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THE PLACER DEPOSITS IN THE UPPER KOUGAROK

SEWARD PENINSULA, ALASKA

THE PLACER DEPOSITS IN THE UPPER KOUGAROK SEWARD PENINSULA, ALASKA

BY A Ben Shallit

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Certificate of Acceptance

This thesis is approved as fulfilling the final requirement for graduation with the degree of Engineer of Mines at the University of Alaska.

Howard G. Wilson
Dean of School of Mines

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Date

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INTRODUCTION

Since the first discovery of alluvial gold on Seward Peninsula in 1866, all of the known fields have been mined to some extent. The richest areas were exploited first. Later large low grade ones were operated with a decrease per unit profit which has necessitated a more efficient method of development. As a result, one of the principal functions of the Territorial Department of Mines is to give technical advice to the miner. The purpose of this investigation is to assist the prospector and operator by a technical study of the relationship of the placers and their genesis in one specified area.

In 1939 while making a reconnaissance survey of Seward Peninsula the desirability of an investigation of the placer deposits near the junction of Taylor Creek and the Kougarok River became evident. The next year a detailed study of this area was undertaken. The economic factors pertaining to mining were considered; topographic, drainage, and detail maps were drawn; samples were taken and assayed; concentrates analyzed, gold types classified and drill-hole logs examined.

ECONOMIC FACTORS

Natural Conditions, Geography

The area under consideration as shown on plate (1) lies in the central part of Seward Peninsula at about 164° 48' West Longitude and 65° 40' North Latitude near the junction of the Kougarok River and Taylor Creek. The Kougarok River heads on the south-east slope of the Kougarok Mountain and flows about ten miles in an easterly direction where it is joined by Macklin Creek, a westerly flowing stream. The combined waters make a right angled turn and flow about four miles almost directly south. Here the river unites with Taylor Creek, and continues in a south by easterly direction joined by ten medium sized creeks in the next thirty-seven miles. At Bunker Hill it flows into the Kuzitrin and continues in a south-westerly direction into Imuruk Basin, Grantley Harbor, Port Clarence and finally the Bering Sea.

Topography

The upper Kougarok region is a dissected plateau. Several mountains rise above this upland. Kougarok Mountain at the head of Kougarok River is about three thousand feet high, and Midnight Mountain, north of Taylor is about twenty-six hundred feet high. The upland probably represents a former stage of planation. It consists for the most part of broad rounded summits, of elevations up to sixteen hundred feet, and of irregular valleys.

Heavy talus, ground ice, and hillside creep have modified the valleys; these together with structural erosion and intrenched meanders have given them their irregular outlines. The larger rivers have, in places, broad gravel covered floors and, in others, narrow steep-

walled valleys. The smaller streams are usually steep-walled, but they too often have sharp bends and irregular drainage.

Alders and willows are the only "timber," and are found along most of the streams. The hills are covered with grass and moss, which hides the bedrock except where it is exposed in the steep-walled valleys and on some of the hill tops.

HISTORY

Discovery of Gold

Gold was first discovered in the Kougarok region in 1899. During the spring of 1900 about forty men came in from the Nome fields and a recording district was established at Taylor. As no bonanzas were discovered the remoteness of the field discouraged prospectors and for several years the district remained undeveloped.

The successful construction of ditches at Nome brought a fresh influx of prospectors to the Kougarok. In a relatively short time, eight ditches were constructed at an expense hardly justified by the extent of proved placer ground.

The first dredge started operating in 1918 at the mouth of Henry Creek and mined the Kougarok River as far as Taylor Creek. About the same time the Kougarok River above Macklin Creek was dredged for about a half mile.

Some gold was produced every year but it was not until 1935 that a new large operation was established. A dredge was built which reworked the tailings left by the original dredging of the Kougarok between Henry Creek and Taylor.

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exploitation of bench gravels in this district belongs to Joe Lucas who in 1937 worked the bench placers near Taylor. Through the application of "outside" construction methods to placer mining he developed the first efficient mechanical operation in this section.

Production

The variable production of gold from the Kougarok district is shown by the following excerpts from official sources:

[1] "Gold Production of Kougarok District, 1900-1908

1900	$50,000.	1904	$150,000.
1901	35,000.	1905	200,000.
1902	50,000.	1906	very small
1903	100,000.	TOTAL	$585,000."

[2] "As rated among the districts of Seward Peninsula, Kougarok stood fifth in the output of placer gold in 1926----the principal interest in that camp appears to have been----the repair of the old tram line from Nome to Shelton."

[3] "No dredging was in progress in the Kougarok district in 1927---- on the whole such work as was in progress on the placer deposits in this district was mainly of a prospecting type, and there were few camps that produced more than a thousand dollars each."

[4] In 1929, "Most of the camps in the Kougarok district were small one or two man affairs, and the largest employed only three or four men. Their individual output was small, none reporting a yield more than a few thousand dollars."

[5] In 1938, "From being one of the smaller producing placer districts in Seward Peninsula the Kougarok has recently been increasing its output until lately it ranked second only to Nome in the value of

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[1] Alfred H. Brooks and others, Investigations of Mineral Resources of Alaska in 1908, Geological Survey Bulletin No. 314, p. 171.

[2] Philip S. Smith and others, Mineral Resources of Alaska 1926, Geological Survey Bulletin No. 797, pp. 26, 27.

[3] Ibid., 1927, Geological Survey Bulletin No. 810, p. 36.

[4] Ibid., 1929, Geological Survey Bulletin No. 824, p. 47.

[5] Ibid., 1938, Geological Survey Bulletin No. 917A, p. 64.

> gold recovered from its mines——the production of placer gold from the Seward Peninsula in 1938——is estimated at $3,487,000, or about $90,000 more than in 1937."

Department of Mines records for 1940 show that the Kougarok district will again rank high in the production of gold from Seward Peninsula. They list 20 separate mining operations in the Kougarok Precinct,[6] employing a total of 171 men. Thirteen operations employ 128 men, while the other 18 employ less than 5 men each. There are actually, three separate mining districts in the Kougarok Precinct, one centering around Iron Creek, one near Bunker Hill, and the area under consideration around Taylor. In this last district there are eleven operations employing 96 men.

TAYLOR

A small group of buildings at the mouth of Taylor Creek is known as Taylor. It was once a community center for the operators on the Kougarok River. It now consists of a road house and two private dwellings. The road house has sleeping accommodations for nine; the regular Alaskan rate of one dollar per meal and one dollar per bed prevails. There is no official post office at Taylor. An airplane company bases here, this or other companies bring mail and freight from Nome and vicinity as often as several times a day.

COSTS

Length of Season

Costs are influenced by the length of the mining season. The average length of the dredging season varies from 90 to 120 days.

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[6] Actually the Kougarok Mining Precinct has been incorporated into the Cape Nome Precinct, but for the sake of simplification the records are kept separately.

with the longer period being the rule the last few seasons. The average length of the hydraulic mining season is about 100 days. The normal water supply is sufficient for most mining purposes, but there are periods when insufficient rainfall causes conditions approaching drought.

Transportation and Freighting

Transportation into this area is by air, road or trail. The only regular year round service is by airplane. There are seven fields in the upper Kougarok serviced by airplane companies based at Nome, Deering, and Taylor. The usual fare between Nome or Deering and any of the local fields is $25 per passenger. The freight rate from Nome is five cents per pound and from Teller three and a half cents per pound. The largest single piece of freight that can be handled by plane with the present equipment is 1500 pounds. The airplane has proved indispensable in the event of accidents to equipment or personel.

Another means of transportation is by way of Bunker Hill and the Seward Peninsula Tramway. The fare on the tramway from Nome to Bunker Hill is $7.50, the freight rate is $12.50 per ton. The 82 mile trip usually takes a full day. From Bunker Hill the tramway terminus to Taylor is 38½ miles. A graveled road has been completed for 18½ miles. Half the remainder should be completed in 1941, and the road finished in another year or two. At present the freight charge is $50 per ton for the 38½ mile haul which must be made by tractor or tractor and truck. When the road is completed this rate will be about twenty per-cent less.

Freight is also brought in by way of Teller. From ship's tackle at Teller to Davidson's Landing the charge is $15 per ton. From the

landing to Taylor, a distance of 44 miles by tractor, it is $50. Elsewhere on long hauls the charge is approximately $1.00 per ton mile.

Supplies

Most of the larger placer operations purchase their supplies "outside," usually in Seattle. Much of the supplies, hardware and provisions used may be obtained in Nome, but a substantial saving is usually made by direct purchase outside. Few replacement parts for tractors, pumps, draglines, etc. are available on the peninsula; wear and break-down must be anticipated in advance if costly delays are to be avoided. Shipping charges between Seattle and Nome are about twenty-five percent of the outside costs.

Labor

Nice copy

Most of the operators do not conform with the regulations set by the Fair Labor Standards Act. Some attempt is made to make the books "look" right, but the hours and wages are approximately the same as they were before. The usual shift is forten hours and is worked seven days a week for the entire season. Wages usually include board which is variously estimated at from $1.50 to $2.50 per man day. The usual wages run from $200 to $350 and board per man month. The following wages are for 10 hours, board included:

Winchmen	$9.00
Engineers and Machine Operators	10.00
Truck Drivers	8.00 or 9.00
Labor	6.00 to 7.50

As a rule there is a surplus of general labor and a slight surplus of semi-skilled labor in Nome during the mining season. Practically all who go to the Kougarok section do so with a job "in sight."

MINING

Operations

No innovations or new methods of mining were observed peculiar to this district. The operations include a dredge, several dragline washing plants, hydraulicking, thawing, bulldozing, an automatic dam, drifting, pumping plants, drag scrapers, shoveling-in, and various combinations of methods and equipment. As elsewhere in the Territory, certain mechanical methods of mining have been adopted where other methods might have been preferable. The result is that some operations are machinery poor, and use mechanical equipment where less costly methods might be applicable.

Partly because of their inability to obtain all of the ground, and partly in an attempt to mine only the richest part, early mining efforts left many virgin spots. Though originally minable in its entirety, the ground is now left as isolated marginal and sub-marginal property. Today most of the operators are limited in their holdings and of a necessity work their particular piece of ground to completion. A few operators however have tied up the largest percentage of probable placer ground and work only the richest portions of their paystreaks. This is an expensive method of mining, and though lucrative to the operators is a very short sighted policy, wasteful of the assets of the Territory.

Recommendations

Past experience has shown that insufficient information regarding physical conditions and values has contributed to financial failures and incomplete or wasteful forms of mining. It is suggested that the

depth of the ground, and the type of bedrock be carefully considered before machinery is purchased. The relative costs per horse-power-gallon-hour of different fuels should be figured. More advantage might be taken of the natural thawing agencies. Careful planning would result in a better balance between natural thawing and mechanical or hydraulic stripping.

The outstanding mining handicap is the difficulty of obtaining locally replacement parts for mechanical equipment and even ordinary camp supplies. The obvious solution is to anticipate in advance probable wear and possible breakdowns. Unfortunately, for financial or other reasons, this policy can not always be carried out.

Considerable churn drill prospecting has been done in this area. Many of the drillers are competent, but some who have mastered the technique of "punching holes in the ground" fail duly to consider the importance of the essential details. The necessity for making accurate water volume measurements in frozen holes can not be too strongly emphasized. The values obtained should be weighed, and their position in relation to bedrock noted. Records should always be in writing.

Because of the spotted and muggety nature of the ground a few shafts should be sunk on drill holes, and the larger volume sample be used in computing a factor. Much of the bench ground is ideal for cheap prospecting by cuts taken out with ditch water. A comparison of the drilled valuations to the actual mining return would if applied to similar ground, or extended development of the same ground, give a technically correct result. Insofar as gold mining is non-competitive, a fuller exchange of information among the various operators would be of mutual benefit.

FUTURE OF MINING

Placers

If the yardage and value estimates of the operators are to be accepted, the upper Kougarok River and its tributaries to a point below Henry Creek, will produce five to ten millions of dollars in the next twenty years. The actual gold content of this gravel is probably much more, but different conditions affecting the cost of mining will probably cut even this estimate to a much lower figure.

A long sighted cooperative policy on the part of the present operators could greatly increase the potential reserves.

Lode

Most lode camps are found in areas which formerly produced placers. No commercial ore bodies have been found so far in this district. Previous experience and the general geologic structure indicate that commercial ore bodies if found, will occur as small rich veins, or mineralized zones in schist, limestone-schist, or different type-schist contacts.

Mining Law vs Local Rules

The Alaskan Mining Laws set forth certain very definite acts which must be performed in order to locate, and maintain title to a placer mining claim. The local custom in this district is to locate, and hold claims with a minimum compliance to even the intent set forth in the statutes. In no other mining district which the author has visited has title to ground been so sketchily held.

The outstanding abuse, aside from the errors and omissions of discovery and location, is the holding of large areas without doing the

annual assessment work. Because so many of the local prospectors concur in this practice, no attempt is made to relocate what in most districts would be considered open ground. The operators too, hesitate to jeopardise their chances of leasing or otherwise obtaining known mineable ground by incurring the enmity of the local group.

It is the intent of the writer to indicate an abuse prevalent to a greater or lesser extent throughout the Territory, which if remedied would result in a definite benefit to the mining industry.

RELATIONSHIP OF THE VARIOUS PLACERS AND THEIR GENESIS

GEOLOGIC FEATURES

Bedrock

One of the important approaches in the solution of a problem of this type is through an understanding of the general geologic features of the district. To that end a foot traverse was first made through the Kougarok section and the reconnaissance geology of this district as set forth in the Survey Bulletin[7] was noted. The Survey found, [8]"The two main stratigraphic units,---the Kiglumik group and the Nome group, with its subordinate member, the Port Clarence limestone----are represented in the Kougarok region.----the Nome group is clearly divisible into two members---(1) the Port Clarence (?) limestone and (2) a succession of graphitic phyllites and quartz schists, mica and greenstone schists, and some beds of semicrystalline limestone."

The particular area which was finally mapped is composed almost wholly of interstratified quartzose and graphitic schists with here and there some of the mica and greenstone variety. Only a few small outcrops of limestone were seen in the mapped area, although there is a great deal outside of it. Some of the greenstone and the dioritic schists observed were probably altered intrusives. The only unaltered igneous rock noted was the granitic stock near the Kougarok-Arctic divide.

There appears to be at least two definite generations of quartz mineralization. The older quartz is deformed and crushed, probably

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[7] Brooks, op.cit. 1, pp. 184-181

[8] Brooks, Ibid. p. 186

during the deformation of the schists. The younger seams and veins cut the older and are less deformed.

Alluvium

Several different types of placer deposits were observed. One consisting of fine sands and gravels was noted as flooring the low land basin to the south of the area, and will not be considered in this paper. The bench gravels are the most important and range from a few feet to over fifty feet above the stream level. Gravels at higher elevations have been examined, but no appreciable work has been done on them. The gravels in these benches appear to be composed of local material and are typically medium river wash made up almost exclusively of schists and quartz. The buried channels consist of gravels similar in composition and size to that found on the benches. The present stream gravels are composed entirely of local material and are partially derived from the reconcentration of the older gravels. As in the other channels quartz is the predominant mineral. No outstanding characteristic other than its relative position differentiates these buried deposits from the older ones.

Ice beds varying in composition from frozen mud to almost pure ice were noted in most of the valleys. These beds occur as lenses of varying size usually between the tundra and the gravels, but sometimes in the gravels. This frozen muck is typical of this region and in one pit was observed to be over thirty feet thick.

The region is covered with tundra, a subariel accumulation of rock, silt, ice and decayed vegetable matter. This, together with the natural accumulation of talus, serves effectively to hide the bedrock

and bench topography and add to the difficulties of prospecting.

Recent History

The recent geologic history of this region has been formulated from a study of the preceding geologic features and their physiographic expressions. The following descriptions and interpretations of these expressions are submitted as evidence of the topographic cycles which caused the formation of the various gravel deposits. The relationship of the gravel deposits to each other can be better understood when their genesis, which is part of the recent geologic history of the region, is known.

The U.S.G.S. has tried to find definite proof of four well defined cycles of erosion in the Kougarok district. The problem is difficult and will not be dealt with in this paper. Most of the present land forms have been developed during the last cycle which probably obliterated much of the previous evidence.

The upland appears as generally accordant summit levels indicating a period of erosion which must have approached planation. The peneplane was uplifted and as shown by many irregularities probably warped. The planation is further indicated by flat tops of most of the domes. It is possible that the flat tops of some of the higher domes indicate a still older period of planation and subsequent erosion.

The entrenched meanders of the Kougarok River show that the area has approached base level. There is also evidence to show an uplift, with probable tilting to the south.

The various bench levels indicate that the uplift was intermittent. There must have been periods of relative stability during which erosion

and sedimentation took place, followed by accelerated uplift.

Sufficient work has not been done on the lowest bench gravels to indicate their extent. They may have been formed during one of the last oscillations which took place during interrupted uplift, or they may be the result of a late warping to the south. If the latter is correct, they should merge with the present stream bed, at some little distance above Taylor.

The present topography is essentially the result of the last uplift and erosion. Enrichment of the present placer gravels is due to dissection of the bench gravels of the last uplift and to the reconcentration of the gold from the obliterated drainage systems.

The present stream tendency seems to be one of erosion with a slight down warping to the south.

A description of the late geologic history of the region would not be complete without mention of hillside creep, which here combined with the usual talus, often obscures the bench topography. The rapidity of the creep may be illustrated by a vertical churn drill hole in a thirty foot ice bed, when uncovered by mining operations two years after being drilled it showed a down hill dip of more than forty-five degrees.

Because all or parts of most of the benches may be entirely obliterated, the present configuration may not give any indication of the actual bedrock expression.

Field Work

Maps were drawn using a Lietz Geologist's Alidade No. 33A and a plane table. The base line was established with a steel tape and plumb bobs. All other distances were calculated by stadia and standard

plane table methods. Differential elevations and contours were figured with a Beaman Arc and by trigonometry. Drainage and special geologic datum was sketched using a barometer aneroid and Brunton Compass. Azimuth and elevation above sea level was approximated from a U.S.G.S. reconnaissance map.

The preliminary survey indicated that the best way to classify the benches was to run a set of differential levels on the known ones. In order to plot this information and other pertinent data, a topographic map on a scale of 1" to 1000' with a contour interval of 25 feet was drawn. (see Plate II). The contours and drainage indicate the physiography of the area. Structure and geology are not represented in detail because of the metamorphosed condition of the rocks and lack of time.

With the topographic map for a basis, a detailed sketch, 1" to 400' was made. (see Plate III). Elevations of all exposures were noted, mined areas shown, and the position of drill holes plotted. This information tended to establish the geographic position of four distinct channels. After making allowances for inaccuracies of field measurements and stream gradients, the relative positions and possible extensions of these channels were marked.

Office Work

Much office work was necessary because there were not sufficient exposures in the field to definitely establish the continuity of the deposits. The formation, as indicated by a study of 513 drill logs, was considered. Six cross sections shown in plate VII were drawn. Other information obtained from these logs was used in classifying gold types (tables 2 and 3), and in comparing the concentrates (table 1).

In order to show the occurrence of pay gravels at different levels, and to compare the physiography of bedrock with the surface expression of the hillside, sketch VI was drawn from 128 drill hole logs. A contour interval of one foot was used, to show the shape of the surface, and of the bedrock. The actual bedrock shape may differ, due to humps or depressions not indicated by the assumed contour closures. The approximate position of the surfaces indicate that the upper pay streak has tended to erode and become concentrated at the lower level. A comparison of the bedrock with the actual surface shows a great deal of similarity. It also tends to show the deviation, which in other localities has completely obliterated all surface indications of underlying deposits.

Laboratory Work

Ten samples of concentrates were obtained, and their quantitatively important minerals identified (table 1). This was done in order to further establish the relationship of the four bench placers, and to compare them with other placers just outside the district. The table shows that while the samples obtained within the area are similar, those from outside have a different composition. This point adds emphasis to the already assumed reconcentration of the upper gravels in some of the lower deposits.

In order to compare the gold found on the different bench levels, 4871 colors taken from drill holes were counted and weighed. An attempt was made to arrive at an average weight per color as a partial method of classification. No relationship was established, because either insuffisient colors were averaged, or due to local enrichment

TABLE 1.

A COMPARISON OF PLACER CONCENTRATES FROM DIFFERENT LOCALITIES

QUANTITATIVELY IMPORTANT MINERALS IN RELATIVE AMOUNTS

Least ---------- Most

LOCATION	Henry Creek	Upper Homestake Creek	Macklin Creek	Left Limit Kougarok at Taylor	Eldorado Creek	Mosey's Point	Upper Kougarok River	Mouth of Goose Creek	Trinity Gulch	Kougarok River above Taylor66
	Garnet	Pyrite	Pyrite	Quartz	Quartz	Garnet	Garnet	Garnet	Garnet	Garnet
	Hematite Ilmenite	Quartz	Rocks	Rocks	Rocks	Quartz	Hematite Ilmenite	Hematite Ilmenite	Quartz	Hema-tite Ilmen-ite
	Quartz	Rocks	Quartz	Limonite	Hematite Ilmenite	Rocks	Quartz	Quartz	Rocks	Quartz
	Magnetite	Limonite	Hematite -Ilmenite	Magnetite	Garnet	Hematite Ilmenite	Rocks	Rocks	Pyrite	Rocks
	Pyrite	Garnet	Limonite	Garnet	Limonite	Limonite	Magnetite	Limonite	Limonite	Pyrite
	Rocks	Magnetite	Magnetite	Hematite Ilmenite	Magnetite	Pyrite	Limonite	Magnetite	Hematite Ilmenite	Limon-ite
	Limonite	Hematite -Ilmenite	-Garnet	-Pyrite	-Pyrite	Magnetite	Pyrite	-Pyrite	Magnetite	Magne-tite
Percent Minus 10 mesh	73	35	34	51	53	61	40	50	60	19

NOTE: (-) Indicates that this mineral was not seen in the concentrate.

TABLE 2.

AVERAGE SIZE OF GOLD "COLOR"

Test No.	Relative position of gravels	No. of Colors	Weight, Mg.	Ave. Wt. per Color
1.	Low pay gravel, down stream from Taylor	781	1095	1.40 mg.
2.	Middle pay gravel, south of test 1	435	1313	3.02
3.	Low pay gravel, directly below test 2	703	1846	2.06
4.	High pay gravel, south of test 3	421	712	1.69
5.	Middle pay gravel, below test 4	74	113	1.52
6.	Middle pay gravel, south test 5	924	1181	1.28
7.	Low pay gravel, below test 6	1528	1688	1.10

TABLE 3.

PLACER GOLD COMPARISON

Locality	Description	Distribution	Fineness	Origin
Mascott Gulch	Bright, angular with attached quartz	Spotted, on bedrock	?	Local
Henry Creek (low bench)	Flat, comparatively coarse, well rounded, stained	Lower gravel, in bedrock	908	
Dreamy Gulch (low bench)	Flat, well rounded, coarse, stained	In bedrock	907	
Kougarok R. at Taylor (low channel)	Flat, rounded, no rough gold, few nuggets, mostly fine, stained	On and in bedrock	923	
Trinity Gulch (low channel)	Coarse, flat, stained, small nuggets, much flour gold, some angular and with quartz	In bedrock	857	Some local
Columbia Creek	Coarse, some stained but most bright and angular and with quartz	Near and in bedrock	?	Local
Head of Homestake	Flat, bright, and coarse, but not nuggety, angular and with quartz	Near bedrock	928½	Local
Mosey's Point (low channel)	Flat, bright, thin, with some rounded nuggets, stained and some with quartz	Some in gravel, mostly in bedrock	862	May be some local
Goose Creek (middle bench)	Flat, bright, rounded, stained, some with quartz, few nuggets	In gravel and bedrock	843	Some local
Kougarok R. above Henry Creek (low channel)	Worn, mostly fine, stained, few nuggets	On and in bedrock	908	
Macklin Creek	Very coarse, practically no fine gold, all angular	Throughout the gravel	918	Local

the average in the same channel varies at different points. With due regard to the insufficiency of the test, an interesting fact was noted; in all of the tests the gold from the upper bench invariably averaged larger per color than that from the bench directly below. The obvious conclusion is that the gold on the lower level is at least partially derived from that above.

A comparison of the types of gold from eleven operations, table 3, adds further importance to the already noted similarity of gold from the relative benches. The worn, rounded and stained condition of most of the gold from the low benches indicates travel, and its dissimilarity to the bright angular gold of local origin should be noted.

SOURCE OF MINERALIZATION

The geologic reconnaissance suggested that the gold found in the placers was derived from the mineralized veins and zones in bedrock. It also indicated that these veins and zones were related to the intrusives found near them. A careful petrographic examination which would make use of the microscope and analytical laboratory could definitely confirm this conjecture. Without this equipment the problem resolved itself essentially into a study of the structural geology and of the assay results of careful sampling.

Granite

A large granitic stock is exposed on the side of Midnight Mountain and just north of the Kougarok-Arctic divide. Two hot springs are found on its south-western margin. Field and office studies indicate that the later quartz veins, and probably the mineralized zones are genetically related to the granitic intrusion. The center of

"The operations include a dredge, several dragline washing plants ——various other combinations of methods and equipment."
(Page 8.)

Upper view, Castleton and Keenan dredge, Kougarok River.

Middle view, Gold Bullion Inc. Eldorado Creek.

Lower view, Alaska Taylor Mining Company, Kougarok River

Cambel and Carroll Shoveling-in, at Goose Creek.

J. C. Kealier Shoveling-in near Taylor Road-house.

"The region is covered with tundra."
(Page 13.)

"The---area---is composed---of interstratified quartzose and graphitic schists---." (Page 12.)

mineralisation, as indicated by the distribution of the gold placers, is found near the granite. Differential erosion shown in Plate V is at least partially responsible for the asymmetrical distribution of the placers.

Mineralogy

The granitic rock is coarsely crystalline and consists of quartz, orthoclase, biotite and plagioclase. The plagioclase appears in a porphyritic phase, with the feldspar phenocrysts up to an inch in length. Neither porphyritic nor pegmatitic dikes were observed. The actual granite-schist contact was not seen due to the tundra and talus overburden.

Age

The metamorphic rocks of this district have been broadly classified as belonging to the Paleozoic system.[9] The texture, the structural position, the domed appearance of the metamorphic rocks, the hot-springs and the vein systems all indicate the relative younger age of the granite. The Geological Survey suggests that similar granites on Seward Peninsula are of late Mesozoic or early Tertiary time.[10]

Hot Springs

Two hot springs are near the south-western border of the granitic mass. An analysis showed that their precipitate consisted almost wholly of calcium carbonate. It also contained appreciable amounts of sulphur and smaller amounts of sodium chloride, calcium sulphate, iron

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9. Brooks, A. H., and others, The Gold Placers of Parts of Seward Peninsula, Alaska. Geological Survey Bulletin No. 328, p. 83.

10 Brooks, Ibid., p. 108

oxide, magnesium carbonate ? and silica. Carbon dioxide and hydrogen sulphide gases were noted.

The vein fillings and zones contained practically the same elements in the form of quartz, calcite and iron sulphides. No other essential minerals were noted.

It may be logically assumed that the surface discharge of a hot-spring represents, to some extent, the escaped solutions which had performed epithermal mineralization below the outlet. Certain essential salts may have been exhausted from the solution before its discharge at the surface; but the similarity between these salts and the composition of the veins in its geologic proximity, indicates a possible common source. Negative evidence is shown by the lack of certain common hot spring deposits, such as cinnibar and stibnite, which are found in the lower Kougarok placer concentrates, but not in the upper Kougarok or in these surface spring deposits.

Distribution of Placers

Plate IV shows the drainage pattern and distribution of known placers. Certain characteristics are at once evident; the proximity of the gold placers to the granite, and the concentration of the placers along certain drainage channels. The genetic relationship of the granite to the veins has been indicated. The areal distribution of the placers as shown on Plate IV further emphasizes this connection. Prospecting experience and the known geology indicate that future discoveries will also accentuate this point.

The concentration of the placers along certain drainage channels is partly due to an older drainage system. The entrenched meanders

indicative of a former period of planation influenced the present drainage pattern. The warping effect of the uplift caused erosion and concentration on the southern drainage while possibly sedimentation was going on to the north.

The mineralized zones overlying the granite were observed to be eroded on the south side of the uplift. The heavier minerals were subsequently concentrated in the south flowing rivers as modified by the east-west structure and the former drainage. To the north and to the west the warping caused a local depression which may have buried any existing mineralized zone and caused sedimentation rather than erosion. To the south-east, erosion did not keep up with up-lift and the mass of Midnight Mountain contains much of the mineralization which may have taken place in that direction. The cross-section sketches, Plate V, were compiled from data shown on Plate IV. They show the results of the differential uplift with erosion, also the relationship between the granite and the overlying mineralized zone, which was eroded to form the placers. The direction in which the probable placers lie is indicated by the direction of erosion.

The distance of the known placers from the granite contact indicates that considerable erosion has taken place. The relatively high gold content of some of the gravels as compared to the values found in the bedrock source further indicates considerable erosion and concentration. The coarsely crystaline texture of the exposed granite points to deep burial at the time of solidification. For these reasons it may be assumed that considerable overlying material has been removed from the granite, and therefore most of its placer material will be found some distance from its source.

Lodes

The bedrock was found to be folded, fractured, and faulted wherever exposed. It contained more or less quartz stringers which were particularly numerous where the bedrock was of the dark colored graphitic and calcareous mica schist varieties.

The Geologic Survey have pointed out that the limestone-schist contacts are a loci of structural weakness, and consequently a favorable place for the formation of veins. The logic of this reasoning is not questioned, but field work has shown that in this particular area most of the mineralized zones, veins and stringers are found in the schist belts, and especially in or near the contacts between the various types of schists. It is not to be inferred that schist-limestone contacts veins are not important; in this area comparatively few, however, were noticed during the present field work.

As before mentioned, there appears to be two generations of quartz. The older variety has been highly contorted, apparently during the metamorphism of the host rock; the younger variety, though somewhat deformed, has, considering the structure of schist, more regularity. Some of the veins occur as mear stringers and lenses less than an inch wide. These conform with the cleavage of the schists, or the bedding between different schists, while others cut the bedding and cleavage. The younger, usually smaller veins and stringers, appear to be more heavily mineralized than the older and usually larger ones. Calcite veins and stringers, though much less numerous than the quartz, were also found to carry values in gold. Aside from the veins and stringers, there are mineralized zones in the schist, containing pyrite.

The source of the placer gold seems to be in small veins, stringers, and mineralized zones. No commercial ore bodies have been found. If any are discovered the structure of the region and the host rocks is such that they may be in the form of small rich veins or mineralized zones in the schist.

Sampling

Thirty-five samples were taken in placer pits and from bedrock sources exposed by erosion, (Table 4). Where it was possible to take a single specimen across a small vein or zone as a sample, that specimen was carefully washed and scrubbed before being assayed. Where the sample consisted of fines as well as coarse material, the sample was not washed and reasonable care was taken to preclude the possibility of introducing placer gold.

As no previous sampling was known to have been done, the samples were taken from the "liver" looking material. As a result no sample proved to be a blank. It is of course possible that placer gold was introduced into some of the unscrubbed material, but there were sufficient scrubbed specimens to check the results.

Crystalline gold attached to quartz was found on Mascot Gulch and is probably derived from a mineralized zone in that vicinity. Angular gold with quartz attached was found on Columbia Creek, Homestake Creek, Trinity Gulch, and Dreamy Gulch. Rounded gold with quartz attached was found at Goose and Macklin Creek.

Assays

The samples were assayed at the Nome Assay Office, of the Territorial Department of Mines. The usual care was taken to prevent salt-

TABLE 4.

SAMPLING AND ASSAY RESULTS

Note: Under the column headed "Type," O identifies Older Quartz; Y, Younger Quartz; C, Calcite vein; and M, Mineralized Zone. The letter "s" following the "Type" letter indicates that the sample has been scrubbed before being assayed.

SAMPLE NUMBER	LOCATION AND DESCRIPTION	WIDTH INCHES	TYPE	VALUE/TON OZ. TROY	VALUE/TON DOLLARS
1347	Pit-right limit Kougarok, high bench-Brecciated quartz in iron stained schist.	grab	Y	0.070	2.45
1348	Pit-right limit Kougarok above Taylor, exposed graphitic schist.	2	O	0.090	3.15
1349	Right limit Kougarok above Taylor, seams in mica schist.	grab	O	0.020	0.70
1350	Right limit Kougarok above Taylor, seams in iron stained schist	120	M	0.120	4.20
1351	Right limit Kougarok above Taylor, seams in graphitic schist.	96	M	0.130	4.55
1352	Right limit Kougarok, near Taylor, small stringers in black schist.	grab	Y	0.125	4.38
1353	Right limit Kougarok near Taylor, Calcite seam in black schist.	grab	C	0.075	2.63
1354	Right limit Kougarok near Taylor, Quartz stringers in black graphitic schist.	3	Y	0.120	4.20
1355	Low bench, left limit Kougarok, below Taylor. Contact between schist and limestone.	6	Y	0.030	1.05
1356	Low channel in Kougarok below Taylor. Quartz lens in black schist.	3	Y	0.075	2.63
1357	Right limit Kougarok below Taylor, low bench. Seams in highly contorted black schist.	1	O	0.070	2.45

(continued)

TABLE 4. (continued)

SAMPLING AND ASSAY RESULTS

SAMPLE NUMBER	LOCATION AND DESCRIPTION	WIDTH INCHES	TYPE	VALUE/TON OZ. TROY	VALUE/TON DOLLARS
1358	Right limit Kougarok below Taylor, low bench. Stringers in black schist.	4	G	0.045	1.58
1359	Pit-Macklin Creek, two miles from mouth. Stringers in micaceous-calcareous schist.	3	Y	0.175	6.13
1360	Pit-Macklin Creek, two miles from mouth. Widest part quartz vein in schist.	15	Y	0.050	1.75
1361	Pit-Macklin Creek, two miles from mouth. Vein, normal to vein of 1359.	6	Y	0.025	0.88
1362	Pit-Macklin Creek, two miles from mouth. Stringers from seam up to 5" wide.	5	G	0.010	0.35
1363	Right limit Kougarok above Taylor, high bench. Seams in mica-calcareous schist.	grab	Ys	0.045	1.58
1364	Right limit Kougarok above Taylor. Contact between graphitic and calcareous schists.	8	Ys	0.080	2.80
1365	Right limit Kougarok above Taylor. Seams in calcareous schist, 18" from contact.	2	Ys	0.015	0.53
1366	Right limit Kougarok above Taylor. Quartz lens in fold of schist.	1	Os	0.030	1.05
1367	High bench, right limit Kougarok, above Taylor. Lens in graphitic schist.	2	Os	0.040	1.40
1368	High bench, right limit Kougarok, above Taylor. Seams of quartz in mica-schist.	grab	Os	0.030	1.05
1369	High bench, right limit Kougarok above Taylor. Quartz seams in iron-stained schist.	120	Ms	0.045	1.58
1370	Right limit Kougarok above Taylor. Seams in zone in graphitic schist.	96	Ms	0.060	2.10

(continued)

TABLE 4. (continued)

SAMPLING AND ASSAY RESULTS

SAMPLE NUMBER	LOCATION AND DESCRIPTION	WIDTH INCHES	TYPE	VALUE/TON OZ. TROY	VALUE/TON DOLLARS
1371	Right limit Kougarok near Taylor. Thin stringers in black schist zone.	grab	Ys	0.110	3.85
1372	Right limit Kougarok near Taylor. Calcite seams near narrow limestone bed.	grab	Cs	0.120	4.20
1373	Right limit Kougarok near Taylor. Quartz stringers in graphitic schist.	3	Ys	0.085	2.98
1374	Left limit Kougarok below Taylor. Quartz on schist-limestone contact.	6	Ys	0.030	1.05
1375	Kougarok River, below Taylor. Small quartz vein in calcareous schist.	3	Ys	0.050	1.75
1376	Right limit Kougarok below Taylor. Quartz seams in highly metamorphosed schists.	1	Qs	0.065	2.28
1377	Right limit Kougarok below Taylor. Fine seams in black schist.	4	Qs	0.005	0.18
1378	Left limit Macklin Creek. One of series of small veins in schist.	3	Ys	0.880	30.80
1379	Left limit Macklin Creek. Specimen from wide part of vein of sample 1378.	15	Ys	0.010	0.35
1380	Bedrock of pit in Macklin Creek. Quartz vein in bedrock.	6	Ys	0.090	3.15
1381	Bedrock of pit in Macklin Creek. Specimen from Calcite seam in bedrock.	8	Cs	0.025	0.88

ing through contamination, and several "blanks" were run between the various assays as checks. All of the assays were run in new crucibles to preclude that possibility of salting. As an added precaution, no other samples were ground or run at the same time.

The highest unscrubbed sample ran 0.175 oz. gold per ton ($6.13), and was from a three inch quartz vein on Macklin Creek; the lowest ran 0.01 oz. per ton ($0.35) and was from a calcite vein in the same locality.

The highest scrubbed specimen, 0.88 oz. gold per ton ($30.80) was also from a small stringer on Macklin Creek. The next highest scrubbed specimen 0.11 oz. gold per ton ($3.85), was from small quartz stringers in a high bedrock reef, on a bench of the Kougarok River. The lowest scrubbed specimen 0.005 ($0.18) was from seams of older generation quartz on a Kougarok River bench. It is interesting to note that all of the samples contained appreciable amounts of gold, and that with one exception the values were relatively low.

CONCLUSIONS

Though some of the conclusions from this study have been tempered by a lack of necessary information the author feels that the essential parts of the problem have been satisfactorily completed. The inferences drawn are that three definite and two probable pay channels exist.

One channel whose bedrock is about six or seven feet below the present river level has been relatively well exploited. Dredging on the north south section of the river, as shown in the detail sketch has been confined to this lower channel. The remaining segements of this pay streak include ground on the right limit of the Kougarok

near the south end of the detailed area (Plate III). Its probable extension may be looked for both up and down the river. Special attention should be paid to the convex side of the creek and through the geologically recently formed bars. The river channel has changed to its present position partly because of such recent factors as hillside creep, ice action, and mining, so that it may or may not coincide with that of the lowest channel.

The next definite pay channel appears to be 15 or 20 feet above the first. No exact bedrock measurements could be taken because of the inaccuracy of drill logs and the jumbled condition of the exposed bedrock. The approximate differences in bedrock levels, is the basis used in differentiating the various channels. This second pay streak is well defined in the upper section of Plate III where the river flows in an easterly direction. In the lower section of this same drawing the channel is indicated in two pits, with a possible unexplored connection between. Concentration in these two pits may be from higher gravels, as is generally believed among the operators, but field evidence indicates a continuation of the same channel found further up stream. The intervening area between the two operations should be explored.

Continuation of this higher channel, as is true of all the elevated benches, depends upon the erosion which took place after uplift. Erosion tends to cut out parts of the channel with possible reconcentration of the heavier minerals at a lower level. In prospecting for a continuation of these benches, the physiography of the hillside slope, in relation to any particular channel, should be first considered. Bedrock elevations, with proper regard for humps and depres-

sions, should then delimit the possible position of the bench sought. Much of the physiography of the valley both up and down stream from Taylor suggest the possibility of finding the remenents of all the channels.

The third channel appears to be about 10 to 15 feet above the second, or about 25 to 30 feet above the lowest. It is well defined on the right limit of the Kougarok River opposite the mouth of Taylor Creek. Lack of accessibility to mining and drill-hole information above Taylor limits the author's possibility of approximating this channel's position up stream. Its extension down stream for about two thousand feet may be ascertained from known bedrock elevations, keeping in mind that its surface expression may be more modified than that of the younger benches.

A fourth channel, about 30 to 35 feet above the third is indicated from drill hole logs and bedrock exposures in two pits. Its existence may however be questioned as the field examination did not preclude the possibility of a local reconcentration from a still higher source. The field evidence indicates thatif extensions of this possible bench are found, they will occur as isolated remnants. About four miles below Taylor, on the left limit of the Kougarok near the mouth of Arctic Creek is a high bench, which from its relative position above the present river could well be an extension of this channel. Gravels are also found upstream from Taylor at an elevation which would coincide with the projected elevation of this bench. The writer has no knowledge of these gravels ever having been prospected.

Many of the streams tributary to the Kougarok have had their

courses modified a mile or two from their mouths. Younger streams have imposed their drainage upon older, either through structural differences or through stream piracy, thereby increasing the gradient and often leaving remnant benches which may justify prospecting.

With the exception of these benches left by pirate streams no gravels were noted at a higher elevation than that of the fourth channel. Since all of the streamlets contain larger amounts of gravel than their erosion would warrant, it is likely that the tundra and hillside creep may have obscured evidence of such higher gravels.

The most important factor in the concentration of placer gold at Taylor is the reconcentration at lower levels of existing gold bearing gravels, which were originally deposited in that vicinity. Another factor is the precipitating effect of the addition of the waters of Taylor Creek to the overloaded waters of the Kougarok. Because of this precipitating effect gold has been found at the mouths of most of the streams tributary to the upper Kougarok. The general east-west structure of the region, which confines the erosion to the mineralized zone except where modified by the uplift, also contributes to the placer concentration. Further, the type and character of the bedrock is such that it acted as a natural riffle and trapped the gold.

The probable remaining gravel channels on the upper Kougarok have already been indicated. The richest remaining gravels will probably be found between Taylor and Macklin Creeks on the Kougarok River in the lower channels. The possibility of finding remnant benches from Taylor down stream is also indicated. The upper courses of some of the southerly flowing streams south of the Arctic-Kougarok divide should be tested, especially where erosion has taken place in the

schists above the granite, which is unexposed. Some of the larger south-east flowing creeks tributary to the right limit of the upper reaches of Taylor Creek, may have developed commercial placers if erosion has progressed sufficiently.

SUMMARY

The placers in the vicinity of Taylor have been described and their genesis studied. An attempt has been made to correlate them to the veins and mineralized zones, and, to the granitic stock on the Kougarok-Arctic divide. Three definite and a fourth probable gravel channel have been differentiated, their position plotted and their extension approximated. Remnant channels left as a result of stream piracy have been indicated. Suggestions have been made as to the likely positions which placers may occupy in the immediate undeveloped areas.

This consideration of the uplift and erosion in relation to the intrusive, may lead to a better understanding of the distribution of the placers of similar fields.

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"A large granitic stock is exposed on the side of Midnight Mountain and just north of the Kougarok-Arctic divide."
(Page 18.)

"---considerable overlying material has been removed from the granite---"
(Page 21.)

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(Page 18.)

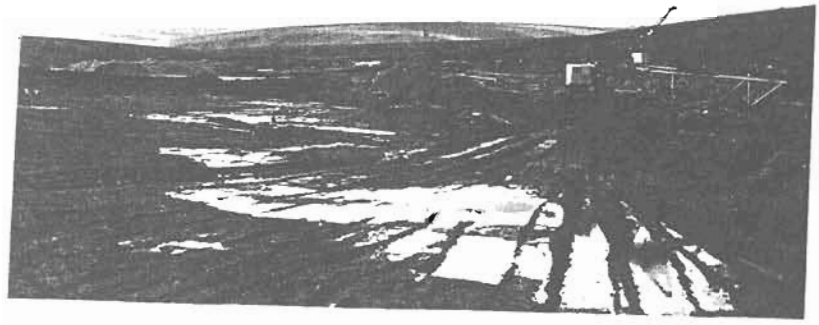
"---considerable overlying material has been removed from the granite---"
(Page 21.)

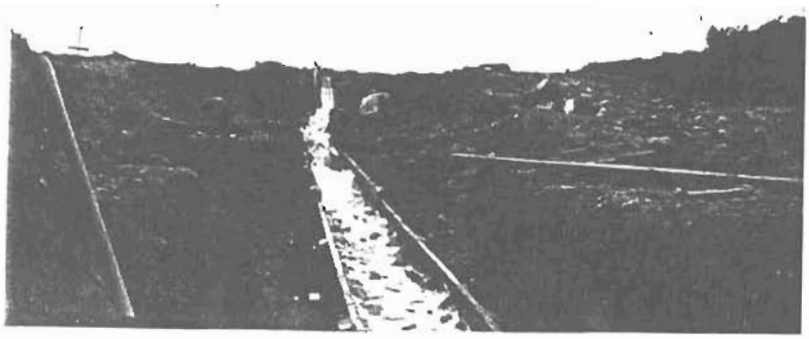
"The operations include a dredge, several dragline washing plants ---various other combinations of methods and equipment."
(Page 8.)

Upper view, Castleton and Keenan dredge, Kougarok River.

Middle view, Gold Bullion Inc. Eldorado Creek.

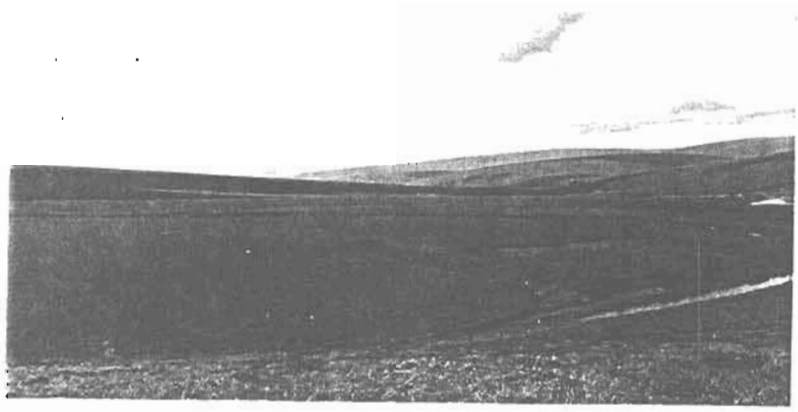
Lower view, Alaska Taylor Mining Company, Kougarok River





Cambel and Carroll Shoveling-in, at Goose Creek.

J. C. Kealier Shoveling-in near Taylor Road-house.



"The region is covered with tundra."
(Page 13.)

"The---area---is composed---of interstratified quartzose and graphitic schists---." (Page 12.)

PLACER DEPOSITS IN UPPER KOUGAROK (Seward Pens.)
By: A. B. Shallit

MR Bendeleben 44-2
1941

TERRITORY OF ALASKA

DEPARTMENT OF MINES

ASSAY OFFICE

AT Nome

April 29, 1941

Mr. B. D. Stewart
Commissioner of Mines
Juneau, Alaska.

Dear Mr. Stewart:

I have the honor to submit a report on the "Placer Deposits in the Upper Kougarok, Seward Peninsula, Alaska".

In accordance with our understanding, a copy of this report has been submitted to the University of Alaska as the final requirement for the Degree of Engineer of Mines.

Mr. H.G.Wilcox, Dean of the School of Mines, has acknowledged the Department of Mines prior rights to the use of the thesis material, and has agreed to submit to the Commissioner of Mines, for approval, the text of any material for publication based upon this work. A notice to this effect has been appended to the thesis copy kept by the University.

Sincerely yours,

A. B. Shallit
Engineer-Assayer

Enc.

NOTED
MAY 3 - 1941
B. D. STEWART
Commissioner of Mines

TERRITORY OF ALASKA

DEPARTMENT OF MINES

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