GOLD PLACERS OF THE RUBY DISTRICT.

By HENRY M. EAKIN.

LOCATION AND EXTENT OF THE DISTRICT.

The chief settlement of the Ruby district is Ruby, situated on the south bank of Yukon River opposite the mouth of Melozitna River. The principal placer mines of the district are about 25 miles south of Ruby on a number of streams that belong to the Nowitna River system. The area that includes the mines is small, but auriferous gravels have been found in the surrounding territory extending from the Yukon southward 50 miles or more, with a width somewhat less in extent. (See general map, Pl. X.)

PREVIOUS INVESTIGATIONS.

The earliest geologic work that touched definitely upon this general region was that of Spurr, who made an exploration of the Kuskokwim Valley in 1898.[1] Collier took some notes on the rocks which outcrop in the bluff near Ruby Creek in 1902, but they were not published, being foreign to the special study of the coal-bearing terranes in which he was engaged. In 1908 Maddren spent a short time in an investigation of the region about the southern headwaters of Innoko River and in 1910 visited the Ruby, Innoko, and Iditarod districts.[2] During that year a topographic reconnaissance was carried by C. G. Anderson from Yukon River at the present site of the town of Ruby to the Innoko and Iditarod districts. Mr. H. E. Birkner, of the Anderson party, made some geologic observations along the route of travel.

FIELD WORK.

During the summer of 1912 the writer visited the Ruby, Innoko, and Iditarod districts. Work was begun at Ruby July 18. The two following weeks were spent in a geologic reconnaissance of the district and in visiting the producing creeks. The reconnaissance was then extended southwest to the Innoko district and thence to the

[1] Spurr, J. E., Reconnaissance in southwestern Alaska in 1898: U. S. Geol. Survey Twentieth Ann. Rept., pt. 7, 1900, pp. 31-264.

[2] Maddren, A. G., The Innoko gold-placer district, Alaska: U. S. Geol. Survey Bull. 410, 1910; Gold placer mining developments in the Innoko-Iditarod region: U. S. Geol. Survey Bull. 480, pp. 236-270, 1911; The Ruby placer district: U. S. Geol. Survey Bull. 520, pp. 287-296, 1912.

Iditarod district, where work was suspended September 10. The placer mines of the Innoko-Iditarod region are treated elsewhere in this report. (See pp. 293–303.) A more comprehensive report on the Iditarod-Ruby region is in preparation, which will be accompanied by topographic and geologic maps.

GEOGRAPHY.

SIZE OF THE GOLD-BEARING AREA.

The mining center of the Ruby district is about 25 miles south of Yukon River at Ruby and comprises half a dozen creeks, all within an area a few miles square. The reports of prospectors indicate that a fairly continuous gold-bearing area extends from the Yukon at Ruby southward 50 miles or more with a width somewhat less in extent. The district has no strict boundaries and the present discussion pertains not only to the gold-bearing area but also to adjacent territory whose study sheds light upon the broader geologic relations (Pl. X).

RELIEF.

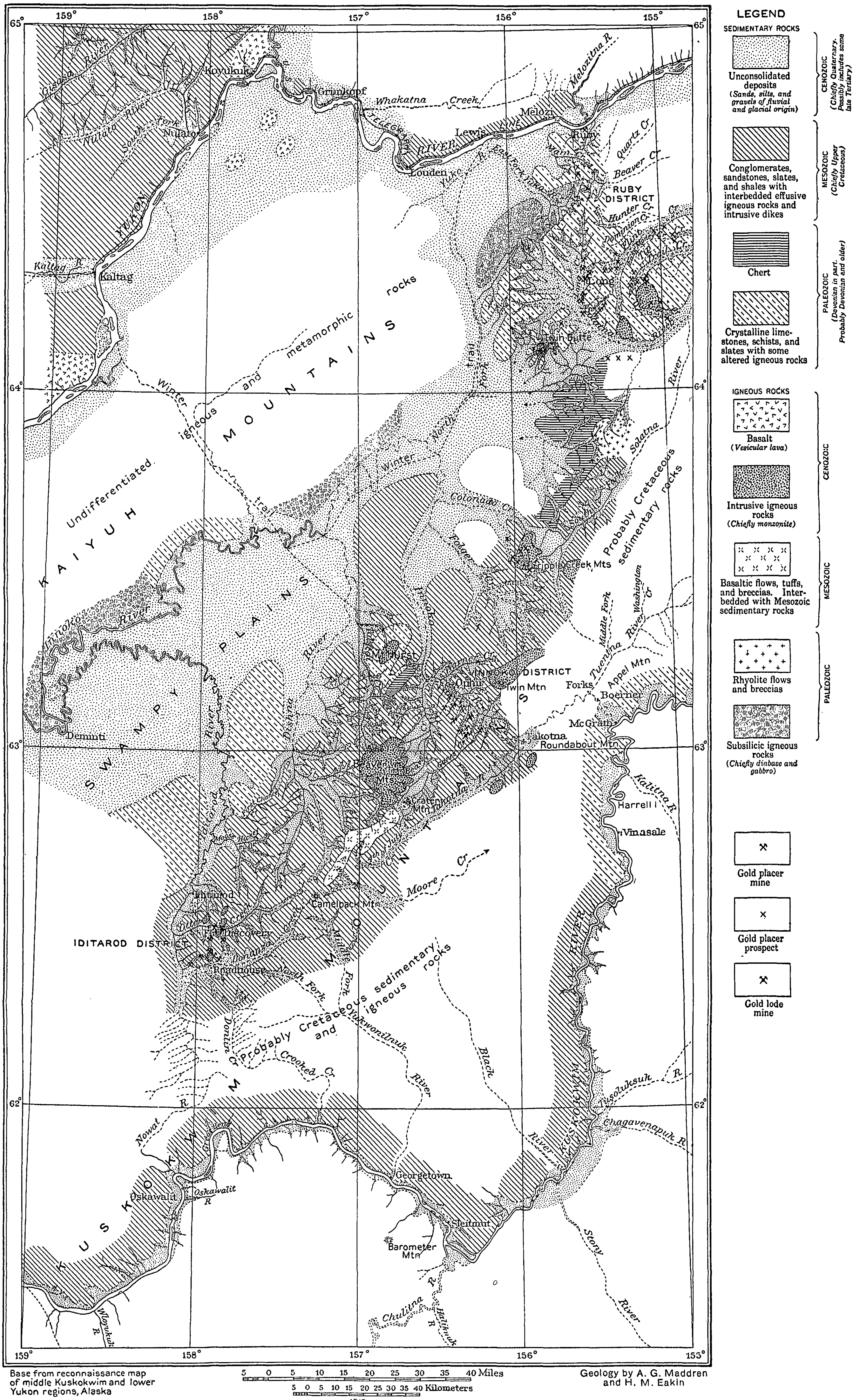
The Ruby district has for the most part a gently rolling topography characterized by broad ridges and dome-like hills of moderate relief. The headwater tributaries of the larger streams are singularly few and widely spaced, the smallest streams being of considerable length and free of laterals and gullies. Stream grades are low and their headward steepening very slight. The slopes of the hills and ridges diminish toward the summits, which are nowhere actually flat, and toward the stream bottoms, where flood plains of considerable width are the rule, even in the smallest streams. Most of the flood plains widen downstream and those of the larger streams are commonly several miles across.

The rolling type of topography is broken in two localities. In the western part of the district is a prominent group of hills of more rugged outline, which is the northeastern extension of the Kaiyuh Mountains. Their maximum elevation is about 2,200 feet. In the vicinity of Ruby the rolling hills break up along Yukon River in steep and in many places precipitous bluffs, 300 to 400 feet high.

The erosional cycle affecting the region has long since passed maturity and is approaching old age. This result has probably been hastened by changes in the major drainage features in late geologic time that have caused an adjustment of the smaller streams to a higher base level of erosion.

DRAINAGE.

Details concerning the courses and relationships of the numerous streams of the district can best be learned from the accompanying map (Pl. X). Some of the streams are directly tributary to the



Base from reconnaissance map of middle Kuskokwim and lower Yukon regions, Alaska

1913

Geology by A. G. Maddren and H. M. Eakin

GEOLOGIC SKETCH MAP OF THE RUBY, INNOKO, AND IDITAROD DISTRICTS.

Yukon, some flow southward and eastward to join Nowitna River, others flow westward into the Yukon basin, whereas the North Fork of the Innoko receives the waters from the southwestern part of the district.

The streams flowing directly into the Yukon named from west to east are Main, Oro, Flat, Center, Melozitna, Ruby, Short, Hanna, Big, and Independence creeks. South of Independence Creek are Quartz and Beaver creeks, which debouch upon the Nowitna lowlands and are probably tributary to the Nowitna. The rest of the Nowitna drainage is delivered through its large western tributary, Solatna River. The principal tributaries of the Solatna from the north, beginning with the lowest, are Flint, Tip, Trail, Quartz, Monument, and Long creeks. The southern tributaries of the Solatna no doubt have been named but no map of them is available. Likewise the streams tributary to the North Fork of the Innoko and Yuko River have not been adequately mapped, although many have been named by persons locating placer claims on them.

CLIMATE.

The Ruby district has, in common with the greater part of the lowlands of central Alaska, a sub-Arctic climate marked by great seasonal variation in temperature, rather scanty rainfall, and infrequency of storms. Winter weather may be experienced from October to April. The other months are for the most part usually mild. The larger streams as a rule thaw in early May and freeze over in late October. Most of the intervening period—usually about 120 days—is available for mining operations. The growing season for the hardier forms of vegetation is from early May to early September. Ninety to one hundred days of midsummer are usually free from frost.

The annual rainfall may be as little as 10 inches and rarely if ever exceeds 20 inches. It comes mostly as rain during the months of July and August. Thunderstorms occur during a short space of midsummer and may be accompanied by considerable precipitation. The sky is generally overcast during the time of the later rains, which, although not violent, may continue for several days or even weeks and make up the greater part of the year's precipitation. The summer of 1912 probably had an exceptionally heavy rainfall. The writer experienced only five days between July 17 and September 2 without rain.

Contrary to the popular conception of the climate of all high latitudes, violent storms are of comparatively rare occurrence in central Alaska both summer and winter. The length of periods without gales or even strong winds is commonly much greater than in the temperate latitudes.

The mean annual temperature is so low that the ground below a slight depth is in most localities permanently frozen. Extremely permeable gravel deposits are usually thawed, owing to the circulation of ground waters.

The thick vegetal mantle covering the region acts as a reservoir for the rain water and consequently the streams have a remarkably even flow. Owing to the frozen subsoil, practically the entire rainfall escapes as surface water, so that streams draining very small areas are often available for mining uses.

FORESTS AND VEGETATION.

The Ruby district is forested for the most part by a scant growth of spruce with scattered tamarack and birch. Small portions of the higher areas are free from timber of any sort. Trees 1 to 2 feet in diameter, suitable for lumber, are to be found along the banks of the larger streams and on the steep slopes at the heads of valleys.

Throughout the district the mosses common to Alaska are especially abundant and grasses adapted for forage are correspondingly scarce. The traveler finds a soft footing, laborious to traverse, and can find camping grounds that have available forage only with difficulty.

FISH AND GAME.

Salmon and several other varieties of fishes are available on Yukon River. In the smaller streams that are unpolluted by mining operations grayling are plentiful. The game is limited almost entirely to ptarmigan, grouse, and rabbits, which are plentiful. Two moose were killed on Long Creek in the spring of 1912, but their presence in the district was considered exceptional. Bear are found but are not numerous.

WATER SUPPLY.

All the drift mining of the district is on streams sufficiently large to furnish the water needed. On the smaller streams, where open-cut methods of mining are necessary, the water supply is scant for groundsluicing and even for the sluice boxes during the drier part of the season. At such times work is often seriously retarded.

SETTLEMENT AND POPULATION.

The principal settlement of the Ruby district is the town of Ruby, situated on the south bank of the Yukon, opposite the mouth of Melozitna River. Its average population during 1912 was probably about 1,000. The district had an additional population of about 300, mostly engaged in prospecting and mining on a group of streams 25 to 30 miles south of Ruby. Part of this number were localized in a small settlement known as "Long," near Discovery claim on Long Creek.

HISTORY AND DEVELOPMENT.

The first discovery of gold in the Ruby district was probably that made in 1907 on Ruby Creek, near the site of the present town. The value of the production from this locality is uncertain, estimates ranging from a few hundred to two thousand dollars. The original discovery proved to be of no great importance, and it was not until 1910 that the discoveries on Long Creek and its tributaries were made that created a widespread interest in the region and led to the development of the present mining district and the settlement of the town of Ruby. The discovery was made by Fernander and Johnson, near the mouth of Bear Pup, a tributary of Long Creek, late in July, 1910. A large number of people arrived during the following summer, and valuable deposits were located on several other creeks in the neighborhood. A substantial town was built in a single summer on the banks of the Yukon at the mouth of Ruby Creek and was given the name of Ruby. Since then the population of the district has remained over a thousand. The business of the town has assumed good proportions. Stores, hotels, etc., have been built, sawmills installed, a telephone line put in service between the town and the creeks, and a telegraphic connection has been made with the Government line on the opposite side of the river. About 25 plants of different kinds were operating on six creeks during all or a part of the summer of 1912. Though most of these outfits were using hand methods, several steam plants were in operation, and additional machinery was being received at Ruby to be installed during the winter of 1912.

TRANSPORTATION AND OTHER COSTS AFFECTING DEVELOPMENT.

The situation of Ruby on the Yukon affords excellent transportation facilities during the summer months, when numerous steamboats ply the river. The fare from Seattle to Ruby, first class, via Skagway, in 1912 was $124. Freight for Ruby is usually sent via St. Michaels. The rate on general merchandise from Seattle in 1912 was $40 a ton. Special classes of goods, such as extra heavy machinery, explosives, and articles of exceptional bulk, were charged 20 to 200 per cent above this rate.

Travel from Ruby to the mining center at Long is difficult in summer, owing to the unimproved condition of the trails. In winter, however, the trails are excellent. Summer and winter freight rates show a corresponding difference. The summer charge to Long Creek in 1912 was 12½ cents a pound, to Trail Creek 15 cents a pound. The winter rates were 5 and 6 cents a pound to Long and Trail creeks, respectively.

Labor in the district was plentiful in 1912. Wages for ordinary workmen were $5 a day and board, for carpenters and mechanics $7.50 to $12 a day and board.

Rough lumber in 1912 sold in Ruby at $50 a thousand feet, dressed lumber at $80 a thousand feet. Cordwood brought $6 at Ruby and sold as high as $10 or $12 on some of the creeks.

The road houses commonly charge $1.50 for a meal and $1 for lodgings.

GENERAL GEOLOGY.

NATURE OF THE ROCKS.

A group of metamorphic rocks, principally of sedimentary origin but including some igneous members, comprises the bedrock of most of the Ruby district. There are minor areas of unaltered igneous rocks, and numerous unaltered dikes and sills cut the metamorphic rocks. Unaltered sedimentary rocks, probably of Cretaceous age, occur in the hills north of the Yukon opposite Ruby. The unconsolidated deposits of the district include present stream gravels, bench gravels, silts, and residual clays. (See geologic map, Pl. X.)

METAMORPHIC ROCKS.

The metamorphic rocks are principally schists, slates, limestones, cherts, and greenstones. The exposures along the Yukon bluffs near Ruby are mainly black quartzitic slate and limestone. The absence of slaty cleavage in places gives black quartzite and quartzite schist phases of the same original rock as that forming the slates. The schists and slates are much contorted and contain numerous quartz veins and lenses and unaltered dikes of varying composition. The limestones are crystalline, banded bluish and white in color, and have complicated structures that indicate a dynamic history similar to that of the schists and slates.

The prominent hills about the head of Long Creek are mostly formed of a quartzose schist. This schist is light colored and in places contains much mica. A little to the northwest of this locality, on the divide between Beaver and Main creeks, dark-colored limestone is associated with more or less sheared cherts.

Exposures of bedrock are not numerous on Long Creek or Bear Pup near the mines, but types of rock like those already described are found. A considerable part of the bedrock here is greenstone, but limestone and schists predominate. The greenstones have more or less schistose cleavage developed and grade into greenstone schists.

On Glen Gulch the bedrock is mostly a crenulated graphitic schist, cut by numerous quartz veins. The stream gravels contain green-

stone and mica schist pebbles, derived from masses which probably form the bedrock in parts of the valley.

The bedrock of Trail Creek basin is like that of Glen Gulch with respect to the metamorphic rocks, consisting of limestones, greenstones, and black crenulated schists. The same abundance of quartz veins is also present.

The metamorphic rocks described above extend from the Yukon southward to a point about 10 miles south of Twin Butte Mountain, where the smooth rolling topography gives place to a series of sharp hills and ridges composed of chert and igneous rocks. Westward the metamorphic rocks extend to the border of the Kaiyuh Mountains, which are mainly of less altered igneous rocks. Eastward they extend beyond the boundaries of the district.

The structure of the metamorphic rocks is rarely evident but is uniformly complex wherever recognized. The principal structural axes trend in general N. 25° E. Along these axes intense folding and faulting have taken place. There has also been much shearing on a small scale and the secondary structure thus developed conforms in general with the major axes. The metamorphism of the original sedimentary and igneous rocks now represented in the group is largely due to the processes attending their deformation. A similar effect has also been induced by igneous activities accompanying their intrusion by large granitic masses and various dikes.

The structural trend of the metamorphic rocks of the Ruby district is northeastward toward the Gold Mountain and Rampart districts, where similar rocks are found. They are probably the equivalents of some of the formations that occur in these districts and farther eastward in the Fairbanks and Circle quadrangles. If so, they are probably of early Paleozoic age, possibly Silurian or Devonian.

UNALTERED SEDIMENTARY ROCKS.

The hills bordering the Melozitna delta north of Yukon River opposite Ruby are formed of shale, sandstone, and conglomerate. The extent of these beds northward was not determined, but they form a belt at least several miles in width which trends northeast and southwest along the Yukon. No other rocks of this character were seen in the district. The shales are dark colored and in some places are very graphitic. They are in general thinly bedded, alternating with thin beds of fine sandstone. Slaty cleavage has been developed in places in both the shales and standstones. The heavier sandstone beds are massive and owing to their hardness form the highest hills and ridges. Their coarser phases grade into grits and fine conglomerates. They are generally gray in color, weathering brown, and evidently contain much material besides quartz.

These beds carry fossil leaves, although no determinable specimens were secured. Owing to this fact and their apparent continuity with the Cretaceous beds that outcrop along the Yukon farther west, which they resemble, these beds are regarded as Cretaceous in age.

IGNEOUS ROCKS.

The igneous rocks of the Ruby district include old, more or less altered basic rocks associated with the metasedimentary rocks throughout the district, a series of basic flows that form an extension of the Kaiyuh Mountains, rhyolite porphyry and quartz diorite intrusives younger than the basic flows, and still younger granitic intrusions.

The old basic rocks are represented on Long Creek and on the divide between Bear Pup and Glen Gulch by actinolite-epidote schists. On Midnight Creek the old basic rocks are diorites and at Twin Butte Mountain diabase. These rocks are all types of the so-called greenstones and are common in all the metamorphic areas.

The rocks of the northeastern extension of the Kaiyuh Mountains within the district are ultrabasic flows. They are principally diabase and quartz gabbro, but some more acidic types approaching rhyolites in composition are found. Their textures vary from medium granular to aphanitic, and some of the finer-textured rocks contain considerable glass. In addition to the area near the mountains this group of rocks extends northeastward and forms the landmark known as the "Thumb," near the head of Beaver Creek. These rocks show more or less alteration and are probably not greatly different in age from those associated with the metamorphic rocks.

Several dikes cut the metamorphic rocks in the Yukon bluffs near Ruby. They range in composition from rhyolite porphyry to quartz diorite. Similar dikes cut the metamorphic and older igneous rocks in other parts of the district. In all places noted they conform with the structure of the older rocks and were intruded subsequent to their principal deformations.

Unaltered granites occupy considerable areas near the heads of Trail and Flint creeks. These rocks are coarsely granular and disintegrate so readily that as a rule they have no special topographic expression. At the head of Flint Creek, however, they form a number of pinnacles 10 to 50 feet high, called the Monument Rocks. Some phases of the granite are remarkable for the abundance of sulphides present in them. The granites are apparently in the form of batholiths, a mile or more in diameter. They are unsheared and must have been injected into the metamorphic rocks since the principal period of deformation.

VEINS AND MINERALIZATION.

Quartz veins are a common feature of the metamorphic rocks throughout the Ruby district. They are especially abundant in the black crenulated schist that outcrops on the head of Boston Creek and on Trail Creek. Brecciated quartz veins are commonly exposed in the bedrock of the placer mines on all the creeks, and quartz bowlders form a large part if not all of the streams gravels wherever exposed.

A few large quartz veins were noted in the bluffs near Ruby. One vein at least 15 feet wide is penetrated by an abandoned prospecting drift. Another vein about 6 feet wide 10 miles south of Ruby has been prospected, apparently without favorable results.

The quartz veins of the district are commonly iron stained on the surface. Hematite was noted in some of the vugs and pyrite and arsenopyrite in others. Arsenopyrite is probably the most abundant of the iron minerals. The quartz veins undoubtedly carry gold in the placer areas, for many nuggets containing quartz are found. Nuggets composed partly of hematite are also found, suggesting that the hematite vugs noted in the quartz veins may be auriferous.

Cassiterite, the oxide of tin, is found in the concentrates on Midnight Creek and probably is a phase of vein mineralization.

UNCONSOLIDATED DEPOSITS.

Practically the entire surface of the Ruby district is mantled by unconsolidated deposits. Gravels commonly occur as the lower part of the alluvium of the present valleys. High gravels have been discovered on top of the river bluffs near Ruby and at Skookum Bar, on a ridge at the head of Big Creek about 5 miles south of Ruby. Silts form a large part of the valley filling of the streams, especially near Yukon River, and may also form part of the upland mantle throughout the district. Residual clays are widespread in the whole region and cover much greater areas than either the silts or gravels. They mantle the lower hills and ridges and have crept down into the valleys. The gravels of the valley bottoms are covered as a rule by a considerable thickness of clay, much of which has come from the adjacent hillsides.

The alluvial deposits increase in depth downstream in all the valleys and are deepest in the trunk valleys and the valleys immediately tributary to them. They are exceptionally deep on the streams near the Nowitna and Solatna lowlands.

On White Channel Creek, a tributary of Trail Creek near its mouth, a shaft penetrated 45 feet of silt and 140 feet of gravel and did not reach bedrock. Seven miles upstream on White Channel Creek another shaft reached a depth of 182 feet without reaching bedrock and 7 miles farther upstream the alluvium is 60 feet deep.

On Long Creek the depth of alluvium ranges from 30 to 40 feet, at the farthest points tested upstream, to 70 feet 5 miles below the mouth of Bear Pup. The increase in depth is probably at a greater rate even farther downstream on Long Creek, for the bedrock slope of Midnight Creek is so much greater than the surface slope that the alluvium at the mouth of Midnight Creek must be considerably over 100 feet in depth.

In general the depth of alluvium corresponds rudely with the width of the valley. In the lower reaches of the Solatna and its tributary streams depths of over 100 feet are to be commonly expected, and depths of 200 feet and more should not be surprising at the border of the more extensive flats.

ECONOMIC GEOLOGY.

THE GOLD-BEARING STREAMS.

Gold placers are the only mineral deposits of the district of commercial value. Placer tin is found in small amounts with the gold on Midnight Creek.

Auriferous gravels have been discovered thus far only in the alluvial deposits of the present streams. The localities where gold is known to occur have been platted on the map (Pl. X) so far as data are available. The localities where the deposits have proved rich enough for mining are indicated by a special symbol. Though auriferous gravels are widely distributed in the district, those rich enough to support mining are limited to the valleys of Ruby Creek, Long Creek and its tributaries, Glen Gulch, and Trail Creek. Because of their greater importance the deposits of these streams will be described first.

RUBY CREEK.

The auriferous deposits of Ruby Creek are confined to a small area on a low bench on the right bank of the stream near its mouth. The alluvium is 12 to 15 feet deep and includes beds of large well-rounded bowlders, lenses of angular detritus, sands, and silts. The coarse materials of the deposit are composed of metamorphic and igneous rocks and vein quartz, all of which occur in the local bedrock. There are no unusual mining difficulties and a low gold tenor is apparently the cause of the scant production credited to the creek.

LONG CREEK AND TRIBUTARIES.

The valleys of Long Creek and its tributaries contain remnants of older alluvial deposits that stand considerably above the present flood plains of the streams. The bedrock floors of the valleys are practically level in cross section, so that the depth to bedrock in many localities increases away from the stream toward the valley wall. There is also a general increase in depth to bedrock downstream.

On upper Long Creek the auriferous deposits are 100 to 500 feet from the stream and are at a depth of 30 to 40 feet below the surface. The gold lies close to bedrock beneath a stratum of gravel 4 to 6 feet thick. The rest of the overburden is clay containing unworn brecciated vein quartz. The gold is coarse, being mostly in pieces worth from 50 cents to $10.

The valley of lower Long Creek has a more or less continuous pay streak extending at least 5 miles downstream from the mouth of Bear Pup. All the discoveries have been on the left side of the stream and for the most part at a considerable distance from it. It is about 50 feet to bedrock at the upstream end of the pay streak as represented in the Windy Bench claim. The depth increases to about 70 feet 5 miles below Discovery claim, although the surface of the alluvium at the latter locality is more nearly at the creek bottom level than it is on Windy Bench. The slope of the bedrock surface downstream is much greater than that of the present stream, and it is probable that the depth to bedrock will increase at least 10 feet to the mile below the last workings on Long Creek. In the upper claims the gold is pretty well concentrated on bedrock, but farther downstream the thickness of the auriferous stratum increases and in places 5 or 6 feet of gravel are hoisted and washed. The width of the deposit also increases downstream from 50 to more than 100 feet.

The gravels of Long Creek are nowhere known to be phenomenally rich, but there is apparently much ground that will yield from $1 to $3 per square foot of bedrock, or $10 to $15 per yard of material mined. The deposits are all frozen, so that timbering is rarely required in the workings. Economical methods of mining are possible that would permit ground yielding even less than $1 per square foot of bedrock surface to be worked at a profit.

The stream gravels of Bear Pup are auriferous for a distance of at least 2 miles above its mouth. The valley is narrow as compared with that of Long Creek, and the pay streak follows closely the course of the present stream. The older filling of the valley has been largely removed, so that the gravels are now only 6 to 12 feet deep. The upstream claims are on the shallower ground, which is mostly thawed. The width of the pay streak varies, but the maximum is about 15 feet and in some places the tenor of the gravels is probably quite as high as those of Long Creek. Open-cut methods are practicable along the entire creek, so that gravels of very low tenor are available for mining.

The gold-bearing gravels of Midnight Creek are like those of Long Creek in lying at considerable depth. About 2 miles above its mouth the depth to bedrock is 18 to 22 feet. A mile below this locality the depth is about 60 feet, and farther downstream probably still greater

depths will be encountered. The richest part of the deposit is not on bedrock but is between 6 and 8 feet above it. The stratum below that which carries most of the gold consists of large quartz, quartzite, and greenstone bowlders with the interstices filled with a stiff greenish clay. All the gravels are auriferous, but only the stratum between 6 and 8 feet above bedrock carries sufficient gold for mining, so far as known. This stratum probably represents a reconcentration of an older valley filling which was removed to a depth of a few feet above bedrock. Subsequently the valley was again aggraded to the present level of its floor. Workable deposits have been discovered on a single claim on Midnight Creek, but as only a small amount of prospecting has been done, it seems likely that more extensive deposits may be found in its valley.

GLEN GULCH.

The gravels of Glen Gulch are known to be gold bearing practically throughout its length, a distance of about 2½ miles. Some of the deposits have proved rich enough to encourage mining by the comparatively expensive method of drifting and hoisting the gravels to the surface by hand and by steam machinery. However, a large part of the placer ground will be available only for the more economical open-cut methods. This is especially true of the upper part of the creek, where the gravels are only 10 to 15 feet deep. The stream gravels deepen downstream to about 25 feet. Several prospecting shafts have been sunk about 50 feet to bedrock on a bench on the left side of the creek near its mouth, apparently without satisfactory results. All the deposits, except those very near the head of the stream, are frozen.

If further prospects should prove the existence of sufficiently large bodies of auriferous gravels to justify the project, water could be brought from Flint Creek, probably under sufficient head for hydraulic mining.

TRAIL CREEK.

Auriferous deposits rich enough to support mining have been discovered in the stream gravels of Trail Creek for a distance of about 2 miles along the valley. Gold prospects have been found farther down the valley for a distance of about 17 miles.

The valley filling is commonly a stratum of gravel on bedrock several feet thick, overlain by muck. The depth to bedrock on upper Trail Creek is about 40 feet. Seven miles down the valley it is 70 feet, and it probably continues to increase farther downstream. All the deposits are well frozen and adapted for drift mining. The gold occurs close to the bedrock, so that a minimum amount of hoisting is necessary in its recovery.

OTHER CREEKS.

Auriferous gravels are said to occur on a number of streams other than those where mining has been done.

On Tip Creek, which heads between Flint and Trail creeks in their lower courses, considerable prospecting has been done. The valley of Tip Creek is said to be broad and flat and the alluvium deep. Prospects rich enough to stimulate further work have been found in a few holes near its head.

Quartz Creek is the next large tributary of Solatna River above Trail Creek. Prospecting has been done on the main stream and several tributaries, and the outlook is said by those interested to be encouraging. The ground is 50 to 180 feet deep and, except in the deepest places, is frozen.

Several of the southerly tributaries of Solatna River have received attention from prospectors, who report encouraging prospects at a number of localities. Rather deep but well-frozen ground seems to be the rule on these streams.

MINING IN 1912.

In the Ruby district, in 1912, mining operations were in progress on six creeks, all located in a small area about 25 miles south of Ruby. Four of these creeks belong to the Long Creek system, namely, Long Creek, Upper Long Creek, Bear Pup, and Midnight Creek. The other two creeks are Glen Gulch, a tributary of Flint Creek, which heads against Bear Pup, and Trail Creek, which is the next creek east of Flint. On Long Creek below the mouth of Bear Pup nine claims were worked by as many plants using steam thawing and hoisting gear. About fifty men were employed most of the summer. Early in the summer several of the plants were prospecting rather than mining. Later reports indicate that considerable new ground yielding good returns was opened and that the whole summer witnessed a general improvement in results along the creek.

On Long Creek above the mouth of Bear Pup three outfits, employing about ten men in all, worked claims Nos. 2, 3, and 4 above Discovery. These plants used small prospecting boilers for thawing, running three or four points each. Hoisting was by hand windlass. Water for sluicing was obtained from Long Creek and carried to the claims by a ditch over 2 miles in length.

On Bear Pup five claims were worked by about thirty men. One plant used steam-hoisting gear to raise the gravel to the sluice boxes after the overburden had been groundsluiced off. The other four plants also used open-cut methods, groundsluicing the overburden and shoveling into the boxes. A large area on No. 1 Bear Pup was being stripped of vegetation preparatory to groundsluicing.

Considerable harm was done some of the workings by midsummer floods, but on the whole the Bear Pup operations were successful.

Only a single claim was worked on Midnight Creek by two men, who used a small prospecting boiler for thawing and a windlass for hoisting. An excellent ditch from the stream furnished abundant water for sluicing, and considering the equipment fine progress was made, apparently with good results.

On Glen Gulch six claims in all were worked. A steam-hoisting plant worked on the lower part of the creek. Upstream were four small plants using the usual prospecting type of boiler for thawing and the hand windlass. Near the head of the stream a claim was being worked by open-cut methods without machinery. Not all of these plants worked continuously throughout the summer. About twenty-five men in all were employed.

On Trail Creek seven claims were worked by three steam-hoisting plants and four plants with small thawing boilers and hand windlass. About thirty men were employed. Good progress was made by most of these outfits throughout the summer.

SUMMARY.

In all, thirty-one claims were worked in the Ruby district, employing a total of 150 men. On fourteen claims steam-hoisting plants were operated; on twelve claims hoisting was done by hand; and on five claims hand open-cut methods were employed.

Exact data regarding the amount of gold production of the district are not available, but the total was probably between $150,000 and $175,000.

GOLD PLACERS OF THE INNOKO-IDITAROD REGION.

By HENRY M. EAKIN.

FIELD WORK.

The Innoko-Iditarod region lies in west-central Alaska and embraces most of the upland area north of Kuskokwim River that is drained by Innoko and Iditarod rivers. The writer spent a month of the summer of 1912 in making a geologic reconnaissance of a part of the region after having made a similar survey of the Ruby district. (See pp. 279–292.)

This region was visited by Maddren in 1908 and again in 1910. His work[1] has contributed much information concerning parts of the region not visited by the writer and has aided in preparing the accompanying geologic sketch map. (See Pl. X, p. 280.)

The placer mines of the region are grouped in two rather distinct areas, known as the Innoko and Iditarod districts, respectively, corresponding in name with the rivers that drain them. Although the two mining districts have many points in common, they have also differences which make their separate treatment advisable.

INNOKO DISTRICT.

GEOGRAPHY.

LOCATION OF THE MINES.

The mining center of the Innoko district is about 75 miles southwest of that of the Ruby district. The principal gold placer mines are in the valleys of five neighboring streams that join Innoko River from the southwest. These, named in order, beginning with the farthest downstream, are Ophir, Spruce, Little, Gaines, and Yankee creeks. All excepting Gaines are only a few miles in length. At the mouth of Ophir Creek is the principal settlement of the district, called Ophir.

A locality about 25 miles northeast of Ophir has been the scene of recent discoveries of placer gold on the headwaters of Colorado Creek, which is tributary to Innoko River. The chief discovery is on a

[1] Maddren, A. G., The Innoko gold-placer district, Alaska: U. S. Geol. Survey Bull. 410, 1910; Gold placer mining developments in the Innoko-Iditarod region: U. S. Geol. Survey Bull. 480, pp. 236–270, 1911.

stream called Cripple Creek, at the mouth of Fox Gulch. These streams head in a small group of prominent mountains about 3,500 feet high. Practically all the streams heading in this mountain group are said to carry some placer gold, but their true value is not evident from the small amount of prospecting that has been done.

Near the divide between Gaines and Yankee creeks, at the head of Carter Creek, is a gold lode mine, the only one in the district.

RELIEF.

The Innoko district is, in general, a rolling country with here and there a group of prominent mountains 3,000 to 4,500 feet high. The three principal mountain groups are the Cripple Creek Mountains at the head of Colorado Creek, the Twin Mountain group 10 miles east of Ophir, and the Beaver Mountains 20 miles southwest of Ophir. Each of these groups is a topographic expression of granitic intrusions and the rocks affected by them.

The topography of the lower rolling country of the district is closely dependent on the structure of the sedimentary rocks that form it. Between the Cripple Creek and Twin Mountains the structure is simple. This area is marked by hogback ridges that break off sharply on one side and have long dip slopes on the other. The valleys are broad and widely spaced and conform to the structural trends of the bedrock. Near Ophir the dips are higher and the interstream ridges are comparatively narrow and steep sided. The influence of structure upon topography is especially evident in the valley of Spruce Creek. The stream follows a straight course on the line of strike of the bedrock. The bedrock dips westward and in its downcutting the stream has migrated in that direction. The west valley wall is now a steep scarp along the base of which the stream runs. The opposite side of the valley slopes gently upward away from the stream over a series of gravel-covered benches. The chief gold concentration in the valley antedates the latest rejuvenation of the stream. Consequently the placers are found in the bench gravels along the east side of the valley up the dip from the stream, and little gold is to be expected in the stream itself.

An effect of structure similar to that seen in the form of Spruce Creek valley can be noted at places on the other streams of the district. It should be borne in mind that in downcutting the stream shifts its position in the direction of the dip, that in such localities gold concentrations are most likely to occur in the gravel benches of the broadly open side of the valley, and that where dips are vertical, or nearly so, lateral shifting of the stream does not occur and any concentrations will be found in the present gravels of the stream.

A set of topographic features of exceptional type has been developed by glaciation in the Beaver Mountains and vicinity, as described

by Maddren.[1] The mountain valleys were given a broad U-shaped form and the adjacent depressions were filled with morainic débris. Drainage lines were altered, the basin of Gaines Creek obtaining considerable area that formerly drained into Beaver Creek. In the adjustment of Gaines Creek to the new conditions a box canyon was cut through the old divide and a lower grade established in its lower course, giving rise to extensive stream terraces.

GENERAL GEOLOGY.

CHARACTER OF THE ROCKS.

By far the greater part of the Innoko district is underlain by a series of Mesozoic sedimentary rocks, probably for the most part of Cretaceous age. They are locally interbedded with basic igneous rocks. Older rocks, including cherts, schists, and limestones, probably of Paleozoic age, occupy certain areas north of the Cripple Creek Mountains and at a locality 15 miles northwest of Ophir. Granites and kindred types of igneous rocks are common to the mountainous areas. Rhyolitic dikes closely related to the granite intrusives are generally distributed throughout the region.

Unconsolidated deposits, including stream gravels, terrace gravels, and glacial and glaciofluviatile deposits occur in the lowland areas. The general distribution of the different formations is shown on the map (Pl. X, p. 280).

VEINS AND MINERALIZATION.

The chief development of veins and mineralization is in the granite and rhyolite dikes that intrude the Cretaceous rocks. The structure of these rocks is in many places complex and their history obscure. However, the later processes affecting such dikes apparently accompanied their invasion by mineralizing solutions, which in some places formed auriferous quartz veins and marked profound changes in the composition of the dikes and their walls. The mineral introduced most abundantly besides quartz is iron carbonate, which makes up a large percentage of some of the dikes and the adjacent altered sedimentary rocks. In some localities the altered dike rock is made up almost entirely of iron carbonate and secondary quartz about equally divided in amount. The original character of the rock is shown by partly resorbed phenocrysts of quartz and pseudomorphs of iron carbonate after the feldspars.

These altered dikes have an important economic bearing, as some of the quartz veins which cut them are known to carry free gold, and they are apparently directly related to rich placer accumulations at several localities.

[1] Maddren, A. G., The Innoko gold-placer district, Alaska: U. S. Geol. Survey Bull. 410, pp. 13–14, 1910.

Veins of pure quartz and of iron carbonate cut the sedimentary series in places independently of the igneous dikes, and they also may have a bearing on the auriferous mineralization.

UNCONSOLIDATED DEPOSITS.

The unconsolidated deposits of the Innoko district include stream gravels, terrace gravels, and glacial and glaciofluviatile deposits. The stream gravels are of normal type and distribution, flooring the valleys, which in general are of medium width, to depths of 10 to 30 feet. The terrrace gravels are developed chiefly along Gaines Creek, owing to the enlargement and rejuvenation of the stream through glacial activity. The terraces increase in elevation upstream on Gaines Creek to the locus of the preglacial divide, where they disappear. Terraces also occur on Little, Spruce, and upper Ophir creeks. These creeks have probably felt a slight rejuvenation due to the increase in size of Gaines Creek and Innoko River above the mouth of Beaver Creek. In the consequent downcutting of their channels the bedrock structure has caused a lateral shifting of the streams, and the former stream gravels now form terraces slightly above the present stream levels.

The glacial and glaciofluviatile deposits are developed chiefly about the Beaver Mountains. The longest glaciers left their terminal moraines probably 5 or 6 miles from the center of the range or about 2 miles from its edge. The older topography has been obliterated by the deposition of material furnished by the glaciers, so that the mountains are now bordered largely by broad gravel plains. The buried topography probably had considerable relief and there must be a corresponding variation in the depths of the glacial deposits.

AURIFEROUS GRAVELS.

Workable deposits of auriferous gravels have been discovered so far only on Ophir, Spruce, Little, Gaines, and Yankee creeks. Gold prospects are said to occur on a number of other streams in the vicinity of the mines. During the summer of 1912 discoveries of placer gold were made on a number of streams heading in the Cripple Creek Mountains. The richest gravels discovered in this locality are on Cripple Creek at the mouth of Fox Gulch and on the headwaters of Colorado Creek.

Ophir Creek has been the chief producer of the Innoko district for a number of years, but its gravels are about exhausted at the present time. The gravels in the lower part of the valley are about 30 feet deep, their depth decreasing upstream to 20 feet at claim No. 6 above Discovery, where a bedrock bench about 7 feet above the top of the stream gravels is covered by 10 feet of gravels. Some open-

cut work has been done on this bench ground, but downstream all the mining has been done by drifting. Ophir Creek has furnished some good mining ground, claim No. 3 below Discovery, considered the best, having produced over $200,000.

Spruce Creek has workable ground only on the benches along its right slope. The benches carry from 2 to 6 feet of gravel covered by 10 to 15 feet of frozen muck. Two claims have been opened up so far. But little is known of the tenor of the gravels farther downstream, where the bench continues for several claim lengths.

On Little Creek auriferous gravels are found beneath the present stream and on benches. The benches are best developed along the middle section of the course of the streams and where widest extend about 500 feet from the creek. On the upper and lower parts of the creek the pay streak is relatively narrow and is confined to the course of the creek. The bench ground and lower creek claims are workable by open-cut methods. The claims farthest upstream have 18 to 30 feet of gravel and are mined by drift methods. Where the benches are widest a width of 300 feet is said to carry sufficient gold for profitable mining.

Gaines Creek has a pronounced development of gravel-covered benches along the right side of the valley and, below the canyon, a rather broad gravel flood plain. Gold occurs in the gravels of both types of deposits, but so far only the bench gravels have proved available for mining. It seems likely that the flood-plain gravels may contain fairly high values in places, but their prospecting is difficult because of their thawed condition.

The original concentration of gold in the Gaines Creek valley occurred in the preglacial time, when the stream was much shorter and had less volume. Apparently a continuous pay streak was formed at that time, which extends for miles along the stream. When the stream was rejuvenated part of the old pay streak was carried down and reconcentrated at the present stream level and should be found in the flood-plain gravels in the reaches between the gold-bearing benches. Parts of the original concentration remain in the bench gravels. Where lateral streams cross the course of the old pay streak they have concentrated its gold from the width of the tops of their recently cut valleys to the narrow gravel deposits in their bottoms. This form of reconcentration has probably given some of the richest spots of the Gaines Creek valley.

The Gaines Creek placers have been worked almost entirely by open-cut methods. Water for sluicing is taken from the small tributaries of Gaines Creek and in many places work has progressed slowly on account of the small supply. The bench gravels are nearly worked out at the present time and the future of Gaines Creek as a producer will depend largely upon the availability of the flood-plain

gravels. If systematic prospecting should prove their worth these gravels would be admirably adapted for dredging.

The Yankee Creek placers are all in shallow stream gravels and extend along the stream for at least three claim lengths. They are worked by groundsluicing the overburden and either hoisting the auriferous material by machinery or shoveling it directly into the sluice boxes.

GOLD LODES.

The sedimentary rocks of the Innoko district are cut here and there by fine-grained granitic and rhyolitic dikes, many of which are more or less mineralized. In several places they are cut by auriferous quartz veins, at least one of which constitutes a workable lode deposit—that being worked near the head of Carter Creek, an eastern tributary of Gaines Creek. The ore body is a quartz vein averaging about 2 feet in thickness along the hanging wall of a rhyolite dike intrusive in the sedimentary series. Under the microscope the gold is seen to occur along iron-stained crevices and in vugs and also within small bodies of magnetite in the quartz vein. Veinlets of iron carbonate cut the quartz vein, and iron carbonate is abundantly present in the altered sedimentary rock on the one hand and in the altered dike on the other. In many specimens the alteration has been so profound as to entirely obscure the original character of the rock, resulting in a type composed almost entirely of secondary quartz and iron carbonate.

The lode has been prospected by a tunnel and two drifts at lower levels connected with the tunnel by a slightly inclined winze. The workings show the vein to be continuous to a depth of 90 feet below the surface and there are no evident geologic reasons why it should not continue to many times that depth.

Several other mineralized dikes and quartz veins have been located as mining properties within a few miles of the Carter Creek mine and very favorable assays are said to have been obtained of samples taken from them. The same type of mineralization as that at the mine is common over a large part of the Innoko district and the general geologic conditions are favorable to the occurrence of gold lodes of value.

MINING IN 1912.

GOLD PLACERS.

No new creeks were added to the list of producers in 1912. Operations were continued on Ophir, Spruce, Little, Gaines, and Yankee creeks, but the ratios of their production are considerably different from those of previous years. Ophir Creek fell off in production, owing to the fact that most of the available ground is exhausted. Little Creek largely increased its output, mainly owing to the dis-

covery of rich bench ground admirably situated for rapid mining. The other streams continued about as before.

Ophir Creek.—Five claims were worked on Ophir Creek by the same number of plants, all equipped with steam machinery. A total of 25 men worked on this creek most of the summer.

Spruce Creek.—Two bench claims were worked on Spruce Creek by open-cut methods. A ditch from the upper course of the creek delivers an excellent supply of water to the claims for groundsluicing. By this method the overburden of muck and lighter gravels are removed. The remaining gravels are then shoveled by hand into the sluice boxes. In all 13 men were employed.

Little Creek.—Both the stream gravels and bench deposits were worked on Little Creek. Operations were in progress on five claims and a total of 26 men was employed. Especially good progress was made on the bench claims and lower creek claims where open-cut methods are in use.

Gaines Creek.—Only the bench claims on Gaines Creek and the reconcentrations in the valleys of side streams near their mouths were worked. A large proportion of the available ground of this character was exhausted during the summer. Ten claims were worked in all by a total force of about 50 men.

Yankee Creek.—Two groups of claims were worked on Yankee Creek by two plants, both using open-cut methods. About 25 men in all were employed.

Summary.—In all 24 claims, located on five creeks, were worked in the Innoko district in 1912 by a total force of about 140 men. Eighteen plants used open-cut methods, and six used steam machinery in hoisting from drifts. The total value of the placer-gold production for the year was probably in excess of $250,000.

LODE MINING.

A single gold lode mine was operated near the head of Carter Creek, an eastern tributary of Gaines Creek. The work consists of a 60-foot tunnel, a 60-foot winze driven at its end, and two drifts of about 50 feet and 30 feet, respectively, at two lower levels. The equipment includes a 12-horsepower engine and boiler, and a "Little Giant" crusher and stamp mill. On the average five men are employed.

IDITAROD DISTRICT.

GEOGRAPHY.

LOCATION OF THE MINES.

The mining center of the Iditarod district is about 75 miles southwest of that of the Innoko district on a group of streams belonging to the Iditarod River system. The most important mines are on Otter Creek and on Flat Creek, its chief southern tributary. A num-

ber of smaller streams adjacent to Flat Creek or heading in the same mountain mass support mining or show excellent prospects. Among these are Glen Gulch and Black Creek, of Otter Creek drainage; Chicken, a tributary of Bonanza; Willow Creek, a tributary of Iditarod River; and Happy Creek, the chief tributary of Willow. There is also a placer mine on Moore Creek, which heads against Otter, about 30 miles east (Pl. X, p. 280).

TOPOGRAPHY.

The topography of the Iditarod district is similar to that of the Innoko in many respects. The general relief is low, and topographic forms are controlled largely by geologic structure. The highest elevations are developed in the regions of igneous intrusions in the sedimentary rocks, notably in the vicinity of the Otter Creek mining center. The larger streams, however, have much broader flats in proportion to their size than have those of the Innoko district, owing to their closer proximity to the trunk streams of this section of Alaska, which have aggraded their valleys extensively in recent geologic time.

CONDITIONS AFFECTING MINING.

What has been said of the climate, forests, and vegetation, fish, and game of the Innoko district applies equally well to the Iditarod district. The water supply in drainage basins of equal size would be about the same. However, the situation of the Iditarod mines gives rise to special problems of water supply, some where an excess of water must be dealt with and others where a scant supply is gained by artificial collecting channels near the mountain tops.

SETTLEMENTS AND POPULATION.

The district has three principal settlements: Iditarod at the head of steamboat navigation on Iditarod River, Flat at the mouth of Flat Creek, and Discovery on Otter Creek. Recent changes in methods of mining and ownership in the district have occasioned a considerable loss in population. At present Iditarod has an average population of about 500, Flat of about 300, and Discovery of about 50, exclusive of the miners. It is estimated that about 975 men are employed in mining in the district, bringing the total population to over 1,800.

TRANSPORTATION.

Supplies reach the Iditarod district by steamboats plying Innoko and Iditarod rivers. The head of navigation in good stages of the water is Iditarod. There is a tramway in operation between Iditarod

and Flat. Wagon roads have been built from Iditarod and Flat to all the important mines. The road on Flat Creek is especially good, having been fitted for hauling heavy dredge machinery. Moore Creek receives supplies from Discovery over a pack trail.

GENERAL GEOLOGY.

CHARACTER OF THE ROCKS.

The Iditarod district is underlain chiefly by sedimentary rocks, apparently a continuation of the series occurring in the Innoko district (Pl. X, p. 280). Here, too, there are basic igneous rocks interbedded with the sedimentary members, and the series is intruded by granitic batholiths and lenticular sills and by a variety of dikes. Westward, in the vicinity of Iditarod, the area of sedimentary rocks is bordered by metamorphic rocks, including schists, limestones, and cherts. The valleys are floored by the usual stream gravels of moderate depth. There are no true terrace gravels known in the district, but there are elevated residual deposits that locally are of economic importance.

VEINS AND MINERALIZATION.

Quartz veins in great abundance but generally of small size cut both the sedimentary and the igneous rocks of the district. Some of those in each situation are auriferous. Some of the veins carry, besides gold, considerable amounts of cinnabar and stibnite.

The availability of any of the veins as minable lodes has not been demonstrated as yet. However, little attention has been paid to this form of deposit and further prospecting may reveal auriferous veins of sufficient size for mining, or stockworks of small closely spaced veinlets in the monzonites or along their contacts rich enough to work. The local richness of some of the residual placers on the hill at the head of Flat, Chicken, and Happy creeks supports this view, but it can be established only by actual tests of the bedrock along the zones of more abundant mineralization.

UNCONSOLIDATED DEPOSITS.

All the unconsolidated deposits of the district revealed by placer-mine operations are of medium or shallow depth and are workable by open-cut methods. They are of two general types—stream gravel deposits of the valley bottoms and residual mantle deposits on slopes and even hilltops, apparently unrelated to drainage lines. No true terrace deposits have been discovered.

The stream gravel deposits range from 10 to 18 feet in depth, including in places a slight overburden of muck. The width of the

deposits corresponds in normal fashion to the size of the streams. The pay streaks are much narrower than the total width of the valley, showing that the first downcutting of the valleys was followed by a long period of erosion under stable conditions during which the present flood plains were formed. At present the valleys are probably aggrading slightly in adjustment to the change of base level that has occasioned the enormous filling of the lower Iditarod and Innoko valleys.

Residual mantle deposits are widespread in the district, but only that covering the slopes and hilltops at the heads of Flat, Chicken, and Happy creeks is of special importance. At this locality a deposit ranging from a few feet to 20 feet in depth has been developed by the weathering of the monzonite batholith and associated rocks.

The igneous rock weathers first along the joint planes, and as the process continues large spheroidal masses are produced, separated from each other by disintegrated rock. Accompanying this action more or less creeping of the loosened materials on the slopes occurs and water action has some effect in removing the finer particles.

The long-continued action of these processes in the Iditarod district has produced residual bowlders that in form illustrate all stages in the transformation of the angular blocks of bedrock to spheroidal forms of small size. Mixed with the monzonite bowlders are weathered fragments of other types of rocks that have crept down from the hilltop above. The interstices are filled with granular sands and angular fragments of quartz stringers. The removal of the sands at the surface has caused in places a concentration of the bowlders.

In the auriferous deposits of this character the gold is distributed throughout the vertical range of the disintegrated materials, and it is not always possible to foretell the locus of maximum concentration. As a rule, however, the richest deposits are near the solid bedrock surface.

MINING IN 1912.

Character of the auriferous deposits.—The general character and distribution of the auriferous deposits have been indicated in the preceding section. There is little variation in the essential character of the deposits of the same type, and the general descriptions may be taken as applying specifically to the various individual placers. It should be stated that stream gravels furnish the placers of Otter, Flat, Willow, lower Happy, and Moore creeks, and the residual deposits those at the heads of Flat, Chicken, and Happy creeks (Pl. X, p. 280).

Producing creeks.—Otter and Flat creeks were the largest producers in 1912, as in previous years, the production of the former being slightly greater than that of the latter. Happy, Glen Gulch, Willow, and Black creeks in the same neighborhood and Moore Creek,

30 miles to the east, all report considerable production. Systematic prospecting was done on the head of Chicken Creek, but little actual mining was accomplished.

Otter Creek.—Three claims were worked on Otter Creek, leased in small tracts to 10 operators. Heavy steam machinery was used in open-cut work. About 450 men in all were employed.

Flat Creek.—The year 1912 witnessed a great change in the mining operations on Flat Creek, owing to the extensive purchase and leasing of ground by the Yukon Gold Dredging Co. A great number of plants discontinued work, and there was a great reduction in the number of men employed.

The Yukon Gold Dredging Co. installed a dredge on the Marietta group of claims, near the head of the creek. It began operating the last of August and continued until near the freeze-up.

Eight other creek claims were worked by steam plants, using open-cut methods and hoisting in buckets to the sluice boxes. On the hillside above the head of Flat Creek five claims were worked by five plants, groundsluicing and shoveling into the sluice boxes being the method used. A total of about 400 men were employed.

Happy Creek.—Five claims were worked on Happy Creek, two of them being on creek placers and the others on ground of the residual placer type. All used open-cut methods without steam machinery. About fifty men were employed.

Glen Gulch.—The operations on Glen Gulch were confined to the early part of the season. A considerable production is reported for this creek, but the work was discontinued before the end of the season, owing to the exhaustion of available placer ground.

Willow Creek.—Two claims were worked on Willow Creek by two plants. About twenty men in all were employed. A prospecting drill was in use on Willow Creek most of the summer.

Black Creek.—A single plant worked on Black Creek part of the summer. No details of the operations are available.

Moore Creek.—One claim was operated on Moore Creek by a single plant that employed twelve men. The ground is shallow and work is done by hand methods.

Chicken Creek.—Systematic prospecting with a drill was done on Chicken Creek during the summer, and a little mining was done. Two plants were operating part of the time. In all, twelve men were employed.

Summary.—Twenty-nine claims, located on eight different creeks, were worked in the Iditarod district in 1912. Thirty-six plants were engaged in the work. Of these one was a dredge, 22 were equipped with steam machinery, and 13 used hand methods. A total of about 975 men were employed. The value of the total gold production of the district, including Moore Creek, for the year was probably about $2,750,000.

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