PLACER MINING ON SEWARD PENINSULA.

By THEODORE CHAPIN.

INTRODUCTION.

The placer-mining industry of Seward Peninsula suffered a general depression in 1913. The value of the gold produced is estimated to be $2,500,000; in 1912 it was $3,025,000. There has been a general decrease each year since 1906, when the output was valued at $7,500,000, to the present year. This is the natural history of a rich placer camp and is due to the facts that the bonanzas are being gradually worked out and that the present output is won largely from gravels of lower grade. The decrease in production in 1913, however, was due in large part to the drought which affected every mining district of the peninsula to a greater or less extent. The past tendency to ascribe any reduction in the gold output of Seward Peninsula to a lack of rain may give this statement a familiar ring, but in this instance the facts justify the statement. From June to late in September practically no rain fell; many of the creeks which usually supply water for mining were absolutely dry, and others were low.

DREDGING.

Dredging is less affected by scarcity of water than other forms of mining, but even the dredge operations were hampered, for many dredgers had to dig into bedrock or construct dams to get water sufficient for flotation. Dredging has become an established method in the mining industry of Seward Peninsula. In 1913 there were 31 gold dredges and one tin dredge operating, with a combined daily capacity of 33,000 cubic yards. It is estimated that during the season they moved 3,500,000 cubic yards of gravel. Four new dredges were installed in 1913 and several were in course of construction, and others which are contemplated will be erected in the near future. Besides those in operation in 1913 there were six temporarily idle.

Dredges are now working in every mining district of Seward Peninsula. This geographic distribution and the fact that they are successfully used to dig deposits of various kinds, including the shallow stream gravels such as are found on Solomon River and the deep gravels of the coastal plain, show their adaptability to the various conditions met in the peninsula.

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The average length of the dredging season in the southern part of Seward Peninsula in a normal year is about 120 days. This figure is based on the actual working season of the successful dredges which work through the season without mishap. By efficient management the dredging season might be lengthened, for a number of dredges work 140 days and one operator claims a season of six months. On Solomon River the season about equals the general average of 120 days. In Nome it is a little longer, and in Council a few days less. The average season in the Fairhaven region is a little shorter than on the southern coast. Steam dredges have a longer average working season than those equipped with internal-combustion engines.

Among the dredges recently constructed in Seward Peninsula flume dredges appear to predominate. That the gold-saving efficiency of the flume dredge is as great as that of a stacker dredge with its greater table area is doubted; however, it has advantages that recommend it for working certain deposits. It can be more easily moved and can be used on shallow gravels where it would be necessary with a larger dredge to dam or to dig bedrock to get flotation.

Most of the dredges of the Seward Peninsula burn distillate. A comparison between the operating costs per cubic yard of dredges burning crude oil and those burning distillate shows little advantage to either fuel, but the working cost of the machines burning wood and coal compares favorably with those burning fuel oils.

A list of the dredges on Seward Peninsula is given in the accompanying table:

Dredges on Seward Peninsula, 1913.

Company.	Location of dredge.	Built.	Type or builder.	Size of buckets (cubic feet).	Bucket line.	Source of power.	Fuel used a day.	Horsepower.	Average daily capacity (cubic yards).
NOME REGION.									
Nome Consolidated Dredging Co.	Bourbon Creek	1908	Reconstructed	10	Close	Electricity		275	2,100
Do.	Wonder Creek	1908	do	7	do	do		275	1,400
Do.[a]	do		American Manganese Steel Co.	10	do	do			
Ernst Alaska Gold Dredging Co.	Rocker Gulch	1912	Flume; American Dredge Building & Construction Co.	1¼	Open	Distillate	75 gallons	40	500
American Gold Dredging Co.	Paluk Creek	1913	do	1½	Close	do	100 gallons	50	1,000
Plein Mining & Dredging Co.	Otter Creek	1910	Risdon	3½	Open	Crude oil	13 barrels	130	800
Julien Gold Mining & Dredging Co.	Osborn Creek	1911	Union Construction Co.	2½	do	Distillate	140 gallons	85	800
Gold Beach Dredging Co.[b]	do	1905	Reconstructed I. B. Hammond	5	do	Crude oil	30 barrels	165	1,000
Saunders Creek Dredging Co.[b]	Saunders Creek	1910	Bucyrus	3½	Close	Distillate	300 gallons	122	2,000
Sioux-Alaska Mining Co.[b]	Moss Gulch	1910	Northern Construction Co.	2¼	Open	do	160 gallons	85	750
Nome Gold Gravel Co.[a]	Cripple River		E. L. Smith	10	do	Crude oil		75	
Arctic Gold Dredging Co.	Hobson Creek	1910	Union Construction Co.	2½	do	Distillate	120 gallons	92	750
Bessie Gold Dredging Co.[a]	Holyoke Creek		E. L. Smith	9	Close				
SOLOMON REGION.									
Nome, Montana & New Mexico Consolidated Mining Co.	Solomon River	1907	Risdon	5	Open	Coal	4½ tons	120	1,600
Seward Dredging Co.	do	1905	West Engineering Co.; Bucyrus machinery.	5	Close	Crude oil	42 barrels	200	2,000
C. E. Kimball	Shovel Creek	1911	Flume; Flume Dredge Co.	3	Open	Distillate	115 gallons	60	1,100
Shovel Creek Gold Dredging Co.	do	1912	Yuba Construction Co.	2½	Close	do	200 gallons	120	833
Sivertsen & Johnsen Mining & Dredging Co.	Solomon River	1900	I. B. Hammond	1½	Open	do	50 gallons	22	300
Do.	do	1910	Risdon	2½	do	Crude oil	15 barrels	65	800
Flodin Gold Mining & Dredging Co.	do	1910	do	2½	do	do	13 barrels	75	1,000
Do.	do	1912	Flume; Flume Dredge Co.	2½	do	Distillate	112 gallons	60	900
Solomon Dredging Co.	do	1910	Bucyrus	3½	Close	Crude oil	25 barrels	140	1,650
CASADEPAGA REGION.									
Ruby Dredging Co.	Casadepaga River	1912	Flume; Union Construction Co.	2½	Open	Distillate	130 gallons	90	800
Willow Dredging Co.[c]	Willow Creek	1910	Union Iron Works	3	do	do	140 gallons	95	600
Nome, Montana & New Mexico Consolidated Mining Co.[d]	Goose Creek	1909	Reconstructed Byron Jackson	2½	do	do	110 gallons	65	800
Oro Dredging Co.[e]	do	1909	Flume; reconstructed Bernard	1½	do	do	40 gallons	18	500

[a] Under construction.
[b] Not in operation in 1913.
[c] Formerly Casadepaga Gold Dredging Co.
[d] Formerly Goldbottom Dredging Co.
[e] Formerly Goose Creek dredge. Will be operated on Elkhorn Creek in 1914.

Dredges on Seward Peninsula, 1913—Continued.

Company.	Location of dredge.	Built.	Type or builder.	Size of buckets (cubic feet).	Bucket line.	Source of power.	Fuel used a day.	Horsepower.	Average daily capacity (cubic yards).
COUNCIL REGION.									
Blue Goose Mining Co.	Ophir Creek	1903	Reconstructed Hammond	3	Close	Wood	9 cords	94	1,600
Wild Goose Mining & Trading Co.	do	1910	Yuba Construction Co.	3½	do	Distillate	300 gallons	140	1,800
Flume Dredge Co.[a]	do	1910	Flume; Flume Dredge Co.	2½	Open	do	115 gallons	60	800
Do	Melsing Creek	1913	do	2½	do	do	do	60	800
Star Dredging Co.	Mystery Creek	1911	Flume; Union Iron Works	2½	do	do	110 gallons	70	1,000
Warm Creek Dredging Co.	Warm Creek	1909	Byron Jackson	2½	do	do	85 gallons	85	1,000
FAIRHAVEN REGION.									
Candle Creek Mining Co.	Candle Creek	1912	Flume; Union Construction Co.	1½	Open	Distillate	120 gallons	50	600
Kugruk dredge	Kugruk River	1913	do	2¾	Close	do	225 gallons	107	1,000
Inmachuk Gold Dredging Co.	Inmachuk River	1912	do	3	Open	do	210 gallons	100	900
Deering Dredging & Mining Co.[b]	do	1912	American Dredge Building & Construction Co.	2	do	do	112 gallons	50	1,000
KOUGAROK REGION.									
Alaska-Kougarok Dredging Co.[b]	Kougarok River	1912	Risdon	2½	Open	Distillate	200 gallons	80	600
PORT CLARENCE REGION.									
Flodin & Hutton[c]	Dick Creek		Flume; Union Construction Co.	2½	Open	Distillate			
Pasadena Gold Dredging Co.	Budd Creek	1912	do	2½	do	do	190 gallons	100	800
Anglo-American Gold Dredging Corporation.	Sunset Creek	1913	Flume; American Dredge Building & Construction Co.	2	do	do	110 gallons	50	500
York Dredging Co.[d]	Buck Creek	1911	Flume; Union Construction Co.	2½	do	do	165 gallons	87	800

[a] Formerly Kimball & Saupe. [b] Formerly Kelliher dredge. [c] Under construction. [d] Tin dredge.

OPERATIONS IN DETAIL.

NOME REGION.

In the vicinity of Nome placer mining was attempted on nearly all the producing creeks, but the operations were seriously hampered by lack of water.

The hydraulic plants of the Pioneer Mining Co. on Specimen Gulch and Anvil and Little creeks and of the Wild Goose Mining & Trading Co. on Cooper Gulch were worked intermittently during the summer whenever water was sufficient, but were idle much of the time. Hydraulic outfits were also mining on Bowlder, Balto, and Osborn creeks.

Considerable activity was shown in drift mining in the winter of 1912–13. On Dexter Creek nine plants took out winter dumps, but only three attempted to sluice. Water was so scarce that one outfit used a rocker washing with seepage water. A number of large plants worked in the deep mines on the coastal plain. A very rich strike is reported from the Golden Cow claim, on the ridge between Otter and Dry creeks, about 3 miles northeast of Nome. In October, 1913, this claim was being prospected to prove the extent of the pay streak. Another promising strike was made on Manila Creek, a tributary of Hobson Creek. Prospecting revealed very rich gravel on schist bedrock about 25 feet below the surface. The gold is coarse and flaky. The pay streak is narrow but is said to be about 10 feet thick. Its length has not been determined.

The Nome Consolidated Dredging Co. operates two large dredges and is building a third. The dredges are working on Bourbon and Wonder creeks in the coastal-plain gravels. The Bourbon dredge is successfully working a deposit over 70 feet thick and is digging 52 feet below the water level. Both are driven by electricity generated at a central power plant on Bourbon Creek. Crude oil is used for fuel.

The hull of the new dredge being built on Wonder Creek was nearing completion in the fall of 1913, and the machinery was to be taken in on the ice during the winter.

Two dredges operated on the Nome beach in 1913. The Ernst Alaska Gold Dredging Co. is working a narrow strip of ground at the mouth of Rocker Gulch on the beach just below the frozen tundra-covered coastal plain.

The Bernard dredge was worked for a part of the summer by the American Gold Dredging Co. on the beach at the mouth of Peluk Creek. This is a flume dredge. The first two boxes are fitted with Hungarian riffles, and below these every other box has wire screen with cocoa matting beneath and the alternate ones contain iron-bar riffles. A perforated plate at the end of the flume leads to the under-

current sluice. Water is pumped by a 10-inch centrifugal pump. The dredge started 150 feet above the high-water mark and planned to work to the water's edge, leaving a wide cut for a place of rapid retreat in case of storm. A cut 100 feet wide was made, 2 to 3 feet of gravel being taken off with each swing of the dredge, and the cut being gradually deepened to a false bedrock of clay 15 feet below the surface.

The Plein dredge is working on Otter Creek near its mouth. The company controls 1,300 acres of ground, including 500 acres on Nome River. In 1913 the dredge was digging just below the supposed end of the second beach line. It appears also to be on a submarine beach, for the bedrock on which the dredge was digging is 12 feet below sea level. Thawing is necessary except along the present stream channel.

The dredge of the Arctic Gold Dredging Co. on Saunders Creek was dismantled and the machinery placed on a new hull built on Hobson Creek. The dredge was placed at the upper end of the dredging ground and is working downstream. This causes considerable dead work, as the gradient of the stream is steeper than is generally considered feasible for dredging, so that it is necessary to build a dam every 150 feet. It is thought that on the lower part of the stream damming will not be necessary.

The dredge of the Julien Gold Mining & Dredging Co. began working on Osborn Creek about the middle of June. The old dredge of the Gold Beach Dredging Co. on Osborn Creek sunk last winter and was sold to J. H. Montgomery.

The Saunders Creek Dredging Co. has worked out its ground on Saunders Creek and is prospecting new ground. No mining was done in 1913. The Sioux Alaska Mining Co.'s dredge on Moss Gulch was also idle in 1913.

The Bessie Gold Dredging Co. is building a large dredge on Holyoke Creek. The dredge of the Nome Gold Gravel Co. on Cripple River is expected to be in operation in 1914.

SOLOMON RIVER BASIN.

Little work was done on Solomon River in 1913 outside of dredging. Three hydraulic plants were in operation during part of the season and about 20 men were sluicing whenever water was adequate. The Seward Dredging Co. worked a hydraulic plant on Shovel Creek and took out two pits aggregating about 8,000 cubic yards. One man was sluicing on Kasson Creek, a tributary of Shovel Creek. An outfit with a horse scraper worked for a month and a half on Big Hurrah Creek, and a little work was also done on Penny Creek, Rock Creek, and Moran Gulch. No mining is being done on East Fork at present, but considerable prospecting has been carried on to determine possible dredging ground.

Nine dredges operated on Solomon River and Shovel Creek, and all report a fairly successful season. The dredge of the Shovel Creek Gold Dredging Co. was installed in 1912 and operated for six weeks. Considerable difficulty was experienced with low water, as the gravel is only 3 to 4 feet deep, so that it is necessary to dig bedrock or dam the stream to get sufficient water for flotation. The gold collects in the limestone bedrock and it is necessary to dig 2 feet of the broken rock. The flat above the dredge has been prospected by drilling.

The Mulligan dredge on Shovel Creek has not been in operation for two years. It is a stationary land dredge and can be moved on light railroad rails. It turns on a circular track 12 feet in diameter and is equipped with open-connected 1-foot cylindrical buckets. The gravels are washed in a flume above the body of the dredge. A small gasoline engine furnishes power to run the bucket line and to pump water. Three claims at the mouth of West Creek were worked out with this machine, which was then abandoned. Dredges of this type may yet be found to be well adapted for working very shallow deposits where water is not sufficient to float a boat dredge.

The Kimball dredge is digging near the mouth of Shovel Creek. The dredges of the Seward Dredging Co. and the Nome, Montana & New Mexico Consolidated Mining Co. are working on Solomon River near the mouth of Shovel Creek. Four other dredges are digging on Solomon River between this point and East Fork—two belonging to the Flodin Gold Mining & Dredging Co. and two to Sivertsen & Johnsen. The dredge of the Solomon Dredging Co. is on Solomon River near the mouth of Butte Creek. The gravel at this place is from 4 to 8 feet thick. In the spring the ground is partly frozen, but no artificial thawing is necessary. The equipment of this dredge was recently changed from coal to oil burning engines, effecting a considerable saving. The Seward dredge is not working in the river channel proper but in the bench deposits, where it is necessary to thaw the ground in advance of the dredge.

BLUFF REGION.

Little work was in progress at Bluff in 1913. One man was working a bench deposit near the beach by pumping sea water. No water was turned into the Topkok ditch.

COUNCIL REGION.

The Council output was derived essentially from the dredges. Winter work was done at only one plant, which employed three men. In the summer 125 men were mining on 23 claims. Six dredges were in operation during the greater part of the summer. Three of these were on Ophir Creek, which continues to be the principal producer. The pioneer dredge of the district is the *Blue Goose*, which

was installed in 1903. This dredge was recently overhauled and a 5-foot open-connected bucket line changed to a 3-foot close-connected line, resulting in an increased efficiency. The dredge of the Wild Goose Mining & Trading Co., also on Ophir Creek, is the largest producer of the district. The other Ophir Creek boat is the flume dredge which for a time was operated on Melsing Creek.

Another dredge was installed by the Flume Dredge Co. on Melsing Creek late in the season of 1913 and ran for about two months.

The dredge of the Star Dredging Co. has been working on Mystery Creek 3 miles from the mouth of the creek and 4 miles northeast of Council City. The gravels are from 2 to 15 feet thick and overlie a clay false bedrock where much of the gold is found. The dredge has a 60-foot flume, 5 feet wide. The upper 15 feet is fitted with railroad iron set longitudinally, and the rest of the flume has Hungarian riffles. The buckets dump into a hopper and the gravel falls on a grizzly, through which the water for sluicing is forced from below. This spout of water and a gate of iron bars in the sluice box are designed to break up the clay, but are ineffectual, as it is necessary to keep a sluiceman constantly forking disintegrated material in the flume. The dredge was recently sold and will be moved to new ground.

The Warm Creek dredge had a fairly successful season, considering the lack of water.

Besides the dredges, several other large plants and a number of smaller ones were in operation. Possibly 30 men, aside from those employed on the dredges, were mining on Ophir Creek. Three hydraulic plants worked part of the season and several men were sluicing. At the mouth of Melsing Creek a plant which was mining a bench deposit took out one pit with a steam scraper, but was forced to quit for lack of water. Mining was also done on Crooked, Dutch, Sweetcake, Elkhorn, and Camp creeks.

On I X L Gulch, a tributary of Fox River, one man mined on a small scale. The supply of water obtained by impounding the flow from springs was sufficient to sluice for a few hours at a time. Little work has been done here, but considerable ground has been prospected and is being held for hydraulicking or dredging.

CASADEPAGA RIVER BASIN.

The Ruby Dredging Co., working on the Casadepaga near the mouth of Ruby Creek, experienced considerable difficulty with large bowlders, but otherwise had a successful season. The property of the Casadepaga Gold Dredging Co. on lower Willow Creek was recently transferred to the Willow Dredging Co. Water was so low on the creek that it was necessary to cease operations soon after the first hard freeze.

On Willow Creek above the dredge one hydraulic plant employed four men, and several men were sluicing. No mining was being done on Ruby Creek, but assessment work is kept up on claims that are being held for dredging ground.

Two dredges were idle on Goose Creek, as there was not sufficient water to run. One of these, which was locally called the *Goldbottom* dredge, has been bought by the Nome, Montana & New Mexico Consolidated Mining Co., and will be operated in 1914. The Goose Creek dredge has been purchased by the Oro Dredging Co. It will be remodeled and moved to Elkhorn Creek, where it is to be operated in 1914.

IRON CREEK REGION.

More mining was being done on Iron Creek and tributaries in 1913 than for several years. From 70 to 80 men were at work sluicing and prospecting. Water was sufficient to work the creek claims. On Sherette Creek one outfit employed five men to do assessment work.

PORT CLARENCE PRECINCT.

In the Port Clarence precinct about 125 men worked a greater part of the summer, but some of them were engaged in construction work. A dredge was installed on Sunset Creek and worked over three months with good results. In the main it worked in thawed ground, but points of frozen gravel which project into the river will have to be thawed before they can be worked. This will be done by stripping and steam pointing. The bedrock consists of greenstone schist and limestone and contains so much gold in the crevices that it is necessary to remove about 3 feet of the rock. A cut 300 feet wide includes two pay streaks and intermediate areas containing more or less gold. Plans are being made for the installation of another dredge on Sunset Creek in the near future.

The Johnstone dredge was operated on Budd Creek near the mouth of Windy Creek for 23 days. It was necessary to work through much barren ground to get to pay gravel, and then some difficulty was experienced with frozen ground. It will be necessary either to strip the ground and allow it to thaw or to thaw it artificially. This dredge was built in 1912 and was run 30 days.

The tin dredge on Buck Creek, in the York district, ran only six weeks and closed for lack of water.

A dredge was taken to Dick Creek, a tributary of Serpentine River, by Flodin & Hutton, but was not installed, as no ground has been prepared for dredging.

Sullivan & Dobson prospected American River for the Budd Creek Gold Dredging Co. They plan to install a dredge in the near future.

KOUGAROK REGION.

In the Kougarok region the drought was severely felt. About 75 men worked part of the season, but all work was curtailed by lack of sufficient water during the entire season and by the early freeze-up. By the middle of September few plants were still in operation.

Dahl Creek was nearly dry. Four outfits tried to sluice, but had sufficient water to work only one claim at a time. Two men worked on Coffee Creek. Quartz Creek was dry, but one man performed a little dead work. No work was done on Windy and Coarse Gold creeks. At the mouth of Little Windy Creek considerable prospecting was done but no sluicing. The ground is being held for dredging. Two outfits mined on the North Fork.

The Wall Real Estate Corporation, owner of the North Star Ditch, was prepared for extensive operations, but could do little mining. Near Taylor Creek a hydraulic elevator was run for 10 days. At this place the river has been turned into a new channel and the old channel will be mined. This company intends to install a dredge in the near future.

A claim near the mouth of Dreamy Gulch was ground-sluiced, and a winter dump which was obtained by drifting beneath the river was partly worked. Two outfits mined on Kougarok River between Taylor and Macklin creeks. Five outfits employing about 15 men were at work on Macklin Creek. George James was constructing a ditch to take water from Schlitz Creek, on Serpentine River, to Macklin Creek.

The dredge of the Alaska-Kougarok Dredging Co., locally known as the Kelliher dredge, is digging on Kougarok River above Macklin Creek. The company is said to own a mile of dredging ground along the river, consisting of a broad flat 600 feet wide. The dredge has cut one strip 100 feet wide for 2,500 feet along the river and has started to make a parallel cut in the adjoining area, which has been artificially thawed. The thawing is accomplished by ground-sluicing off a foot and a half of moss and muck, which overlies a layer of frozen muck and lenses of clear ice. This material is in part broken by blasting and then thaws naturally by exposure to the sun and air. Water for sluicing is obtained by two ditches, one to Trinity Creek and one to Columbia Creek. The latter was recently cut and will be finished in another season.

Above the Kelliher dredge three outfits mined from June until September.

FAIRHAVEN DISTRICT.

In the Fairhaven district four dredges were in operation in 1913, and each had a fairly successful season. One of these was on Candle Creek, one on the Kugruk, and two on Inmachuk River. The

Kugruk dredge was installed in 1913 and operated for about a month and a half. Other dredges which are planned for this region may be installed in the near future. Representatives of the Dearborn Investment Co. extensively prospected the company's holdings on Kugruk River last season and expect to install a dredge in 1914. It is also reported that another company will put a dredge on Independence Creek, a tributary of the Kugruk.

The Keewalik Mining Co. on Candle Creek employed 25 men during the spring and 15 in the summer, but work was confined principally to dead work, as there was little water for mining. Several large plants were sluicing, but the output was small. On the Inmachuk the Fairhaven Ditch & Water Co. employed about 100 men. The winter output of 1912–13 was exceptionally small, owing in part to a shortage of coal.

LODE DEVELOPMENTS ON SEWARD PENINSULA.

By THEODORE CHAPIN.

GENERAL CONDITIONS.

During the later part of the summer of 1913 a few of the lodes in the vicinity of Nome were visited and information was gathered regarding development of lodes in other parts of Seward Peninsula.

The only metals being commercially extracted from bedrock on Seward Peninsula are tin and tungsten. The development of these lodes, the erection of a test mill, and the production of nearly 5,000 pounds of concentrates of tin and tungsten constitute the most notable achievement of the year in lode mining in Seward Peninsula. Lodes bearing gold and silver have produced ore in the past, and although none are in successful operation at present several give promise of future production. On one property a short distance from Nome a mill has recently been erected and some ore tested. On another property a lode carrying nearly 50 per cent of antimony sulphide and notable amounts of gold and silver has been opened and awaits the capital necessary for its operation. Lodes carrying other metallic sulphides are known. Deposits of copper, lead, and graphite have been prospected, but have not contributed any notable production. Bismuth, iron, and arsenic sulphides are not known to occur in workable quantities in the quartz lodes, but may prove valuable for the gold they contain. Deposits of iron oxide have been reported near tidewater a short distance from Nome, but have never been developed.

GOLD.

On account of the great amount of placer gold which this region has yielded, the principal interest in lode mining centers in the discovery of gold-bearing lodes. The opening of gold-bearing fissure veins and other workable deposits in this vicinity has helped to remove the prejudice against lode mining and to stimulate interest in prospecting. The greatest activity in lode prospecting in the vicinity of Nome has been on Anvil and King mountains and on the divide between Anvil

and Glacier creeks. (See fig. 13.) Recently a number of claims have been staked and the necessary assessment work done, but what is generally recognized as development work is rarely carried on, and, as a rule, surface cuts are the only workings.

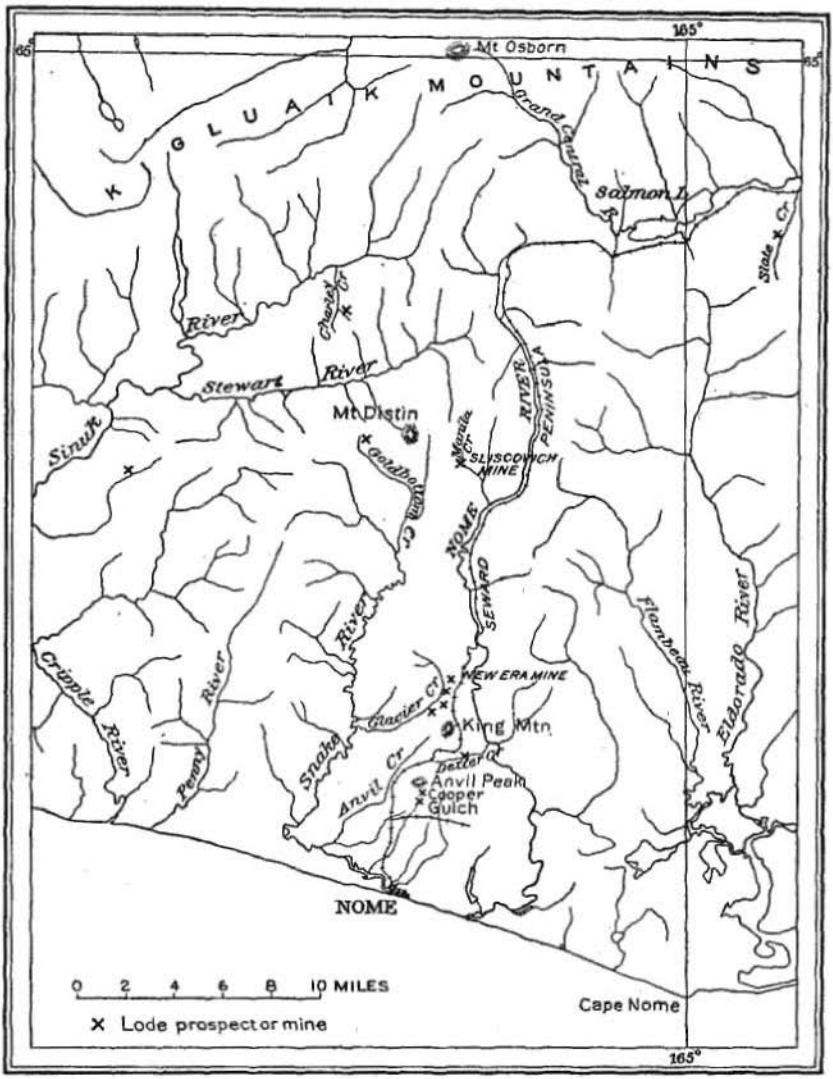

FIGURE 13.—Sketch map showing location of auriferous lodes near Nome.

GEOLOGY.

The prevailing rocks in the vicinity of Nome belong to what has been called the Nome group,[1] and consist of schists containing limestone beds and locally intruded by greenstone and granite. There

[1] Moffit, F. H., Geology of the Nome and Grand Central quadrangles, Alaska: U. S. Geol. Survey Bull. 533, pp. 26–28, 1913.

are also extensive deposits of gravel, some of which are marine and some fluviatile. The schists are broadly classified as chloritic, feldspathic, and siliceous graphitic schists. All the lode deposits are found in the Nome group and the included intrusive rocks.

TYPES OF GOLD LODES.

The gold lodes of the Nome region are divided into two general classes—vein deposits and disseminated deposits.[1] The veins include those deposits in which mineralization occurred along more or less well defined structural planes. They contain a considerable amount of quartz or calcite gangue. The disseminated deposits occur in fracture zones, mineralized by gold-bearing solutions that penetrated along minute openings. Such deposits are poorly defined and grade insensibly into the surrounding rocks. These two modes of occurrence are not sharply differentiated, but show gradations from one to the other. On the basis of vein material the vein deposits are divided into quartz veins, calcite veins, and veins composed of quartz, albite, and chlorite. The quartz veins are the only ones thought to be commercially important, although calcite veins are known to carry free gold. The auriferous quartz veins have further been separated into two classes, one in which the gold is associated with the sulphides of iron, arsenic, and antimony or other minerals, and one in which the gold has no mineral association except with the quartz.

In the sulphide-bearing lodes, whether fissure veins or disseminated fracture zones, the gold either occurs free in the sulphide or inclosing quartz or is present in a state of chemical combination. A division made on this basis is the most important classification from economic considerations, as the deposits of the two kinds require entirely different plants for the treatment of the ore. Failure on the part of operators to determine the character of the ore in depth has caused considerable loss in the erection of machinery not suitable for treating the ore.

The gold-bearing lodes of Seward Peninsula have been characterized[2] as a type of Alaskan deposits peculiar to this region, as it has never been proved that they bear a genetic relation to intrusive rocks, like most of the other gold-lode deposits of Alaska. This is true of the greater number of the lodes, but a type which appears to be somewhat different from those previously described and apparently directly connected with intrusive rocks is found in a mineralized dike (p. 405). This lode, which was recently opened, may not prove to be of economic importance, but is interesting as a new type of lode in this vicinity.

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[1] Moffit, F. H., op. cit., p. 128.

[2] Brooks, A. H., Geologic features of Alaskan metalliferous lodes: U. S. Geol. Survey Bull. 480, p. 70, 1911.

MINES AND PROSPECTS.

NEW ERA MINE.

The property of the New Era Mining Co. is about 6 miles north of Nome. (See fig. 13, p. 398.) The claims are located on Snow Gulch, a tributary of Glacier Creek, and on Kanoma Gulch, a small branch of Snow Gulch. The ore bodies are stringer lodes and disseminated deposits in schist and occur near a limestone contact.

The principal underground development consists of a tunnel 315 feet long, driven to crosscut the lode, which is said to strike about northeast and dip 40° NW. At the time the tunnel was visited a cave-in rendered it inaccessible, so only surface workings could be examined. The face of the tunnel was said to be 10 feet in ore, but the entire width of the lode had not been determined. The lode, as judged by specimens from the dump, is composed of stringers of quartz with much included schist, both quartz and schist containing considerable pyrite and arsenopyrite. The arsenopyrite occurs as small irregular bunches and as isolated crystals in both vein matter and schist and appears to be contemporaneous with the quartz. Some of the pyrite may perhaps have the same relation, but most of it is of later origin than the arsenopyrite and fills fractures which penetrate that mineral. A small amount of albite occurs with the quartz. Small bunches of calcite were seen in pyritized schist, but their relation to the quartz was not determined.

No visible gold could be detected in any of the samples taken from this tunnel, nor can free gold be obtained on crushing the ore. The gold is contained in the sulphides and extends into the wall rock for a considerable distance. The quartz stringers are frozen to the schist and do not easily separate from it, but this is not a serious obstacle, for the included schist is mineralized. As the wall rock also contains gold, the width of the minable rock must be determined not by the walls of the vein matter but by the distance to which the mineralization has penetrated the walls. Assays on ore taken from the tunnel show high values, but inasmuch as many of these assays were made from very small samples, they carry little weight in determining the average value of the lode.

On the ridge between Nakoma and New Year gulches, at an elevation of 600 feet, an opening has been made on a lode which strikes N. 60° E. and dips 75° NW. The lode is about 6 feet wide and is composed of schist cut by nonpersistent lenses of quartz with few sulphides. The gold is concentrated along the footwall of the lode, where particles of visible gold occur in gash veins. Assays made on about 5 inches of the footwall are said to have shown high values, but the conditions under which this material was selected are not known.

A short distance below this opening is a mineralized zone of schist 100 feet wide. It occurs at a limestone contact and appears to be a deposit of the disseminated type. A small opening had been made but did not penetrate the oxidized surface zone, so the unaltered part of the ore body was not visible. The surface zone is soft, decomposed chloritic schist of dark-green color minutely seamed along fractures with tiny threads of iron oxide, evidently derived from the oxidation of the pyrite which occurs as impregnations in the schist. Quartz is not visible except as lenses in the schist. The managers report that careful sampling across the surface of this lode indicated the presence of gold in commercial quantities, but a test mill run of 150 tons of the ore showed that only a portion of the gold contained is free-milling, for less than half the amount indicated by the assay was recovered on the plates. The surface portions of the lode may have a gold content much greater than the lower portions, for the gold contained in the surface zone may be the residual concentration from a considerable vertical section of the vein, now removed by erosion. Considerable prospecting will be necessary to determine the gold content at depth and the size and extent of the ore body, inasmuch as the lode of this character is not as regular as a fissure vein.

The custom stamp mill at Nome was taken over by the New Era Mining Co. upon its reorganization last year and placed on the property at Snow Gulch. This was a great convenience in making test runs, but it was soon evident that the mill was poorly equipped for treating the ore, for much of the gold was not recoverable by the simple process of crushing and amalgamation employed in this mill. Plans for testing the claims with a diamond drill have been made.

About half a mile southwest of the New Era tunnel, at an elevation of 450 feet above sea level, the Golden Eagle claim has been staked on a lode which appears to be the same one cut by the New Era workings. The lode is being prospected by a drift tunnel, which at the time of visit was about 50 feet under cover. The vein where exposed on the surface was only about 6 inches thick, but it grows wider with depth and at the face of the tunnel has a thickness of over 6 feet. It is composed of dull opaque quartz and carries no sulphides. The operators state that samples representative of the ore of the entire vein showed commercial values.

ANVIL CREEK.

A little prospecting has recently been done on Anvil Creek, but at the time of visit no work was in progress. Near the mouth of Quartz Gulch a lode with a general northeast strike and steep northwest dip has been opened in several places by shallow surface cuts. The lode is a crushed zone in schist filled with reticulating veins composed of quartz and a carbonate which appears to be dolomite. The exact

composition of this mineral was not determined, but chemical tests show it to be a carbonate of calcium and magnesium with only a trace of iron and to be near the composition of dolomite.

The metallic content of the lode consists of pyrite and arsenopyrite, which appear to have been introduced at different times. The arsenopyrite for the most part occurs as large crystals and irregular masses in both quartz and dolomite and is evidently contemporaneous with the primary vein formation. The pyrite is of later origin and occurs as reticulating veins cutting the quartz-carbonate vein and including grains of the arsenopyrite.

A claim on the ridge between Anvil Creek and Snake River, near the north end of the knoll west of Banner station, has been prospected recently. An irregular body of quartz was opened by a shallow surface cut, but not enough work was done to show the relations. No well-defined vein is in view. The lode consists of dull-white quartz with no sulphides or visible gold. Stringers of quartz penetrate the schist, and blocks of schist are included in the quartz mass.

GOLDBOTTOM CREEK.

Considerable development work is reported to have been done on the Connolly & Jensen quartz mine, on Goldbottom Creek. This property is equipped with a small stamp mill run by water power and was necessarily idle during the drought of the summer of 1913. It is stated, however, that a quantity of ore is ready to be milled whenever water is available.

COOPER GULCH.

Near the head of Cooper Gulch, about half a mile east of Anvil Peak, a little work has been done on a calcite vein. A number of openings have been made on the lode, but the only accessible one was a short open cut which showed a reticulating vein of calcite. The strike of the vein is in general N. 30° E., but it is very irregular in direction and dip. In places it stands vertically, but in others it flattens out into lenses that lie nearly horizontal. The country rock is schistose limestone.

A short distance to the east, near the limestone contact in the schist, another claim is being prospected by a short tunnel that exposes the lode for a few feet. The lode is defined by two polished vertical walls about 4 feet apart, which inclose ledge matter and brecciated schist, all more or less mineralized. The interior and borders of the lode are composed of bodies of ferruginous calcite, between which are masses of crushed schist that has been partly replaced by calcite. The calcite of the veins and the replaced areas has been altered in large part to limonite, which gives a rusty appearance to the entire lode. Some shattering evidently followed the formation of the lode, as calcite

veinlets fill fractures that penetrate vein and wall rock. No sulphides or gold were seen on specimens of the rock.

DEXTER CREEK.

On Dexter Creek about 300 feet above the mouth of Grouse Gulch a prospect tunnel has been driven for a distance of 400 feet. The wall rock exposed at the portal, the only part of the workings accessible at the time of visit, is decomposed mica schist, and the entire tunnel is said to be in rock of similar character. No evidence of mineralization is apparent, although the inclosing rock is reported to contain gold.

Assessment work on a number of other claims in this vicinity is reported, but little work has been done in developing them.

SLISCOVICH MINE.

Several quartz veins containing antimony have been opened on Seward Peninsula, but only one of them, the Sliscovich mine, has been developed to a producing basis. This property, situated near the head of Manila Creek, at an elevation of 1,100 feet (fig. 13, p. 398), was staked in 1905, and a little work has been done on it each year since. The vein, which strikes N. 60° E. and dips 45° NW., was traced on the surface for over half a mile, nearly across the basin of Manila Creek. Besides a number of prospect pits two openings have been made to develop the lode. A short distance below the point of discovery a 50-foot adit was driven to crosscut the lode, but no further work was done at this place. The main opening is at an elevation 100 feet lower. There an adit was driven 315 feet to the lode, which was opened by an inclined shaft for 100 feet.

The lode is composed essentially of dull, opaque quartz and stibnite, the sulphide of antimony, in approximately equal amounts, although slight variations in the proportions of the two minerals appear from place to place. Near the surface the antimony predominates, and in places nearly pure stibnite occurs in small bunches. A number of assays and analyses have been made on samples of the ore, all of which show rather constant antimony, gold, and silver. An analysis made on a small shipment of ore said by the owners to have been obtained by accurate sampling of the vein was submitted for chemical determination and showed the following:

Gold and silver not published.

Antimony (Sb)	35.05
Sulphur (S)	13.79
Silica (SiO_2)	48.80
Molybdenum (Mo)	None.
Qualitative arsenic (As)	None.
Wet lead	Trace.
	97.64

Lime and magnesia present but not determined quantitatively.

An analysis by the Tacoma Smelting Co., of Tacoma, Wash., showed:

Gold and silver not published.	
Antimony	36.40
Silica	49.00
Iron	5.10
	90.50

Although locally referred to as "the antimony mine," the property is being exploited solely for its content of gold and silver. The antimony appears to be of later origin than the quartz. Brecciated vein quartz has been healed by masses of stibnite that have inclosed quartz fragments and penetrated them as tiny veinlets of the sulphide.

The gold has two modes of occurrence. A part of it is free and may be seen readily in picked hand specimens (Pl. XVII). An examination of polished sections shows the greater part of the visible gold to be associated with the stibnite and to occur along the borders of the stibnite areas or in the connected cracks and veinlets which penetrate the quartz. It was probably introduced with the antimony. A small amount of the gold, however, has no apparent connection with the stibnite and may have been introduced with the quartz prior to the sulphide mineralization. The free gold is not evenly distributed throughout the vein but occurs in bunches and appears to be more plentiful in the surface portion of the vein. The greater part of the gold contained is invisible, occurring in a state of chemical combination with the stibnite. It may thus be seen that the lode owes its economic value to the sulphide mineralization, for most of the gold in both modes of occurrence was introduced through this agency. Locally the lode widens and narrows, varying in thickness from about 20 inches to 3 feet and appearing to widen and to become a little steeper with depth.

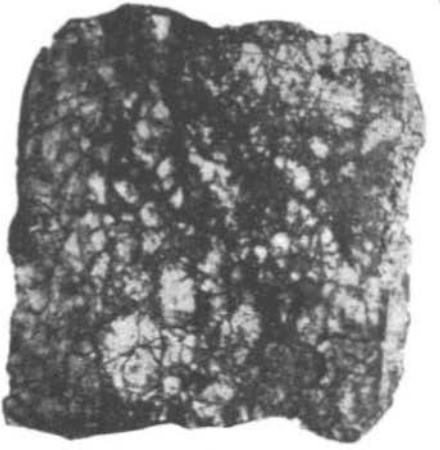
The country rock is dark-green chloritic schist composed mainly of quartz, chlorite, and colorless mica, in large part muscovite, with accessory amounts of calcite, epidote, hematite, and zircon. Bordering a seam of gouge that defines the footwall of the lode, about 15 inches of the wall rock has been altered to a mass of quartz and sericite with considerable white pyrite in small aggregate. The altered wall rock also contains small seams of gouge. The country rock along the hanging wall also has been silicified, but to a lesser extent.

Ore has not been mined regularly, but several small shipments have been made primarily for mill tests to determine the value of the ore.

CHARLEY CREEK.

Bismuth-bearing quartz veins occur on Charley Creek, a small stream which enters Sinuk River about 25 miles north of Nome. Moffit [1] visited this locality in 1906 and noted the occurrence of two

[1] Moffit, F. H., op. cit., p. 133.



A

B

ORE FROM SLISCOVICH MINE, NOME DISTRICT.

A, Natural size; *B*, Same specimen enlarged 2 diameters.

parallel quartz veins that were found to carry bismuth. These veins are about 8 and 12 inches thick and are separated by 16 to 18 inches of schist. They occur in strike joints dipping 50°–60°. At that time they were traceable on the surface for only a short distance because of the covering of slide rock. It is reported that recent prospecting on Charley Creek has uncovered a 4-foot quartz vein that carries 15 per cent of bismuth and a fair gold content. This locality was not visited in 1913, but a sample of the ore was obtained. It is composed of dull white and gray quartz, with small masses of intergrown native bismuth and bismuthinite (bismuth trisulphide).

SLATE CREEK.

A prospect is being opened on Slate Creek, a small stream which flows into Kruzgamepa River from the south 4 miles east of Salmon Lake. The lode is a mineralized dike cutting greenstone. The rock is badly weathered, so that its original character is in doubt, but it appears to have been a fine-grained quartz-feldspar rock in which all the feldspar is now replaced by sericite and kaolin. The dike has been fractured and filled with ferruginous calcite that has partly replaced the included fragments and the walls. A later fracturing of the lode was healed by irregular veinlets composed of quartz and calcite deposited simultaneously. No assays of this lode were made, but small amounts of gold were obtained by crushing and panning the rock. The ledge, which is about 3 feet wide, strikes east and dips 70° N.

A short distance south of the open cut mentioned is an outcrop of rock which appears to be another dike about 10 feet thick and parallel to the one described. It is an even-textured rock of gray color and very fine grain and, like the other dike, was probably a quartz-feldspar intrusive. Quartz, the only original mineral now found in it, occurs with a finely granular mass of epidote. Traversing the rock in many directions are irregular veinlets composed mainly of a green silvery micaceous mineral which proves to be chlorite. With it are associated a number of other vein minerals—quartz, albite, calcite, epidote, and a colorless amphibole which is probably tremolite. This dike is not thought by the prospectors to be of economic value, and work has therefore been confined to the other lode.

The country rock is fine-grained greenstone. It is evident that this was originally a basic igneous rock, but it has been entirely recrystallized. Green hornblende is the most conspicuous mineral, but considerable amounts of chlorite and epidote are present. Garnet and pyrite are abundant and may be readily seen in the hand specimen. Albite fills the interspaces and includes rutile and titanite and fragments of other minerals.

The claims covering this property were located on Slate Creek half a mile above the mouth of Rock Creek in the spring of 1913. At the time of visit the only development work done was a small surface cut, but plans were being made to open the lode by an inclined shaft.

IRON.

Deposits of iron ore in the Nome region have been prospected and a number of locations have been recorded. The property, composed of four groups of claims, is located on Sinuk River and some of its tributaries, about 18 miles from the coast and 20 miles northeast of Nome in a direct line, although the route traveled to reach it is about 30 miles long. This locality was not visited, and information regarding it was furnished by the owners of the claims. The bedrock is described as consisting of chloritic, micaceous, and talcose schists, cut by sills and dikes of greenstone and overlain by limestone, inclosing the bodies of iron ore, which covers an area 25 miles long and 10 miles wide. Development work has been done only on the Monarch group, situated between Sinuk River and Washington Creek. One shaft and 30 open trenches on this group of claims have disclosed a large ore body. Specimens of ore in the possession of the owners of this property were examined. The highest-grade ore is composed essentially of limonite, which is rather massive except along the numerous open spaces, where botryoidal and mammillary forms exhibiting fibrous texture are well developed. A little hematite is also present as narrow layers separating the massive from the fibrous limonite. Ore of poorer grade contains more or less limestone.

The following analyses furnished by the owners of the claims were made by the Western Steel Corporation, of Seattle, on samples said to be representative of the ore in various cuts:

Iron.	Silica.	Phosphorus.	Manganese.
58.76	2.14	0.026	0.44
53.92	8.65	.022	.74
59.86	3.85	.010	.38
57.55	4.82	.015	.76
37.19	.90	.004	.90
15.29	2.70	.017	11.22

The following report was made by the Pacific Coast Testing Laboratory on samples submitted to it by the owners of the property:

Iron.	Silica.	Phosphorus.	Manganese.	Lime.
53.88	7.07	0.047	0.83	.....
45.34	4.15	.049	.89	.....
34.76	1.00	.038	.92	23.00

Some gold is also reported, but no assay returns are available for publication.

No work other than that necessary to hold the ground is being done on this or the adjoining groups of claims, although for years there have been indefinite plans either to open the property and ship the high-grade ore or to erect a plant on the ground for its treatment. Natural resources which might be utilized for the production of power are available near by. A hot spring 2 miles below the location of the claims is said to maintain a uniform flow during summer and winter and could possibly be used to generate electric power. Another possible resource is coal. Coal-bearing rocks outcrop on Coal Creek, a tributary of Sinuk River, a short distance below the iron prospects. It is reported that a tunnel driven to prospect the coal cut 17 thin seams ranging in thickness from 3 to 16 inches. The coal is said to be of bituminous grade and of fair quality, but the extent of the coal-bearing rocks is not known.[1]

TIN.

Ever since placer tin was first produced on Seward Peninsula search for its bedrock source has been continued and a number of tin-bearing lodes have been located, but no regular production has been maintained. In 1906 the Bartels Tin Mining Co. milled 10 tons of concentrates, the first and until this year the only production recorded from tin lodes in Alaska.

The Lost River tin-bearing lode prospects are located 6 miles from the coast, on Cassiterite Creek, a tributary of Lost River, in the extreme eastern part of Seward Peninsula. This property has recently been taken over by the Jamme Syndicate and actively developed. A small concentrating plant erected in the spring of 1913 was operated for about two months to test operating conditions fully and produced 5,000 pounds of concentrates containing over 60 per cent of metallic tin and 11 per cent of tungsten. The ore bodies of this locality are described as mineralized dikes of quartz porphyry which cut the Port Clarence limestone and are intimately connected with granitic intrusions.[2] Plans for future development include the installation of a larger plant on the property, as well as a smelter at Seattle.

On Ear Mountain during the summer of 1913 a party of men were prospecting a tin lode and found tin in sufficient quantity to encourage further winter development. The ore is reported to lie in a shear zone in the granite.

Tin lodes are known also at Brooks Mountain, at Cape Mountain, and on Buck Creek, but little work has been done at any of these places recently.

[1] Collier, A. J., The gold placers of parts of Seward Peninsula, Alaska: U. S. Geol. Survey Bull. 328, p. 84, 1908.

[2] Knopf, Adolph, Geology of the Seward Peninsula tin deposits, Alaska: U. S. Geol. Survey Bull. 358, p. 49, 1908.