

# THE TARAL AND BREMNER RIVER DISTRICTS.<sup>1</sup>

By FRED H. MOFFIT.

## GEOGRAPHY AND GEOLOGY.

The search for gold and copper which began in the mountains south of Chitina River with the rush of prospectors to the Copper River basin in 1898 has been carried on spasmodically since that time. As a result copper was found in the mountains east of Taral during the first summer and a few years later (1901) the gold placers of Bremner River were discovered. Of course, no copper has yet been produced in this district, but the facilities for transportation offered by the Copper River & Northwestern Railway during the last year have stimulated interest in the development of copper properties, so that considerable prospecting has been carried on.

Bremner River is the largest tributary to Copper River between Chitina River and the coast. Its valley and Hanagita Valley, north of it, extend eastward from Copper River to the Tana divide, a distance of about 50 miles.

This is a region of high mountains, lying on the border of the great St. Elias ice cap. Numerous glaciers feed its streams and its topography bears evidence of recent and severe glaciation. Its climate is intermediate between that of the coast and that of the interior Copper basin. On the lower Bremner the weather is more like that of the lower Copper and the coast than that of the upper Bremner and Hanagita valleys. Vegetation, particularly in the Bremner Valley, is luxuriant. The valleys are timbered with spruce to 2,500 or 3,000 feet above the sea. Thus Bremner and Little Bremner valleys are well timbered, but the higher parts of Hanagita Valley, particularly in the vicinity of Summit Lake and the head of Tebay River, are above timber line. Some of the spruce is of good size and suitable for lumber. Many trees with a diameter of 18 to 24 inches were seen and a few were found that measured over 3 feet, but these largest trees were not over 35 or 40 feet in height. The finest timber is on the lower part of Little Bremner River and the eastern end of Hanagita Valley.

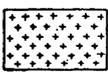
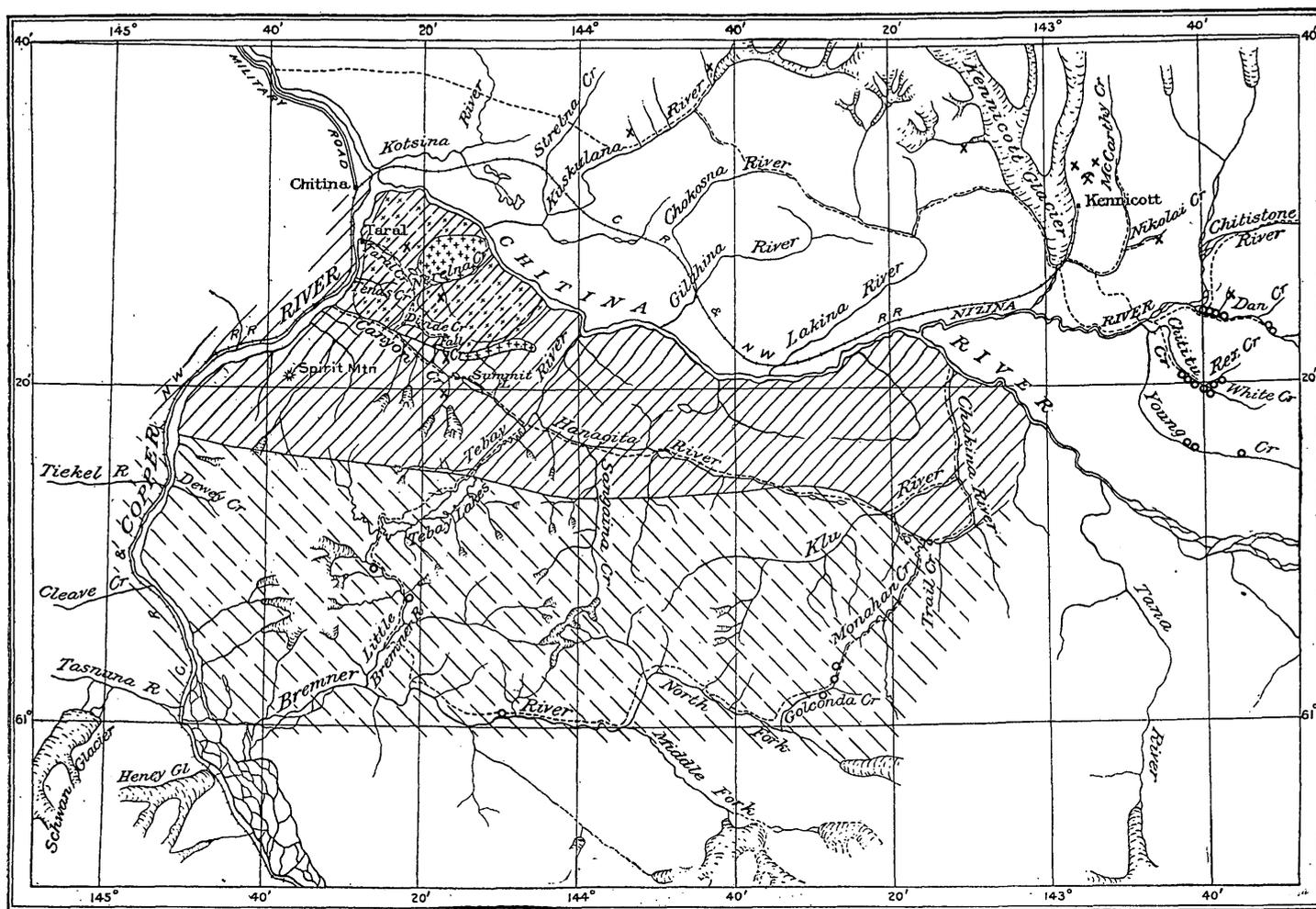
<sup>1</sup>This paper is a preliminary statement of the results of a geologic reconnaissance by Fred H. Moffit and Theodore Chapin in Hanagita and Bremner River valleys in 1911. The work will be described more fully in a later publication of the Geological Survey.

One small stream, Golconda Creek, a tributary of Bremner River, has yielded most of the gold so far produced in this district, although Little Bremner River has contributed a part. Gold in commercial quantities has not been found near Taral nor between the Chitina and the Bremner in Hanagita Valley. The total production of the district is not known, but probably several thousand dollars have been produced each year since mining began. It should be said, however, that the very high cost of supplies and difficulty of access have done much to discourage prospectors.

The region between Chitina River and the coast (Pl. V) is part of the Chugach Range and is characterized by an exceedingly rugged topography having great relief. It is drained by several streams, of which Bremner River is much the largest and, except the more accessible streams of Hanagita Valley, the best known. Hanagita Valley and the valley of Bremner River furnish the main routes of travel through this region. They will be considered more fully in connection with the descriptions of the placers.

The most important geologic features of the district can be stated briefly as follows: A belt of metamorphic sedimentary beds, including schist, slate, and limestone, extends eastward from Copper River to Tana River and includes the prevailing rocks of the mountain on both sides of Hanagita Valley except in the vicinity of Taral and the upper part of Klu River. These sedimentary beds are intruded by igneous rocks, chiefly dioritic in character, but near Taral they either include or are associated with masses of greenstone. The diorite is of at least two periods of intrusion. Locally, as in the vicinity of Tebay River, the sediments are so intricately intruded and so much altered that they have taken on a banded structure and appear as gneiss. The two periods of diorite intrusion are well shown here, for in many localities the older schistose diorite is cut by younger unaltered dikes. This belt of altered sediments and intrusives includes beds of fossiliferous limestone and is, in part, of Carboniferous age. It is succeeded on the south by a wide area of slate and graywacke, which includes nearly all the Bremner River drainage, so far as it is now known. The beds of the slate and graywacke succession are folded but are less metamorphosed than the sediments on the north. Like them, they are intruded by dioritic dikes and sills, which are most common near the boundary between the two groups and are locally abundant. The slate and graywacke represent the eastward continuation of the rocks found in the vicinity of Valdez. Their relation to the sediments north of them is unknown and their age has not been definitely determined.

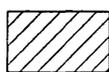
A massive conglomerate, which contains pebbles and cobbles of greenstone and diorite in a tuffaceous matrix, and which is associated with fossiliferous tuffaceous sediments, forms the western base



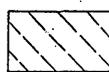
Diorite



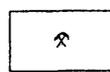
Undifferentiated slate, limestone, and conglomerate, with large masses of intruded greenstone and diorite



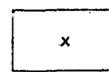
Slate, schist, and crystalline limestone, with important diorite intrusions



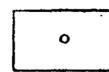
Slate and graywacke



Copper mine



Copper prospect



Gold placer

GEOLOGIC SKETCH MAP OF THE HANAGITA VALLEY AND BREMNER RIVER REGION.

of the mountain just east of Taral on the south side of Chitina River. The relation of the conglomerate and tuff beds to the narrow schist belt between them and Copper River is that of unconformity, but whether of faulting or of deposition or of both is uncertain at this locality, although adjacent regions give evidence of depositional unconformity. The fossils contained in them are of Jurassic age. These three groups of rocks—the belt of metamorphic sediments and intrusives prevailing in Hanagita Valley, the larger area of slate and graywacke to the south of it, and the tuffaceous sediments near Taral—represent the geology of the region adjoining Chitina River on the south, so far as it is known.

The known mineral resources of this district, as already stated, include gold and copper. Copper is confined to the greenstone areas east and south of Taral, including Canyon Creek, and gold in commercial quantities has been found only in the slate and graywacke area comprising Bremner River basin.

## GOLD.

### DISTRIBUTION.

All the gold so far produced in the Bremner River valley has been obtained from stream gravels. Little effort has been made to find lode deposits and none to develop such as have been discovered. The success of the Cliff mine at Valdez sent many prospectors into the mountains between Valdez and Copper River in 1911, especially into the more accessible country adjacent to the military road and the Copper River & Northwestern Railway. A large number of small gold-bearing quartz veins was found along the west side of Copper River between Tasnuna River and Chitina, but very few of the prospectors crossed to the east side of Copper River, although the geologic conditions are the same as on the west side. Bremner River valley may be said to be practically unprospected, so far as lode deposits are concerned.

The three parts of the Bremner River valley of present or prospective importance because of known placer gold deposits are Golconda Creek, Little Bremner River, and the lower part of Bremner River above the Little Bremner.

### GOLCONDA CREEK.

#### GENERAL FEATURES.

Golconda Creek is tributary to the north fork of Bremner River, which it joins 5 miles below the great glacier whose waters are the principal source of that stream. It heads in the high mountains between Hanagita Valley and the Bremner but, unlike most of its neighbors, is a clear stream, although melting snow furnishes much of its water in the spring and early summer. It runs southwestward

and is between 8 and 9 miles long. In its course from the little lake at its head to its mouth it falls 2,600 feet, or at an average rate of about 300 feet to the mile.

Golconda Creek valley is typical of the valleys in the region. Glaciation has left unmistakable marks in the U-shaped cross section and straightened valley walls, and the stream channel shows the deep narrow canyon in the lower course and broad gravel flood plain toward the head which would be found in almost any important valley in any of the mountain districts of the Copper River basin. A broad, low pass leads from the head of Golconda Creek to Monahan Creek, thus affording a route of travel either westward into the Hanagita Valley or northward to Chitina River. This pass is the gateway by which Golconda Creek valley is entered the year around, for the trail down Bremner River is not available either for winter freighting or summer travel. Bremner River above "the forks" does not afford a highway to Golconda Creek, for the "12-mile canyon" is impassable for sleds in winter and for boats in summer. Monahan Creek, therefore, is at present practically the only route for reaching the upper Bremner River and its tributaries. It flows into Chakina River, which in turn empties into Chitina River 4 miles above the mouth of the Nizina and thus makes it possible to reach the line of the Copper River & Northwestern Railway with comparatively little difficulty. Freight for Golconda Creek, including a small hydraulic plant, followed this route in 1910. The pass has an elevation of about 4,000 feet above the sea, but is only 1,000 feet above timber on the Monahan Creek side and only 1,200 feet above the principal placer workings on the Golconda Creek side. Furthermore, the approaches on both sides offer little difficulty to travel, that from Golconda being the better.

Golconda Creek lies wholly in an area of slate belonging to the Valdez group (see Pl. V), but the slate is cut by numerous light-colored, fine-grained dikes of diorite porphyry, whose presence is distinctly shown in many places on the bare mountain sides. The slate exposed along the creek is hard and siliceous and in places is almost schistose. Its cleavage, which appears to correspond closely in dip and strike with that of the bedding, is nearly horizontal, for the most part dipping slightly to the south, but in places showing a low northerly dip. Perpendicular joints cause the slate to break into angular blocks and slabs, and as disintegration has not advanced far enough since the recent glaciation to soften the rock and make it crumble, great piles of these large slate fragments are seen on the dumps of the placer workings.

#### PLACERS.

The stream gravels of Golconda Creek are shallow, for in only a few places are they known to have a thickness greater than 8 feet.

They consist chiefly of slate but contain a small proportion of diorite. Diorite boulders, the largest several feet in diameter, are included in the heaps of slate slabs on the mine dumps, yet fortunately for the miner they are much less common than the slate. Most of the slate can be broken with a sledge and then carried away, but the diorite is too hard for this treatment and requires powder to break it into pieces small enough to handle. For the most part the stream gravels are reworked material from the high bench gravels in which the creek has incised its present channel and formed its narrow flood plain.

Gravel benches, which are prominent in many places on both sides of the channel, may prove to be a source of gold in the future, although no mining has been done in them and they have not been prospected. However, they are known to contain gold in some places and there can be little doubt that the gold content of the creek gravels is in part if not almost entirely a reconcentrated deposit from the benches. These placers thus resemble those of many other Alaskan districts, such as these on Chititu, Dan, and Valdez creeks, where the rich gold-bearing gravels are a reconcentration product from earlier, more widely disseminated deposits that are now being dissected and laid down anew by the present streams.

Golconda Creek gold is described by the miners as "shot gold." Thin, flaky pieces are uncommon, although many pieces are worn quite smooth, yet in general the gold is rough and little worn and many pieces of it carry included quartz. A nugget found on the creek in the early days and valued at \$52 is the largest piece of gold yet taken from the gravels.

Most of the mining on Golconda Creek during the seven or eight years following the discovery of gold in 1901 was carried on a short distance below Standard Creek, or about 4 miles below the head of the stream. Pick and shovel were used at first but later a small hydraulic plant was employed in connection with a dam and a "boomer" for disposing of the tailings. During this time the ownership of claims was gradually gathered into the hands of two men. In 1911 the Golconda Mining Co. obtained an option on eighteen claims and installed a hydraulic plant on the stream about a mile below Standard Creek. Most of the summer (1911) was devoted to putting this plant in place and getting it into shape for work. The company now has a mile of ditch line, which takes water from Standard Creek and other small eastern tributaries of Golconda Creek and delivers it at the penstock with a head of approximately 250 feet. From the penstock the water is conducted to the giants by an iron pipe 1,800 feet long. Over 100 feet of 30-inch flume was in place on the 1st of August and bedrock had been reached at its upper end. Unfortunately the condition of the ground prevented the company from placing the boxes

so as to take advantage of an excellent dump furnished by the canyon and there may be trouble in disposing of the tailings under the present arrangement. This difficulty can be remedied, however, if it shall arise.

Mining on a more extensive scale would require increased water supply, for the water now available is barely sufficient for present needs. Additional supply could be obtained by extending the ditch so as to take water from the head of Golconda Creek and by collecting it from other tributaries, such as Shovel Creek. Golconda Creek flows at an elevation so high that it will be difficult to bring water from sources outside its valley. This elevation also increases the cost of lumber, for the productive part of the creek is above timber line, and it is therefore necessary to bring logs for lumber and general mining purposes from Bremner River or from Monahan Creek.

#### LODE DEPOSITS.

Little attention has been given to prospecting for lode deposits on Golconda Creek and in its vicinity. The slate country rock is cut by numerous porphyry dikes and by less conspicuous veins of quartz or quartz and calcite. No direct connection between the intrusives and quartz veins was proved, but they are closely associated at numerous places. Some of the quartz veins are mineralized, but none of them are known to carry gold in commercial quantities. Two claims, the Golconda and the Mammoth, have been staked on the slope of the mountain north of the pass between Golconda and Monahan creeks. The slate is here intruded by several prominent dikes of fine-grained diorite porphyry and is cut by a perpendicular fault running north and south. This fault is traced with little difficulty throughout most of the length of the two claims, for the shattered slate near the fault breaks down more easily than the harder rock on each side, leaving a well-defined depression. Discovery stake, which is on the end line between the two claims, is several hundred feet higher than the summit of the pass. At this point a mass of quartz and calcite, cut longitudinally through its center by the fault, shows evidence of movement after the vein filling was introduced. The west half of the vein consists of cavernous iron-stained quartz, but the east half is made up of calcite containing veins and crystals of quartz. This exposure of vein material is about 60 feet long. Some distance below it, along the fault plane, is another lens of quartz, 6 to 8 feet thick, associated with a fine-grained dike. The vein is found again in a little gulch above the Discovery stake, but the intervening space is barren, although the fault itself is plainly seen. It is evident that the vein filling occurs in a well-defined fault fissure and that it pinches and swells markedly, so that the quartz and calcite masses take the form of lenses irregularly scattered along the fault. Pyrite and zinc sulphide are present in the vein, and a

small amount of gold is reported in assay returns. No work had been done on the property at the time of visit in August, 1911, so that only the surface exposures could be examined.

#### BREMNER RIVER.

Bremner River is now of little importance as a gold-producing stream. No mining was in progress on the north fork in August, 1911, and work on the main river was confined to one locality just above the head of "threemile canyon." The valleys of the lower river and its branches bear evidence of intense glaciation, and at present practically all the important tributaries that make up the Bremner River system head in glaciers, some of which, like those giving rise to the three principal branches, are of large size. The north and middle forks of the river and also the main stream below the forks lie in an area of slate and graywacke, but the quantity of diorite pebbles and bowlders on the river bars shows that there must be important bodies of igneous rock in the mountains between Bremner and Tana rivers, and particularly at the head of the north fork.

The retreat of the ice in these valleys gave opportunity for the deposition of large masses of gravel, which in many places form high benches along the river. Doubtless some of these benches once extended continuously across the valley floor and have been cut into by the river and removed in part.

It was in lower benches of this kind, bordering the river, that mining was carried on in 1911 near "threemile canyon." Here a ridge of slate and graywacke once dammed the river, probably forming a lake and causing a great quantity of sand and fine gravel to be deposited. As the river gradually cut its channel into the slate and formed the canyon it also attacked the gravel deposit above the developed a succession of benches. Fine gold occurs in these benches and may be panned from almost any of the river bars. The amount, however, is so small that it has not offered particular encouragement to prospectors.

In the early part of the 1911 season two men were at work on the north side of the Bremner about half a mile above the canyon. A cut, averaging approximately 10 feet in depth, had been carried down to bedrock in the first bench bordering the river and extended 100 to 200 feet back from the river. The bench at this point consists of sand and fine gravel, probably laid down in quiet water, resting on a slate or graywacke bedrock with smooth undulating surface produced by glacial erosion. Water for sluicing was brought from a small stream near by, and although the head was small it was possible to move a large mass of material in a very short time owing to the fineness of the sand and gravel. Work was interrupted about the middle of summer by failure of the water supply, in consequence of which the gold production was disappointingly low.

Too little prospecting has been done to furnish any proper estimate of the gold content of these gravels. The gravel deposits are extensive and a vast amount of material can be handled easily because of its fineness, yet there are doubtless some boulder beds present that would offer difficulties.

If systematic prospecting should prove the presence of gold in commercial quantities an excellent water supply with good head can be had at slight expense from the small streams on the north, for the topography at this locality is favorable to the combination of a number of them with comparatively little labor.

A branch of Bremner River which joins the main stream near the lower end of "threemile canyon" was the object of some interest in 1907. An option on a number of placer claims was secured and a party of men with supplies was sent in to exploit the ground, but the returns were so unsatisfactory that the project was abandoned in the middle of the summer. In 1911 only one man was at work on the stream.

The lower part of Bremner River is easily reached in winter from the Copper River & Northwestern Railway near the mouth of Tasnuna River, for there are no canyons on the lower Bremner with water too swift to freeze and the river ice affords good sledding.

In summer small boats can be used as far up as the junction of the north fork and main river, but the water above "threemile canyon" is swift. Near the head of the canyon is a rapid and small fall that makes boating dangerous but not impossible at certain stages of the water. The current is less rapid below the canyon and near Copper River is almost sluggish.

A good summer trail ascends Bremner River from the Little Bremner to Golconda Creek. It is on dry ground all the way and offers no more difficulties than are usual to mountain trails in new and little traveled regions. Horses have never been taken down Bremner River below the Little Bremner, for the river flood plain is quicksand and the steep mountain slope on the river's north side is covered with thick alders and in places with spruce.

#### LITTLE BREMNER RIVER.

Little Bremner River was the first stream in this district to receive attention from placer miners and was the scene of considerable mining activity before the richer placers of Golconda Creek drew a part of the population to the upper Bremner country. Interest in the Little Bremner, which for several years nearly died out, was revived somewhat in 1910, but late in the summer of 1911 only three men were at work on the stream.

The Little Bremner is a glacial stream about 12 miles long, deriving most of its water from melting snow and ice in the mountains

southeast of Spirit Mountain on Copper River. A broad, low pass connects it with the head of Tebay River and thus with Hanagita Valley.

The valley of Little Bremner River, although strongly glaciated, does not show such a pronounced U-shaped cross section as is seen on Bremner River and its other branches. The river flows through a succession of short canyons and intervening gravel flats that occupy overdeepened basins produced by ice erosion of the valley floor.

Slate and graywacke form the country rock of all that part of the stream to which the name "Little Bremner" is applied, but Falls Creek, a large upper tributary, heads in the schist area between Bremner River and Canyon Creek on the north. Toward the head of the river, as the schist boundary is approached, numerous light-colored porphyritic dikes make their appearance. The dip of the slate cleavage, which in most places, although by no means everywhere, corresponds approximately with that of the bedding, is from  $30^{\circ}$  to  $40^{\circ}$  N. on the lower river, but gradually decreases.

Prospecting on the Little Bremner in 1911 was confined to the lower end of the flat between the uppermost canyon and the glacier from which the river rises. The flat is between 1 and 2 miles long and about one-quarter mile wide. It was formed by the filling of a shallow basin with outwash material from the glacier, whose stream now shifts back and forth across the surface. The presence of coarse gold in the gravel has been known for some years, and a small amount has been obtained by the pick-and-shovel method of mining.

In 1911 a drill was brought in to prospect the ground, in order to determine whether it would be profitable to install mining machinery. Three holes were put down, reaching bedrock at a depth of 47 feet. The section revealed was 7 feet of coarse surface gravel, underlain by 40 feet of glacier mud, containing rounded and angular rock fragments. Gold is reported to have been found only in the surface wash.

Conditions are favorable for placer mining at this place if the gold content of the gravel proves sufficient to encourage it. Falls Creek would furnish the water necessary for hydraulic operations, or it is possible that the upper Tebay Lake could be diverted to the south side of the divide. Either would supply the necessary head. Furthermore, the Little Bremner possesses a good supply of excellent timber, suitable for all ordinary mining purposes.

## COPPER.

### DISTRIBUTION AND CHARACTER OF THE DEPOSITS.

A number of copper claims have been staked in the mountains between Canyon Creek and Chitina River and at the head of Canyon Creek. One of these, the Blakney property, near Taral, is patented. On three or four others considerable work has been expended, but

the work done on the remainder has consisted only of the assessment work necessary to hold the property. Most of the copper prospects are in shear zones or fractures of various kinds in greenstone, and thus resemble the copper deposits in the Nikolai greenstone of the Kotsina-Chitina district. The only known exception to this mode of occurrence is on Canyon Creek, where the copper minerals are associated with a dark basic dike cutting limestone and schist.

The Blakney property is near the head of Taral Creek, 5 miles east of Taral and approximately 3,400 feet above it. Greenstone, probably derived from an original diabase intrusion or a surface flow, forms the country rock, but is succeeded only a short distance to the east by diorite.

The diorite is believed to be younger than the greenstone and intruded into it. The greenstone has been subjected to great pressure, and as a result is much shattered. Locally the rock is so much crushed that it is difficult to obtain a good hand specimen. Furthermore, the rock has undergone extensive chemical alteration, which is greatest in places where the rock is most crushed.

At the Blakney property a fault zone, made up of numerous parallel fractures and filled with copper and iron sulphides, is exposed on the south side of the creek. The ore body is made up of parallel veins of pyrite and chalcopyrite, ranging in thickness from one-half to 18 inches, separated by thin sheets of greenstone. This mineralized belt in the fault zone is about 3 feet thick. It strikes N. 75° W. and dips 45° SW. An incline was sunk in the ore at its lowest exposure on the creek. From that place the vein extends up the creek for 200 feet till it is cut off by a cross fault striking N. 40° W. and dipping high to the northeast. This ore body is much larger than any other yet discovered in the vicinity of Taral, and so far as the writer knows is as large as any chalcopyrite body not of a disseminated character yet found among the copper deposits of the Chitina region.

#### SURPRISE CREEK.

Surprise Creek, a short tributary of Nerelna Creek, occupies one of the principal gulches on the east side of that stream, which it joins about 2 miles from Chitina River. Near the mouth of the creek the bedrock is greenstone, intruded by a great mass of diorite, but farther upstream the prevailing rock is greenstone, associated with schist and much-altered siliceous limestone.

About 1½ miles from the mouth of Surprise Creek a short tunnel has been driven in a shattered zone in greenstone containing copper minerals. The fractures in this zone are veined with an intergrowth of quartz and epidote. Particles of chalcopyrite, pyrite, chrysocolla, chalcocite, and bornite are found in the quartz and also dissemi-

nated through the greenstone, their relative amounts in the rock corresponding with the order in which they are named, chalcopyrite being greatest. The occurrence of these minerals is similar to that so common in the Nikolai greenstone.

#### FALLS CREEK.

Falls Creek is a tributary of Canyon Creek, rising in the mountains northwest of Summit Lake. Most of the stream lies in a small basin more than a thousand feet above Canyon Creek, to which it descends in a succession of falls through a narrow, precipitous gulch. This creek is reached from the trail between Taral and Canyon creeks by a branch trail leading up Divide Creek and over the ridge between Divide and Falls creeks. The rock exposures of the basin show a confusing association of greenstone and altered sedimentary beds, including slate, schist, and highly siliceous thin-bedded limestone. Greenstone is the prevailing rock of the mountain slopes south of Falls Creek. Altered sediments prevail on the north side.

Two tunnels, one 105 and the other 150 feet long, were driven into the mountain, on the south side of Falls Creek, in 1911. They are approximately 400 feet apart and about 250 feet above the level of the camp near the creek. Specimens of ore from the longer tunnel show disseminated bornite, covellite, and chalcopyrite in greenstone.

Copper minerals are also found near the trail on the ridge between Divide and Falls creeks. A small open cut in the jointed and fractured greenstone shows chalcopyrite and bornite as veins filling fractures in the rocks and disseminated through it. Covellite and the carbonates resulting from oxidation are present in small amount.

#### CANYON CREEK.

Canyon Creek, whose head lies in the mountains southwest of Summit Lake, in the Hanagita Valley, is fed by several small glaciers leading down from the snow fields between Canyon Creek and Little Bremner River. In its upper courses, near the main trail running past Summit Lake, it flows through a narrow gravel-floored basin surrounded by high mountains composed of intensely folded and much altered sedimentary beds, among which a massive limestone, several hundred feet thick, is conspicuous. This limestone is seen on both sides of the valley but is not continuous, for it has been extensively faulted, so that schist intervenes in places between limestone outcrops.

Indications of copper were found on the west side of the creek about a mile from the main valley of Canyon Creek and Summit Lake. A tunnel was driven into the limestone along a copper-stained fault plane just at the top of the talus slope and about 500 feet above the valley floor.

The limestone is highly siliceous. It dips  $35^{\circ}$  to  $45^{\circ}$  N. The fault plane strikes N.  $40^{\circ}$  E. and dips about  $45^{\circ}$  NW. Smaller perpendicular faults showing slickensided rock faces, nearly at right angles to the main fault, are also present, but they show no copper stains. Near and a little below the tunnel is a dark, fine-grained dike in schist, which probably is faulted into the limestone. The dike rock contains pyrite or pyrite and chalcopyrite and is seemingly the source of the copper stains along the fault plane in the limestone above. It is reported that assay shows nickel as well as copper to be a constituent of the ore.

A large open cut and a tunnel, 20 feet under cover, together with a trail leading to the property, represented the development work done on the claim at the end of August, 1911. The showing was then sufficient to encourage the owners to the expenditure of a considerable further sum in proving up the property, and the construction of a trail down Canyon Creek to Copper River was begun early in September.

#### SUMMARY.

In summarizing it may be said that the copper deposits east of Copper River in the vicinity of Taral are all associated with altered igneous rocks. Those north of Canyon Creek appear to be closely related in origin and are found in distinct veins and in disseminated deposits in greenstone closely resembling the copper deposits of the Kotsina-Chitina region. The deposit near the head of Canyon Creek differs from these in that it is probably derived from a dike of more basic character than the greenstone and occurs within a mass of limestone.

## THE CHITINA COPPER DISTRICT.

By FRED H. MOFFIT.

### PROGRESS IN 1911.

The most important event of the year 1911 affecting the mineral resources of the Chitina Valley was the completion of the Copper River & Northwestern Railway to Kennicott, followed by the first shipment of copper ore from the Bonanza mine to Cordova. A train-load of chalcocite, the first commercial shipment of copper ore from the Copper River basin, arrived in Cordova on April 7, and the day was immediately christened "Cordova Day" by the citizens of that town and given over to a celebration of this important event. The road reached the new town of Chitina, opposite the mouth of Chitina River, early in the summer of 1910 and construction work was pushed as rapidly as possible from Chitina to Kennicott during the fall and winter. Train service between Cordova and Chitina was interrupted at times by snowslides and frozen overflows on the tracks, but during last summer additional snow sheds were built and the tracks were elevated in the troublesome places, so that hereafter there will be no great difficulties in keeping the road clear.

The permanent bridge over Copper River above Chitina has not yet been put in place, but the temporary bridge has fulfilled all the requirements in spite of high water, which loosened some of the piling. Another source of trouble during the summer arose from the occurrence of small landslides in the new cuts along the river, requiring close attention from those in charge of the tracks. Notwithstanding all difficulties and annoyances, however, no serious accidents took place and regular shipments of ore were made over the road all summer.

### COPPER.

The Kotsina-Chitina district was not visited by members of the United States Geological Survey in 1911, but some information concerning it was obtained from miners who had been at work there and from other sources.

It is evident that although the region received less publicity than in some former years it was the scene of a large amount of development work in 1911. This work was not confined to one or two properties, but was in progress in all parts of the district. Up to this time no copper ore other than that from the Kennicott Bonanza has been produced. Shipments of chalcocite were made from the Bonanza once or twice each week throughout the summer. The ore is sacked before it is loaded into the cars and is hauled to Cordova, where it is transferred to steamers and carried to the Tacoma smelter. A first dividend has been paid to the owners of the mine, and it is reported that the managers are preparing to proceed with the development of other claims, such as the Jumbo and the Independence, which form a part of the property including the Bonanza.

Prospecting was active in several near-by localities. A force of men was employed in developing the Mother Lode claims, which lie on the same fault zone as the Bonanza mine, about three-fourths mile north of it, on the McCarthy Creek side of the ridge. Construction of a road up McCarthy Creek to these claims was begun preparatory to the installation of mining machinery during the coming summer.

Development was also resumed on the "Nikolai mine," near the head of Nikolai Creek. Nothing had been done on this property since it was patented, about 10 years ago. During that time the old shaft had become filled with ice and the open cuts had been nearly covered by loose débris. About 500 feet of tunnel was driven in 1911. An adit was started near the creek and crosscuts and tunnels were driven in the ore body, revealing a larger amount of copper ore than the surface exposures and shaft had indicated.

A tunnel was also driven in the ore body of the Westover claim, on Dan Creek. Earlier development work, done when the claim was visited by the writer in 1909, consisted of an open cut which did nothing more than to clear away the talus material from the ore body. The tunnel was driven along the fault plane, cutting the ore, and is reported to have proved that the ore extends to some distance.

A promising body of copper is being explored at Copper Mountain, north of Kuskulana River. Work began on this property four or five years ago and a long tunnel has been driven. It is reported that an ore body has been cut by one of the tunnels over 1,000 feet below the outcrop. This is a fact of great importance to those interested in this copper district, since it gives the best indication so far discovered of the depth to which the copper deposits may extend. A survey for a branch road connecting the Copper Mountain camp with the railroad has been made, and construction work will probably begin in the near future.

Development of copper properties in this part of Alaska has gone on slowly, owing to the unusual difficulties to be overcome, yet it appears that a change is taking place and that more rapid progress will be made from this time on.

It is evident that an earnest effort has been made during the year to develop mining properties so as to put them on a producing basis. Stock companies have not been formed or shares sold during the last year or two for two reasons—first, the transportation facilities offered by the railroad have been better, and, second, the copper market has been depressed.

#### GOLD PLACERS.

A prosperous year is reported from the Chititu Creek and Dan Creek gold-placer district. Nearly all the mining on the Chititu took place on its northern tributary—Rex Creek. A few men were working at the mouth of this stream, shoveling into sluice boxes. The hydraulic plant which has been operated for several years on the lower claims of Chititu Creek above the canyon was moved to the lower part of Rex Creek and installed there. A dam was constructed and several hundred feet of flume and 2,000 feet of iron pipe were put in place in the early part of the season. Frozen gravel was encountered, but the giants were so placed as to avoid difficulty, and a successful season resulted. A much larger plant, to take the place of the one moved from Chititu Creek to Rex Creek, will be taken in during the winter of 1911–12.

Mining was also in progress on the upper part of Rex Creek, and it is reported that some gold was produced. An hydraulic plant will be placed in operation there during the summer of 1912.

On Dan Creek preparations for the installation of an hydraulic plant on the lower part of the creek below the canyon were continued, and in addition work was done on the benches south of Dan Creek and on Copper Creek, its southern tributary. It is also reported that some work was done on Young Creek near Calamity Gulch, but the Nizina district was not visited by members of the United States Geological Survey in 1911 and the extent of operations on Young Creek was not learned.