regions of southern Arizona, the lack of water, both for placering operations and for use in camp, is a serious drawback there, as is also the cemented condition of the gravel in several areas. Many types of dry-washers have been tried in this region, usually with very indifferent success for reasons outlined in this bulletin, and the high summer temperatures that prevail there should deter anyone from prospecting in this region during the summer months unless he is accustomed to the conditions he will encounter and knows how to meet them.

Recent field investigations, made by Mr. J. B. Tenney, before many of the streams had dried up, revealed the fact that the average recovery of each placer miner of the State was less than a dollar a day. Of course this statement means that a few were doing fairly well, a larger number were earning expenses, and the majority were not recovering enough gold to buy food. Rumors that good wages can be made in this way, therefore, should be heavily discounted. A person not in robust health or one who has not sufficient funds to finance his entire trip runs a splendid chance of starving to death if he tackles placer mining in Arizona. If, however, a man in good health is out of work, has enough money to pay camp expenses for some time, and is willing to work hard, a prospecting trip

will doubtless prove preferable to lying around and doing nothing, but it should be taken with the full realization that it is highly probable that it will yield little gold. Of course, some rich, virgin ground *may* be found, but the chance of making such a discovery is small. It is this chance, however, that has actuated all prospectors and led to the discovery of most mineral deposits.

June 15, 1932. G. M. BUTLER.

ARIZONA GOLD PLACERS

(Third Edition, Revised)

BY

ELDRED D. WILSON

Recent Information

BY

J. B. TENNEY

GENERAL ORIGIN AND FEATURES OF GOLD PLACERS

Gold placers, or deposits such as gravel and sand that contain notable concentrations of auriferous material, all result from the slow milling and concentration processes incident to the natural erosion of pre-existing gold-bearing rocks. The origin of most gold placers is traceable directly to auriferous veins, lodes, or replacement deposits, that, in many instances, were not of high grade.

According to Emmons,* placers are not apt to form from gold-bearing outcrops that contain notable manganese, chlorides, and iron sulphides, unless precipitating agents such as calcite, siderite, rhodochrosite, pyrrhotite, chalcocite, nepheline, olivine, or leucite are abundant, or unless erosion is very rapid. In other words, the gold may be dissolved and carried below by means of natural chlorination processes that are established when solutions containing chlorides, together with sulphuric acid from the oxidation of iron sulphides, act upon manganese dioxide; but this process is neutralized if precipitating agents are present, and may be ineffective if erosion is very rapid.

According to Lindgren,† the best conditions for the concentration of gold into placers are found in moderately hilly regions where deep secular decay of the rocks has been followed by slight uplift. As the rocks of a region break up and decay under weathering, rainfall washes away most of the resultant detritus, grinds it by striking and rubbing it together and by dragging it along the stream bed, and liberates most of the included gold. Because gold is six or more times heavier than ordinary rock, the liberated particles of gold will concentrate along the bottom and come to rest where the stream gradient lessens. The coarser particles will settle down first, but the fine and flaky gold will be carried farther along. The best placer concentration results

*Emmons, W. H., The Enrichment of Ore Deposits: U. S. Geol. Surv. Bul. 625, pp. 305-324. 1917.

†Lindgren, Waldemar, Mineral Deposits, pp. 211-234.

probably obtain in rivers of moderate (about 30 feet per mile) gradient, under nicely balanced conditions of erosion and deposition. Except where gravel bars may form in certain slower reaches, very little concentration will take place in the gorges. Such bars, through further deepening of the channel, may be left as elevated benches.

Most of the gold in a placer usually rests on or near the bedrock. Occasionally, the coarser gold is scattered through the lower four to twenty feet, or the gravel may be richest a few feet above bedrock, but never are the values equally distributed vertically. Among the best types of bedrock are compact clays, somewhat clayey, decomposed rock, and slates or schists whose partings form natural riffles. Smooth, hard material does not catch or retain the gold effectively. Gold works down for some distance into the most minute crevices of hard rock, for one to five feet into the pores of soft rock, and for many feet along the solution cavities of limestones.

Crystallized gold, which is sometimes found in placers, according to Lindgren,* indicates close proximity of the primary deposit. He states that there is probably no authenticated case of crystallized gold occurring in gravels that have been transported far, and that it is difficult to believe the assumption that such crystals are formed by secondary processes in the gravels. The high insolubility of gold in most surface waters is demonstrated by the fact that flake or flour gold, which often is in 2,000 particles per one cent's worth, may be carried by rivers of moderate gradient for hundreds of miles.

The fineness, or parts of unalloyed gold per thousand, of placer gold is usually greater than that of the vein gold of the same district. This increase in purity, which is proportional to the distance that the placer material has been transported, and to the decreasing size of the grains, has been shown to be due to the solution and abstraction of silver by surface waters.

YEARLY RAINY SEASONS OF ARIZONA

The advent of rain is of great importance to the placer miner in Arizona. It exposes nuggets and provides temporary water for wet methods of concentration, but it hinders the dry-washer, whose dirt must be dry. Usually in Arizona, as in much of the Southwest, the least rain falls in May and June, and the most during July, August and the winter. Often this rain comes with a local violence that fills dry arroyos with torrents.

*Lindgren, Waldemar, op. cit.

GENERAL DISTRIBUTION OF ARIZONA GOLD PLACERS

Due to the presence of gold-bearing rocks in the majority of the mountain ranges of the Southwest, gold placers that have been of economic importance occur in every county of Arizona except Apache, Coconino, Graham, and Navajo. As indicated on the accompanying map (Fig. 1), the placer districts of Arizona that have been notably worked are situated in the southern, mountainous, and desert half of the State. They are localized in the vicinity of the Colorado River from a point south of Yuma to about as far north as Topock, and in various portions of the Gila River drainage area, but are best developed in Yuma, Yavapai, and Pima counties. As described further on in this report, very extensive placers occur also in Apache, Coconino, and Navajo counties, but under prevailing conditions they are of too low a grade for profitable mining. Many additional placers, not of economic importance, are found in the gulches that issue from the numerous mineralized mountain ranges throughout the southern half of the State.

HISTORY OF ARIZONA GOLD PLACER MINING

The original discovery of placer gold in Arizona probably was made by Indians long before the advent of white men. As early as 1774, according to Elliot's History of Arizona (1884), certain placers of the Quijotoa district, about 70 miles west of Tucson, were being worked extensively by Padre Lopez, a Castilian priest. In 1858, according to Hamilton,* placers were discovered on the Gila River, about twenty miles east of where it joins the Colorado, by Col. Jacob Snively. About 1862, the La Paz placers, near the Colorado River about 65 miles north of Yuma, were discovered by Capt. Pauline Weaver. The greatly increased prospecting that followed these discoveries soon resulted in the finding of the Dome Rock, Plomosa, San Domingo, and Yavapai County gold gravels. The Greaterville placers became known in 1874, and by 1900 many additional, but less important, discoveries were made in various parts of the State.

Since the most important placer fields of Arizona were brought to light prior to 1875, and each of them was feverishly gophered as soon as possible, the most active and prosperous period for placer mining in the State was from 1858 to about 1880. Before 1885, most of the richer gravels had

*Hamilton, Patrick, Resources of Arizona. 1883.

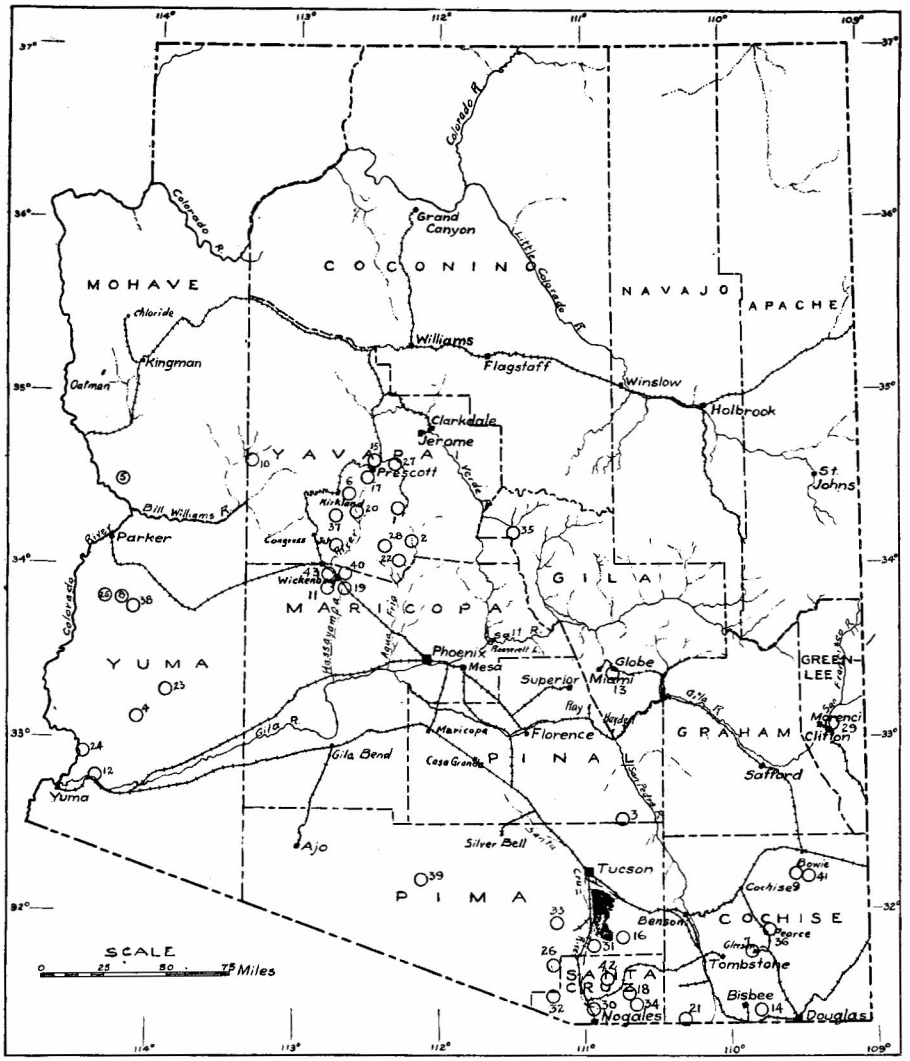

Fig. 1.—Index map showing location of Arizona gold placers.

1. Big Bug
2. Black Canyon
3. Cañada del Oro
4. Castle Dome
5. Chemehuevis
6. Copper Basin
7. Courtland-Gleeson
8. Dome Rock
9. Dos Cabezas
10. Eureka
11. Garcia
12. Gila City (Dome Siding)
13. Globe
14. Gold Gulch (Bisbee)
15. Granite Creek
16. Greaterville
17. Groom Creek
18. Harshaw
19. Hassayampa (Maricopa Co.)
20. Hassayampa (Yavapai Co.)
21. Huachuca
22. Humbug
23. Kofa or S. H.
24. Laguna
25. La Paz
26. Las Guijas or Arivaca
27. Lynx Creek
28. Minnehaha
29. Morenci-Clifton
30. Nogales
31. Old Baldy
32. Oro Blanco
33. Papago
34. Patagonia
35. Payson
36. Pearce
37. Placeritas
38. Plomosa
39. Quijotoa
40. San Domingo
41. Teviston
42. Tyndall
43. Vulture
44. Weaver and Rich Hill

been harvested, largely by crude, although expedient, methods of dry-washing and, in some areas, by sluicing, rocking, and panning. In order to rework the gravels for the values not recovered by the early miners, various attempts at dredging, hydraulicking, and large-scale dry concentration have been made, but so far these efforts have been unsuccessful. In general, the placer industry of Arizona during the last forty years has been unsteady, and has depended upon such factors as unemployment and seasonal rainfall, or promotional enterprises. Its particular decline during the past few years has been due to ever-increasing wages and costs of operation, as well as to the obvious fact that the richer, more easily worked placers already have been harvested.

Since the severe curtailment of the large copper mines of the State, and the consequent general unemploymnt which started in 1930, a large number of men have attempted to gain a living from placer mining. Most of these men have gone to the better known, old placer districts. The results have been very discouraging. There are, however, some districts which were relatively poorer at the start and which were consequently less intensively worked in the early years, and were quickly abandoned and forgotten. Although the chances of quick fortunes are not great in these poorer fields, they are now the most attractive, and may, possibly be made to yield a living wage to the small operator. In some of these leaner fields it is quite possible that low-grade. large-scale operations may be profitable.

PRODUCTION

The total production of Arizona's placers is difficult to estimate. Because the major production was during the early frontier days, when no records were kept, any estimate must be based largely on information secured from pioneers of the various districts. Such figures are necessarily inaccurate. They may be too low, because of the generally sporadic, often scattered operations of transient miners; they may be too high, because of the human tendency to exaggerate regarding gold; or, they may be lacking for districts where no pioneers remain who remember anything about early production. Furthermore, many of the early-day, migratory miners secretly carried their gold in belts or in packs with them when they left the country, and spent at the local towns only what was required for supplies and pleasure. In the table of the various placer counties and districts of Arizona, shown on page 17, the U. S.

Mineral Resources* yearly production records for 1900-1929 are given. This reported production, which from 1900-1929 was $854,655, has been falling off rapidly during the last few years, and for 1924 was the lowest of any year on record.

YUMA COUNTY

The important gold placer districts of Yuma County are La Paz, Plomosa, Dome Rock, Kofa (S. H.), Gila City, Castle Dome, and Laguna. These districts, which are situated in one of the most arid portions of the Southwest, have but little water outside of the Colorado and Gila rivers. The climate of the region is uncomfortable for placer mining during the summer, but very enjoyable in winter. According to the U. S. Weather Bureau, Quartzsite, which is situated near the Plomosa, La Paz, and Dome Rock placers at an elevation of 800 feet above sea level, has a mean annual rainfall of 6.53 inches, a mean annual temperature of 69.6°, a maximum temperature of 119°, and a minimum of 9° above zero on record. Likewise, Yuma, which is about twenty miles from the Laguna and Gila City placers at an elevation of 141 feet, has a mean annual rainfall of 3.13 inches, a mean annual temperature of 71.7°, a maximum temperature of 118°, and a minimum of 22° above zero.

According to Heikes,† Yuma County placer production from 1860 to 1880 is estimated at from $20,000,000 to $42,000,000 in gold, but these figures are probably excessive. The 1900-1924 yield was about $133,000.

LA PAZ PLACERS

The La Paz placers are situated in the Colorado River Indian Reservation of west-central Yuma County, along the west slope of the Dome Rock Mountains, about nine miles west of Quartzsite, nine miles northeast of Ehrenberg Ferry, and six miles west of the Colorado River. The district is accessible by desert roads from Ehrenberg and Quartzsite.

The Dome Rock Mountains, which rise precipitously to heights of as much as 2,200 feet above the adjacent plains, attain at Ferrar Peak an elevation of 2,900 feet above sea level. From their western foot, bench lands, composed largely of sand and clay overlain in part by gravel and coarse outwash, slope

*Published annually by the U. S. Geological Survey up to and including the year 1923, and by the U. S. Bureau of Mines since 1923.

†Heikes, V. C., U. S. Geol. Survey Mineral Resources for 1912, Part I, p. 256.

gently westward nearly to the river, where usually there is an abrupt descent of about one hundred feet to the bottom lands. No perennial streams flow through the placer district, but several branching arroyos drain the run-off of the rainy seasons to the Colorado River. A very scanty water supply is obtained from Gonzales Wells, or from uncertain natural tanks, such as Goodman Tank, in the bedrock of arroyos.

History—According to former State Historian Hall,* the presence of placer gold near the Colorado River was learned from the Indians soon after the establishment of the military post at Yuma. These Indians gave a few small nuggets and eagle quills of the gold to a trapper, Capt. Pauline Weaver, and in about 1862, according to Browne,† guided Weaver and his party to the rich gravels. It is said that the party picked up about $8,000 in nuggets, returned to Yuma for supplies, and spread news of the discovery. Several hundred miners soon rushed to the district, found the placers to be very rich, and established the adobe town of La Paz about 2¼ miles from the river. This town, which soon attained a cosmopolitan population of over 1,500, became a station on the Overland Trail from San Bernardino to Ft. Whipple, and was the county seat until 1871.‡ The district flourished until about 1864, when apparent exhaustion of the higher-grade placers and discoveries of new diggings caused a decline in activity. In 1873, 1874, and 1876, additions to the Colorado River Indian Reservation included much of the placer ground and greatly restricted mining. La Paz became practically deserted, and the site of this once flourishing town is now marked only by adobe ruins.

Production—Information on the earlier production of the La Paz placers is given by Browne,§ who quotes a letter from Mr. A. McKay, a member of the Territorial legislature from La Paz, as follows:

"Of the yield of these placers, anything like an approximation to the average daily amount of what was taken out per man would only be guess work. Hundreds of dollars per day to the man was common, and now and again a thousand or more a day. Don Juan Ferra took one nugget from his claim that weighed forty-seven ounces and six dollars. Another party found a chispa weighing twenty-seven ounces. Many others found pieces of from one to two ounces up to twenty, and yet it is

*Hall, Sharlot M., Personal communication.

†Browne, J. Ross, Resources of the States and Territories West of the Rocky Mountains. 1868.

‡Bancroft, H. A. A History of Arizona and New Mexico, p. 616.

§Browne, J. Ross, op. cit. 1868.

contended that the greater proportion of the larger nuggets were never shown . . . . It is the opinion of those most conversant with the first working of these placers that much the greater proportion of the gold taken out was in nuggets weighing from one dollar up to the size mentioned above . . . . As has been said above, the gold was large and generally clear of foreign substances. . . . All that was sold or taken here went for $16 to $17 an ounce. Since the year 1864 until the present, there have been at various times many men at work in these placers, numbering in the winter months hundreds, but in the summer months not exceeding seventy-five or one hundred; all seem to do sufficiently well not to be willing to work for the wages of the country, which are and have been for some time from $30 to $65 per month and found. No inconsiderable amount comes in from these placers now weekly, and only a few days ago I saw, myself, a nugget which weighed $40, clear and pure from foreign substance. . . .

"Of the total amount of gold taken from these mines, I am . . . . at loss to say what it has been . . . . I have failed to find any pioneer whose opinion is that less than $1,000,000 were taken from these diggings within the first year, and in all probability as much was taken out in the following years."

According to Hall,* local gold nuggets and dust were the principal currency, particularly for gambling, in La Paz; but a large portion of the gold obtained by the Mexican placer miners went to Mexico.

According to Heikes,† the largest nugget found in this region was valued at $1,150 and assayed about 870 in fineness. Most of the gold particles or nuggets ranged in value from five cents to $10, although $20- and $40-pieces were not uncommon. On account of the crude methods of recovering the gold entirely by dry washing in pans or wooden "bateas," it is apparent that only the coarser gold could be saved, and only extremely rich ground would be payable. Wet methods were out of the question, for, according to Jones,‡ water packed from the town of La Paz to the placers brought $5 a gallon during the rush period. With the introduction of dry-washer machines in the late sixties, greater quanties of material could be handled and a greater percentage recovery effected, but by that time most of

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*Personal communication.

†Heikes, V. C., Dry Placers in Arizona: U. S. Geol. Survey Mineral Resources for 1912, Part I, p. 259.

‡Jones, E. L., Jr., Gold Deposits near Quartzsite, Arizona: U. S. Geol. Survey Bul. 620, p. 49. 1916.

VALUE OF GOLD AND COMBINED SILVER PRODUCTION OF ARIZONA GOLD PLACERS

Year	Cochise Co.	Gila Co.	Greenlee Co.	Maricopa Co.	Mohave Co.	PIMA COUNTY			Pinal Co.	Santa Cruz Co.	YAVAPAI COUNTY					YUMA COUNTY			Total Arizona
						Greaterville District	Quijotoa District	Total			Big Bug District	Weaver District	Walker District	Hassayampa District	Total	Castle Dome District	Plomosa District	Total	
1900																			$188,097
1901																			105,024
1902																			43,407
1903						$1920	$5400	$7320	$416										11,751
1904						2500	6400	8900	3229						$124		$4000	$4000	16,846
1905				$705		5033	9046	14079	539			$16273			26697		829	829	42,849
1906	$1930			301		2839	3014	5853	281			9466			17848		4754	14463	40,685
1907	843	$127	$415	1296		5032	3810	8842	446			11011			21087		3532	12072	45,128
1908	180		662	1726		3109	1058	4167	542	$299		6089			13708		2057	9787	31,071
1909		68	311	696	1380	2209		2209		92		6980			15599	$2205	2136	8385	28,740
1911	115	276		965		2067		3858	1164	622	$2121	5993			11595		2383	8426	26,078
1910	521	215	944	1109		2146	251	2397		871		4813			9603		2498	7118	23,721
1912				1356	35	3557	927	4484	793		6192	4839			16001		9523	20612	43,281
1913			203	1070		3495		8431	1111		2369	5515			10272			9767	30,854
1914	228	146	2280	1564		2393		7461	506	308	2038	4210	3733		12238	1413	2061	5542	30,273
1915	1789		813	1001				2650	608	509	4147		4587		13977	1103	3608	14058	35,405
1916	1946		111	414				1799	225		1692		1372		3609	534		6299	14,394
1917				3108				4877					2424		3780	1822	1172	5636	17,401
1918			314			416		416	224				1647		2205		907	1108	4,267
1919	1267			390									1225		2101			976	4,734
1920			208			1226		1226							3149				4,583
1921	499	527	618	934		1511		1621	416		1529		1104		5891			2108	12,614
1922	85	243	627	775	751			2906	230				1225		5835		297	642	12,094
1923	319		1413	419	174			622	302				2356		4532			1132	8,913
1924				388				211	319			310	765		2239				3,157
1925				124		126		126			1506		314		2365		1103	1672	4,287
1926	112			683		271		271			847	901	445		4730			874	6,670
1927															4412				6,280
1928			500		173	620		620			484	1144		1208	3940		734	1016	6,426
1929				160		511		511			175	711	2764	935	4600		354	354	5,625
Total 1900-1929	$9843	$1602	$9379	$19184	$2513	$40981	$29906	$95857	$11351	$2701	$23100	$78255	$23961	$2143	$222137	$7086	$41948	$136867	$854,655

the richer ground had been worked over. Many old-time miners of the district assert that production between 1862 and 1869 amounted to $7,000,000. Later production, however, has been comparatively small.

Geology—The geology of the region, as interpreted by Jones, is indicated on the accompanying map (Fig. 2). He considers that the benchland deposits were formed by the Colorado River, but that the placer gravels were derived largely by erosion of the gold-bearing quartz veins and stringers contained in the pre-Cambrian schists of the Dome Rock Mountain.

The placers occur mainly in Goodman Arroyo and Arroyo La Paz, and in certain tributary gulches such as Ferrar, Garcia, and Ravenna. According to Jones,* "Ferrar Gulch, tributary to Arroyo La Paz, contained the richest and most productive placers of the district. Evidences of former work are seen in the old excavations and . . . . in exposures of bedrock where the wash was shallow. . . . The thickness of the gold-bearing wash is variable, ranging from a few feet on the mountain slopes to an unknown measure in Arroyo La Paz and in the gulch traversed by the Quartzsite-Ehrenberg road. Shafts have been sunk in the wash to depths of thirty feet without reaching bedrock and it is reported that in places the wash is at least sixty feet deep. By far the greater part of the auriferous material is unworked, especially that in the lower courses of the arroyos, where the wash is deep. Ferrar Gulch for most of its course has been practically worked out.

"The gold-bearing material consists of sand and clay inclosing angular rock fragments of greatly variable size. Tests indicate that about 20 per cent of the wash will pass through a quarter-inch screen, and the largest boulders weigh several hundred pounds. The material near the surface is unassorted and is unconsolidated, being readily worked with pick and shovel. That at depths of 15 or 20 feet is consolidated, but the cementing substances readily disintegrate on exposure to air. Deposits of wash below the depths of test pits may prove to be similar to the outwash on the east slope of the Dome Rock Mountains and in the Plomosa placers, where the material is firmly cemented with calcium carbonate and requires crushing in order to free the gold. In Goodman Wash below the Goodman tank a deposit of calcareous tufa several feet thick was noted. The ground stands sufficiently well to permit the sinking of shafts without the use of timber. The wash is readily worked in dry-

*Jones, E. L., Jr., op. cit., p. 51.

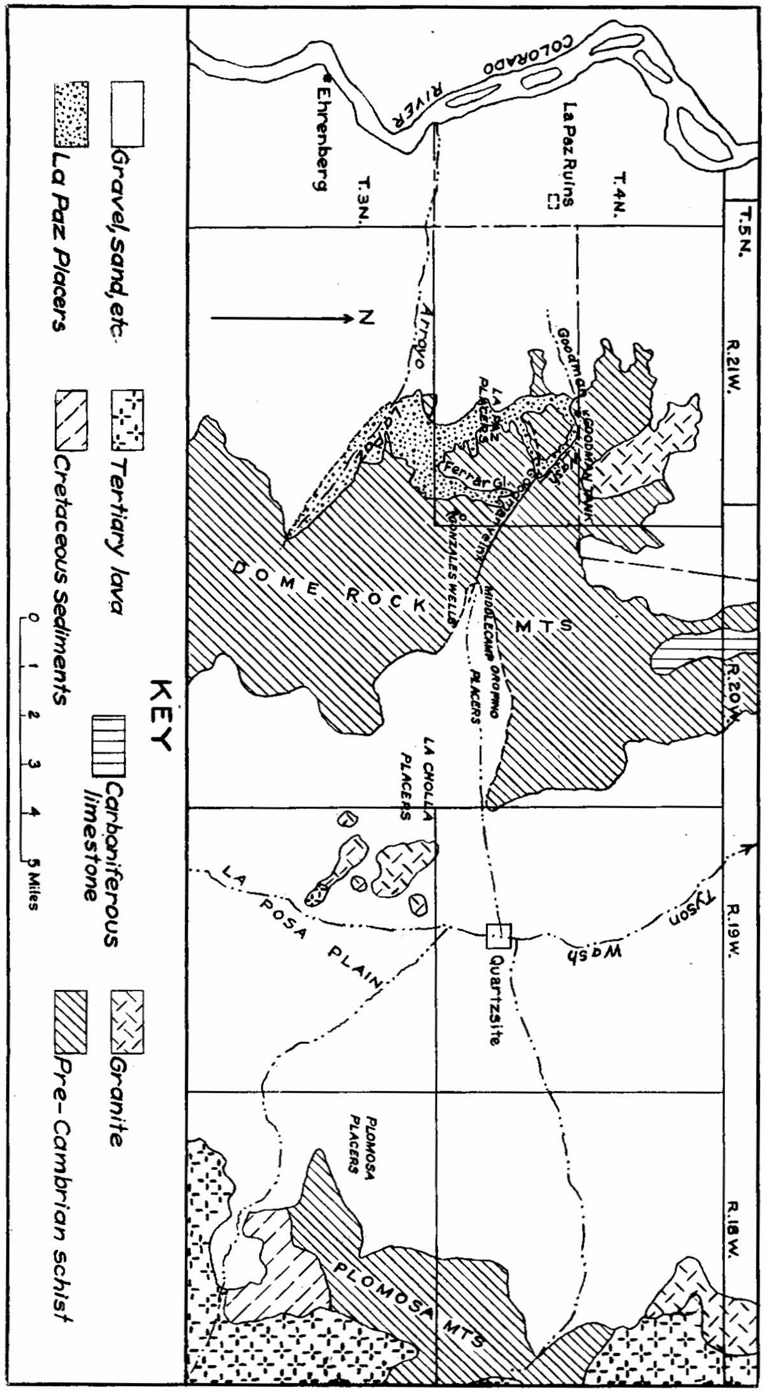

Fig. 2.—Geologic reconnaissance map of the La Paz, Dome Rock and Plomosa placer regions.

washer machines, the only requirement being that the ground must be dry. The gold is said to be distributed throughout the wash, though in the early workings the richest yield was obtained near bedrock. The size of the gold now recovered from the deposits of the La Paz district probably averages only a few cents, but, as already stated, the gold recovered from the early workings was much coarser. The gold is rough and angular, and particles of iron cling to some of the nuggets. Magnetite is always found in the concentrates, and boulders of magnetite, the largest weighing several pounds, are frequently found on the surface.

"No estimate could be made of the probable gold content of the wash in the La Paz district because of lack of detailed data and of uncertainty as to the limits of the wash, but in one area the deposit, said to contain values of 50 to 75 cents per yard and much of it 30 feet or more deep, occupies at least 640 acres, and considerable areas extend into the smaller gulches."

Present Operations—Occasional dry-washing and some assessment work are still carried on within the La Paz district. Many plans for dry concentration have been tried, but so far they have not met with desired success. Hydraulic treatment of the gravels was planned several years ago by the New La Paz Gold Mining Co. This company secured a large portion of the placer ground of the district after it had been excluded from the Colorado River Indian Reservation in 1910, but in 1912 the land was included again in the reservation, where it remained until late 1915. Since 1915, the company is said to have been engaged in litigation and preliminary development. Their plan is to pump water from the Colorado River, or from wells near the river, for about 4½ miles to a reservoir 540 feet above the river, or 225 feet above the placers. According to the engineers who sampled the property for the company, there are available 1,300,000 cubic yards of relatively unbouldery, uncemented, clay-free gravel that averages $2.80 per cubic yard.

PLOMOSA PLACERS

The Plomosa placers are situated, as shown in Figure 2, about five miles southeast of Quartzsite and fourteen miles east of the La Paz placers, near the western foot of the Plomosa Mountains, and at the eastern edge of La Posa Plain. This district produced considerable gold soon after its discovery in the early sixties, but no estimate of the amount is available. Its 1900-1924 yield, together with that of the Dome Rock placers,

is given by the U. S. Mineral Resources as $39,757. Unsuccessful attempts have been made to work the Plomosa placers on a large scale both by dry concentration and by hydraulicking, but, so far as is known, all the production made has been by small, individual dry-washers.

Geology—The general geology of the Plomosa placer district is indicated in Figure 2. The Plomosa Mountains, which east of the district are about two thousand feet above sea level, or one thousand feet above the plain, consist largely of pre-Cambrian schist, granite, and later volcanic rocks. These schists, which contain gold-bearing quartz veins and stringers, probably were the original source of the Plomosa placers.

According to Bancroft,* the placer gravels, which occur in certain old drainage channels leading away from the southwestern part of the mountains, are made up of fragments of schist, granite, and quartz, cemented by lime carbonate. This conglomerate or "cement rock" varies in thickness from a few inches up to many feet, depending largely on the shape and size of the former channels, and rests upon grayish-green, schistose bedrock.

Regarding the placers, Heikes† quotes extracts from a professional report by John A. Church as follows:

"In some localities pits have been sunk to a depth of 20, 30 and 50 feet or more to beds of cement which are richer than the gravel. Near the mountain the gold is coarser, but the gravel is much less. Miles of the great deposit, extending westward from the mountains and from 3 to 4 miles in width, have been cut into by floods from the mountains, forming deep ravines, and they afford miles of banks 10 to 15 feet high in which the upper layer of gravel is well exposed. From these banks, as far as investigations could be made, samples gave an average return value of 64 cents per cubic yard with gold estimated at $18 an ounce. . . . There were no failures. The results lay between the extremes of 42 cents and $1.04 per cubic yard. To get the limit of the deposit it would be necessary to pursue the tests to points where gold failed. . . . The limit of the gravel actually explored was 2,400 by 1,500 feet and 8 yards deep. . . . Within this area bedrock was not reached at any time. . . ."

Recent Operations—No work other than annual assessment work has been done for several years. The more favorable

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*Bancroft, H., Reconnaissance of the Ore Deposits in Northern Yuma County, Arizona: U. S. Geol. Survey Bul. 451, p. 88. 1911.

†Heikes, V. C., op. cit., pp. 257-258.

ground is all held by location, and work by the small operator is discouraged.

DOME ROCK PLACERS

Quartzsite vicinity is an extensive dry-placer field. Heikes* states: "Surrounding the postoffice of Quartzsite . . . . and extending in every direction, covering an area of about 7,500 acres, is found dry-placer ground with values to an average depth of fifteen feet and varying from five to fifty feet. The coarse gold content is reported to average from 10 cents to several dollars."

On the east side of the Dome Rock Mountains, from two to seven miles west of Quartzsite, several placer tracts occur among certain large and small branches of Tyson Wash. The three most important tracts, namely, Middle Camp, Oro Fino, and La Cholla, as roughly outlined by Jones, are shown on Figure 2. Like the Plomosa placers, these gravels have been worked intermittently by individual dry-washers since the early sixties, but none of the several attempts that have been made to work the ground on a large scale have proved successful.

Regarding these placer tracts, Heikes quotes Church as follows:

"Middle Camp, the most northerly of the three, has granite gravel; Oro Fino, in the center, has much porphyritic slate; and La Cholla, at the south, is mostly composed of quartzite and schist pebbles . . . . At La Cholla . . . . which is near the mountains, there is a siliceous cement, very rich, but also so very hard that it requires to be broken by powder before going to the dry-washer. At Oro Fino the shale bedrock is very near the surface. In Middle Camp there is cement, but of a much softer kind. . . . (Here most of the sampling was performed) . . . . The camp (?) occupies the east and west valley crossing the mountain range, a mile wide and 4 or 5 miles long . . . . This is the chosen locality for the individual dry-washer, who takes his machine to some point where the bedrock can be reached quickly. It is here that the rich seams of gravel on the bedrock yield from four to ten times the value of the thicker gravels, and in crevices there have been found nuggets worth $10 to $25. La Cholla, south of Middle Camp, lies along the foot of the mountains, like Plomosa, and is 3 or 4 miles in length. . . . The depth of the gravel is irregular in passing from Middle Camp through Oro Fino to La Cholla. . . . The value of these

*Heikes, V. C., op. cit., p. 258.

placers was known to the miners who, in that early day, passed over all the region adjoining the Colorado, but the almost total absence of water in the mountains compelled the miners to pack their rich dirt to the river or to distant tanks to be washed. Oro Fino was the most celebrated camp of that day. There, when the art of dry-washing was learned, the rich bedrock was the scene of active work."

According to Jones,* 640 acres of the Oro Fino tract was sampled by the Catalina Gold Mining Co. with test-holes, up to thirty feet deep, sunk every few hundred feet. From these samples it was found that the gold content ranges from a few cents to over $1 per cubic yard and averages thirty-eight cents per yard. The colors run from less than one cent to twenty-four cents each, and the gold is of about $19 per ounce fineness. Here the gold-bearing material consists of unconsolidated rock debris up to twelve feet thick, and an underlying cemented gravel eighteen more feet thick.

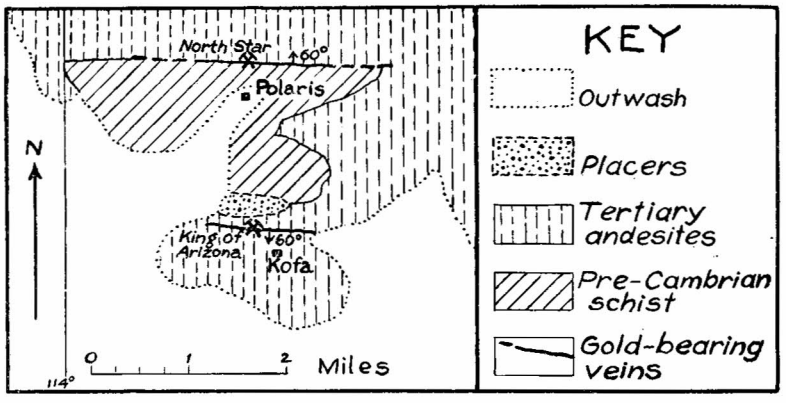

Fig. 3. Geologic reconnaissance map of the Kofa, or S. H., placer region, after E. L. Jones, Jr., and N. H. Darton.

KOFA, OR S. H., PLACERS

A small area of gold placers situated in the Kofa, or S. H., Mountains of central Yuma County, about fifty-six miles northeast of Yuma, has been described by Jones.† A geologic sketch map of the vicinity is shown in Figure 3. Of these placers, Jones says:

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*Jones, E. L., Jr., op. cit., pp. 52-53.

†Jones, E. L., Jr., A Reconnaissance in the Kofa Mountains, Arizona: U. S. Geol. Survey Bul. 620, p. 164. 1916.

"The known placer deposits of the Kofa Mountains occur in a gulch draining westward north of the detached hills in which the King of Arizona Mine is located. These placers have been worked for many years, and the production is reported to be about $40,000 in gold nuggets. At present (1914) the placers are being worked in a small way, and a yearly production of several hundred dollars is reported. The gold occurs in outwash deposits which consist of boulders and fragments from the metamorphic and volcanic rocks. The gold-bearing debris is said to be from a few feet to seventy feet deep over an area of approximately sixty acres. The gold is coarse and occurs near bedrock. It has evidently been derived from the disintegration of auriferous veins in the metamorphic rocks, as it is much coarser than that contained in the North Star and King of Arizona veins."

GILA CITY PLACERS

The Gila City placers are situated in southern Yuma County, about twenty miles east of Yuma, in the vicinity of Dome station.

According to Hamilton,* these placers were discovered in 1858 by Col. Jacob Sniveley, and Hall† states that they were known to certain trappers in the middle forties. During the few years following, this area was worked very actively. Farish‡ says that Lt. Lowry, who visited there in 1859, found about 100 men and several families working the gravels at Gila City, near the present site of Dome. He saw more than $20 washed from eight shovelsful of dirt, and was told that from $30 to $125 per day was recovered by each worker. Hall* states that the early-day miners here were largely Mexicans, who took most of their gold to Mexico. Consequently, no estimates of the production of these placers can be made.

According to Carl Lausen§ the Gila City placers are said to average 35 cents per cubic yard, and the distance to bedrock, where the best values are, is eight to twenty feet. The gold-bearing gravels, which extend for one to two miles between the northern termination of the Gila Mountains and the Gila River, were probably derived by erosion of gold-bearing quartz veins contained in the schists and granites of the Gila Mountains.

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*Hamilton, Patrick, Resources of Arizona. 1883.

†Personal communication.

‡Farish, T. E., History of Arizona, Vol. 1, pp. 296-297. 1915.

§Oral communication.

Occasional mining of the gravels is still done by individuals and it is said that the average daily returns are at least miner's wages. One nugget worth $88, brought to the Arizona Bureau of Mines in 1926, is said to have come from these placers.

In December, 1926, it was reported that dredging operations were being contemplated for the McPhaull & Palm holdings, three miles west of Dome.

Recent Operations—During the winter and spring of 1931-1932, from seventy-five to one hundred men were placering intermittently in the dry gulches within a radius of six miles of Dome station. The greatest activity was in a dry wash southeast of Muggins Peak, six miles northeast of Dome. About $600 in gold dust was reclaimed from the whole district during the season. All activity had ceased on the advent of hot weather in May.

CASTLE DOME PLACERS

The Castle Dome placers are situated about three or four miles south and east of Castle Dome, or about thirty-two miles northeast of Yuma, at an elevation of 1,100 to 1,200 feet above sea level. Finely divided gold is said to occur in the gravels of the arroyos and intervening mesas. This gold probably occurred originally in a finely divided condition within quartz veins of the Castle Dome Mountains. Nothing is known of the early production of these placers, but their yield from 1909 to 1918 is reported at $7,086.

LAGUNA PLACERS

The Laguna placers are situated in southwestern Yuma County, along the Colorado River, in the vicinity of Laguna Dam, about 10 miles northeast of Yuma. According to Mr. A. P. Irvine,* of Wickenburg, a large amount of coarse gold was found in potholes in the gneissic rock about one hundred feet above the river. This coarseness points to a rather local origin instead of to a long transportation by the Colorado River. The U. S. Mineral Resources report from the Laguna placers a production of $1,457 in 1910 and $1,989 in 1912.

Recent Operations—Very little activity was reported from this district in the 1931-1932 season.

YAVAPAI COUNTY

The principal gold placers of Yavapai County are in the Lynx Creek, Weaver, Rich Hill, Hassayampa, Big Bug, Groom Creek,

*Oral communication.

Minnehaha, Granite Creek, Placeritas, Black Canyon, Eureka, Humbug, and Copper Basin regions.

LYNX CREEK PLACERS

The Lynx Creek placers are situated in central Yavapai County, along Lynx Creek from near Walker, seven miles southeast of Prescott, to its junction with Agua Fria Creek, thirteen miles east of Prescott.

Lynx Creek, which flows north between foothill ridges of the Bradshaw Mountains, and northeast and east through the conglomerate terraces of Lonesome Valley, has an approximate length of eighteen miles. Since it extends between elevations of about 7,000 and 4,600 feet above sea level, and drains a large, high region, it receives a considerable amount of water each season, and is perennial in its upper, pine-wooded course. At Prescott, which is about 5 miles west of the creek at an elevation of 5,320 feet above sea level, the 1926 fall of rain and snow water was 18.16 inches, the highest temperature was 101°, and the lowest 2° below zero.

History and production—According to former State Historian Hall,* the Lynx Creek placers were discovered in 1863 by a party of California miners headed by Capt. Joe Walker. As the news of their discovery filtered back to California, the number of placer miners on Lynx Creek increased to two hundred or more. Active work, with hand rockers, pans, and small sluices, continued along the stream for several years before the exhaustion of the richest gravels.

Like most of the placers of the Southwest, unfortunately, no records of the early-day yield are available, but Lynx Creek is noted as one of the most productive gold-bearing streams in Arizona. Raymond† reported its 1874 production at $10,000, and Hamilton‡ estimated the total prior to 1881 at $1,000,000. According to Mr. A. C. Gilmore,§ of Prescott, about 100 men were working the Lynx Creek placers prior to 1885, and some of them recovered about $20 per day. Mr. W. R. Shananfelt,§ of Prescott, states that one man recovered $3,600 in eleven days from the lower reaches of the creek. Inasmuch as many of the early miners carried a large portion of their gains out of the country, Hall* asserts that the Lynx Creek placers have

*Personal communication.

†Raymond, R. W., Statistics of Mines and Mining in the States and Territories West of the Rocky Mountains for 1874.

‡Hamilton, Patrick, Resources of Arizona. 1881.

§Oral communication.

produced at least $3,000,000. As shown in the table on page 17, the production from 1914 to 1929, inclusive, was $23,961.

Much money has been spent in efforts to work these placers on a large scale. In the late eighties, an Englishman, B. T. Barlow-Massick, built a small dam above the present highway bridge, installed about 2½ or 3 miles of thirty-inch pipe, and did some hydraulicking, but a flood destroyed the dam. About 1900, the Speck Company tried out an old dredge a short distance below the bridge, but the roughness of the bedrock there prevented its success. Later, Mr. G. S. Fitzmaurice operated this dredge farther down the creek, but, after recovering about $800 worth of gold, the dredge fell apart. A large, expensive, patented, gold-saving machine was tried out nearby at about this time, but also without success.

Geology—The geology of the Lynx Creek placer region is indicated on the accompanying map (Fig. 4). The oldest rocks are coarse to mediumly fissile schists of sedimentary and igneous origin, extensively intruded by slightly schistose dikes of granite, pegmatite, and diorite. These schists strike roughly N.-S., and dip steeply. Larger masses of dark, hornblende diorite and light-colored, medium-grained granite intrude these schists. In the northern portion of this area, these pre-Cambrian rocks are overlain by a conglomerate of medium-grained, fairly well rounded gravels, stiffly cemented in a matrix of sand and volcanic ash. This conglomerate, which constitutes the bedrock of the placers of lower Lynx Creek, appears to be overlain by the late Tertiary basalts in Bald Hill. The youngest formation in the region is the series of gravels, sand, and boulders that occupy the bed of Lynx Creek. This material, which contains the placer gold, is generally well-rounded, except in the upper reaches of the stream.

From near Walker to a point about eight miles in air line downstream, or to the Lynx Creek Mining Co. dam, 2 miles below the bridge, the placers occur as thin benches or bars whose few yards of width can not be shown on a map the scale of Figure 4. Downstream from that point, in the bottom of the steep-walled gulch formed in the conglomerate fill of Lonesome Valley (see Fig. 5), the placers attain a maximum width of over one-eighth mile and a thickness of eight to twenty-four feet. It is said that although some gold is present throughout this eight to twenty-four feet of thickness, the richest material is at the conglomerate bedrock and in a four-feet streak about

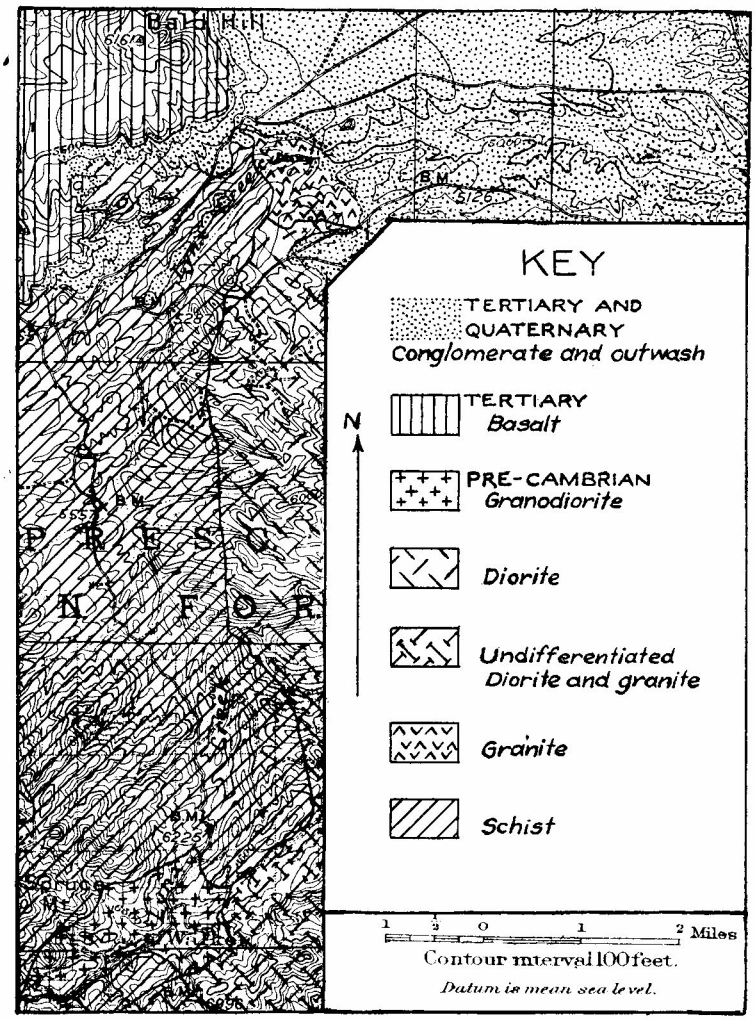


Fig. 4.—Geologic map of the Lynx Creek region. Geology of northern 6½ miles by Eldred D. Wilson, southern 4 miles by T. A. Jaggar and C. Palache. Base map from U. S. G. S. Jerome and Bradshaw Mts. sheets.

two feet higher. Lindgren* states that the average value is reported at 18 cents per cubic yard.

According to Lindgren,* "At Walker the placers yielded

*Lindgren, Waldemar, Ore Deposits of the Jerome and Bradshaw Mountains Quadrangles, Arizona: U. S. Geol. Survey Bul. 782, p. 109. 1926.

nuggets worth as much as $80, at about $16 an ounce. Lower Lynx Creek produced a finer-grained gold of higher value, worth about $18 an ounce. Such an enricchment in the value of the gold is common and indicates a solution of the silver by the waters." The gold of lower Lynx Creek ranges from finely divided material up to $4- or $5-nuggets, and is associated with considerable hematitic and magnetitic black sand.

The placer gold of Lynx Creek was doubtless derived from disintegration of the numerous gold-bearing quartz veins contained in the pre-Cambrian rocks of the Walker region.

Recent Operations—During the 1931-1932 winter and spring season, upwards of twenty-five men were working in upper Lynx Creek and in the dry wash tributaries, between Walker and the main highway. In the main channel, three miles south of Walker, one operator cleaned to bedrock with drag line excavator and power shovel. Insufficient values occurred to warrant continuation of the work.

In the dry gulches tributary to the main channel a number of pocket hunters operated intermittently. Pay dirt was sacked and carried down to water at various places and was there treated in rockers. Very small wages were realized.

In lower Lynx Creek below the dam of the Lynx Creek Mining Company, there was no activity. It is reported that a large dredge is being built and is to be installed during 1932 to treat the gravels extending from the dam down stream for four miles. Partial testing of the ground is reported to have shown values averaging fifty cents a yard.

WEAVER AND RICH HILL PLACERS

The Weaver and Rich Hill placers are situated in southern Yavapai County, from Stanton to Weaver Creek, a short distance northwest of Octave and from six to eight miles in air line east of Congress Junction.

This placer area is at the southern margin of the Weaver Mountains, which rise to over five thousand feet above sea level, or to more than two thousand feet above the adjacent desert plain to the south. Rich Hill stands at an elevation of 5,200 feet above sea level between the deeply eroded canyons of Antelope Creek on the west and Weaver Creek on the east. Since the higher portions of the Weaver Mountains receive at least eighteen inches of rainfall per year, these two south-flowing creeks generally have some water in their upper courses, and are subject to torrential floods during the rainy seasons.

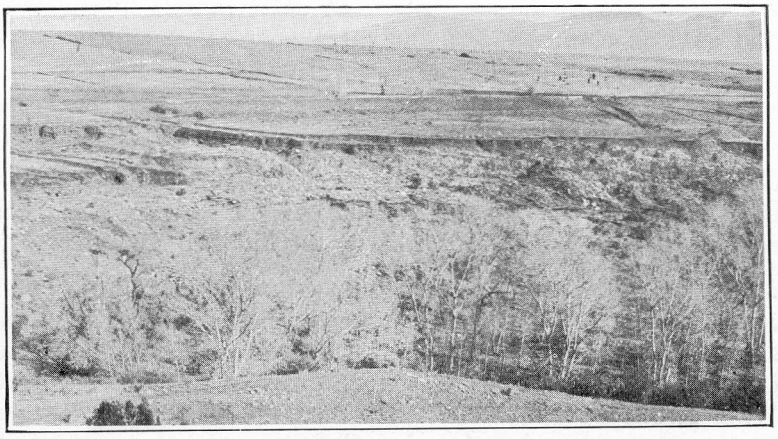


Fig. 5.—View northeast across lower Lynx Creek placers and Lonesome Valley. Photo by W. R. Shananfelt.

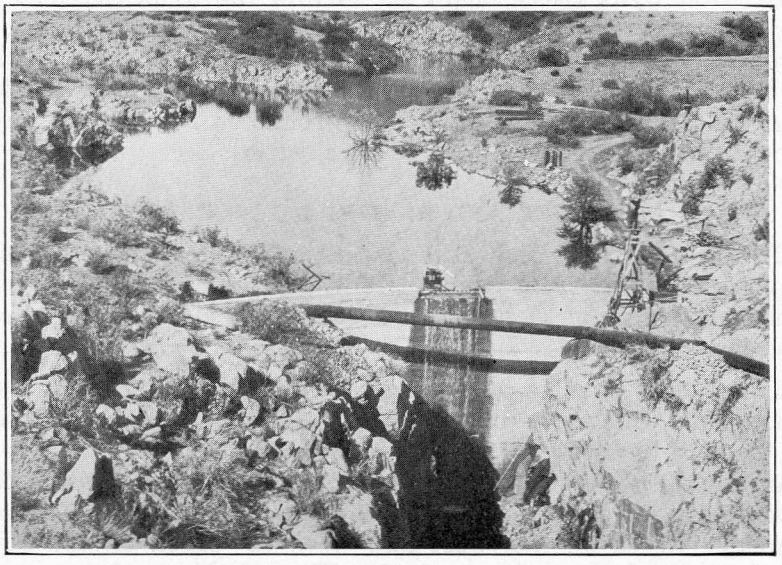
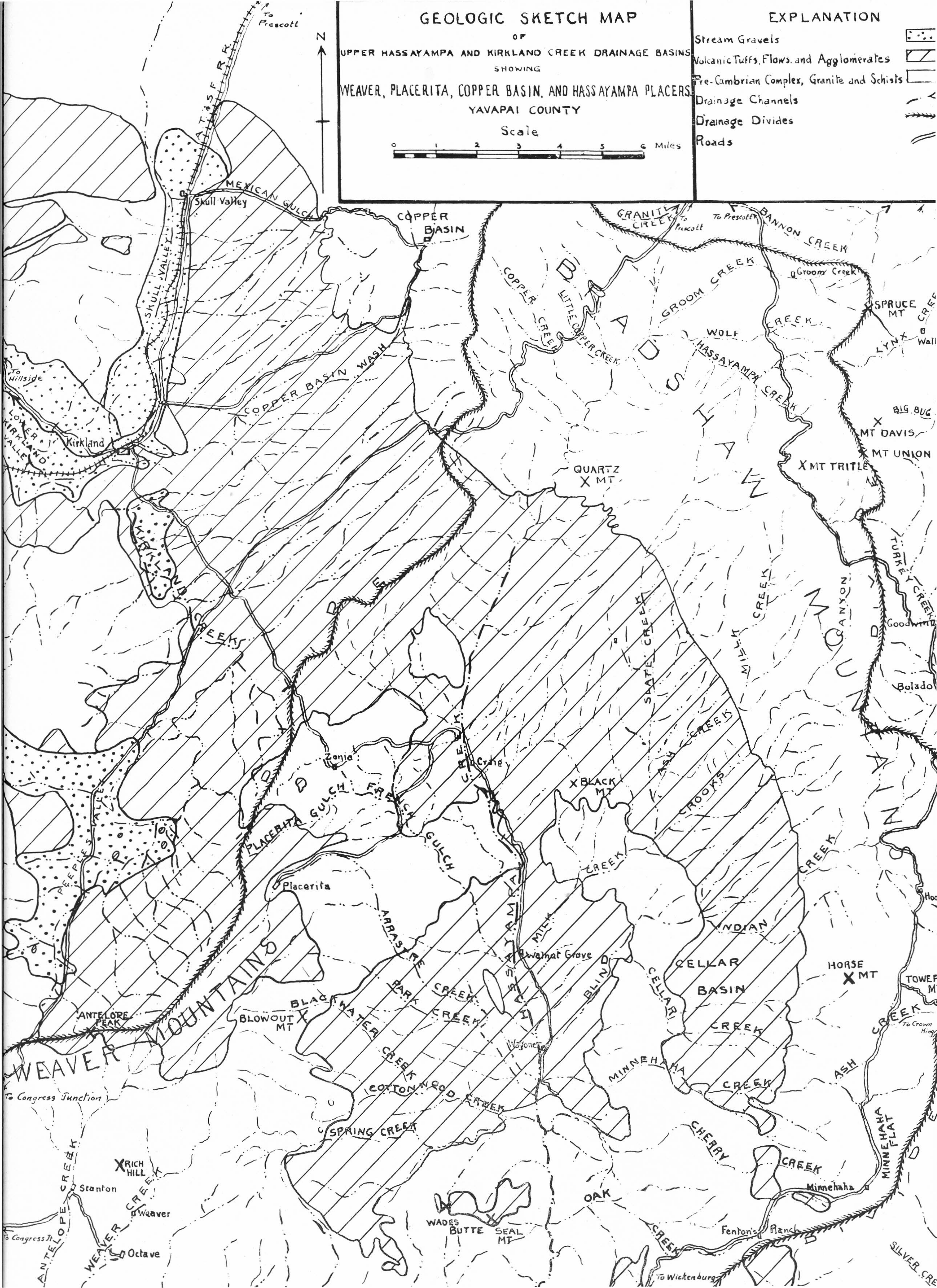


Fig. 6.—Dam and reservoir of Lynx Creek Mining Co. Photo by W. R. Shananfelt.


GEOLOGIC SKETCH MAP
OF
UPPER HASSAYAMPA AND KIRKLAND CREEK DRAINAGE BASINS
SHOWING
WEAVER, PLACERITA, COPPER BASIN, AND HASSAYAMPA PLACERS
YAVAPAI COUNTY
Scale
0 1 2 3 4 5 6 Miles
EXPLANATION
Stream Gravels
Volcanic Tuffs, Flows, and Agglomerates
Pre-Cambrian Complex, Granite and Schists
Drainage Channels
Drainage Divides
Roads
N
To Prescott
A.T.&S.F. R.R.
MEXICAN GULCH
Skull Valley
SKULL VALLEY
COPPER BASIN
GRANITE CREEK
To Prescott
BANNON CREEK
Groom Creek
GROOM CREEK
COPPER CREEK
LITTLE COPPER CREEK
BRADSHAW MOUNTAINS
WOLF CREEK
HASSAYAMPA CREEK
SPRUCE MT
LYNX
BIG BUG
MT DAVIS
MT UNION
MT TRITLE
QUARTZ MT
To Hillside
LOWER KIRKLAND VALLEY
Kirkland
COPPER BASIN WASH
KIRKLAND CREEK
TURKEY CREEK
Goodwin
MILK CREEK
CANYON
SLATE CREEK
Bolado
Zonia
Crtg
BLACK MT
ASH CREEK
CROOKS
PLACERITA GULCH
FRENCH GULCH
PEEPLES VALLEY
Placerita
ARRASTRE CREEK
HASSAYAMPA
MILK
Walnut Grove
BLIND
INDIAN
CELLAR
CELLAR BASIN
CREEK
HORSE MT
TOWER MT
To Crown King
ANTELOPE PEAK
WEAVER MOUNTAINS
BLACKWATER CREEK
BLOWOUT MT
PARK CREEK
Wagoner
MINNEHAHA CREEK
ASH CREEK
To Congress Junction
COTTONWOOD CREEK
SPRING CREEK
CHERRY CREEK
MINNEHAHA FLAT
RICH HILL
Stanton
ANTELOPE CREEK
WEAVER CREEK
Weaver
Minnehaha
OAK CREEK
WADES BUTTE
SEAL MT
Fenton's Ranch
To Congress Jt.
Octave
To Wickenburg
SILVER CREEK

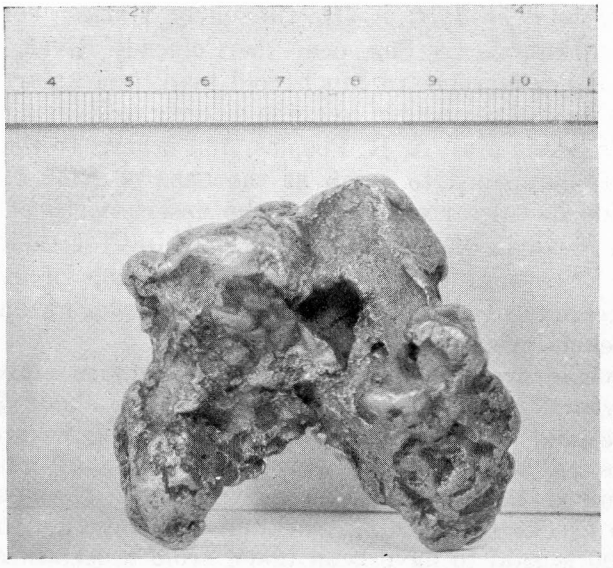


Fig. 7.—Gold nugget from the Weaver placers, Arizona. Natural size.

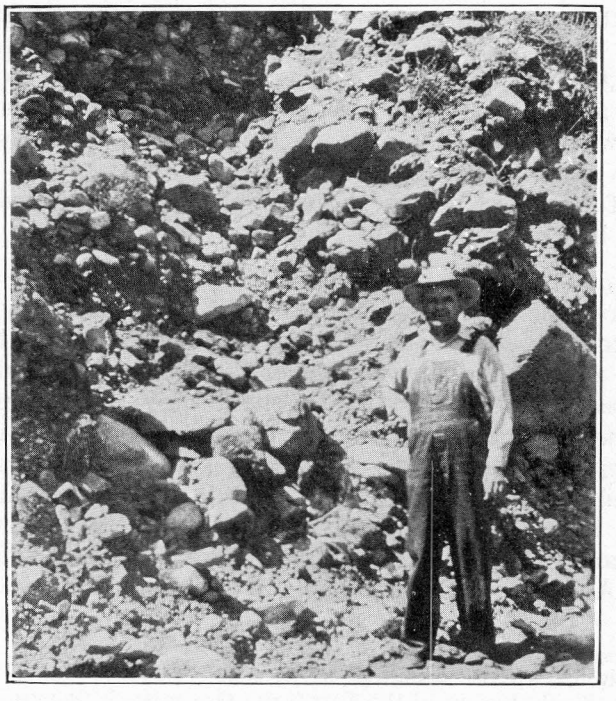


Fig. 8.—Typical gravels of Weaver Creek placers.

History and production—In the early sixties, certain Indians who came to La Paz, near the Colorado River, to trade, reported the occurrence of much gold many miles farther east. One of them was persuaded to guide a party, consisting of Capt. Pauline Weaver, Maj. A. H. Peeples, and others, to the locality. This party happened to camp at the base of Rich Hill, after their guide had deserted them on the desert north of Wickenburg. A Mexican of the party, while looking for their strayed animals, discovered loose gold nuggets on top of Rich Hill. This discovery led also to the finding of the placers on Weaver and Antelope creeks.

This whole area became the scene of intense activity, and in five years, according to Hall,* produced about $500,000. The loose gold underneath the boulders and in the crevices of the rocks on Rich Hill was easily gathered, but more effort was required to work the bouldery gravels of Weaver and Antelope creeks by panning, rocking, and sluicing. As much as $40,000 is said to have been taken from a certain acre, and the production of the whole area, prior to 1883, was estimated by Hamilton† at $1,000,000. The town of Weaver, on Weaver Creek, flourished until about 1896. Blake,‡ in 1899, stated that the score or so of men who were working these placers from year to year were supposed to be recovering over $2,000 per month. Production from 1905 to 1929, inclusive, amounted to about $78,255, and the purchase of about $1,000 worth of gold at Octave alone, during the first half of 1927, is reported by Mr. F. W. Lyman, storekeeper. The old town of Weaver, however, has long been deserted, and is marked by crumbling ruins.

Geology—The Weaver Mountains, which are made up mainly of pre-Cambrian granites and schists, overlain by Tertiary lavas, contain numerous gold-bearing quartz veins that were in part responsible for the placers. It is quite possible, however, that a large part of the gold may have been derived from the reworking of ancient channels extending under the lava, represented by the high rich gravels found on top of Rich Hill. The gold in these possible ancient channels could readily have been derived from veins in the pre-Cambrian schists and granite of the western flanks of the Bradshaw Mountains. A search for old channels in the upper parts of Antelope

*Personal communication.

†Hamilton, Patrick, Resources of Arizona. 1883.

‡Blake, W. P., Report of the Territorial Geologist, in Report of the Governor of Arizona, 1899, p. 60.

and Weaver creeks is well worth consideration. The general geological features are shown in Figure 9.

Broadly speaking, the placer ground covers an area of approximately eight by five miles. It is said that the most productive portions, which were in the northern half of this area, included about ten acres on the north-eastward-sloping top of Rich Hill; certain portions of the sides of the hill; the channels and benches of Weaver, Antelope, and other washes; and the gravel mesas that lie between these washes. On the top of Rich Hill the gold occurs on bedrock that in places is covered with boulders and a thin layer of residual clay. Along the washes below, and in the mesas, however, the placer material consists of iron-stained gravel and sand, up to ten or more feet thick, together with abundant, subangular boulders that are two to six feet in diameter (see Fig. 8). On Rich Hill, according to Blake,* one nugget worth $450, and three worth a total of $1,008, were found. Mr. C. B. Hosford,† of Octave, stated that the largest nugget found on upper Weaver Creek was worth $396, and that two chunks of quartz contained $450 worth of gold. Occasional nuggets worth from $1.50 to $7 are still being found above old Weaver. Away from the margin of the mountains, however, the particles of gold are much smaller. According to Heikes,‡ the fineness of the Rich Hill and Weaver placer gold is 910.

Recent Operations—During the winter and spring months of the 1931-1932 season, a large number of men was camped in the vicinity of Octave and the old town of Weaver, and were employed intermittently at working the gravels of Weaver Creek. Water was plentiful and a very small wage was made by a few individuals, who used rockers and sluice boxes. All the ground is privately owned, but no objection is made to small-scale work, usually without royalty. The gravels are excessively coarse and hard to work, and the ground has all been worked and repeatedly reworked for the past seventy years. Occasional large nuggets are found, but average earnings are very small.

In the spring of 1931 an unusually large nugget was brought into the office of the Arizona Bureau of Mines from the Weaver region. This nugget was described by Heineman§ as follows:

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*Blake, W P.., op. cit.

†Oral communication.

‡Heikes, V. C., Dry Placers in Arizona: U. S. Geol. Survey Mineral Resources for 1912, Part I, p. 259.

§Heineman, Robert E. S., An Arizona Gold Nugget of Unusual Size, American Mineralogist, Vol. 16, No. 6, June, 1931, pp. 267 to 269.

". . . . The nugget is in general outline shaped somewhat like a human molar. It measures approximately 53 mm. across the widest portion of the "roots," and 47 mm. from the bottom of the "root" to "the crown." Several fragments of slightly iron-stained quartz remain in the center of the mass. . . . The total weight is 270.90 grams, . . . and it may be calculated that the nugget consists of 252.38 grams of metal and 18.52 grams of quartz . . . . worth $152.62 in gold and 22.71 grams of silver worth 21 cents at date of writing.

One attempt at large-scale work with drag line and power shovel was made during the 1931-1932 season, but insufficient values were found to warrant the high expense of handling the coarse gravel.

HASSAYAMPA PLACERS

Placer gold occurs along practically the whole course of the Hassayampa in Yavapai County. Hassayampa Creek rises in the Bradshaw Mountains at an elevation of approximately 7,000 feet above sea level, about eight miles south of Prescott, and crosses the Yavapai-Maricopa County line two miles north of Wickenburg at an elevation of about 2,000 feet. Due to its large drainage area, this creek carries torrential floods in the rainy season, and abundant subsurface water during the dry months.

History and production—According to Mr. T. J. Laird, of Groom Creek, the placers of Hassayampa Creek in Yavapai County were first worked by the early Spanish explorers, then, after the sixties, by Americans, and finally by Chinamen, who reworked some of the ground prior to 1899. The period of greatest activity in these placers is said to have been from 1885 to 1890, and very little mining has been done in them since 1899. Large-scale operations were at one time about to be tried below Walnut Grove reservoir; but the washing out of the earth- and rock-fill Walnut Grove dam in 1890 stopped this project. It is supposed that most of the gold that could be recovered by ordinary, small-scale methods has been harvested; but, according to Mr. W. N. Agnew, of Groom Creek, a few experienced placer miners who reworked a portion of the ground about 1912 recovered over $1 per day each. No records of the total production are available, but all the local estimates are over $1,000,000.

Geology—The Hassayampa River rises in the high mountain peaks of the Bradshaw Mountains south of Prescott. This region is composed of pre-Cambrian schist and granite cut by

later quartz diorite, and contains many gold-bearing veins, some of which were highly productive at their outcrops. The river flows in a general southwesterly direction, and at Quartz Mountain, about six miles southwest of Prescott, the old pre-Cambrian complex is covered by a thick series of old conglomerate, volcanic tuffs, and flows of probable Tertiary age. For about twelve miles, the river cuts through this young complex. Below Wagoner, the volcanic rocks are left and the river has cut a deep channel in the older pre-Cambrian rocks.

The placers are found partly as shallow placers in the head waters of the river, derived from the recent erosion of the gold-bearing veins, and partly in the volcanic region below Quartz Mountain. It is quite possible that a part of the gold found in this part of the stream channel may be derived from the reworking of old channels formed prior to and during the volcanic activity. A search for possible old channels in the volcanic complex in the numerous tributaries of the Hassayampa is well worth consideration.

Figure 9, opposite p. 32, shows the general topographic and geologic features of the basin of the Hassayampa, as a guide to prospecting the area.

Present Operations—During the 1931-1932 season, a little work was being done in the headwaters of the creek with indifferent results, as the ground has been worked steadily for the past seventy years. This part of the stream channel is all privately owned and all work is discouraged.

Some work was done with rockers in the main stream gravels south of the Box north of Wickenburg, and very small earnings were reported.

BIG BUG PLACERS

The Big Bug placer region is situated in south-central Yavapai County, in the general vicinity of Big Bug Creek, Mayer, Poland, McCabe, and Humboldt. This region lies on the northeast slopes of the Bradshaw Mountains, and extends from Big Bug Mesa, 7,100 feet above sea level, down to Agua Fria Creek, 3,600 feet lower. Big Bug Creek, which empties into Agua Fria Creek, is perennial in approximately the upper half of its course.

History and production—Gold was discovered within the Big Bug region in the late sixties, but the greatest activity in placer mining there was during the eighties. Considerable rocking and panning have gone on, especially in upper Big Bug Creek as far down as Mayer, and in Chaparral and other gulches near

McCabe. Dry-washing has been done to some extent in the drier portions of the region, and a large-scale hydraulic project was once contemplated for the mesa land between Mayer and Humboldt. No estimates of the early production are available, but the 1910 to 1929 reported yield, as shown in the table on page 17, was $23,100.

Geology—The principal rocks of the Big Bug region are pre-Cambrian schists, smaller amounts of granite and granodiorite, abundant rhyolite dikes, and Tertiary basalt flows.

These placers occur in the stream channels and on certain of the intervening mesas of a roughly triangular area that extends for about 20 miles east and northeast from the head of Big Bug Creek. The gold of the stream placers is generally coarse. One of the largest nuggets found in the Big Bug region contained about $500 worth of gold, and is illustrated in Figure 10. In the gravel mesa between Humboldt and Mayer, the gold, which is rather finely divided and associated with considerable clay, amounts to about thirty to forty cents per cubic yard.*

Certain quartz veins within the older rocks of the vicinity provided the gold for the stream placers, but the finely divided gold of the gravel mesas between Mayer and Humboldt probably has undergone longer transportation.

Recent operations—During the winter and spring season of 1931-1932, about seventy-five men were reported as working intermittently in the banks of the main channel above Mayer. Work was done by tunneling into the banks and washing the gravels in sluice boxes and rockers. This is one of the oldest fields worked in Arizona, and the banks have been in the past literally honeycombed by tunnels, raises, shafts, and stopes. A very small wage was earned by a few men but the average earnings were from twenty-five to fifty cents a day. The gravels are excessively coarse, and only a small yardage can be handled in a shift.

One large-scale operation is being attempted by the Humphries Investment Company of Denver. In early May, 1932, excavation by power caterpiller-mounted shovel had been commenced in the main channel, and a Barber Green stacker was being installed to handle the pay gravel. A partial test of the ground showed values of $1.00 a yard.

GROOM CREEK PLACERS

The Groom Creek placers are situated in south-central Yavapai County, along Groom Creek, from four to six miles south

*Oral communication from Mr. Homer R. Wood, of Prescott.

of Prescott. This creek heads in the Bradshaw Mountains west of Walker, at an elevation of about 7,300 feet above sea level, and joins Hassayampa Creek at a point some five miles in air line farther southwest and some 1,900 feet lower.

These placers were discovered in the sixties, and were worked actively during the eighties. Their total production, according to former State Historian Hall,* probably has amounted to about $100,000.

Quartz veins contained within the local pre-Cambrian schist, which has been intruded by diorite, granodiorite, granite, and dikes of rhyolite porphyry, were the original source of the gold of these placers.

MINNEHAHA PLACERS

Placer gold occurs along Minnehaha Creek, about twenty-five miles in air line south of Prescott, below elevations of 5,500 feet above sea level. Lindgren† says: "Minnehaha Flat is a northward-trending, well timbered and watered basin on the headwarters of Minnehaha Creek, which discharges into Hassayampa River near Walnut Grove. . . . Placer mining was carried on here in the eighties of the last century all the way up from the 'Old Log House' to the Button Mine, also in branches coming in from the east. The gold was worth about $17 an ounce and was extracted by arrastres, sluices, and dry-washers. The probable production was $100,000, according to Mr. M. A. McKay, an old-time resident of the district. The gold is believed to have been derived from the Fortuna lode near Lapham's place."

GRANITE CREEK PLACERS

Placer gold occurs along the upper branches and main course of Granite Creek, which rises a few miles south of, and flows northward through, Prescott. These placers were discovered in the sixties, and were worked south of Prescott to a considerable extent during the eighties. It is said that New England Gulch, a branch of Granite Creek about four miles south of the city, was very rich, and that one old-time placer miner recovered about $20,000 worth of gold from there prior to 1922. According to Mr. Homer R. Wood, of Prescott, some small nuggets have been found in digging excavations for buildings in that

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*Oral communication.

†Lindgren, Waldemar, Ore Deposits of the Jerome and Bradshaw Mountains Quadrangles, Arizona: U. S. Geol. Survey Bul. 782, p. 177. 1926.

city. Lindgren* states that a little placer gold has been mined also at Del Rio, about 22 miles north of Prescott.

PLACERITAS PLACERS

Placeritas placers are situated in southwestern Yavapai County, about eleven miles in air line south-southeast of Kirkland, at elevations of less than 5,000 feet above sea level, in the vicinity of Placerita, French, and Arrastre creeks. In 1899, Blake† stated that "The placers . . . . at Placeritas have long been known and worked, and are regarded as good-wages mines." According to A. B. Colwell,‡ a dredging project was attempted a few years ago on a rather small area of ground in French Gulch, about 1 mile below Zonia, but the dams failed. Mr. W. R. Shananfelt, of Prescott, states that some $10 nuggets have been found in this gulch, but a large number of coarse, flat boulders occur throughout the gravel.

Recent operations—This old field was not as rich in the early years as some of the surrounding fields and was not as extensively worked. During the past winter and spring season, 1931-1932, a number of men were working the gravel bars of Arrastre, Placerita, and French gulches with fair success. The gravels are not as coarse there as in the surrounding fields. The search for old channels in this area is warranted, as a reference to Figure 9, opp. p. 32, will show. The gold is in part derived from gold veins in the pre-Cambrian formations of the Weaver Mountains and in part, possibly, from the reworking of old gravels within the volcanic rocks.

COPPER BASIN PLACERS
(By J. B. Tenney)

This old placer field is situated in the dissected mesa east of Skull Valley and Kirkland Creek. The area is carved from a complex of volcanic tuffs and flows interbedded with old, partly consolidated conglomerates and sands. The placers, now being worked, occur as shallow sandy clay deposits, in the dry arroyas tributary to Copper Basin wash and other dry washes tributary to Skull Valley and Kirkland Creek. The gold is derived in part from the present erosion of the gold-bearing veins cutting the pre-Cambrian granite of Copper Basin, and in part from the reworking of old conglomerate within the volcanic complex. An interesting feature of this field is that considerable cinnabar

*Op. cit., p. 54.
†Blake, W. P., Report of the Territorial Geologist, in Report of the Governor of Arizona, 1899, p. 66.
‡Oral communication.

(mercury sulphide) and some natural amalgam are found, derived from cinnabar-bearing veins outcropping in Copper Basin.

The placers are shallow, varying from one or two feet on the mesas to eight feet in the arroyo bottoms. This field was never very rich, but the values are quite evenly distributed. For this reason, the area was long abandoned, and was not rejuvenated until 1929 when the first reopening of the field took place.

Four large companies, each treating upwards of three hundred yards a day, are now operating large tracts of ground. The field is not suitable for small-scale work due to lack of water and to the abundant clay in the gravels. The four companies have developed ample water by means of shallow wells and have installed treatment plants, drag lines, and small power shovels. Due to the abundant black sand, the treatment consists of screening and tabling followed by amalgamation of the black sand concentrates. One company is using the Girand centrifugal concentrator with success.

A partial test of a large acreage indicates values varying from 35 cents to $4 a yard with an average from the whole field of about $1 a yard.

The location of this placer district is shown in Figure 9, opp. p. 32. As is seen, it is situated in the northwestern end of the large volcanic complex extending in a southeastly direction from Skull Valley to Minnehaha Creek, with southwestern outliers extending to Antelope Peak in the Weaver Mountains, and beyond Walnut Grove to Spring Creek. The search for possible old channels in this large area is well warranted and may yield mines similar to those of the western foothills of the Sierra Nevadas in California.

BLACK CANYON PLACERS

Placer gold occurs along Black Canyon, which drains the water of Turkey, Poland, and Bumblebee creeks southward into the Agua Fria River. According to Lindgren,* "Placers have been worked at several places in Black Canyon, particularly below the Howard Copper Company's property. A few years ago a Portuguese is said to have taken out $20,000 near the old stone cabin 1 mile below Howard. There are also small placer deposits near Turkey Creek station, and every year more or less dry washing is done by Mexicans in this locality."

Recent operations—A number of parties were attempting to

*Op. cit., p. 157.

work the Black Canyon gravels in the past season, 1931-1932. This is one of the old fields which have been worked intermittently for the past sixty years. The gravels are excessively coarse and hard to handle, and the gold is associated with abundant black sand, only a part of which can be separated by means of a magnet. Results were very disappointing.

On one bar of limited yardage, three miles south of Bumblebee, power shovels and a treatment plant are being installed. A partial test of the ground indicates about $1 a yard values.

EUREKA PLACERS

Gold placers occur in Burro Creek and other gulches of the Eureka district of western Yavapai County, about eighteen miles in air line northwest of Hillside. According to Mr. Homer R. Wood, of Prescott, more than one hundred men were dry placer mining at the old Placeras, near the Cowboy Mine, during the late fifties. The U. S. Mineral Resources record a placer production of $363 from the Eureka district in 1914, and a little in 1922.

HUMBUG PLACERS

Regarding gold placers in the Humbug district of southern Yavapai County, Lindgren* says: "The Humbug district, adjoining the Tiptop on the west, contains many gold-bearing veins, but most of its production evidently came from placers, now exhausted, in Swilling, Carpenter, and Rockwall gulches, which are small tributaries of Humbug Creek." According to Allen,† an attempt to work the placers of Humbug Creek was made in the early nineties by an English company that spent considerable money in building a camp, dams, and pipe lines for hydraulicking; but the attempt failed through lack of water and through inability to save the gold known to be present.

PIMA COUNTY

The principal gold placer districts of Pima County are Greaterville, Quijotoa, and Las Guijas. Other placers are known in various portions of the county, but, except in the Old Baldy and Papago districts, they have not been of any economic importance.

GREATERVILLE PLACERS

Greaterville district is situated in southeastern Pima County, at the eastern foot of the Santa Rita Mountains. The small

*Op. cit., p. 178.

†Allen, M. A., Arizona Gold Placers: Univ. of Ariz., Bureau of Mines Bul. 118, p. 19. 1922.

village of Greaterville, which is in the approximate center of the placer area at an elevation of 5,280 feet above sea level, is about thirty-four miles in air line southeast of Tucson and 8½ miles northwest of Sonoita, a station on the Nogales-Benson Branch of the Southern Pacific Railroad. The district is accessible by several short roads that branch west from the Tucson-Patagonia highway.

The Santa Rita Mountains, which attain in Old Baldy Peak, 7½ miles southwest of the camp, an elevation of 9,432 feet above sea level, receive abundant rainfall and are well timbered. Although this rainfall varies somewhat from year to year, the average annual amount for elevations of 4,000 to 6,000 feet above sea level is over fourteen inches, and for elevations over 6,000 feet is from sixteen to more than twenty inches. About seventy-five percent of this precipitation occurs in July, August, September, and October, and a large part of the other twenty-five percent falls during the winter as snow. The rainy season run-off has dissected the eastward-sloping placer region with numerous steep-sided, nearly east-west arroyos that drain to Cienega Creek and are about one hundred feet deep near Greaterville. However, the only perennial stream of the district is fed by springs and is situated about four miles south of the village. Sufficient water for domestic purposes, but not for much gravel-washing, is obtained from shallow wells in Empire, Ophir, Kentucky, and Big gulches.

History—According to Raymond,* placer gold was discovered in the Greaterville district in 1874 by A. Smith. From 1875 to 1878, the placers were worked by two hundred or more men.† The virgin gravels are said to have been so rich that each man recovered $10 or more daily by rocker with water packed in for four miles on burros and retailed at about three cents per gallon. After 1880, due to the richer gravels having been worked over, activity in the camp declined, and by 1886 had practically ceased.

According to Schrader and Hill,‡ sluicing was carried on in Kentucky Gulch for a few months during 1900. In 1902, considerable ground was owned and operated by the El Oro Mining Company. By 1905, the Santa Rita Water and Mining Company had begun operations on about two thousand acres of pat-

*Raymond, R. W., Statistics of Mines and Mining in the States and Territories West of the Rocky Mountains for 1875, pp. 389-390. 1877.

†Hinton, R. J., Handbook of Arizona, p. 213. 1878.

‡Schrader, F. C., Mineral Deposits of the Santa Rita and Patagonia Mountains, Arizona: U. S. Geol. Survey Bul. 582, p. 159. 1915.

ented ground. Their hydraulicking equipment, which was extensive, included eight or ten miles of ditch and pipe line from a system of dams in Gardner and South canyons in the mountains. Profitable operations were conducted by them for a short time, but the death of the manager, Mr. Stetson, and of the financial backer, Mr. McAneny, caused a suspension of the work.

Further hydralic operations* were tried by another company, at the junction of Kentucky and Boston gulches, with a 125-foot head of water brought through an 8-mile pipe line from the first canyon south of Gardner Canyon. Considerable sluicing of the creek bed is reported to have shown, however, that the gravels in the overburden there were rather coarse, and that the returns were too low to warrant further work.

Another company installed* a one-ton steam shovel, screens, and a conical concentrating tank in Empire Gulch just below Enzenberg Canyon, but the pay dirt was not rich enough to warrant the removal of the 16 or more feet of overburden.

Production—According to Raymond,† the yearly production of the Greaterville placers from 1874 to 1883 was estimated at $12,000. Burchard‡ places the 1884 output at $18,000. The total up to 1909 was estimated by J. P. Coyne§ at $7,000,000. From 1902 to 1929, the production of the district reported by the U. S. Mineral Resources, as shown on page 17, totaled $40,981. The L. E. Jones Company, of Greaterville, reports‖ purchasing $67 worth of placer gold from the district during the last half of 1925, $182 during 1926, and $32 up to May 20 in 1927.

Geology—The accompanying map (Fig. 10), after Hill¶ and Schrader* shows the general geology and the distribution of placer gravels in Greaterville vicinity.

The oldest rocks in the area are Devonian and other Paleozoic limestones, which outcrop 1¼ miles southwest of Greaterville in a prominent ridge about ½ mile wide. These strata dip steeply southwestward, are overlain on the southwest by Cretaceous red sandstones and shales, and are bounded on the northeast, with fault contact, by Mesozoic or later granite.

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*Schrader, F. C., op. cit.

†Raymond, R. W., Mines and Mining West of the Rocky Mountains, p. 342. 1876.

‡Burchard, H. C., Production of the Precious Metals in the United States, p. 46. 1884.

§Hill, J. M., Notes on the Placer Deposits of Greaterville, Arizona: U. S. Geol. Survey Bul. 430, p. 12. 1910.

‖Oral communication.

¶Hill, J. M., op. cit., pp. 11-22.

Next younger than the Devonian are the Cretaceous rocks already mentioned, and a north-south belt, from one to two miles wide, of thin-bedded, gray to maroon, arkose, sandstone, conglomerate, dolomite, and shale that outcrops west, northwest, and southwest of Greaterville. Hill regarded the age of these rocks as Cambrian, but it is probably Cretaceous. This belt is bounded on the west and southwest by younger granite, and on the east by outwash débris and gravel. It is intruded also by the granite porphyry of Granite Mountain, and by dense, light-colored rhyolitic dikes. In the northern half of the area mapped in Figure 10, the strata dip from 5°-10° eastward, but, in the vicinity of Granite Mountain, the dip is at steeper angles away from the intrusive. In the vicinity of the larger intrusives, there has been considerable local metamorphism that is marked by sericitization and silicification. Near Granite Mountain, the beds are strongly impregnated with quartz and sericite, together with some calcite, pyrite, and chalcopyrite. Here also are the gold-bearing quartz veins that probably gave rise to the placers.

The granite west of the Cretaceous belt was regarded by Schrader* as older than those sediments, and by Hill† as pre-Cambrian. It was found by the writer to be intrusive into the Cretaceous, and its age, therefore, is Mesozoic or younger. This granite is coarse-grained to porphyritic, weathers light-brown to greenish-gray, and is somewhat sheeted and jointed. Under the microscope it is shown to contain deeply kaolinized orthoclase and albite, quartz, and chloritized biotite. This intrusion had no obvious connection with the origin of the gold of the district.

Mesozoic or younger granite porphyry also intrudes the Cretaceous sediments, and, 1¼ miles west-southwest of Greaterville, forms knob-like Granite Mountain, which rises to 5,500 feet above sea level. This granite weathers white, except where stained yellow or brown by alteration of impregnated pyrite, and is of granular to porphyritic texture. According to Hill‡ it is made up of orthoclase, quartz, kaolinized, undetermined plagioclase, biotite, and magnetite. This granite porphyry seems to have furnished the mineralizing solutions for the gold-bearing quartz veins that were the source of the placers.

The outwash débris material east of the Cretaceous belt is

*Schrader, F. C., Mineral Deposits of the Santa Rita and Patagonia Mountains, Arizona: U. S. Geol. Survey Bul. 582. 1915.

†Hill, J. M., op. cit.

‡Hill, J. M., op. cit., p. 16.

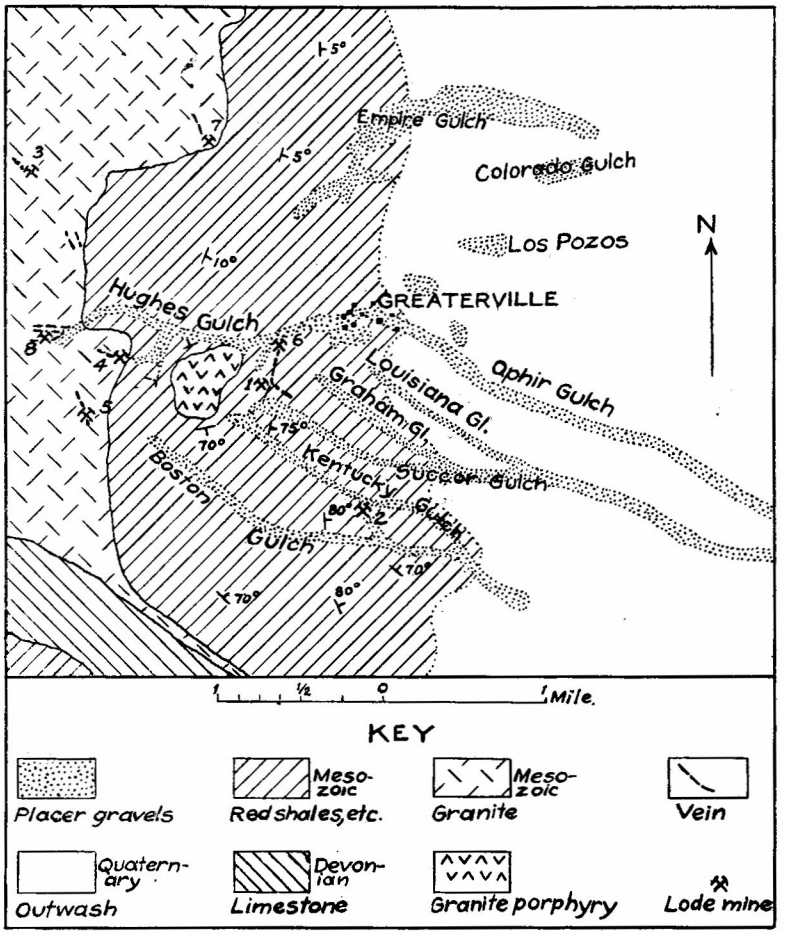

Fig. 10.—Geologic map of the Greaterville placer region, after Schrader and Hill, with certain alterations. Lode Mines: 1, Fulton; 2, Harshaw; 3, Mountain King; 4, Quebec; 5, Royal Mt.; 6, St. Louis; 7, Wisconsin; 8, Yuba. Devonian area includes other Paleozoic rocks.

made up of eastward-thickening, imperfectly stratified, very angular gravel and sand that has been derived by erosion from the Santa Rita Mountains. This material often has a matrix of clay or lime carbonate cement. It is dissected by many broad, deep-sided gulches, and contains the gold placers of the district.

Character and distribution of the gravels—Schrader* gives the following description of the gravels, based largely upon the

*Schrader, F. C., op. cit., p. 161.

work of Hill. The location of the gulches mentioned can be seen on the accompanying map (Fig. 10).

"They (the placers) are irregularly distributed, chiefly in the bottoms of the present stream courses and gulches, where the principal diggings occur in shallow ground, and also upon the benches, slopes, and tops of the ridges, where some of them seem to represent deposits in old stream channels, examples of which occur just south of Greaterville 30 feet above the valley, on the crest of the ridge to the southeast, and on the north side of Hughes Gulch below the mouth of Nigger Gulch 15 feet above the bottom. They consist chiefly of a 2-foot bed of angular gravel which rests unconformably upon the bedrock of all the different older formations contained in the area, including the early Quaternary "cement rock." They are covered by 1 foot to 20 feet or more of overburden composed of later Quaternary and recent gravels and wash. In places, as in Kentucky, Ophir, and Empire gulches, the upturned, irregularly eroded edges of the underlying sedimentary beds form natural riffles, behind which the gold has been concentrated.

"The gravels of the gold-bearing bed are generally small, the pebbles, as a rule, being less than an inch in size, though in many places cobbles 4 to 8 inches in diameter occur. In a few places the gravels are crudely stratified and slightly cemented, generally by lime. They are sharply angular and but slightly water worn. The sand consists chiefly of angular fragments, and many of the particles of quartz and feldspar show well-preserved crystal faces. The coarse material consists chiefly of red and yellow sandstone, shales of various colors, arkose, a little dense white rhyolite, and granite porphyry. The gravels rest in most places in a red-brown clayey matrix which is handled without difficulty by hydraulic methods."

Character of the gold—"The gold, which is rather uniformly distributed throughout the bed, is mostly coarse. It ranges from flakes one-tenth of an inch in longest diameter, which was the size of most of the material recovered at the time of the visit in 1909, to nuggets worth a dollar or more. The gold of the early days was all coarse, nuggets ranging from $1 to $5 in value being common. Some nuggets brought into Tucson contained from $35 to $50 worth of gold, and the largest nugget reported from the camp weighed 37 ounces and had a value of about $630. The gold averaged about $17 to the ounce fine, and it was not difficult for a man to take out an ounce a day. The gold, like the containing gravels, is very angular, with many pointed projections, denoting that it is of local origin and has not traveled far. A little quartz adheres to some of it and seem-

ingly also galena, both of which are reported to have been common in the large nuggets. The gold is mostly bright, but some of it is iron-stained and concentrates from panning contain considerable magnetic black sand."

According to L. E. Jones Company of Greaterville, a nugget worth $228 was found in 1924, and the average fineness of the 1926 product was about 81.

Productive gulches—Schrader* says:

"The productive gulches were Boston, Kentucky, Harshaw, Sucker (Succor), Graham, Louisiana, Hughes, Ophir below its junction with Hughes, the upper parts of Los Pozos and Colorado, Chispa on the road from Enzenberg camp to Greaterville, and Empire below its junction with Chispa.

"Boston Gulch: In Boston Gulch, which heads in the col south and west of Granite Mountain and trends a little south of east, gold was found in paying quantities from its head a point about half a mile south of its junction with Kentucky Gulch at the Kentucky camp. In the upper 2 miles of its course the gold was found in a channel 5 feet wide on bedrock, at 2 to 4 feet below the surface. Below Harshaw Gulch the gold was still confined in a 10-foot channel in the valley bottom, 5 to 10 feet below the surface. Below the mouth of Kentucky Gulch the valley is wide, and for half a mile below this point the gold was distributed on bedrock at a depth of 10 to 16 feet for a width of approximately 50 feet.

"Harshaw Gulch: In Harshaw Gulch, a short, narrow tributary of Boston Gulch with steep bedrock sides, the pay streak, which in places was rich, was confined to the bottom of the gulch, about 4 feet wide.

"Kentucky Gulch: In Kentucky Gulch, which heads south-southeast of Granite Mountain and joins Boston Gulch at Kentucky camp, the gold occurs throughout its length on bedrock in a channel 6 to 10 feet wide. At the upper end of the gulch the pay streak lay at the surface, but the covering gradually thickened to 6 feet at the mouth of the gulch.

"Sucker Gulch: In Sucker Gulch, which has three small heads southeast of Granite Mountain, the gravels were productive to a point a little below its junction with Ophir Gulch. From its head to the mouth of Graham Gulch the pay channel was 6 to 9 feet wide and 3 to 12 feet below the surface. Between Graham and Louisiana gulches the pay channel averaged from 20 to 50 feet in width and the depth was from 12 feet at the former to 25 feet at the latter gulch. Below the mouth of Louisiana

*Schrader, F. C., op. cit., pp. 162-164.

Gulch the gold was found distributed through the gravels on bedrock for a breadth of 100 feet. The overburden at the lower end was excessive, and therefore but little work was done.

"Graham Gulch: In the lower end of Graham Gulch, a short branch of Sucker Gulch heading southwest of the St. Louis mine, the pay gravel covered the entire bottom, about 100 feet in width, on bedrock at 12 feet below the surface. At the upper end of the gulch the pay streak was 10 feet wide and was covered by only 6 inches of soil. Some gravels 15 feet above the bottom of the gulch on the south side were also productive.

"Louisiana Gulch: At the head of Louisiana Gulch, which heads about a quarter of a mile south of Greaterville and joins Sucker Gulch a little more than a mile below, gold was found almost at the surface, but near the mouth of the gulch it lay at a depth of 10 to 12 feet. The average width of the pay streak was about 6 feet.

"Hughes Gulch: In Hughes Gulch, which heads 2 miles west of Greaterville, just south of the Yuba mine, and extends north of Granite Mountain, a narrow channel, rarely over 6 feet wide from its head to its mouth, was found productive at 2 to 6 feet below the surface.

"Nigger and St. Louis gulches: Nigger and St. Louis gulches, small tributaries of Hughes Gulch, the first named lying to the west and the second to the east of Granite Mountain, contain small gold-bearing gravel channels.

"Ophir Gulch: Ophir Gulch, which heads northeast of the Yuba Mine, contains no placer deposits above its junction with Hughes Gulch. Below Greaterville, however, a channel 200 feet wide was found to contain gold as far down as the mouth of Sucker Gulch. The bedrock is rather deep here and little work has been done.

"Los Pozos Gulch: Los Pozos Gulch, which heads about a mile northeast of Greaterville, contains workable gravels in the upper 3,000 feet of its course.

"Colorado Gulch: On Colorado Gulch, a short branch of Empire Gulch, half a mile north of Los Pozos Gulch, some gold was found at shallow depths through a distance of 2,000 feet in the upper part of its course, nearly to its head.

"Chispa Gulch: In the lower three-quarters of a mile of Chispa Gulch, a small branch of Empire Gulch heading southwest of Enzenberg Gulch, a 5- to 10-foot pay streak on bedrock at about 10 feet below the surface yielded very high returns and was being worked at the time visited in 1909. In the lower portion of an east branch of Chispa Gulch gold was also being obtained from gravels 3 feet below the surface. At the head of

the western fork of Chispa Gulch, which is about a mile in length, pay dirt lay at the surface, but at the mouth of the fork the gold was contained in a 50-foot channel on bedrock with 10 feet of overburden.

"Empire Gulch: In Empire Gulch placer gold was found only along a mile and a half of its course below the mouth of Chispa Gulch. The gold occurs in a bed 2 feet thick resting on conglomerate bedrock and is covered by 16 feet of overburden. Near the mouth of Chispa Gulch the pay gravels were about 300 feet in width, but at the lower end of the pay belt they were distributed over a width of a thousand feet."

Origin of the placer gold—Since most of the productive gulches head in the Cretaceous sedimentary belt that surrounds Granite Mountain, the placers very probably were derived mainly by erosion of quartz veins of that vicinity. These veins have been prospected in the Yuba (Inghram), St. Louis, Quebec, and other lode mines, and found to contain more or less free gold. Particularly in the Yuba, some beautiful wire gold has been found. That the gold of the placers has not been transported far from its ultimate source is proclaimed by the angularity of its flakes and nuggets.

Present operations—A small amount of placer mining is carried on intermittently in the district by a few men, chiefly Mexicans, who dig pits or shallow shafts to bedrock and gopher out the gold-bearing gravels. This material is then washed in rockers, but frequently the clay matrix of the gravels somewhat lowers the percentage of recovery that ordinarily can be made by rocking or by other known hand methods. Due to this clayey matrix, also, dry-washing is possible only in the loose sands of the washes, during the driest months of the year. Much of the known richer ground has been reworked one or more times, and the floors of many of the gulches are literally pocked with pits, as illustrated in Figure 12.

However, several of the best mining engineers who have examined the area estimate, according to Schrader,* that it still contains about $50,000,000 worth of gold. Due to such factors as overburden, clayey matrix, and lack of abundant local water supply, this gold can be recovered profitably only on a large scale, by dredges or by certain adequate hydraulic methods, after ample water supply has been developed. Because of these facts, large-scale placering operations are contemplated by the Gadsden Purchase, Inc., and by the Greaterville Dredge Gold Mining Company.

*Schrader, F. C., op. cit., p. 165.

Gadsden Purchase, Inc., which is the successor of the Santa Rita Water and Mining Company, has control of several thousand acres of ground in Hughes, Colorado, Los Pozos, Hefty, Ophir, Succor, Louisiana, Kentucky, Boston, Harshaw, and Fish gulches. This ground, according to M. E. Young* contains from forty to sixty cents gold per cubic yard. The company plans to bring water, from reservoirs in Cave, Gardner, and Sawmill canyons, through about 12½ miles of ditches, tunnels, and steel pipe lines. Hydraulic, drag-line, and dredge operations are contemplated.

Recent operations—In the past year, 1931, the total gold recovered and sold at the Jones store was a little more than $1100 from the intermittent work of about twelve Mexican miners. In the first three months of 1932, a little more than $300 was taken in from the steady work of about twelve men. On the the ground controlled by the Gadsden Purchase, Inc., no outsiders are allowed to work. On other ground, outsiders are allowed to operate on a small scale. A few men have attempted in the past season to work in Empire and Colorado gulches with very indifferent success.

QUIJOTOA PLACERS

The Quijotoa gold placer district is situated in the vicinity of the Quijotoa Mountains of central Pima County, about 70 miles west-southwest of Tucson. According to Stephens,† the placers in all cover probably 100 square miles, and Heikes‡ states that they extend north and south for some distance on both sides of the Mexican boundary.

The Quijotoa Mountains, which rise to about 4,000 feet elevation above sea level, or approximately 1,500 feet above the surrounding plains, extend from Covered Wells on the north to South Mountain on the south, or to within about twenty miles of the Mexican line. This region has a very hot climate in summer, and there is no water supply except from wells and from earth or rock tanks. The mean annual rainfall is probably about thirteen inches.

History—There is no record of how long these placers have been known, but, in 1774, according to Elliot's History of Ari-

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*Oral communication.

†Stephens, Bascom A., Quijotoa Mining District Guide Book: Tucson Citizen Pt. & Pub. Co. 1884.

‡Heikes, V. C., Dry Placers in Arizona: U. S. Geol. Survey Mineral Resources for 1912, Part I, p. 260.

zona (1884), a Castilian priest named Lopez carried on extensive mining in an area about six miles north of the Quijotoa Mountains. It is said that Lopez utilized the docile Papagos for his work, and that the Mexicans who continued mining there until 1849 washed the gravels with water brought by Papago squaws from tanks in the valleys. For many years after 1849, there was little activity in the placers; but, in the early eighties, a very lively boom in lode mining attracted thousands of men to the district, and caused four or five towns to spring up. As this boom subsided, many of the men turned to placering, and there has been a small amount of activity ever since.

In 1906, the Imperial Gold Mining Company was said to own most of the productive ground, and to be leasing to dry-washers.

In 1910, a Quenner pulverizer and a Stebbins dry concentrator are said to have been installed by the Manhattan Company in the Horseshoe Basin area, on the east side of the mountains, but, due to conditions being different from those that obtained where these machines had been successful, the experiment failed.

Production—Considerable gold was recovered from the Quijotoa placers during the early days, but there is no record of the amount. In 1899, Blake* was informed that "The placer mines in the near vicinity of Quijotoa, worked by the Papagos in their crude way, are producing annually between $6,000 and $7,000 worth of gold." As shown in the table on page 17, the U. S. Mineral Resources record a production of $29,906 from the district between 1902 and 1913. Only a small amount per year has been recovered since 1912.

Geology—The Quijotoa Mountains, which are made up mainly of younger granite and lavas, contain numerous deposits of silver, gold, lead, and copper. Erosion of these gold-bearing rocks furnished, in the manner described on page 9, the material for the placers. In these placers, the gold occurs from the surface down into a stratum of cement-gravel or caliche, which carries more gold than does the dirt above it. Much of the ground is said† to average over eighty cents per yard, and Stephens‡ states that the red colored dirt averages $5 a ton. This last figure, however, is probably too high for the area as a whole. In general, the gold is coarse.

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*Blake, W. P., Report of the Territorial Geologist, in Report of the Governor of Arizona. 1899. p. 64.

†Oral communication from Chas. E. Wooddell.

‡Stephens, Bascom A., op. cit.

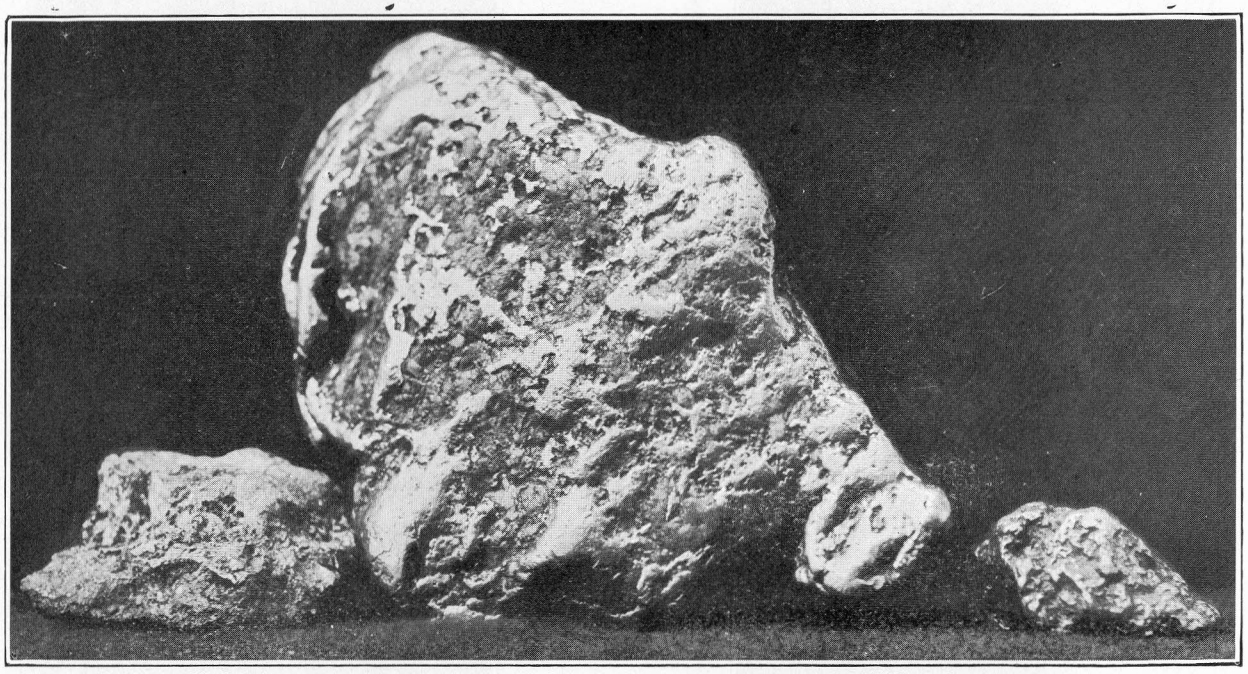

Fig. 11.—Nugget from Big Bug placers, nearly actual size. Photo by Bate.

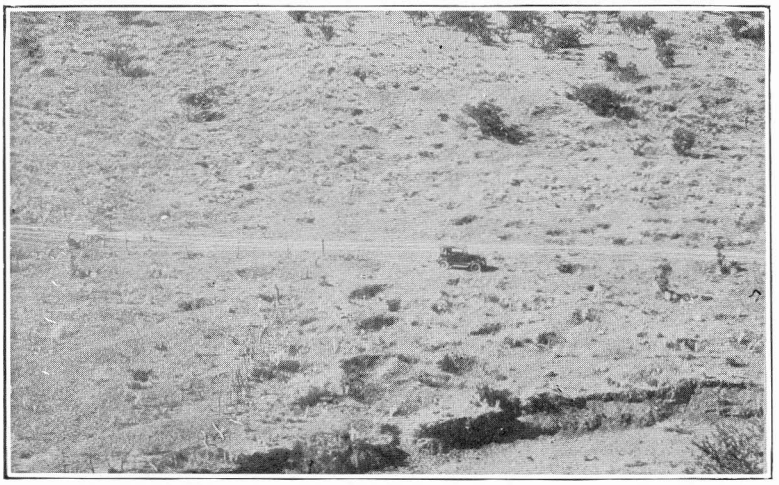

Fig. 12.—View of Ophir Gulch, ¼ miles east of Greaterville, showing pits of older placer mining.

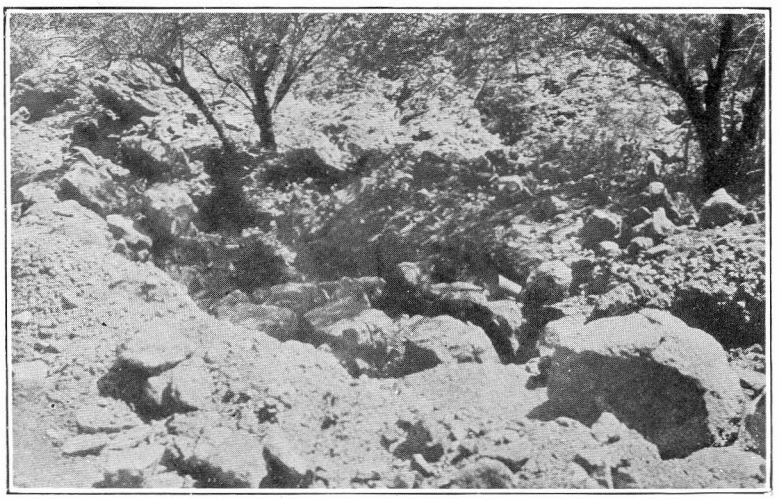

Fig. 13.—Typical placer work on San Domingo Wash.

Recent operations—The Horseshoe Basin placers are all privately owned, and no work is permitted. It is reported that, on the north flanks of the range, a little work was done on similar ground. The district is hampered by lack of water and by the cemented character of the gravels.

LAS GUIJAS, OR ARIVACA, PLACERS

Las Guijas, or Arivaca,* placer district is situated in southern Pima County, in the vicinity of Las Guijas Mountains, about fifty miles south-southwest of Tucson and immediately northwest of Arivaca.

Las Guijas Mountains, whose rounded summits attain an elevation of about 4,300 feet above sea level, or about 1,000 to 1,300 feet above the surrounding plains, extend for about eight miles northwest from Arivaca. Temperatures in the summer are high, and the mean annual rainfall is probably about fourteen inches. The drainage of the district flows northwest to Altar Valley through Arivaca and Las Guijas creeks. Arivaca Creek, which occupies a large channel along the southwestern foot of the mountains, contains water in its upper reaches during all of the year, but Las Guijas Creek, along the northeastern foot, is much smaller and drier. The district depends for its water supply upon shallow wells along the creeks, and upon the flow of Arivaca Creek itself.

History—There is no available record of the date of discovery of these placers. According to Bryan,† they were being worked in Las Guijas Creek by Mexicans and Americans in the sixties and seventies, and probably suggested the name "Guijas," which is Spanish for "rubble" or "conglomerate," for this creek and for the mountains. Irregular, small-scale operations have been carried on for the past fifty years, by sinking pits or shallow shafts to bedrock. The few inches of richer material is then gathered up and treated in crude, hand dry-washers during the dry seasons, or in rockers after each rain. It is said that occasionally, between 1890 and 1900, as many as one-hundred placer miners were working in the district.

Several projects for large-scale operations have been contemplated, but, so far, none have been successful. In 1915, the New Venture Gold Placer Company planned to pump water from Arivaca Creek, three miles away, for a special agitating

*Papago word for "little spring" or "little house," according to Kirk Bryan.

†Bryan, Kirk, The Papago Country, Arizona: U. S. Geol. Survey Water-Supply Paper 499, p. 379. 1925.

sluice. This company had control of 4,200 acres of land, and asserted that each acre carried about 4,800 cubic yards of gravel worth $1 per cubic yard.

Production—No records of the production of these placers are available, but the total amount was undoubtedly large. Most of this yield was prior to 1900, for placer activity in the district gradually died down to practically nothing by about 1915. The 1926 production that was purchased in Arivaca is said to have been about $30.

Geology—Las Guijas Mountains, which are made up of lava flows, Cretaceous sediments, and younger granite, contain gold-bearing quartz veins that were the original source of the placers. The placer gravels have accumulated both on the piedmont slopes or "mesas" and in the stream beds. Although the earliest placering in the district was mainly on the northeast side of the mountains, along Las Guijas Creek, it is said that gold-bearing gravels extend practically around the range. Duzrano, Pisquero, Yaqui, and Sangose are the most noted gulches.

The mesa gravels are said to contain some gold scattered throughout their maximum thickness of fifteen to twenty feet, but, in both the mesa and stream gravels, the highest values are at bedrock, or at clay-cemented false bedrock. In the mesa gravels, the gold is more angular and unpolished than in the stream beds, and often contains attached particles of the original gangue minerals. In general, the gold is rather finely divided, but it is said that many of the nuggets were worth from $5 to $15, and that one nugget valued at $192 was found in 1893.

Recent operations—It was reported that at least fifty men were working intermittently in the dry gulch tributaries of Las Guijas gulch during the wetter months of the 1932 spring season. The ground is all privately owned, but no objection was raised by the owners to small-scale work. Most of the work was done by gophering on bedrock and treating the gravels in rockers. Earnings were very small, and did not average over fifty cents a day. All work had ceased by the first of May due to lack of water. The ground is not adapted to dry work due to the fineness of the gold.

OLD BALDY PLACERS

The Old Baldy placer district is situated in southeastern Pima County, at the northwestern base of the Santa Rita Mountains, in the vicinity of Madera Canyon, about 30 miles

south-southeast of Tucson. Of these placers, Schrader* says: "The Madera Canyon alluvial cone, heading near the foot of the mountains at an elevation of about 4,500 feet, slopes northwestward toward Santa Cruz River and has a radial length of at least five miles. It is composed of gravels and sands discharged from the mouth of the canyon. These gravel deposits in places are probably over 100 feet in thickness and they all carry colors of gold. Toward the head of the cone an eighty-foot shaft was sunk in them without reaching their lower limit. Below the road forks, however, the deposits are deeply trenched by recent gulches from forty to fifty feet in depth, some of which cut through the deposits to the underlying bedrock granite, and here considerable gold placer mining was done with fair returns in the early days, mostly in the late eighties, water being brought from Madera Creek by ditch and flume."

PAPAGO PLACERS

Some small placers are situated in the Papago mining district of southern Pima County, along Ash Creek on the Sunshine-Sunrise group of claims, about thirty miles southwest of Tucson. According to Allen,† "the area covered by the auriferous gravel is very small, but Mexicans working in the rainy seasons are said to make good wages by the use of rockers. There is ample water in the creek for the use of rockers then, and the remains of old diggings indicate that a considerable amount of work has been done there in the past."

MARICOPA COUNTY

The principal placers of Maricopa County are in the Vulture, San Domingo, and Hassayampa regions. The annual rainfall of these regions is only about 10.5 inches, and the summer temperature sometimes is 113°. Their water supply during the dry seasons is from intermittent Hassayampa Creek or from wells, but the abundant, sub-surface seep of the Hassayampa has never been known to fail.

VULTURE PLACERS

The Vulture placers are situated in northwestern Maricopa County, in the vicinity of the Vulture Mine, about fourteen miles by road southwest of Wickenburg. North of these placers, the

*Schrader, F. C., Mineral Deposits of the Santa Rita and Patagonia Mountains, Arizona: U. S. Geol. Survey Bul. 582, p. 180. 1915.

†Allen, M. A., Arizona Gold Placers: Univ. of Ariz., Bureau of Mines Bul. 118, p. 12. 1922.

extensively dissected Vulture Mountains rise to elevations of 3,500 or more feet above sea level, or nearly 2,000 feet above the desert plain that adjoins the region on the south.

History—According to Mr. A. P. Irvine, who has been in the district for many years, these placers were first worked about 1867. At times during the five or ten years following, as many as two hundred or more men were placering with dry-washers in the arroyos of the vicinity. Blocks of ground only fifty feet square were allowed each miner, but many men recovered from $25 to $50 per day each. By about 1880, the richest, readily obtainable gold had been harvested; but some dry-washing, principally by transient miners or gambucinos, has been done every year after each torrential rain. Evidences of the early activity along the arroyos are still to be seen in the numerous old pits, piles of screenings overgrown with small brush, and decaying dry-washer machines. In the northern portion of the area, even some of the thin, hillside gravels were scraped up and dry-washed.

Geology—The principal rocks of the Vulture region consist of pre-Cambrian schists, dikes, and irregular masses of granite, probable Mesozoic monzonitic dikes, and Tertiary andesitic and rhyolitic lava flows. Within this schist are the large, rich, gold-bearing quartz vein of the Vulture Mine, and many smaller veins. Practically all of these smaller veins carry visible free gold, and even the most minute drainage channels leading down from them contain placer gold.

The Vulture placer ground covers about three square miles in Red Top Basin, northwest of the Vulture Mine, and continues down Vulture Wash for about two miles southeast of the Vulture Mine. The placer gravels, which are composed mainly of medium to fine, angular pebbles of schist and quartz, are generally less than ten feet thick, and rest upon schist bedrock. Considerable caliche cement is encountered in all but the thinnest gravels, and has limited dry-washing operations to the ever-narrow arroyos that are typical of this field.

Although some gold is distributed throughout these gravels, it is more abundant near bedrock. Several samples, taken from random localities at the time of the writer's visit, revealed abundant colors when panned. Even the old dry-washer tailings show fine colors upon panning, for those machines could recover only the coarser gold. The gold is mostly coarse and angular. During the early days, according to Mr. Irvine,* many $10- to $20-nuggets were found, and some worth $100 were reported.

The origin of the placer gold, in Red Top Basin at least, appears to have been the small quartz veins of that vicinity. In this connection, Carl Lausen* has observed that the gold of these veins, like that of the adjacent placers, is coarser than obtains in the Vulture vein. It is possible, however, that the gold in the drainage below the Vulture Mine may have been derived in part from the Vulture vein.

Present operations—At present, the only placering done in this region is by gambucinos, who are said to make better than ordinary day's wages after each heavy rain. Most of the ground is held as lode claims, as follows: Red Cloud Group of six or more claims, by A. P. Irvine; Red Top Group of six claims, by D. R. Finlayson; Banker Group of four claims, and Red Top Extension Group of seven claims, by A. P. Irvine; Laguna and Regina groups of nine claims, by A. P. Irvine and under option to W. E. Hanson; and the Vulture Group of thirty-two claims, by the Vulture Mining Company. Inasmuch as the early day dry-washers operated mainly along the arroyos, but not on the caliche-cemented gravels of the intervening ridges, a large amount of placer gold still remains in the Vulture region.

GARCIA PLACERS

According to Carl Lausen,* some gold placers occur in the vicinity of the Garcia gold mine, which is about nine miles east of the Vulture Mine. Considerable dry-washing was done south of the outcrop of the quartz vein of this mine soon after the Vulture placers were discovered.

SAN DOMINGO PLACERS

The San Domingo region is situated in northern Maricopa County, and surrounds San Domingo Wash, which is an eastern tributary of Hassayampa Creek, about forty-five miles northwest of Phoenix. This sharply and intricately dissected portion of the western foothills of the Wickenburg Mountains is from about 2,300 to 3,300 feet above sea level. It is traversed by a few roads from Morristown, or Hot Springs Junction, a station on the Santa Fe Railroad.

History and production—The gold placers of this region were discovered many years ago, and some persons assert that they were known to the early Spanish explorers. It is said that the greatest activity in the region was between 1870 and 1880, when the towns of Old San Domingo and New San Domingo

*Oral communication.

were maintained by the placer miners. About 1875, Old Woman Gulch, which is a southern tributary of San Domingo Wash, is said to have produced over $150 per day. New San Domingo, which stood on the mesa about seven or eight miles east-northeast of Morristown, is said to have had a population of 1,500 men in 1885.

Several projects have been planned for hydraulicking certain areas in the region. Several dams have been proposed to catch the torrential run-off of the rainy seasons, and it has been suggested that the sub-surface water of Hassayampa Creek could be diverted. One dam was built across San Domingo Wash in 1910 by a Mr. Sanger, and sluicing was started; but the reservoir filled up with sand and gravel before operations had proceeded for one season. Dry-washing, or rocking when there was enough water, has been carried on in the region every year since its discovery, and has supplied a large proportion of the production of Maricopa County recorded on page 17.

Geology—The principal rocks of this region are pre-Cambrian granites, gneisses, and schists, Tertiary basalts, andesites, rhyolites, agglomerates, and sandstones, and various dikes. Quartz veins, probably of both pre-Cambrian and post-Cambrian age, have furnished the gold that erosion has concentrated in the placers.

The placers occupy a belt, six or seven miles in length and of very irregular width, along the drainage system of San Domingo Wash. They are not confined to the stream beds alone, but are found also on some of the gravelly mesas that separate the gulches.

The gold itself is said to be angular, fairly coarse, and of 925 to 965 fineness. Several prospectors of the region state that, although much of the gold found was in pieces worth about $1, nuggets valued at $30 were common in the early days, and several containing $10 to $15 were found in 1925. The gold is reported to lie mostly near bedrock in the upper reaches of the gulches, but somewhat distributed through the gravels of the lower country, and to be associated with considerable black sand. Although the areas worked by the early-day dry-washers were rather rich, most of the ground is of too low a grade for such treatment. According to T. L. Carter,* part of the Lotowana Mining Company property along Rogers Wash was tested by over 200 holes, and an area of 300 to 350 acres, 2½ miles

*Carter, T. L., Gold Placers in Arizona: Eng. and Min. Journal, vol. 91, pp. 561-562. 1911.

wide and 1,000 feet long, was found to range from one to twenty feet to bedrock and to average from forty to eighty cents per cubic yard. Sanger Wash was sampled by Mr. A. P. Irvine* and found to average 43 cents per cubic yard.

Present operation—The San Domingo placers are still being worked to a small extent by dry-washers, or by rockers when there is enough water. Figure 13 illustrates the type of mining necessary for such operations.

HASSAYAMPA PLACERS

Although some gold is present in the gravels and sands of the whole Hassayampa in Maricopa County, it is reported to be relatively most abundant for a few miles below the mouth of San Domingo Wash, which is about seven miles southeast of Wickenburg. According to Mr. A. J. Kellis,* of Wickenburg, who sampled a portion of this ground several years ago, bedrock is from fifty to seventy feet at the mouth of San Domingo Wash, and the average gold content there is about 53 cents per cubic yard.

The Hassayampa Placer Gold Company, of Phoenix, has control of about 6,400 acres of ground in and below the Hassayampa gorge that begins about six miles south of Wickenburg. After considerable testing of this ground, the company reports planning the installation of a dredge.

PINAL COUNTY

CAÑADA DEL ORO, OR OLD HAT, PLACERS

The only known gold placers of importance in Pinal County are in the vicinity of Cañada del Oro,† in the Old Hat district. These placers, which extend also into Pima County, lie at elevations of over 2,600 feet above sea level, near the northwestern base of the Santa Catalina Mountains, from four to ten miles south of Oracle postoffice and sixteen to twenty-nine miles north of Tucson.

The water supply of this placer region is chiefly from wells and from the intermittent flow of Cañada del Oro Creek. The mean annual rainfall at Oracle, which is 4,500 feet above sea level, is about 19.44 inches but on the Santa Catalina Mountains, which attain 9,150 above sea level at Mt. Lemmon, less than ten miles southeast of the placer area, much heavier summer rains and winter snows obtain. Cañada del Oro, therefore,

*Oral communication.
†Spanish for "Canyon of the Gold."

sometimes carries torrential floods during the summer, and a steady, small flow from the melting snows in the spring.

History and production—These placers are said to have been discovered by the Spaniards, during the early days of Tucson. Numerous old pits, trenches, and tunnels indicate considerable early placer mining, and many thousand dollars worth of gold are reported to have been recovered. The production from 1903 to 1924, inclusive, amounted to $11,351.

Geology—The Santa Catalina Mountains are made up principally of pre-Cambrian gneiss, schist, and granite, Paleozoic sediments, post-Carboniferous granite, granite porphyry, diabase, and diorite, and Tertiary sediments and lavas. Gold-bearing quartz veins, such as occur in the vicinity of the Copeland, Kerr, Matas, and other prospects in the upper reaches of Cañada del Oro, were the probable source of the placer gold.

A description of the placers, based upon information from Capt. J. D. Burgess, is given by Heikes:* "An area of 25,000 acres, ... covering nearly the whole of T. 10 S., R. 14 E., Gila and Salt River Meridian . . . is found containing valuable dry placer gravel, which has apparently been deposited at intervals by floods from the Santa Catalina Mountains so as to form a deposit of nearly equal value from surface to bedrock, there being no pronounced accumulation of heavy gold at bedrock except in the stream, Cañada del Oro Creek, which passes through the region. The bed of dry gravel is from six feet deep at the creek side to 252 feet at the summit, with an average thickness of about 150 feet. The deposit is in general a loose gravel, uncemented. There are, however, alternating strata of deep red, clayey material. These strata are of nearly uniform thickness of three to four inches and probably were formerly surfaces existing between floods, each being covered by a later flow of gravel from rainfall-eroded veins farther up the mountain. Shafts sunk on the hillsides from 27 to 50 feet in depth show values from 10 to 42 cents per cubic yard. The average is difficult to determine, as the gold is not equally distributed. All the gold is found in well-rounded nuggets ranging from fifty cents to $5 in value. There is a tradition of a lump weighing 16 pounds with probably 40 percent of quartz, whose discoverers were found murdered in their camp 16 miles north of Tucson. The nugget had disappeared. In fineness the gold averages about 905. Generally the placer material is dug, screened, and hauled to the creek, and there worked by rockers,

*Heikes, V. C., Dry Placers in Arizona: U. S. Geol. Survey Mineral Resources for 1912, Part I, pp. 259-260.

or sluiced when there is enough water. Many dry-washers have been tried, but most of the gold lies in the red clayey seams which apparently acted as bedrock for each period of deposition. Pulverizing this adherent material gives good results with the common bellows type of 'dry washer.' A boiler and pump were once used to throw water against the creek bank, but the water at that time proved insufficient for extensive operations."

Recent operations—In the lower Cañada in T. 10 S., R. 15 E., about two miles west of the end of the road, several men worked during the 1931-1932 winter season in a dry gulch tributary of the Cañada, with fair success. These men were working on ground owned by the Gold Channel Placers Company. Two hundred and forty acres of this ground was later leased on a 10 percent royalty basis to Mears and Guthrie who installed a gas engine and pump at the Cañada and laid 150 feet of pipe up the dry gulch preparatory to sluicing the ground. A partial test showed values of about $1 a yard. The gravels are shallow, varying from a few feet up to ten feet. The values are apparently derived from the erosion of the iron-stained hills, formed of quartzite shale and schist, lying to the north of the Cañada.

In the upper Cañada, near the crest of the Catalinas, several men worked high gravel banks by sluicing, and are reported to have made fair wages during the past season.

On the eastern flanks of the Catalinas, work on bars in Alder Canyon was reported to have yielded fair wage returns.

COCHISE COUNTY

In Cochise County, the best known gold placers are found in the Dos Cabezas and Teviston districts. Other placers, of less economic importance, are known in the Huachucas and Bisbee districts, and a silver-gold placer occurs at Pearce.

DOS CABEZAS PLACERS

The Doz Cabezas placers are situated in north-central Cochise County, in the vicinity of Dos Cabezas village, at elevations of 5,000 or more above sea level. Allen* states that these placers were discovered in 1901 by some Mexican prospectors, but, although this discovery induced considerable local excitement, only a small amount of gold was recovered. During 1906, according to Heikes,† water was plentiful in the district for a

*Allen, M. A., op. cit., p. 19.

†Heikes, V. C., U. S. Geol. Survey Mineral Resources for 1906, p. 155.

number of months, so that considerable placer ground was worked by several companies and by a number of Mexicans. Many of the latter made from $4 to $6 per day with simply a gold pan. Some gold has been recovered from the Dos Cabezas placers practically every year since their discovery. The most productive years, as recorded by the U. S. Mineral Resources, were 1906, with $1,939; 1911, with $115; and 1914, with $228.

Practically all the gulches in the vicinity contain gold-bearing gravels. These gravels are rather thin in the canyons a short distance north of the village, but, toward the south and away from the mountains, they thicken rapidly. Sufficient clay is said to be contained in the placer material to handicap extraction. The abundant gold-bearing quartz veins and stringers that occur in the Mesozoic and older rocks of the Dos Cabezas Mountains appear to have been the original source of the gold.

TEVISTON PLACERS

The Teviston placers are situated in north-central Cochise County, on the northeast side of the Dos Cabezas Mountains opposite the Dos Cabezas district. Of these placers, Heikes* says: "During the wet season dry-placer ground in the Teviston district yields a small quantity of gold yearly. About 300 acres have been reported valuable to a depth of from three to ten feet, the latter being the greatest depth prospected. Bedrock is from fifty to seventy-five feet in depth. Most of the gold is coarse, and the ground by tests has yielded from three cents to $28 per cubic yard. The largest nugget found was valued at $375. Some cement or caliche has been found in prospecting the ground, but values have been found in the gravel beneath."

HUACHUCA PLACERS

Blake† states that "Placer gold is found in the Huachuca Mountains. It is reported that placer miners are constantly at work near the Harper Mine, and making good wages."

Of the placer activities in the southeastern Huachuca Mountains, a few miles north of the Mexican line, during 1919, Heikes‡ states: "The placer operations near Garces produced a little gold. These placers are in the vicinity of mineral veins containing tungsten, and some scheelite has been recovered

*Heikes, V. C., Dry Placers in Arizona: U. S. Geol. Survey Mineral Resources for 1912, Part I, p. 259.

†Blake, W. P., Report of the Territorial Geologist, in Report of the Governor of Arizona, 1899, p. 66.

‡Heikes, V. C., U. S. Geol. Survey Mineral Resources for 1919, Part I, p. 342.

from the placer gravels in addition to the gold. It is reported that a nugget of gold weighing 8½ ounces was recently found in the Old Timer placer in Ash Canyon, where about 50 ounces of gold were recovered during the year." A little placer gold production was reported from the Huachuca Mountains during 1921 and 1923.

GOLD GULCH PLACER, BISBEE DISTRICT

Of the Gold Gulch placer, which is situated about 4 miles southeast of Bisbee, Ransome* says: "Small quantities of placer gold have been obtained from the upper part of Gold Gulch. This gold has been derived from the Glance conglomerate, and concentrated in the sand and gravel of the present arroyo. It is not present in sufficient quantity to be of economic importance."

PEARCE PLACER

Some interesting information upon the placer at Pearce, central Cochise County, has been furnished by Lewis A. Smith†. This placer, which lies at the eastern and western margins of Pearce Hill, furnished, in 1895, the first carload of ore from the district. Further shipments, made between 1917 and 1927, have brought the total production of this placer to $8,700. The material, which has been derived by weathering of the quartz veins of Pearce Hill, is made up largely of boulders from a few inches to over three feet in diameter. It had a maximum thickness of twenty-five feet at the eastern margin of the hill and fifteen feet at the western margin. The eastern margin averaged about twelve ounces in silver and $1.25 in gold per ton, while the western averaged fifty-seven ounces in silver and $15 in gold. These values were contained in manganese-stained, sugary quartz, and were present mainly as cerargyrite, embolite, and free gold.

GREENLEE COUNTY

MORENCI PLACERS

Gold placers occur in the Morenci, or Copper Mountain, district of central Greenlee County. Nothing is known of the early yield of these placers, but from 1907 to 1928, inclusive, they produced $9,379.

According to Lindgren,‡ the gravels of the Gila conglomer-

*Ransome, F. L. Geology and Ore Deposits of the Bisbee Quadrangle,

†Oral communication.

‡Lindgren, Waldemar, Clifton Folio: U. S. Geol. Survey Geol. Atlas of the U. S., Folio 129, p. 13. 1905.

ate, resting in front of the older rocks on lower San Francisco River and Eagle Creek, are sometimes gold bearing, although the metal usually occurs only as very fine flakes. The late Quaternary bench gravels along the San Francisco above Clifton contain gold in a somewhat more cencentrated form, and at Oroville 3 miles above Clifton attempts have been made to work them by the hydraulic method, but the results were not encouraging. This gold is probably derived from a system of veins outcropping on lower Dorsey and Colorado gulches, a few miles north of Clifton on the west side of San Francisco River.

According to Blake,* a large sum of money was expended on a pipe line for the hydraulicking project near Oroville, but the want of adequate fall and space for the tailings caused the abandonment of the enterprise.

Gold Gulch, two or three miles west of Morenci, was worked for placer gold about 1884. Lindgren† believed the origin of this gold to be limonitic, auriferous pockets in narrow, irregular quartz veins that cut masses of limestone and other sediments included within the diorite. He also states‡ that the Gila conglomerate south of Morenci contains a little finely divided gold, which is concentrated in Morenci Canyon, about four miles below the town, and in shallow gullies.

Recent operations—The placers of Gold Gulch, San Francisco River, and Chase Creek were discovered in 1872 at the same time that the copper deposits were found. The ground did not prove to be rich, and possible recoveries were less than wages which could be earned at the copper mines. The fields are quite extensive, and have been worked intermittently and in a small way ever since.

In the past year, due to the curtailment of the copper mines, considerable revival of placer mining has taken place.

The most extensive field is in the San Francisco River Gila conglomerate beds for a distance of several miles up and down the river from Clifton. Work is done by tunnelling into the conglomerate at bedrock, and transporting the gravel to the river for sluicing and rocking. Dry-washers are used if the workings are far from the main channel, to make a preliminary concentration.

In Chase Creek, a tributary of San Francisco River, consid-

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*Blake, W. P., Report of the Territorial Geologist, in Report of the Governor of Arizona, 1899, p. 66.

†Op. cit.

‡Lindgren, Waldemar, Copper Deposits of Clifton-Morenci District, Arizona U. S. Geol. Survey Prof. Paper 43, p. 212. 1905.

erable work is being done in old channels in Gila conglomerate by tunnelling and by treatment of the gravels at the creek in sluice boxes. A small supply of water is always available.

In Gold Gulch, a tributary of Eagle Creek, west of Morenci, the gravels of the creek are being worked and tested for a distance of about two miles. Their thickness varies from a few feet up to fifteen feet, and the values are largely concentrated in the three or four feet of gravel at bedrock. The average value for the whole gravel deposit is reported to be about seventy-five cents a yard. The gravel is medium coarse and not difficult to handle. Water is present as an underflow next to bedrock and is ample for sluicing.

Most of the valuable ground is held by the Phelps Dodge Corporation and only employees are permitted to work on it. It is estimated that, after July 1, when the copper mines are to be closed indefinitely, the placer fields will furnish work which will enable about two hundred men to earn seventy-five cents to $1.50 a day, each.

SANTA CRUZ COUNTY

ORO BLANCO PLACERS

The best-known placer districts of Santa Cruz County are Oro Blanco, Patagonia, Harshaw, Tyndall, Nogales, and Palmetto.

The Oro Blanco placer district is situated in the Oro Blanco Mountains of southwestern Santa Cruz County, in the vicinity of Ruby and Oro Blanco, about twenty-five miles west-northwest of Nogales and a few miles north of the Mexican boundary.

The Oro Blanco Mountains, which attain in Montana Peak, at Ruby, an elevation of 5,500 feet above sea level, or about 1,500 feet above the deepest gulches, receive approximately fifteen inches of rainfall per year. However, there are no perennial streams in the region, and the local water supply comes from reservoirs or from shallow wells.

History and production—These placers are said to have been worked since the time of the early Spanish explorers. According to Mr. J. S. Andrews,* of Tucson, former storekeeper at Ruby, about $2,000 worth per year was produced from 1896 to 1904, but this activity died down after 1907. Of the activity in 1899, Blake† says: "Most of the placer mining is carried on in a desultory way, often with a small and wholly inadequate water supply, and in certain places with dry-washing machines

*Oral communication.

†Blake, W. P., Report of the Territorial Geologist, in Report of the Governor of Arizona, 1899, p. 71.

worked by hand. The returns are small, but the miners manage to get their living, especially where they can get water." An attempt at sluicing was made in 1906 by Kelly Brothers; but their earth-fill dam washed out and caused the enterprise to fail. In 1911, only two properties were productive, and there has been very little activity in the placers of the district since 1915.

Geology—The Oro Blanco Mountains, which are made up principally of pre-Cambrian granite, Cretaceous sediments, Tertiary lavas, and various minor intrusives, contain numerous gold-bearing quartz veins and stringers. Consequently, placers were formed in most of the gulches that issue from the mineralized areas. According to Blake,* "In almost every ravine or gulch, gold can be found by panning, and even on the hillsides and on the surface generally especially where the soil is reddened by decomposed pyrite, gold can be obtained by dry washing." Alamo and neighboring gulches, south and southwest of Ruby, contained the richest gravels. Mr. Andrews states† that the placer gold was not very coarse, but ranged from flour up to one nugget worth $8. The fineness of the gold bought by Mr. Andrews from Old Oro Blanco was about $10 per ounce, and from Alamo Gulch about $16. The average fineness from the whole district was only about $12 per ounce, and the whiteness of the material containing this relatively high content of alloyed silver suggested the Spanish name "Oro Blanco" (white gold) for the district.

Recent operations—Due to the unusually wet season, considerable activity was in evidence in the 1931-1932 winter season. About $800 was sold at the Ruby store from the operations of a dozen gambucinos. All work had ceased early in April due to lack of water.

PATAGONIA PLACERS

The gold placers of the Patagonia district, Santa Cruz County, are situated on the eastern slopes of the Patagonia Mountains, about nine miles south of Patagonia and 6 miles north of the Mexican boundary, at an elevation of 5,200 to 5,800 feet above sea level. Of these placers, Schrader‡ says: "Placer gold occurs in the Patagonia district in the Quaternary stream grav-

*Blake, W. P., op. cit.
†Oral communication.
‡Schrader, F. C., Mineral Deposits of the Santa Rita and Patagonia Mountains, Arizona: U. S. Geol. Survey Bul. 582, p. 348. 1915.

els in the piedmont portion of Mowry Wash and its tributaries, being present on the main wash at the east border of Guajolote Flat about 1½ miles southwest of Mowry, on a south-side tributary gulch about 1¼ miles south-southwest of Mowry, and on two north-side parallel tributary gulches about 1½ miles southeast of Mowry.

"The production is small, as the deposits are worked only by Mexicans when in need of money. The average earnings are about seventy-five cents a day for each man. The placers at the Guajolote locality were being worked by dry-washing at the time of visit (1909). The deposits at this place seem to be about five feet thick. The known production in 1909 was two ounces of gold. In 1906, when, after the closing of the Mowry Mine, many unemployed men were in the country, the production was about $200."

HARSHAW PLACERS

According to Schrader,* "The only placers known in the Harshaw district occur about 2 miles southwest of Patagonia, between Sonoita Creek on the northwest and Alum Canyon on the southwest. Here the Quaternary gravels underlying the mesa-like area, which is about a mile square, contain placer gold and are workable under favorable conditions. They are said to contain also native lead. They were worked by A. J. Stockton and other pioneers by jigging in the early day."

TYNDALL PLACERS

Schrader† says: "Placer gold occurs in the Tyndall district, and some was produced in the early days 2¼ miles southwest of Salero and 1 mile south of Mount Allen, at the southwest base of Grosvenor Hills, on each side of the township line, in the S. W. ¼ Sec. 35 and adjoining ground, in the open basin-headed canyon which is tributary to Ash Canyon."

NOGALES PLACERS

According to Schrader,‡ "Gold placer deposits occur in the northeastern part of the Nogales district on Guebabi Canyon, which drains into Santa Cruz River from the northeast at a point about 6 miles north of Nogales. The canyon extends southwestward through a large area which is commonly known as the Guebabi district but which, except along the canyon, is

*Schrader, F. C., op. cit., p. 279.
†Schrader, F. C., op. cit., p. 220.
‡Schrader, F. C., op. cit., p. 355.

barren of ore deposits . . . . Along the course of the stream gold placers of considerable extent are reported to occur in the Quaternary gravels. . . . The placers produced considerable gold in the early days, and were being worked to a moderate extent in 1909."

PALMETTO PLACERS

The Patagonia Placer Mines Co., which has control of 320 acres in the Palmetto district, planned to recover placer gold from the Quaternary gravels at a point about 2½ miles northwest of the Three R Mine, and six miles by road southwest of Patagonia. This company installed a sluice and a drag-line excavator adjacent to the bed of the main arroyo in 1927, but, after a month of intermittent work, the project was abandoned.

MOHAVE COUNTY

CHEMEHUEVIS PLACERS

The Chemehuevis placers are situated in southwestern Mohave County, at the southwestern foot of the Chemehuevis Mountains, about five miles from the Colorado River and thirty miles southeast of Needles, California. These placers have been worked in a desultory way by dry-washers since the sixties, and are said to have yielded fair returns.

According to Hedburg,* the placers occupy an old channel about one mile wide, three to five miles long, and ten to thirty feet deep. The gravel, which he believes to have come from the Chemehuevis Mountains, consists largely of gold-bearing quartz, porphyritic débris, and volcanic material, and is cemented with lime carbonate. On the basis of samples obtained from ten pits, twenty feet deep, Hedburg estimated that these placers average $2 per cubic yard.

OTHER MOHAVE PLACERS

In late 1920, plans were being made for sluicing in Jumbo Wash, about eighty miles northwest of Kingman, with water pumped from the river; but there is no record of the outcome of this enterprise.

Some placer mining is said to have been done in the vicinity of Vivian, which is about 2¼ miles southwest of Oatman.

A small yield of placer gold from the Owens district, which is southeast of Yucca, was reported by the U. S. Mineral Resources in 1923.

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*Hedburg, E., The Calizona Placers, Arizona; Mining World, vol. 31, p. 138. 1909.

The sands and gravels of the Colorado River, downstream from the mouth of the Grand Canyon, contain finely divided gold that has encouraged several unsuccessful, large-scale enterprises. One of these efforts is mentioned by Heikes* as follows: "The large dredge built in 1909 on Colorado River, near the Arizona side, opposite El Dorado Canyon, Nev., was of the suction type and rated at 7,000 yards daily, but this is probably a high estimate. It was built to work the sand bars and failed on first test to extract the fine gold. It was subsequently carried from its moorings by high water and wrecked during the spring of 1910."

GILA COUNTY

GLOBE PLACERS

Placer gold occurs in the Globe region along Pinal Creek, Lost Gulch, Gold Gulch, and some of the Richmond Basin gulches. A little mining of these placers has been carried on by individuals since the seventies, but most of their production was during the early days.

According to Carl Lausen,† most of the placer mining along Pinal Creek was done upstream from a point about one mile southeast of the railway depot. Nuggets worth from a few cents up to 25 cents were found, and a few worth $5 were reported.

A little placer gold has been recovered from Lost and Gold gulches, about 4½ and ten miles west-northwest of Globe. Blake‡ states that "Placer deposits of considerable extent and value have been worked for years in Lost Gulch, Globe district. These deposits appear to have been supplied by the disintegration and erosion of a multitude of small veins traversing the . . . . region." The U. S. Mineral Resources report a production of $127 worth of placer gold from Lost Gulch in 1907.

According to Carl Lausen,§ some placer gold probably was recovered from many of the small stream channels that drain westward from the Apache Mountains through Richmond Basin, north of Globe. This basin is noted for its rich placers of horn and native silver.

PAYSON PLACERS‖

Considerable rich float from the gold-bearing veins of the

*Heikes, V. C., U. S. Geol. Survey Mineral Resources for 1910,Part I, p. 235.

†Oral communication.

‡Blake, W. P., op. cit., p. 66.

§Oral communication.

‖Lausen, Carl, and Wilson, E. D., Gold and Copper Deposits Near Payson, Arizona: Univ. of Ariz., Bureau of Mines Bul. 120. 1925.

Payson district, northern Gila County, was picked up during the seventies and eighties.

Although the quartz veins of the district show free gold at the surface, placers are not common. One short tributary of the East Verde River drains the region in which most of the gold veins occur; yet the prospectors of the district state that no placer gold has been found in it. Placers, however, have been worked in a small way for a number of years below Ox Bow Hill, but only during the rainy season when water is available. These gravels are only worked sporadically, and yield but a few dollars per day. On the slopes of Ox Bow Hill immediately below the outcrop of the vein, Mr. Boozer panned about an ounce of gold. Some of this gold consisted of rather coarse, flat nuggets up to a quarter of an inch in length. These nuggets are of a deeper color than the vein gold, and probably contain little or no silver. Mr. Boozer states that any pan of the dirt from the slope will show a few colors.

OTHER GILA PLACERS

Small gold placers occur in the Dripping Spring and Banner districts of southern Gila County, and in the Mazatzal district of the northwestern part of the county. The U. S. Mineral Resources report a small production of placer gold from the Dripping Spring and Mazatzal districts during 1910, and from the Banner district during 1914.

APACHE, COCONINO, AND NAVAJO COUNTIES

Although no placer gold production has been reported from Apache, Coconino, and Navajo counties, the Triassic Chinle* formation of the Painted Desert in northeastern Arizona deserves mention as a low-grade gold placer that is of spectacular interest from a geological rather than a practical point of view. This formation, which was known as the Shinarump prior to 1917, consists largely of mauve to variegated clays. It underlies the major portion of northeastern Arizona north of the Little Colorado River, and outcrops as shown on the Arizona Bureau of Mines geological map of Arizona.

An account of the gold in the Chinle clays has been given by Lawson†. According to him, these clays, when examined microscopically, appear to be composed almost wholly of a colloidal substance with a very small admixture of fine silt and some concretion of lime carbonate and iron oxide. When immersed

*For a description of the Chinle, see Gregory, H. E., U. S. Geol. Survey Prof. Paper 93, pp. 42-50. 1917.

†Lawson, A. C., The Gold in the Shinarump at Paria: Economic Geology, vol. 8, pp. 434-448. 1913.

in water, the clays swell enormously, break down rapidly, and run like milk. The mixture is in such a fine state of division that it passes freely through filter paper. Lawson found that these clays averaged five cents in gold per cubic yard at Paria, Utah, and states that they "appear to be similarly auriferous at Lee's Ferry . . . .; and it is probable from the extreme uniformity in the physical characteristics of the formation wherever it has been observed that it is similarly auriferous throughout its extent." The gold is probably in a very finely divided condition.

In Arizona, the Chinle underlies, with a maximum thickness of 1,182 feet, an area of approximately 12,000 square miles, and outcrops over approximately 4,000 square miles. If the average gold content is five cents per cubic yard, and the average thickness be taken at five hundred feet, or less than half of the maximum, then the total gold content of the outcropping areas of Chinle in Arizona is over 103 billion dollars, and the total for the whole formation in the State is over 309 billion. Lawson* state, however, that "The value of the ground is very problematical. If a method of successful hydraulicking and recovery of the gold be developed it will only be after a long period of experimentation, at large expense, at a few favored localities, where a vast yardage of the clays is free from overburden, and where abundant water may be had cheaply."

Hundreds of placer claims have been staked out upon the Chinle formation, and offered for sale at large figures, but thus far all attempts at hydraulicking the ground have been ineffective.

*Op. cit.

PART II

SMALL SCALE GOLD PLACERING

BY

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FACTS ABOUT GOLD

IDENTIFICATION OF PLACER GOLD

Placer gold can usually be identified by noting certain of its characteristics, as follows:

1. *Color:* Pure gold is brass-yellow in color, but, as recovered from placers, it is usually alloyed with more or less silver and sometimes with copper. Silver tends to lighten the color without changing other characteristics, and a high percentage of silver makes gold silver-white with a slight yellowish tint.

2. *Specific gravity:** The specific gravity of pure gold is about 19.3.

In other words, a given volume of pure gold is about seventy percent heavier than the same amount of pure lead.

3. *Malleability and ductility:* When gold is hammered on an anvil, it flattens out without cracking or breaking. A knife blade, needle, or similar tool cuts or indents gold in much the same manner as it does metallic lead. Iron pyrites or copper pyrites (fool's gold) and various other minerals that are often confused with gold are brittle and break easily when hammered. They can be reduced to a dark colored powder. Mica is much softer than gold, does not break easily when hammered, and may be crushed with some difficulty to powder.

4. *Solubility:* Gold can not be dissolved in either nitric, hydrochloric (muriatic), or sulphuric (oil of vitriol) acid alone. It is soluble, however, in aqua regia which is a mixture of about one volume of concentrated (strong) nitric mixed with about two volumes of concentrated (strong) hydrochloric (muriatic) acid. Aqua regia solutions† of gold turn purple when stannous chloride is added to them. Ferrous sulphate, when added to such solutions, throws down a brown precipitate.

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*The specific gravity of a substance is equal to its weight divided by the weight of an equal volume of distilled water at 4° centigrade (39° Fahrenheit).

†Detailed instructions for making these tests are given in the Arizona Bureau of Mines Bulletin No. 128.

IMPORTANT PHYSICAL PROPERTIES OF GOLD

Two of the physical properties of gold, that is, its high specific gravity (great weight) and its amalgamating characteristics, are utilized as the basis for practically all known methods used in its recovery by placering. The specific gravity (weight) of pure gold* is about 19.3 times that of water, and it is six or more times as heavy as ordinary rock. Advantage is taken of this high specific gravity (great weight) whenever gold is recovered by gravity concentrating methods whether by use of the miner's pan, the batea, the horn-spoon, the rocker (cradle), the dry-washer, the long tom, the sluice, burlap, carpet, blanket, fleece, cocoa mat, canvas, or any other such machine or material. The fundamental principle underlying the recovery of the gold when these things are used is the fact that, when suspended in water or air, it settles faster than most of the other minerals with which it is associated. This action is due to the fact that its weight is great as compared to the weights of the associated minerals. Fine, flaky, porous, and flour gold tend, however, to float in moving water, and, in dry-washing, they are apt to blow away with the tailings or waste. Gold may also float off in water if oil, grease, or clay is present.

The amalgamating methods used in placering are based upon the fact that, when clean, bright gold is brought into contact with clean, metallic mercury (quicksilver) by force or by means of a rubbing or abrasive action, the gold and mercury unite and form a paste called amalgam. Grease, oil, and various other substances interfere with this reaction, and dirty or rusty gold does not amalgamate readily.

Gold, as found in placers, varies much in size; it ranges from nuggets that weigh several ounces and even pounds to specks or colors that are commonly known as fine or flour gold. Some specks of flour gold are so minute that it takes as many as two thousand colors to weigh enough to be worth one cent. The following classification of gold on the basis of size is from Young's† "Elements of Mining."

Coarse gold—that which remains on a 10-mesh screen.

Medium gold—that which remains on a 20-mesh screen and passes a 10-mesh screen (average 2,200 colors to one ounce).

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*Gold as recovered from placers is seldom pure, but is almost always alloyed with varying proportions of silver. The specific gravity of placer gold is, therefore, somewhat less than for pure gold, being from 15.0 to 19.2.

†Young, George J., 1st ed., Elements of Mining, McGraw-Hill Book Company, Inc., New York, 1916, p. 351.

Fine gold—that which passes a 20-mesh screen and remains on a 40-mesh screen (average 12,000 colors to one ounce).

Very fine gold—that which passes a 40-mesh screen (average 40,000 colors to one ounce).

Flour gold—not defined, but presumably smaller than "very fine gold."

Purington quotes examples of finely divided gold as follows:

170 colors to one cent (314,500 to one ounce)

280 colors to one cent (436,900 to one ounce)

500 colors to one cent (885,000 to one ounce)

The grains of gold in a placer deposit are often much smaller than the grains of associated minerals.

The word "nugget" should be applied only to a piece of water-worn native gold larger than a grain of wheat.

VALUE OF GOLD

The price or value of *pure* gold is established at $20.67 per troy ounce (one troy ounce equals about 1.1 avoirdupois ounce). Because the gold as found in and recovered from placers is seldom pure, the average value of placer gold may be roughly taken at about $18.50 per troy ounce.

To encourage the small operator the U. S. Government assay offices have been authorized to purchase gold in minimum quantities of forty dollars worth, whereas the previous minimum was one hundred dollars. This regulation requires, however, that the seller state the source of his gold.*

SEEKING PLACER GOLD

Since moving water has been the most potent factor in the development and formation of most placer deposits, the usual practice is to seek placer gold by panning along the water courses, that is, along stream beds, bars, gulches, and arroyas. Even though a placer of worth-while proportions and values may be situated far above any water course, nevertheless the showings which have been washed down from it, to that watercourse, if followed up and traced out, may lead the prospector to the deposit. Black sand and the heavy minerals that accompany placer gold, serve to some extent as a guide, and the spots where heavy concentrations of it occur deserve special attention and testing, but it should be remembered that black sand and other heavy minerals are so excessively common that

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*Jackson, C. F. and Knaebel, J. B., Information Circular 6611, U. S. Bureau of Mines, Department of Commerce, Washington, D. C., April, 1932, pp. 1 and 5.

they can be panned from almost any soil. Large quantities of them mean, therefore, merely that conditions were especially favorable to concentration and gold is by no means always found where large quanties of black sand occur. All areas that look as though a slowing down or slackening of the water current has at some time taken place are worthy of testing since in such areas the rate of flow of the stream may have been so small as to cause it to drop the gold that it was transporting.

Gold, being heavier than most of the material with which it is associated, tends to settle and to sink to the bedrock. Bedrock and the dirt for a few feet above it should, therefore, be explored and tested with special care. Depressions in the bedrock may hold rich pockets of gold, and bedrock that is fissured and shattered, acting as riffles, may hold good gold values.

A great many men, in the past two years, have been attempting to make a living in Arizona from the reworking of old placer ground in the old richer fields. In such ground, the easiest-found gold has been won, but frequently, if the ground has not been worked over many times, the bottom has not been carefully searched, and the painstaking cleaning of crevices, and pot-holes may yield lucrative results, especially where the bottom is soft or fissured. Evidence of such rich pockets are partly cemented rounded gravels and sand apparently forming a part of the bed-rock. Any such suspicious part of the bedrock should be picked into for possible overlooked bonanzas. Such pot-holes and crevices may extend for several feet down into the bed-rock and will almost invariably contain rich gravel.

Worn, rounded, smooth placer gold has traveled far from its mother lode, while sharp, angular placer gold or nuggets or grains that contain quartz or other brittle gangue minerals are comparatively close to their source. When seeking for the source of placer gold, the gold itself as well as "float" (rock carrying minerals) is followed up until no more is found. By trenching or sinking at that point, the mother lode may be opened up providing it is still there—has not been all removed by the processes that produced the float and placers.

PLACER EQUIPMENT AND METHODS

THE GOLD PAN

The gold pan (pan or miner's pan) (Fig. 14) is made from stiff sheet metal. Iron or steel is usually used, but aluminum and copper pans are available. Enamelware pans do not rust, but the coating chips off. Copper-bottomed pans with steel

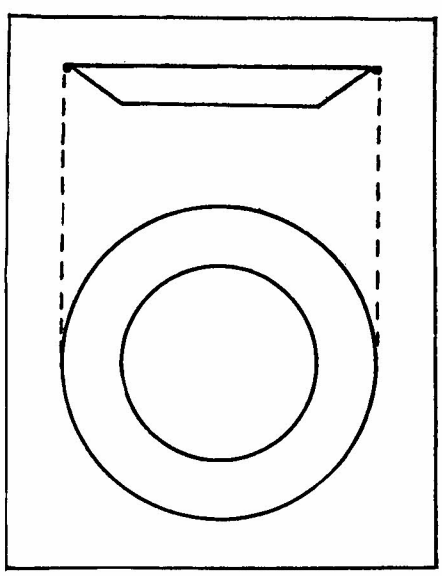

Fig. 14.—Gold miners' pan.

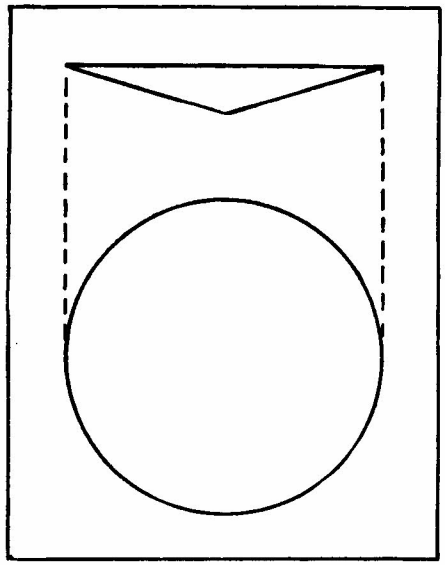

Fig. 15.—Batea.

sides and solid copper pans with the copper surface coated with mercury* (quicksilver) are often used to collect gold by amalgamation. Diameters of pans at the top vary from ten inches to eighteen inches with depths of from two to three inches. The inside surface of the pan must be kept smooth and free from oil, grease, and rust.

THE BATEA

The batea (Fig. 15) is used for panning gravel in Latin America and the Asiatic countries. It is usually made from hard wood, but sometimes sheet metal is used. Top diameters run from fifteen to thirty inches. A batea is handled in much the same way as a miner's pan, but the concentrates (gold and the heavy minerals) collect near its center.

THE MINER'S SPOON

The miner's gold washing spoon (Fig. 16) is sometimes used to test or sample small quantities of sand or dirt. It is made from either ordinary horn, hard rubber, copper, or polished

*Copper and mercury amalgamate readily. The mercury is rubbed on the clean copper surface.

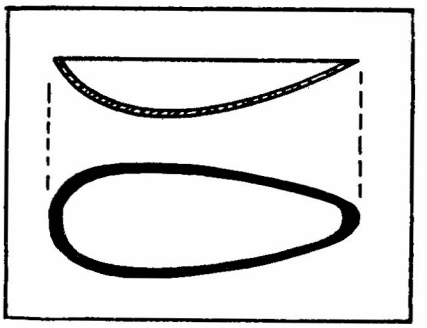

Fig. 16.—Miners' spoon.

steel. Spoons made from horn and hard rubber break easily, steel spoons rust, and in a dry climate, horn spoons check badly.

OTHER UTENSILS

Frying pans, pie plates, and similarly shaped utensils are also used to pan gravel.

PANNING

Panning is an operation that is very difficult to describe. It is best learned by observation supplemented by advice and practice. No matter whether a pan, batea, or spoon is used, the operation is essentially the same, but it is assumed that a pan is being used in the attempt to describe the procedure, which follows:

Fill the pan nearly full of dirt and place it in water deep enough to cover the pan and its contents. Work over the contents with both hands, breaking up the lumps and throwing out the stones. After the contents have been thoroughly disintegrated and the stones have been removed, grasp the pan with both hands, at opposite sides of the top, for the panning operation. Holding the pan about level and keeping it and its contents under water, give it a rotating motion, rapidly alternating the direction, so as to agitate the contents and allow the heavy particles to settle to the bottom. Then move the hands until they are a little back of the middle of the pan. This action tips the pan away from the panner. With the pan in this inclined position, give it a circular, sidewise, shaking motion that washes the contents from side to side. This brings the lighter material to the surface and washes it toward the front or lip of the pan while the heavy particles work their way toward or remain on the bottom. Some of the lighter material may wash out of

the pan. To remove more of the lighter material, flow water over it by raising and lowering the lip of the pan through the surface of the water. Experienced panners scrape off considerable of this light material with their thumb. These operations are repeated until nothing but the concentrates (gold and the heavy minerals, called black sand) * are left in the pan. By carefully washing a small amount of water over the concentrates, in the trough of the pan, gold colors may show.

The gold is usually separated and recovered from the other heavy minerals of the concentrates by one or a combination of the following methods.

(1). Pick out each piece of gold. A sharp-pointed pair of tweezers may be used for this purpose.

(2). Remove the magnetite (magnetic iron) by the use of a magnet (this separation is best made when the concentrates are dry). Further separation is made by careful blowing and panning.

(3). Pan the concentrates in an amalgamated copper-bottomed† or copper pan or grind them with mercury (quicksilver) in an iron mortar or grinding pan (muller).

Instead of cleaning up the concentrates from each pan separately, it is often advisable to accumulate a quantity of them before treating them further. The amount of gravel that can be panned in ten hours by a fairly good panner is a little more than half a cubic yard,‡ but this quantity is reduced if the gravel is cemented or if sticky clay is present. One cubic yard of average dirt in ten hours is about the maximum that can be carefully panned by a very skilled panner when all conditions are favorable.

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*The heavy minerals in concentrates, commonly called black sand, contain magnetite (magnetic iron oxide), ilmenite (iron-titanium oxide) hematite (non-magnetic iron oxide), iron pyrites (iron sulphides), marcasite (white iron sulphides), rutile (titanium oxide), wolframite (iron, manganese tungstate), zircon (zirconium silicate), garnet, and other heavy minerals. The specific gravities of these minerals are as follows: Magnetite 5.1, ilmenite 4.7, zircon 4.7, iron pyrite 4.9, marcasite 4.9, wolframite 7.2, garnet from 3.5 to 4.5, hematite 4.8. The specific gravity of placer gold ranges from 15.0 to 19.2. So rarely does any mineral in the concentrates, except gold, have value that a prospector is running practically no risk of overlooking something worth saving if he assumes that his "black sand" is is worthless.

†Copper and mercury amalgamate readily. The mercury is rubbed onto the clean bright surface of the copper.

‡Peele, Robert, 1st ed., Mining Engineers Handbook, John Wiley and Sons, Inc., New York, vol. 1, 1918, p. 755.

ROCKER OR CRADLE

The miner's rocker or cradle (Fig. 17) made in many sizes and shapes, consists of a box or trough mounted on two rockers which are set crosswise beneath the bottom of the box, a screen box or hopper, and an apron. Other features are usually incorporated in its construction, but the ones mentioned are the essentials. If gold values can be recovered satisfactorily with a pan or batea, rockers or cradles may be used, and they handle somewhat larger amounts of dirt. With a rocker or cradle, two men working together can wash from three to five cubic yards* of average dirt in ten hours unless sticky clay and cemented gravel are present. It is good practice to soak and stir up clayey dirt in a puddling box before putting it through the rocker. Otherwise, the clay and thick, muddy water may carry off the fine, flour gold. More water is usually used in rocking gravel than in panning. The amount varies much, from fifty to one hundred gallons for each cubic yard of dirt handled by the rocker, if the water is used sparingly. Some of the water from the discharge can be reclaimed and used over again if it is caught in a settling basin. It is sometimes advantageous to transport the dirt and do the rocking near the water supply. The rocker catches coarse gold effectively, but fine gold is apt to float off, especially if thick, muddy water is used and if sticky clay is washed through the rocker or cradle.

Figure 17 shows a knockdown rocker or cradle and is from the article "How to Make a Rocker" by W. H. Storms in the June 24, 1911 issue of the Engineering and Mining Journal and Pamphlet No. 31 by W. W. Staley of the Idaho Bureau of Mines and Geology. A longitudinal section through the center of the rocker, an end view, and a removable screen box or hopper, are shown.

A—Cleats—The back (N) slips in between them.

B—Cleats—To hold bottom (L) of rocker.

C—Cleats—To hold front crosspiece.

D—Cleats—To support canvas apron.

E—Cleats—To hold top crosspiece.

F—Cleats—To support hopper or screen box. They should be placed so that the bottom of the hopper (screen) is about level when the rocker is set upon its rocker ways (bases).

X—Bolt holes for ½-inch iron bolts used in holding rocker together.

I—Riffies—¾ inch high by 1 inch wide.

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*Taggart, A. F., 1st ed., Handbook of Ore Dressing, John Wiley and Sons, Inc., New York, 1927, p. 641.

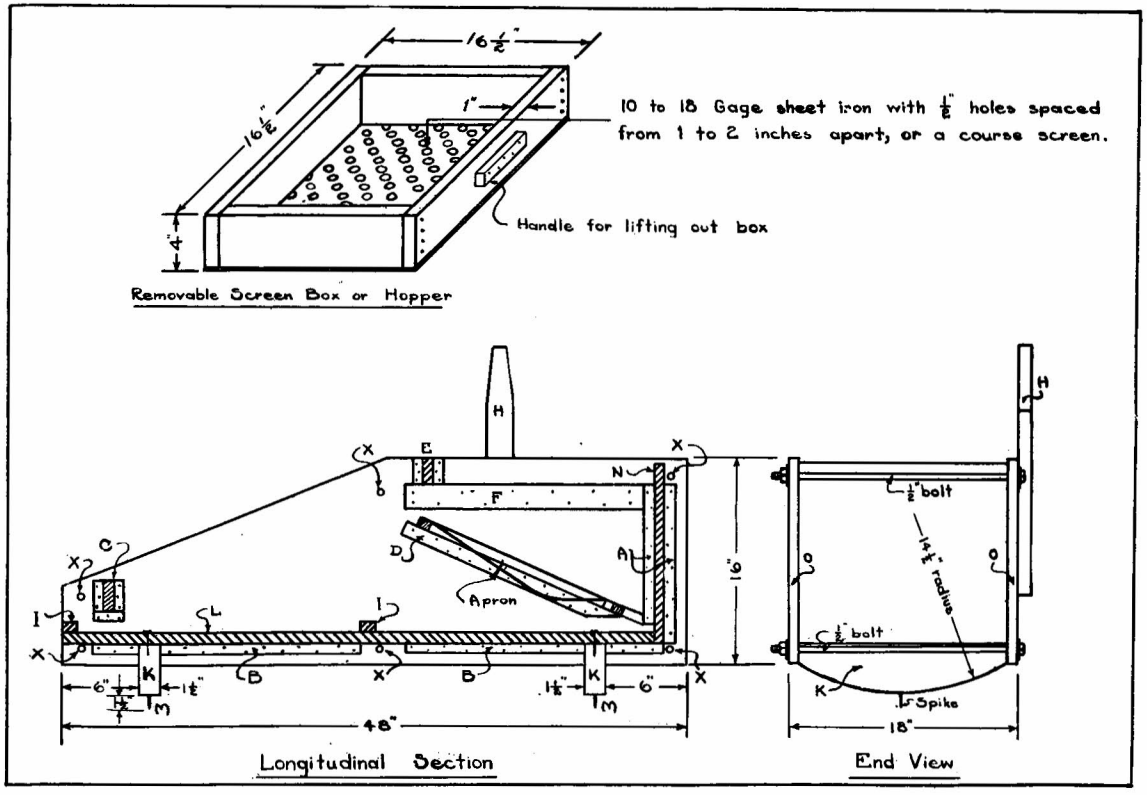

Fig. 17.—Knockdown rocker.

H—Handle for rocking rocker or cradle. (Some rockers or cradles have the handle fastened to the screen box or hopper.)

K—Rockers.

L—Bottom board of rocker or cradle (1-inch lumber dressed to ¾ inch is heavy enough).

M—Spike to prevent rocker or cradle from slipping down grade.

N—Back of rocker cradle.

O—Sides of rocker or cradle.

Construction—Rockers or cradles range from ten to seventy inches in height with an outside width of from eight to thirty inches. Lengths range from fifteen inches to nine feet, the usual length being from three to four feet. Some persons find short rockers or cradles poor flour gold catchers. Extra long rockers or cradles catch fine gold better than the short ones, but they may be difficult to transport. To prevent loss of gold, the bottom board should be in one piece and free from knots, cracks, and checks. When clear lumber is unavailable, the bottom is often covered with a piece of carpet, canvas, burlap, or blanket. Such a covering* acts as a good flour or fine gold catcher and it is, therefore, a good plan to use it in all rockers. The covering should be taken up occasionally and cleaned of its gold. (Washed in a tub. Some miners burn the covering to recover the gold.) Soft lumber which will not shred or rough up under working conditions is best to use in the construction of the body of the rocker or cradle.

Apron—The apron is a canvas-covered framework made of about ¾x1½ inch lumber, with the side pieces extending at the lower ends a little beyond the lower crosspiece. Where a rectangular frame is used, the clearance can be provided by having the bottom end of the frame rest against a block of wood that is nailed to the back of the rocker. Corrugated iron is sometimes used†. The canvas is tacked onto the framework so as to leave a sort of a sag or pocket about an inch deep at the lower end. The material that passes through the screen falls onto the apron and a first concentration takes place since some of the coarse gold and other heavy minerals are caught in this pocket. The apron can be readily removed and its contents

*Some rockers do not use riffles in the bottom but only the covering. A piece of wire cloth or netting is often used to hold it in place. When the dirt carries so much black sand that its banking up behind the riffles prevents the riffles from catching the gold, this practice is advisable.

†Taggart, A. F., 1st ed., Handbook of Ore Dressing, John Wiley and Sons, Inc., New York, 1927, p. 640.

washed into a pan for final cleaning. Some rockers or cradles use more than one apron, but, for ordinary work, one is enough. To catch the gold that passes the apron, riffles, as shown in the sketch, are used. Three-quarter inch holes bored through one side of the rocker at the end of each riffle help in the clean-up. A cork plugs each hole when the rocker or cradle is in use.

Screen Box—Dimensions for this particular hopper or screen box are given in Figure 17. The ends should fit loosely, but not too loosely, in the rocker or cradle. About half an inch of clearance between the sides of the rocker and the sides of the screen box gives the proper bump. The cleats that support it should be set so that the bottom of the screen box is nearly level when the rocker or cradle is set up on its rockways (bases). Clearance for withdrawal of the apron should be provided. The screen or bottom of the screen box is usually made from thin sheet metal (about 18-gauge iron) perforated with holes about half an inch in diameter. The holes are spaced about two inches apart. Some persons use wire screen cloth netting with half-inch holes for this purpose.

Slope of Bottom—The slope or grade for the bottom or floor of the rocker cradle depends upon the character of the material being handled by it and is usually determined by the "cut and try" method. Light material requires a flatter slope than gravel which contains much heavy minerals. The usual practice is to give the bottom a slope of about two inches in three feet, which can easily be accomplished by setting one base (plank) higher than the other. Some people make one of the rockers about two inches higher than the other rocker and use level bases. A heavy plank is usually used as a base or rockerway under each rocker, and these planks should be well secured so that they will not move and shift around when the rocker or cradle is being rocked. Cross pieces nailed from one plank to the other make the base more rigid. Holes or grooves in each base (plank) must be provided to take care of the spike that prevents the rocker or cradle from working down grade. Cleats fastened to each rocker are sometimes used instead of spikes.

Operation—Enough material is dumped into the hopper or screen box to fill it from one-half to two-thirds full. While a stream of water is poured over the material, usually from a dipper, the rocker or cradle is given a rocking motion and kept rocking. The material is worked over and the clean stones and boulders are picked out, inspected, and, if found valueless, discarded. The water washes the fine material through the screen onto the apron where some of the gold and heavy minerals are

caught. The material which does not remain on the apron washes over its end onto the bottom of the rocker or cradle where more of the gold and heavy minerals are caught behind the riffles. The lighter and worthless material washes over the riffles and out of the rocker or cradle. It is advisable to occasionally test, by panning, some of the tailings or waste flowing out of the rocker to find out if gold values are being lost.

The water should be added in a steady stream and the volume should be sufficient to carry the waste out over the riffles without banking. Too much water may wash the gold out of the rocker. Clay, as well as thick, muddy water, may carry off the fine, flour gold. Clean-ups depend upon the amount of gold being caught and how the rocker is functioning. Usually clean-ups take place after each fourth or fifth batch, but the concentrates behind the riffles should be watched and clean-ups governed accordingly.

THE LONG TOM

The long tom (Fig. 18) is a modified sluice box which is often used in place of a rocker. Dimensions vary greatly but usually range from six to twelve feet in length, the upper end being from fifteen to twenty inches wide, the lower end being from twenty-four to thirty-two inches wide., with sides from six to twelve inches high. Attached to the lower end is an inclined screen (B) set at an angle of forty-five degrees to the bottom. This screen is a piece of heavy sheet iron perforated with three-eighths or one-half inch holes. The tom is usually given a slope of about one inch per foot of length. A wide riffle box (C), usually set on a flatter grade than the tom (A), with its upper end set under the lower end of the tom, receives the fine material and water that pass through the holes in the screen (B).

Operation—The material is shoveled into the tom (A) or into the flume (D). A stream of water flows from the flume (D)* onto the upper end of the tom. The material is worked over by means of a rake, fork, or square-ended shovel so as to break up the lumps of clay and to clean the dirt off the stones. The clean stones and boulders are forked or shoveled out and the fine material is worked through the holes in the screen. It falls into the riffle box where the gold, with or without the aid of mercury (quicksilver), and the black sand settle behind the riffles. The tailings or light waste material wash out of the

*A pipe or hose is sometimes used to supply the water to the tom.

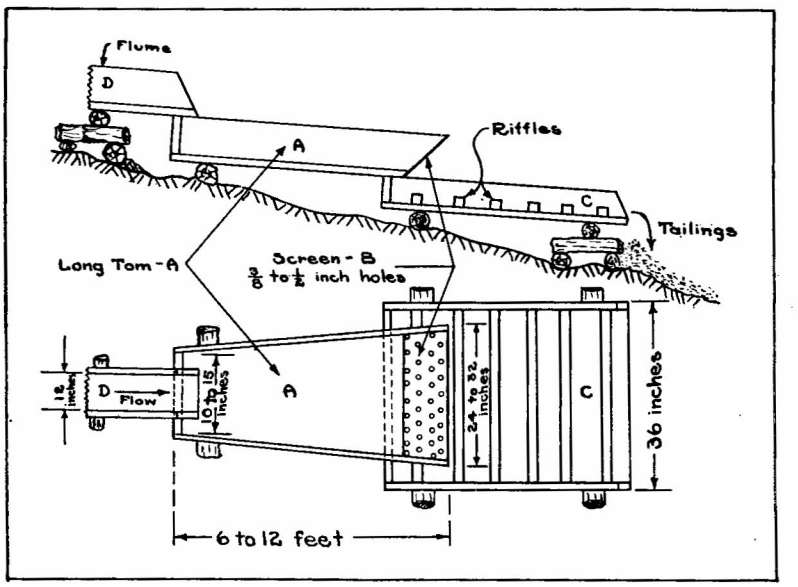

Fig. 18.—Long tom.

riffle box. Often the riffle box is supplemented and followed* by one or more sluice boxes the bottoms of which are covered with canvas, carpet, fleece, burlap, or some similar material for catching the fine, flour gold that passes over the riffles. Toms are regularly cleaned up, the gold and amalgam collected from the riffles being washed in rockers or pans. The amount of material that can be handled by a tom in ten hours, two men working together, is as high as six† cubic yards of average dirt and from three to four yards of somewhat cemented dirt. The long tom requires an ample water supply, but it uses less water than the sluice. In small-scale operations, where lumber is expensive and scarce, it finds favor. Long toms are now little used in this country because, where the grades are satisfactory and an ample supply of running water is available, a sluice is usually as effective and requires less labor to operate.

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*An inclined screen allows the pebbles and coarse sand to be easily discarded. To get best results the pulp (fine sands, flour gold, and water) should flow over the mats or covering in a thin sheet.

†Wilson, E. B., 3rd Ed., Hydraulic and Placer Mining, John Wiley & Sons, Inc., New York, 1918, p. 70.

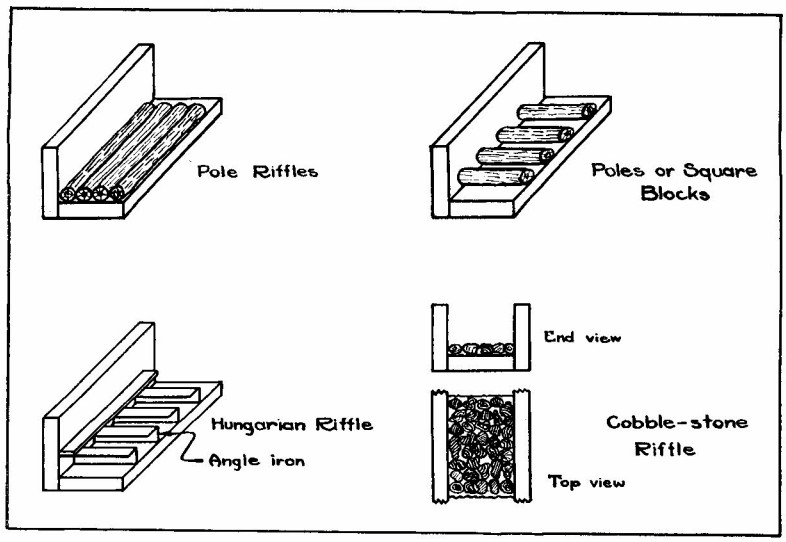

Fig. 19.—Various types of riffles.

SLUICES

Sluice is a term applied to a sloping trough or channel through which gravel is washed by a stream of water used by placer miners to separate and recover gold from gold-bearing gravel. A ditch or ravine that is used to accomplish this purpose is called a ground sluice, while a sluice made from wooden boards is often called a box sluice. The latter is usually made up of twelve-foot sections, called sluice boxes, which are butted together and held in place by wooden strips nailed to the outside. When sluice boxes must be frequently moved, telescoping sections are sometimes used.

Sluice boxes vary in width from eight inches to over six feet and in depth from eight inches to over five feet. Although most sluice boxes are made from wooden boards, sluice boxes made from sheet metal have many advantages and are sometimes used in large-scale operations.

Riffles—"Riffles* have three chief functions: (a) To retard the material moving over them and give it a chance to settle, (b) to form pockets to retain gold which settles into them, and (c) to form eddies which roughly classify the material in the riffle spaces. The strength and shape of the eddies (the "boil"

*Peele, R., 1st ed., Mining Engineers' Handbook, John Wiley and Sons, Inc., New York, vol. I., 1918, p. 783.

of the riffle) must be strong enough to prevent the riffles from filling up with heavy sand (packing) and not too strong to prevent the lodgment of gold."

There are many different kinds and shapes of riffles, a few in common use being shown in Figure 19. They are made from various materials. The riffle used is selected by the operator from the material available. Wood, iron, steel, or cobble stones are usually used for the ordinary run of mixed coarse and fine gravel. Carpet, burlap, canvas, cocoa matting, and such materials, held down by wire netting or metal strips, are commonly used for fine sands and to catch fine, flour gold.

Slope—The slope* of the sluice depends upon the character of the gravel and gold, kind of riffles, and the quantity of water available. A limited water supply makes it necessary to use a steep slope if the largest possible quantity of gravel is to be run through the sluice. Moderately fine gold is caught best on a steep slope when the water is spread out in a rather thin sheet. Slopes given sluices vary from six inches to twelve inches for each twelve-foot sluice box and the slope should be uniform throughout.

Water Consumption—Unless an ample water supply is available, it is useless to build a sluice. The supply of water should be sufficient to furnish all of the water needed for sluicing while the sluice is in operation. Water consumption varies much, running from 3,600 to 8,300 gallons† of water per cubic yard of gravel washed.

Clean-up—The clean-up consists of treating the concentrates in a pan or rocker. The gold is separated and recovered from the concentrates that result from the panning or rocking operation by one or a combination of the following methods:

(a) Pick out each piece of gold. A sharp-pointed pair of tweezers may be used for this purpose.

(b) Remove the magnetite (magnetic iron) by the use of a magnet. Further separation is made by careful blowing or panning.

(c) Pan the concentrates in an amalgamated copper-bottomed or copper pan or grind them with mercury (quicksilver) in an iron mortar or grinding pan. The gold is recovered from the amalgam by retorting or by dissolving the mercury in dilute nitric (one part strong acid to one part water) acid.

Figure 20 shows three views of a small sluice box with a re-

*Taggart, A. F., op. cit., p. 645.

†U. S. Bureau of Mines Information Circular 6611, 1932, p. 15.

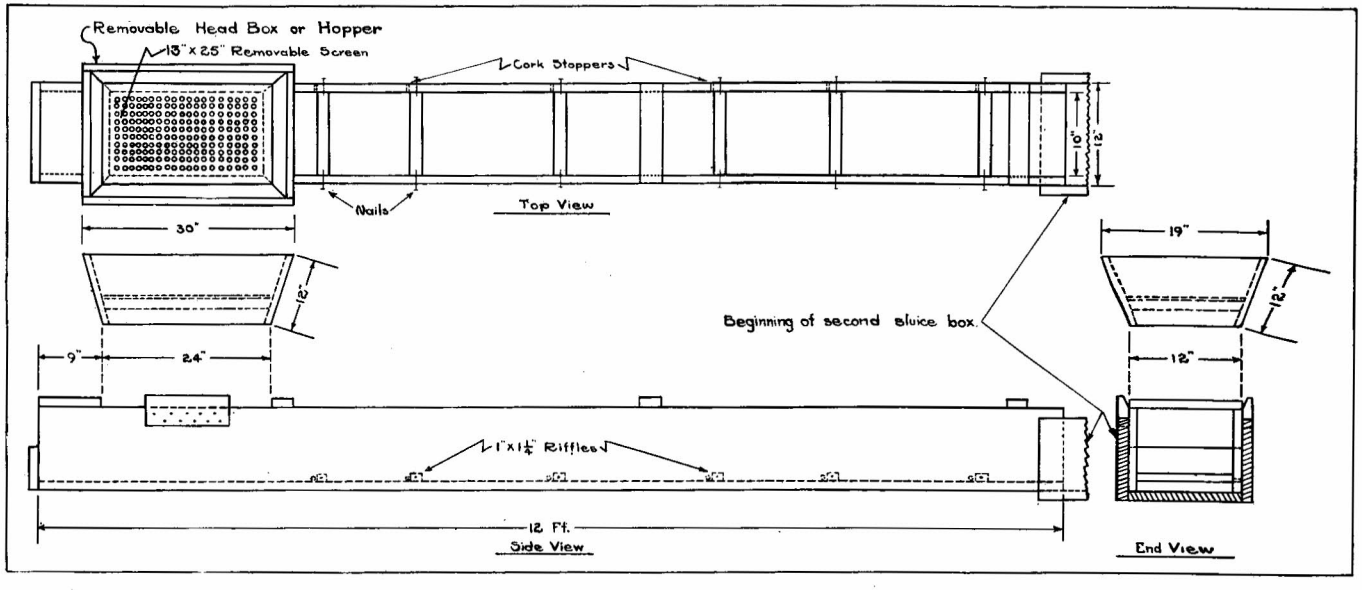

Fig. 20.—Sluice box details.

movable head box or hopper. Lengths used run from six feet to twelve feet, and the box is constructed of 1x12-inch rough lumber. The riffles are fastened by nails driven into their ends, through the sides of the sluice box. These nails should not be driven home, but their heads should be left projecting so that they can be easily withdrawn when the riffles are removed for the clean-up. Wedges are sometimes used to hold the riffles in place instead of nails, but are troublesome. Carpet, burlap, canvas, and such material, held in place by wire netting or by metal or wooden strips, is often used instead of some of the riffles to catch the gold. When much black sand is present, some operators use only such material for the whole length of the sluice, instead of riffles. When a sluice box is worn out, it may pay to burn it and pan the ashes to recover any gold that it contains.

Operation—The gold-bearing dirt is shoveled or dumped into the head box or hopper. A steady stream of water is run over it and washes the fines through the screen into the sluice. The light material washes through the sluice and out of it, the gold being caught behind the riffles or on the fabric covering. Stones and oversize are shoveled or picked out of the hopper.

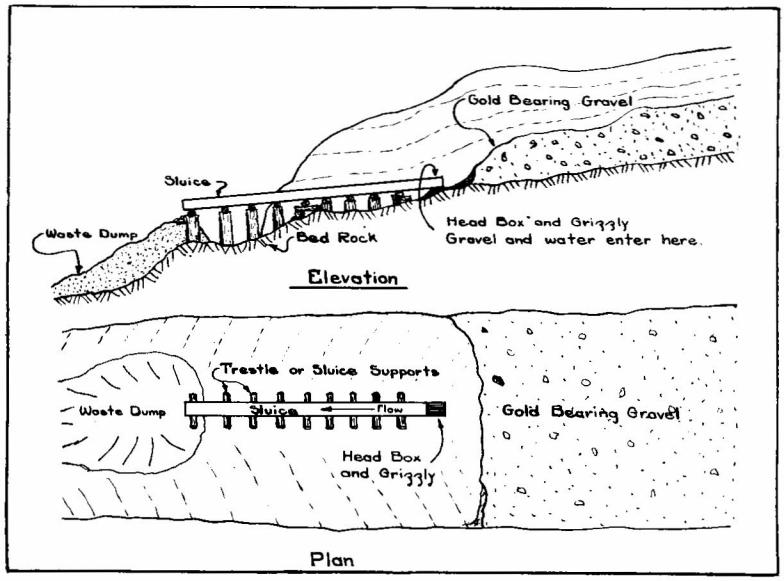

Fig. 21.—Sluice lay-out.

Amalgamation—Coarse gold is usually caught in the upper riffles, but the fine, flour gold tends to float in the moving water and to wash away with the waste. To catch this fine, flour gold, mercury is frequently added to the riffles. Clean mercury amalagamates with the clean, bright, flour gold and the amalgam is caught in the riffles. Care must be taken in adding the mercury to prevent it from breaking up into small globules that will wash away.

All the foregoing methods of wet gravel treatment necessitate the presence of ample water. The methods are so far superior in efficiency to the dry methods briefly described in the following paragraphs that by "hook or crook" wet methods should be used. In Arizona, except perhaps in the dryest of the desert regions, every dry arroya or canyon will run water at least once a year, even if for only a few short hours. If pay dirt is found in such an arroya or canyon in sufficient quantity, the building of earth-work dams and ditches above the deposit during the dry season to catch the one or two rainy season cloudbursts affecting the area during the rainy season, may allow for the rapid working of the deposit with ample water, and at a far greater profit than by the laborious and costly hauling or pumping of water to the deposit, or the hauling of the gravel to the nearest permanent water. In this work, the enormous force of running water should be realized, and reservoir sites should be chosen amply large to protect the dams from flood water. The "farming" of several such deposits might be possible in the dry season by a prospecting party of several men, with the expenditure of no funds other than a grubstake to tide them over until the one or two favorable rains filled their reservoirs.

RETORTING

The separation of mercury from amalgam by distillation is commonly called retorting.

The retorting of small batches of amalgam is usually done in a covered cast-iron receptacle called a retort. An iron pipe about four feet long is fitted into a hole in the cover and is bent close to the retort so that most of the pipe slopes downward when the retort is set up and covered. This sloping part of the pipe is surrounded by a metal jacket through which cold water passes continuously, and the pipe should discharge into a vessel filled with water to a point slightly above the end of the pipe. Sometimes, instead of being enclosed in a water jacket, the pipe is wrapped with burlap or some other loose fabric upon

which cold water is poured. If the fire is allowed to die out, water may be drawn up into the retort, resulting in an explosion.

After the inside of the retort is coated with an emulsion of clay or chalk or is lined with two sheets of newspaper, the amalgam is added. The retort should not be filled over three-quarters full since amalgam swells when heated. An emulsion of clay or chalk is also used to lute the joint between the cover and the retort. To avoid the danger of the swelling amalgam closing the condensing pipe, the heat should be applied very slowly at first and gradually raised to a dark red heat. Near the end of the operation, the heat may be raised to a cherry-red. The mercury is driven off as a vapor and the gold remains in the retort. The mercury vapor cools and condenses to liquid mercury as it passes through the discharge pipe.

When small amounts of amalgam are to be retorted, it is good practice to send them to an assayer and have the work done by an experienced man who has the proper equipment. Retorting or burning the mercury from the amalgam in a frying pan or shovel is not only a very dangerous operation which should *never* be conducted in a closed room, but it results in a loss of gold. The fumes of volatilized mercury *are very poisonous.* If a human being inhales them, he may lose his teeth or his life.

An ingenious and simple method to use in retorting a small quantity of amalgam (up to an ounce in size) is by means of a potato. Choose a large, well-rounded potato, fresh and without drying cracks, and cut it in two halves. Scoop out in one half, a hole large enough to hold the amalgam and place the amalgam in the hole. Join the two halves and wire them tightly together. Place the potato in the hot ashes of a camp fire and let it bake done (from a half to three-quarters of an hour). Remove the potato, let it cool, unwire it, and a gold button will remain in the center. After removing the button, place the potato in a pan and squeeze out the distilled quicksilver from the pulp.

DRY CONCENTRATORS

The recovery of gold from gold-bearing gravel in arid districts, where water is scarce and too expensive to be profitably used in any of the small-scale wet concentrating methods already outlined, has been responsible for the development of many ingenious methods and machines. Practically all of the methods and machines that are used in the field to accomplish

this purpose utilize moving air or wind instead of water as a medium of separation.

"From results of experimental work* done at the University of Arizona the following facts have been obtained. A dry concentrator will not make as high recovery as a wet concentrator. Under favorable conditions, the recovery will be approximately ten to fifteen percent less with a dry machine as compared with a wet machine. It follows, therefore, that a wet machine should be used in preference to a dry machine where water is available.

The difficulty with the practical operation of dry concentrators is due to the fact that they require the material treated to be in an ideal condition. First, the material must be dry; moist or damp material is not satisfactory as feed for dry machines. Second, the material must be disintegrated and this condition practically limits the use of dry concentrators to sandy, dry material or material that can be sun-dried and easily disintegrated.

When Dr. Chapman refers to disintegrated material, he means sand, gravel, etc., in which the particles of gold are free —unattached to and not included within the waste material. If some clay is present, it may become very hard when dry and cement the gold to the sand or gravel which may still appear to be loose or disintegrated. Such gold is lost in dry-washers, but might be released and recovered if treated with water.

A third drawback to the use of dry-washers is the fact that all nuggets too large to pass through the screen, in which the openings should be relatively small since close sizing is desirable, are lost unless the material that collects on the screen is examined very carefully. About a year and a half ago, a $152-nugget was in this way left lying on the waste dump in the Weaver district. (See Fig. 7.)

Blanket—One of the primitive methods involves the use of a dry blanket with which the dry, gold-bearing material is tossed up into a strong wind. The wind winnows it and blows the light fines away. The coarse stuff is picked out by hand and the fine concentrates remaining on the blanket are then treated by blowing and hand picking until the gold is collected. Some of the gold is caught in the hair of the blanket.

Dry Panning and Blowing—The dry, gold-bearing gravel is dumped into a pan and shaken up so as to bring the lumps and coarse stuff to the top. After they have been removed, the

*Chapman, Dr. T. G., personal communication, 1932.

remainder is slowly poured, from about shoulder height, into a second pan which is placed on the ground. A strong wind blowing through this stream of material winnows it and carries away the light fines. This operation is repeated several times until a concentration has taken place. The concentrates are then winnowed by tossing them up from the pan into the wind. Following this operation, the material remaining is panned just as in water. The concentrates from this panning are then cleaned further by blowing with the mouth.

Dry-Washers—Practically all of the small-scale, dry concentrating machines that are used in the field are dry jigs although dry tables are being tried out on one or more large-scale developments. Dry jigs, locally called dry-washers, differ widey in design and construction, but practically all of them are built so as to subject a bed of the gold-bearing gravel to intermittent pulsations of air. These blasts of air bring the light particles to the top, the gold and heavier particles settling beneath.

Figure 22 shows a dry-washer that is made in this State. Like others of its type, it consists essentially of a screened hopper and feed-box and a cloth-bottomed, inclined tray with cross riffles, beneath which is a bellows. The bellows forces intermittent blasts of air up through the cloth. This action agitates the material, brings the lighter fines to the top, and blows them away. The gravel is fed through the hopper upon the upper end of the tray and is slowly moved down the slope by this agitation. The gold lodges behind the upper riffles and the material of lower specific gravity (less weight) flows over the riffles and gradually passes out of the tray at its lower end.

A machine of this type is usually operated by two men. One turns the wheel that operates the bellows while the other feeds the gravel and watches its progress over the riffles. When the riffles appear to be loaded with concentrates, the tray is removed and the concentrates are transferred to a pan for further cleaning and concentration.

The capacities of dry-washers range in eight hours from three cubic yards of dry gravel upward. When properly operated, they catch rather effectively the coarser gold that passes the screen, but fine, flaky, flour gold is apt to go off with the waste and be lost.

Detailed diagrams of dry-washers are not included in this bulletin since it appears to be undesirable to recommend any particular type or types. Almost any standard style of machine will work fairly satisfactorily where conditions are all favorable, but such conditions are so rarely encountered in Arizona that the use of dry-washers is very apt to prove disappointing.

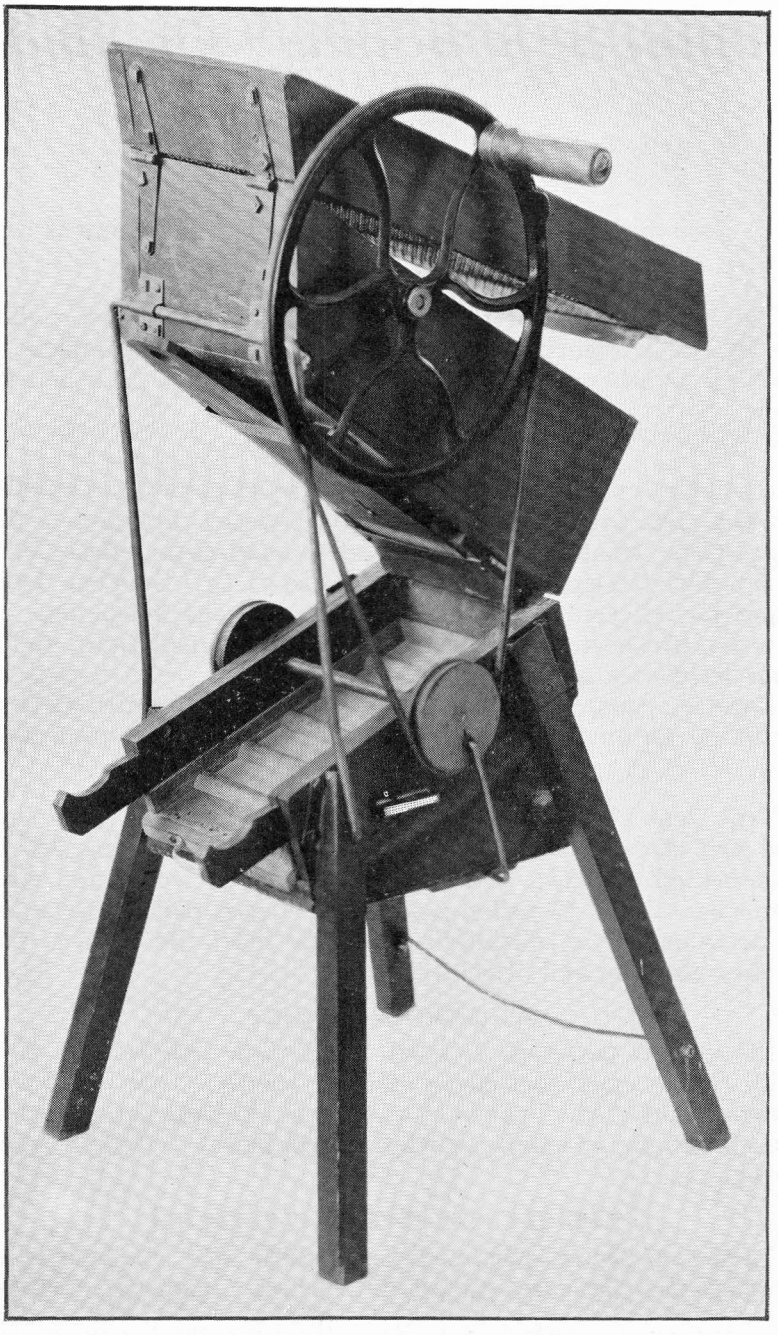

Fig. 22.—Dry-washer.

PART III

SUGGESTED LIST OF EQUIPMENT FOR PROSPECTING IN THE SOUTHWEST*

By

CHARLES H. JOHNSON

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The following list of equipment is intended more as a check list to aid in securing the essentials. It is not complete, as clothing or other personal effects will conform to each person's ideas.

PROSPECTING TOOLS, ETC.

Hammer (one single jack), shovel (round point, long handle), miner's pick, prospector's pick, moils (two or three), gold pan, horn-spoon, small mortar and pestle, magnifying glass, blowpipe outfit, determinative tables, sample sacks (some use double paper sacks), compass, maps (topographic and geologic).

If the prospector expects to make a permanent camp and do some hard rock mining:

Powder, caps, fuse, hand steel, forge, blacksmithing tools including an anvil, spoon (to clean drill holes), tamping stick.

GENERAL CAMPING EQUIPMENT

Tent, tent pins (steel), lengths of rope, canteens (one small and one large), saw, hammer, assorted nails, folding cot (to keep bed off ground), blankets, canvas blanket cover and wrap, water containers (5 gallon gas cans or kegs), pail, soap, lantern or acetylene lamp, flashlight, matches, jackknife, canvas bags to stow clothing and other things in.

COOKING EQUIPMENT

Large stew pan (one or two), small stew pan (one or two), grill, frying pans (one large and one small), large iron spoon, carving knife, can opener, Dutch oven, knives, forks, spoons, tin, aluminum, or enameled ware (cups, plates, coffee pot, etc.), towels, etc.

MEDICAL AND FIRST-AID SUPPLIES

Take along your own medicines—those that you are accustomed to use. Be certain that they include a laxative, an emetic,

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some iodine or mercurochrome, and a first-aid kit. A snake bite kit may prove invaluable.

Some use castor oil, salts, or baking soda as a laxative or purgative. There are scores of other equally effective remedies.

Some use large quanties of tepid salt water or mustard water as an emetic (to produce vomiting). Other equally effective remedies are available.

PART IV

FOOD SUGGESTIONS FOR A PROSPECTOR

By

Margaret Cammack Smith

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Do you know that how you feel depends largely upon what you eat every day? Your ability to stand the heat of the sun, your ability to work without undue fatigue, your pep, and your ambition and enthusiasm depend upon what you eat perhaps more than upon any other one thing.

The good health of many a pioneer and prospector has been undermined by wrong food. A diet of soda biscuits, bacon, and beans does not make continued health possible. You must have a well rounded, balanced food supply.

Foods differ in composition and, therefore, in their effect and value to the body. They are grouped as follows:

1. *Energy foods.* Those foods that supply the fuel for the work of your muscles. An insufficient amount of energy-giving foods results in inefficiency and in loss of body weight. The body burns its own fat and muscle tissue unless enough food is eaten.

2. *Muscle-building foods.* They are necessary for building muscles and keeping already formed muscles in repair.

3. *Protective foods.* Milk, eggs, vegetables, and fruits are in this class. Special attention should be paid to these foods since the minerals and vitamins which they contain protect you against disease. They aid in the prevention of nervous disorders, digestive upsets, scurvy, tooth decay, anemia, rheumatism, colds, tuberculosis, etc.

4. *Bulky food—Roughage.* Certain foods are necessary to keep the system lubricated, to promote proper action of the digestive tract and bowels, to aid in the elimination of waste products. Constipation and its accompanying ills, such as sluggishness, headaches, etc., can be prevented by the liberal use of the bulky foods, namely fruits and vegetables and whole grain.

The following weekly food allowance has been planned to satisfy the food needs for the maintenance of health of a workman (as far as possible only foods which can be kept for long periods of time in good condition without ice have been included).

WEEKLY FOOD ALLOWANCE

Food	*Amount*	*Remarks*
Group I		
Milk	At least three 1-lb. cans evaporated or 1 lb. dried (Klim). (This is the equivalent of 3 quarts of fresh milk.)	Milk is the most essential food. It is the greatest health protector. It can be used in any way.
Group II		
Vegetables Carrots Onions Cabbage Beets Parsnips Turnips Potatoes Squash	Select at least 6 pounds from this group but not more than 2 pounds of these should be potatoes.	These vegetables are the health protectors and bulky foods. In this group, cabbage and carrots are superior to the others. If fresh vegetables, such as lettuce, celery, spinach, etc., are available they may be wisely substituted. Canned vegetables are more expensive, but otherwise can be substituted.
Group III		
Fruits Canned Tomatoes, 1 lb. or citrus fruits, 3 lbs. or fresh apples, 6 lbs.	Select 1 pound from this group.	Tomatoes or citrus fruit or fresh fruit or raw vegetable is necessary each day to prevent scurvy, rheumatism, pyorrhea, etc.
Dried prunes, apples, apricots		

Group IV

Dried beans or peas	Select 2½ to 3 lbs. from this group	Canned beans or peas may be substituted, but are more expensive. They are the energy foods.
Cereals (whole grain) Rolled oats Wheatena Shredded wheat Brown rice Whole wheat flour Whole wheat bread Sugar	From 6-8 lbs. from this group.	

Group V

Dried meat Bacon Ham Cheese	Select 2½ lbs from this group.	These foods are the muscle builders. Fresh meat or eggs may be substituted if available.

You will also want some coffee, tea, salt, and baking powder, and perhaps some fat, such as ½ lb. of butter, salt pork, or canned Crisco to make the food ration more palatable.

Remember to eat for health—Pay especial attention to getting enough of the protective foods, milk, vegetables, and fruits. The milk may be canned and the fruits and vegetables canned or dried for the most part.

PART V

TREATMENT OF SUNSTROKE OR HEAT PROSTRATION

BY ....

FRED P. PERKINS, M. D.

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TREATMENT IN THE FIELD

When a case of heat prostration or sunstroke develops in the field, first remove all tight clothing and put the patient in the shade. Dash cold water on head and body at frequent intervals, not continuously. The throwing of water has a two-fold purpose: cooling the surface and stimulating the cardio-vascular system by the force of the water being dashed upon the surface, causing a contraction and subsequent dilitation of the capillary circulation, forcing the cooled blood away and the hot blood to the surface. Give frequent sips of cool water internally and move patient to hospital as soon as possible.

TREATMENT IN A HOSPITAL

The best results have been obtained by following the method used at St. Vincent's Hospital in New York where a series of 197 cases were treated with a mortality of only 6 percent. The patient is immediately wrapped in a sheet and placed on a cot which has been covered with a rubber blanket. Dippers full of cold water are dashed upon him from a distance of several feet. Every two or three minutes a stream of ice cold water is poured on his head from a height of six or eight feet. When his temperature falls to 103° F., he is wrapped in a blanket and surrounded with hot water bottles. The gradual reduction of temperature proves the safest method. When the patient is wrapped in a sheet upon which the water is dashed, a too sudden withdrawal of the heat from the surface is prevented. Unfavorable symptoms have developed when ice tubs or packs have been used.

This treatment must be given carefully and the patient watched continuously for sudden changes in the circulation; and it may be necessary to give some quick heart stimulant, such as tincture of camphor or aromatic spirits of ammonia, to tide over a weak heart for a time. Always remember the patient's condition, a superheated condition, and don't lose your head and overtreat. For excessive thirst, have patient put something in his mouth which will stimulate the salivary glands —a pebble or small piece of wood or chewing gum will often be all that is necessary.

PART VI

INFORMATION ON POISONOUS ANIMALS

By

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SCORPION AND CENTIPEDE

Stings of the common scorpion are not dangerous to adult persons. In most instances and for most individuals, the scorpion sting is less painful than the sting of a common honey bee. It is sometimes dangerous for small children, however.

The bite of the large centipede, while very painful, is not really dangerous. The centipede has a single pair of poison jaws under the head. The claws of the remaining legs are not poisonous and are not capable of leaving a fiery trail, notwithstanding the many stories to that effect.

Weak ammonia may be somewhat helpful as a palliative for scorpion stings and centipede bites, though I do not feel at all certain that it accomplishes anything. Strong ammonia, on the other hand, will produce a burn more severe and requiring a longer period for recovery than the original sting or bite. I believe that suction is of value in the case of all poisonous stings or bites.

TARANTULA

The tarantula, while generally very much feared, is not so apt to bite as is usually believed and is not very painful or dangerous when it does so. Secondary germ infection of all such wounds is more or less likely to occur and should be guarded against by antiseptic treatment.

VINEGARONE, ETC.

The vinegarone, child of the earth, praying mantis, and similar forms sometimes regarded as dangerous are in fact nonpoisonous and entirely harmless.

BLACK WIDOW SPIDER

The black widow or shoe-button spider is a really poisonous species. It is usually jet black, shiny, the size of a pea or old-fashioned shoe button and has an hour-glass shaped red mark beneath the body. Illness, sometimes serious, frequently follows the bite of this spider. Fortunately, however, persons are

not bitten by the black widow as often as might be expected since the spider is really quite common, in southern Arizona at least. A physician's care is needed in case of such a bite. I make no recommendations as to treatment.

GILA MONSTER

The Gila Monster is the only venomous lizard in the world. All others are harmless so far as poison is concerned. The Gila Monster is not deadly. There is no absolutely authentic case of human death certainly due to Gila Monster bite on record, all stories to the contrary notwithstanding. Let these animals alone and you will never be bitten, as may be the case with rattlesnakes. I know of no case where a bite has been inflicted except where the victim was fooling with or teasing the Gila Monster. In case a bite is incurred, release the bitten part as soon as possible. Wash the wound and apply suction. The wound should be treated with antiseptic. See a physician if symptoms develop.

SNAKES

Rattlesnakes are the only really dangerous poisonous snakes which we have to fear in Arizona. The coral snake, while its venom is doubtless more deadly, drop for drop, than that of the rattlesnake, is too small to be regarded as very dangerous and there is no fatality on record for this species as far as I know. In fact I do not even have a record of any case of a bite by this species in Arizona.

Treatment of Rattlesnake Bite. A full account of treatment of rattlesnake bite goes rather beyond the bounds of this statement, but perhaps I can outline the most important things within such limits. First of all, discard the idea of using potassium permanganate. Experiments have proved it is worthless in any strength that one would dare use.

Let us divide the treatment into two phases: first, emergency treatment or first aid, and second, medical care. Every case of rattlesnake bite should be brought to the care of a physician as soon as possible, so you are concerned primarily with the first phase.

1. *Keep cool;* rattlesnake bites are *painful,* but only a small percentage is fatal.

2. Apply tourniquet at once between wound and heart, tight enough to hinder venous circulation, not necessarily tight enough to shut off arterial flow. A stout band or strip of rubber is good and can be most quickly applied.

3. Open fang punctures by cross cuts 1/8 inch deep, with sharp, sterile knife. (Safety razor blade is easily carried in sterile package). Suck the wound, by mouth if necessary. Mouth must be free of wounds or abrasions. Best to have a suction bulb, or apply suction mechanically as soon as possible, since long continued suction has been proved efficacious.

4. Loosen tourniquet every 20-30 minutes for two or three minutes.

5. If *Antivenin* be at hand, administer at once according to directions.

6. Keep patient *quiet*... Give stimulant if there is weak heart action or fainting. *Alcohol is not a stimulant.* Black coffee, aromatic spirits of ammonia, and strychnine, *are* stimulants. (Plenty of alcohol will neatly finish what the venom has started.)

7. As soon as possible get a physician who should continue the suction treatment, give *Antevenin* if not previously given, and care for the wound to prevent infection.

Suction removes venom in bloody serum for hours after bite is inflicted. *Antivenin* counteracts the venom which has gotten into the blood stream, and will benefit many hours after bite. Be careful not to *slash* indiscriminately or two deeply in opening for suction and drainage, especially on hand, foot, wrist, or ankle, as serious damage to tendons may result.

Incision and suction have been successfully used in Texas in cases of rattlesnake bite. The removal of poison in blood or bloody serum from the wound may be increased by strong suction, and for many hours after the bite is inflicted. Suction should be kept up for twenty minutes out of each hour over a period of fifteen hours or until swelling ceases. Mechanical suction is, of course, necessary for this purpose. We can recommend the "B D" outfit costing $1.50. Many cases of rattlesnake bite could be saved by proper use of this treatment alone, though we believe in *Antivenin* as an additional precaution and relief. The physician (who should be seen as soon as possible) should have, or be able to secure, *Antivenin.*

Very few bites are quickly fatal. Most of the fatal bites do not result in death before 18 to 48 hours so there is ample time for treatment.

DONT'S

Don't run or get overheated. Circulation, increased by exercise or by alcohol, serves to distribute the poison much more

rapidly through the body. Don't injure the tissues by injecting potassium permanganate, which is now known to be of no value as an antidote. Do not depend upon snake bite "cures" or home remedies commonly used. They are of no value. Do not cauterize the site of the bite with strong acids or the like.

Don't forget *strong black coffee,* and don't take whiskey or other alcoholic drink.

PART VII

LAWS, REGULATIONS, AND COURT DECISIONS IN RELATION TO THE LOCATION AND RETENTION OF GOLD PLACER CLAIMS IN ARIZONA

BY

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INTRODUCTION

Although occurrences of many substances besides gold or other precious metals may be located as placer claims, which substances include alum, asphalt, borax, diamonds, guano, gypsum, kaolin or china clay, marble, mica, onyx, various salts of soda, roofing slate, umber, building stone, etc., every statement made in this bulletin about locating and holding placer claims should be understood to apply specifically to claims chiefly valuable for the gold, silver, or other precious metal which they contain.

Since the federal and state statutes bearing on the matters discussed are not always entirely clear, it has frequently been necessary to appeal to the courts for decisions on various questions relating to placer claims. Sometimes the decisions of different courts seem to be at variance with each other, and one cannot speak positively about the true intent of the law in such cases.

The statements that follow are either transcriptions of the statutes themselves or are based on court decisions. It is believed by the writer that they are trustworthy, but he recognizes that some of them are merely matters of opinion based on court decisions which might be reversed by higher courts.

WHO MAY LOCATE PLACER CLAIMS

A citizen of the United States (either male or female) or one who has declared his intention to become a citizen before the proper court may locate placer claims.

An Indian or a minor child may make valid locations as may an unincorporated group or association of people who individually are entitled to locate placers. Locations may also be made by a corporation chartered under the laws of any state or territory of the United States, but no officer or employee of

the General Land Office, including clerks, special agents, and mineral surveyors, can locate such claims.

SIZE AND SHAPE OF PLACER CLAIMS

Each placer claim, if located by *one* person or a corporation (a company incorporated under the laws of any state, which is legally an individual), may not exceed twenty acres in area and should conform in shape to the system adopted in surveying the public lands of the United States. If previously located claims or patented ground cover part of the area desired, however, such property may be excluded from a placer claim even if to do so gives the claim a non-rectangular shape and necessitates running one or more of the boundaries in a direction other than north and south, or east and west.

A 20-acre placer claim should cover half of a quarter of a quarter section if located on surveyed land and measure 660 feet by 1,320 feet. The smallest tract recognized or considered is 10 acres and measures 660 feet by 660 feet. Five-acre tracts will not be recognized. If a claim is located on unsurveyed land, it should have the same dimensions and shape that it would have if on surveyed land and the boundaries must run north and south, and east and west (true, not magnetic, bearings).

While it has been held that, where the topography is such as to make it practically impossible to lay out rectangular claims, as in gulches with precipitous walls, placer claims may be located so as to conform to their environment, the land office regulations require that entries be as compact as possible in form and this office will not approve entries that cut the public domain into long, narrow strips or decidedly irregular tracts. The locators of placer claims will, therefore, probably find it advantageous to take up only square (10 acres) or rectangular (20 acres) claims of the dimensions already given if it is possible to do so. An individual or a corporation may locate any number of placer claims.

THE LOCATION OF CLAIMS BY GROUPS OF PEOPLE

The law permits *two* individuals to locate a 40-acre placer claim, *three* persons a 60-acre claim, etc., but the largest placer claim that can be located by a group or association of persons is 160 acres, and *eight* people must constitute the locating group for a claim of that size since not over 20 acres is allowed for each individual constituting such a group. The provision that allows 20 acres for each member of a group not exceeding eight

persons has been the basis of rank fraud. One person may locate the claim and use the names of other people as dummies who really have no interest in the ground, who afterwards convey their interest to the real locator thus enabling one person really to locate and eventually to acquire a placer claim that may contain as much as 160 acres. Such locations, if proved to be fraudulent, will be set aside by the courts.

LOCATION PROCEDURE

The first requirement is the discovery of mineral within the limits of the claim to be located. The grade of the metal-bearing sand, gravel, loose rock, or dirt does not have to be such as to make it possible to work it profitably where the discovery is made, but it does have to contain such values as would encourage a prospector to do more work at or near the point of discovery in the hope of finding material of higher grade.

When a claim is located by a group or association of two to eight individuals, the discovery of mineral at a single point is all that is required.

After the discovery of mineral, the following things must be done:

1. Post a location notice.
2. Mark the boundaries of the claim, at each angle, with a post or monument of stones.
3. Within 60 days after the date of the location, record a copy of the location notice in the office of the county recorder.

THE LOCATION NOTICE

Arizona statutes require that the location notice must contain:

a. The name of the claim.
b. The name (or names) of the locator (or locators).
c. The date when the claim was located.
d. The number of acres claimed.
e. A description of the claim with reference to some natural object or permanent monument that will identify the claim.

Blank location notices or certificates can be obtained from stationery stores for five cents each. The following blank notices, however, may be used.

....., a citizen (or citizens) of the United States (or who has—or have—declared his—or their —intention—or intentions—to become a citizen—or citizens—

of the United States), the undersigned, claims (or claim) by right of discovery and location this, the ..... placer mining claim which contains ..... acres, situated in the ..... Mining District, County of ....., State of Arizona, which is bounded and described as follows, to wit:

Beginning at (if on surveyed land, make the starting point a corner of one of the subdivisions of such survey)....., a (post or stone monument), where this notice is posted, hence (give direction) ..... feet to a (post or stone monument), hence (give direction) ..... feet to a (post or stone monument), hence (give direction) ..... feet to (a post or stone monument), hence (give direction) ..... feet to the place of beginning from which (mention some natural object or permanent monument) bears (give approximate direction and distance).

Dated and posted on the ground this.....day of ..... 19.....

Signed.....

.....

The law does not require that the names signed to a location notice be signatures. In other words, anyone can sign for someone else. The location notice should be prominently posted at some point on the claim, as at the point of discovery or one of the corner posts. The printed blank placer location notices, as well as the blank just given, assume that it is posted at one of the corners of the claim. It should be posted in such a way as to be protected from the weather, and a good plan is to tack it on the inside of a stout, tight box which has been nailed to a post.

MARKING BOUNDARIES

Arizona statutes require that a post or monument of stones be erected at each angle of a placer claim.

If wooden posts are used, they must be at least four inches in diameter and four feet six inches in length, and each post must be set at least one foot into the ground and surrounded by a mound of earth or stones of unspecified height. Where it is impossible to set posts into the ground, they may be supported by piles of stones.

When a mound of stones alone is used as a monument, it must be at least three feet high and four feet in diameter at the base.

If it is impossible to erect and maintain a post or monument of stones, a witness post or monument may be used, to be placed as near the true corner as the nature of the ground will permit.

NO DISCOVERY EXCAVATION NECESSARY ON PLACER CLAIMS

Although gold or some other valuable mineral not in a vein or lode must be discovered before a placer claim may be legally located and although considerable excavation work must sometimes be done to make such a discovery, the Arizona or Federal Laws do not require that any work be actually done on a placer claim in order to complete the location procedure. In other words, no work not needed to make the discovery of mineral need be done on a placer claim until after noon of July 1 following its location.

If a placer claim exceeds 20 acres in size, the work mentioned may be all done at one point.

ANNUAL LABOR OR ASSESSMENT WORK

In order to retain an unassailable title to placer ground which has been legally located, $100 worth of improvements must be made or $100 worth of work must be done on each *claim*, regardless of its size, every year, between noon of July 1 following the location of the claim and the next following July 1 at noon and during each succeeding year until a patent is obtained. This work may all be done at one point no matter what the size of the claim. If the annual labor has been commenced, but has not been completed by noon of July 1, and is diligently carried on thereafter until completed, the owner of the claim is deemed to have complied with the law, but an additional $100 worth of work must be started or completed before noon of the next succeeding first of July in order to retain title to the property.

PERMISSIBLE ASSESSMENT WORK ON PLACERS

The federal or state statutes do not specify exactly what work will satisfy the requirements of the annual labor law. Court decisions furnish the only guide in these matters, and they, naturally, do not cover all of the questions that might be propounded. Such questions can be answered positively only by carrying the matter through the courts, and one man's opinion is as good as another's.

From court decisions, which other courts might reverse, we

learn that the cost of doing certain things on or in connection with placer claims may be considered as probably fulfilling the annual labor provisions of the law, as follows:

1. Digging of a prospect hole or holes or of a cut or cuts.
2. Digging of a drain ditch or ditches.
3. Removing brush so as to get at the underlying gravel.
4. Constructing ditches, flumes, and pipe lines for conducting water to the claim for use in mining thereon.
5. Erecting of other works for mining.
6. Installing machinery.
7. Constructing any building, roadway (built *exclusively* in order to benefit the claim and necessary in order to develop it), and other improvements used in connection with and essential to the development of the claim.
8. Making drill tests on placer ground, if done in connection with actual dredging operations on adjoining claims.
9. Purchasing a dredge and placing it on the claim.
11. Employing a watchman to take care of and protect mining property while idle if such services are necessary to preserve buildings or other structures erected to work the mine, which would be needed if actual work were resumed, provided it is intended to use such structures again within a reasonable time.
11. Constructing dams or reservoirs on or off the property for the sole purpose of storing water to be conducted to and used in mining operations on the property.
12. Constructing a flume, which may be partially off the property, to carry away tailings and other waste material.

WORK THAT MAY NOT BE USED AS ANNUAL LABOR

Court decisions (which likewise might be reversed by other courts) have been made to the effect that the cost of doing certain things on or in connection with placer claims do *not* fulfill the annual labor provisions, as follows:

1. Constructing a reservoir on a claim to store water to be conducted and used elsewhere.
2. Expending money in travel in an endeavor to arrange to conduct water to the claim.
3. Placing on the ground tools, implements, lumber, and other material which are not used to any extent and are subsequently removed.
4. Erecting log cabins to be used by laborers (other decisions have approved the construction of necessary buildings, such as

boarding houses, bunk houses, stable, and blacksmith shops as fulfilling the requirements of the annual labor law).

5. Erecting a stamp mill or a lime kiln.

6. Employing a watchman merely to warn off prospectors and to prevent claim jumping or to prevent the stealing of small tools like picks, shovels, etc.

7. Surveying for a ditch, flume, or pipe line if the ditch, flume, or pipe line has not been dug or constructed.

FILING AFFIDAVIT OF PERFORMANCE OF ANNUAL LABOR

Neither the Arizona nor the Federal Statutes require that affidavits that the annual labor has been performed *must* be filed with anyone, but the Arizona Statutes provide that such affidavits *may* be filed with the Recorder of the county wherein the claim is located, within three months after the expiration of the time fixed for the performance of annual labor or the making of improvements upon a mining claim. In other words, under existing laws, such affidavits must be fiiled prior to noon of the first of October that follows the first of July after the work is completed.

The Arizona Statutes also provide that the recording of an affidavit of annual labor constitutes *prima facie* evidence that the labor has been completed. It is, therefore, desirable to file such affidavits in order that recorded evidence that the title to the claim is clear may be available.

Blank affidavits of performance of annual labor may be secured at stationery stores.

LODES WITHIN PLACER CLAIMS

A placer location does not cover any lodes that may exist within it. Either the holder of the placer claim or any stranger may locate and hold a lode included within an unpatented placer claim by following the procedure laid down in the Federal and State Statutes for locating lode claims, just as though no placer claim had been located around the lode. Furthermore, strangers are permitted to enter peaceably upon an unpatented placer claim, without the owner's consent, to locate a lode claim. After a placer claim has been patented, its owner also owns any lodes included within it if their existence was unknown when the patent was issued.

PLACERS WITHIN LODE CLAIMS

The owner of a lode claim is also the owner of any unlocated placer deposits that may exist thereon. It is, however, essential

that the lode claim should have been legally located on a deposit of mineral in place, in vein or lode form, and that all requirements of the statutes that govern the acquirement and holding of lode claims shall have been met.

PLACERS ON INDIAN RESERVATIONS

Mining claims, lode or placer, can be located and held on Papago Indian Reservations just as though the land were public domain.

According to the act of June 30, 1919, citizens of the United States, associations of citizens, or domestic corporations may prospect for deposits of gold, silver, and other valuable metalliferous minerals on unallotted lands on Indian reservations, and, if a deposit is found, may locate and lease it from the Government, if the Secretary of the Interior has declared that the area where the deposit is found is open to exploration.

Placer mining claims are located and held on all Arizona Indian reservations, except Papago reservations, exactly as on the public domain in that State, with the following exceptions:

1. Persons who have merely declared their intention to become citizens of the United States cannot make valid locations.

2. A copy of the location certificate must be filed with the Superintendent of the Indian Reservation, and the County Recorder, within sixty days.

3. After the claim has been located, the locator has one year within which to apply for a lease through the Superintendent of the Reservation. Such a lease is for twenty years, and the holder has preferential rights to obtain renewals for successive 10-year periods.

4. After the lease has been obtained, the holder must pay monthly a royalty of not less than 5% of the net value of the output from the claim. At the time this bulletin goes to press, the royalty on the net value of the output from gold deposits is fixed at 10%.

5. After the lease has been obtained, the claim holder must pay *in advance* an annual rental of at least 25c per acre for the first calendar year after the lease is obtained, at least 50c per acre for the second, third, and fourth calendar years, respectively, and at least $1.00 per acre for each year thereafter during the term of the lease. The rental is credited against the royalties as they accrue.

A locator on unsurveyed land must at his own expense have

the claim surveyed by a U. S. surveyor before a lease will be granted.

7. Not over 40 acres may be leased for not less than $1.00 per acre for a camp site, mill site, smelting and refining works, etc., by each holder of a mining claim lease.

8. Lands containing springs, water holes, or other bodies of water needed or used by the Indians for watering livestock, irrigation, or water power purposes are not open to exploration and lease.

9. Claims on Indian reservations cannot be purchased.

It should be noted that the usual $100 worth of annual labor must be performed on each claim in addition to the payment of royalty and rental.

Anyone who plans to prospect and mine on an Indian reservation should obtain a copy of the law and the rules pertaining thereto from the Commissioner of the General Land Office, Washington, D. C. A complete set of the necessary application and other blanks can be obtained from him for $1.00.

Since the Secretary of the Interior may at any time declare additional land open to exploration or withdraw land previously open to exploration, it would be wise for a prospector on an Indian reservation to secure from the Superintendent of the Reservation information as to what lands are and are not open to exploration, before he does any work on that reservation.

On May 15, 1932, all of the Wallapai, Western Navajo, San Juan, Navajo, Kaibab, San Carlos, and Fort Apache reservations, and parts of the Salt River, Colorado River, and Gila River reservations had been declared to be open to prospectors and prospective leasers, in Arizona.

PLACERS ON STATE LANDS

When Congress granted statehood to Arizona, it gave the public land in Sections 2, 16, 32, and 36 in each township to the State for school purposes. The State also owns much additional land, and it is necessary to correspond with the State Land Department at Phoenix to learn whether any area is or is not on state land.

Mining claims may be located on Arizona state lands, even such lands as have been leased for agricultural purposes (since the State reserves to itself the minerals on such leased lands), in exactly the same way as though they were on the public domain, with the following exceptions:

1. If a placer deposit is located on state lands not already leased as mineral ground to some one else, the locator should post a location notice, stake out the claim, and apply to the State Land Department for a two-year prospecting permit or lease. A fee of $2.00 must be sent with the application. When notified that the application has been granted, a rental fee of $5.00 per claim and an issuance fee of $2.00 must be sent to the State Land Department before the permit of lease is delivered.

2. The fact that land has been leased for agricultural or grazing purposes does not prevent a prospector from searching for mineral deposits thereon. He has the right to prospect on such land so long as he does not harm the lease-holders' crops or improvements, and, if he finds a mineral deposit, he may locate it and apply for a prospecting permit or lease, as stated in the preceding paragraph.

3. It is not necessary to file a copy of the location certificate with the County Recorder.

4. Not more than fifty tons of ore can be removed from a claim held under a prospecting permit.

5. If a commercially valuable deposit is found on land held under a prospecting permit within two years from the date of that permit, and the owner desires to exploit it, he must surrender his permit to the State Land Department, and obtain a five-year operating and development lease.

6. The Arizona Statutes provide that the annual rental to be paid for an operating and development lease shall not be in excess of five percent of the net value of the output of minerals. The net value is computed by subtracting all costs, excepting the expense of prospecting and such preliminary work, from the gross value of the ore.

7. Annual labor to the value of five dollars per acre must be performed on placer claims held under lease from the State, and an affidavit that such labor has been performed *must* be filed each year with the State Land Department.

8. The lessee may cut and use timber upon the claim for fuel, buildings required in the operation of any mines on the claim, and necessary drains, tramways, and mine timbers, but for no other purpose.

9. Mineral claims on state land cannot be purchased.

For further information concerning the leasing of mineral deposits on state land and for the necessary forms, applications should be addressed to the Commissioner of the State Land Department, Phoenix, Arizona.

PATENTING PLACER CLAIMS

A placer mining claim, located on the public domain, may be patented or purchased from the United States Government, after at least $500 worth of work has been done upon it, for $2.50 per acre or fraction of an acre plus various fees. If on unsurveyed land, the claimant must also pay for a survey made by a U. S. Mineral Surveyor. Patent procedure is so complicated that it would serve no good purpose to outline it in this bulletin, and anyone who contemplates applying for a patent should consult an attorney-at-law.

MAPS OF ARIZONA

The Arizona Bureau of Mines now has available for distribution three different maps of the State, as follows:

1. Base map of Arizona in two sheets on a scale of about eight miles to the inch. This map is strictly geographic, with the position of all towns, railroads, rivers, surveyed lands, national forests, national parks and monuments, etc., indicated in black, and the location of mountains and other topographic features shown in brown. It also indicates where the various mining districts are situated, and is accompanied by a complete index. It was issued in 1919 and is sold, unmounted, for 35c, or mounted on cloth with rollers at top and bottom for $2.50.

2. A topographic map of Arizona in one sheet, on the same scale as the base map. It shows 100-meter contours, and there is a meter-foot conversion table on the map. It was issued in 1923, and is sold, unmounted, for 50c, or mounted on cloth with rollers at top and bottom for $2.50.

3. A geologic map of Arizona on the same scale as the base map, printed in many colors. It was issued in 1925, and is sold both mounted and unmounted for the same prices as the topographic map.

The following unmounted Arizona Map may be obtained from the U. S. Geological Survey, Washington, D. C., for $1.00.

A relief map of Arizona on the same scale as the base map, printed in various shades of brown, black, and blue. It was issued in 1925, and looks exactly like a photograph of a relief model of the State.

POSTAGE IS PREPAID ON ALL MAPS

SERVICES OFFERED BY THE BUREAU

The Arizona Bureau of Mines will classify free of charge all rocks and minerals submitted to it, provided it can do so without making elaborate chemical tests. Assaying and analytical work is done at rates fixed by law, which may be secured on application.

The Bureau is always glad to answer to the best of its ability inquiries on mining, metallurgical, and geological subjects; and takes pride in the fact that its replies are always as complete and authoritative as it is possible to make them.

All communications should be addressed and remittances made payable to "The Arizona Bureau of Mines, University Station, Tucson, Arizona."