GOLD PLACERS BETWEEN WOODCHOPPER AND FOURTH OF JULY CREEKS, UPPER YUKON RIVER.

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GENERAL CONDITIONS.

An area roughly blocked out by the basin of Fourth of July Creek on the east, Woodchopper Creek valley on the west, Yukon River on the north, and an ill-defined line paralleling the Yukon on the south has long been known to contain auriferous gravels. The region thus blocked out, which is here to be described, comprises more than a thousand square miles.

The town of Eagle, on the Yukon 30 miles above the eastern boundary of the region, and Circle, on the Yukon 30 miles below its western boundary, are the nearest settlements. There are steamboat landings and a few buildings at Nation, on the Yukon near the mouth of Fourth of July Creek, and also at the mouth of Woodchopper Creek. Besides these there are some scattered small mining camps back from Yukon River. The northern part of this region is readily accessible from the Yukon, but in the parts that are remote from that river the means of communication are still very primitive. Trails and winter sled roads lead up most of the principal creeks.

Some mining was probably done in this region as early as 1898, but the developments here to be noted have been made chiefly during the last six or seven years. The incomplete data at hand indicate that the value of the total gold production of the region to date is less than $150,000, the greater part of which has come from Mineral Gulch, a tributary of Woodchopper, and from Fourth of July Creek. Some gold has been taken from Coal Creek and a little from tributaries of Washington Creek. In 1911 placer mining was being done on Woodchopper, Coal, and Fourth of July creeks and employed about 30 men. The long-continued drought, which resulted in low water in the streams depended on for sluicing, seriously interfered with mining, and consequently the gold output was very low.

SURVEYS AND INVESTIGATIONS.

The accompanying sketch map (Pl. X) includes data obtained by Geological Survey parties at different times. Most of the drainage shown has been taken from the map of the Circle quadrangle, which is based on accurate topographic surveys made in 1903, 1904, 1905, and 1908. The basin of Fourth of July Creek and vicinity, however, has not been covered by instrumental surveys, and its drainage as indicated on the map is based on foot traverses and is therefore only approximately correct.

Among the previous geologic workers in this field whose results are here utilized are Collier,[1] who investigated the Tertiary coal measures of Washington Creek; Brooks and Kindle,[2] who studied the Yukon section; and Brooks,[3] who has reported on the placers of Woodchopper and Washington creeks. The senior writer [4] in 1903 traversed the southern part of the area here to be described, and in 1911, assisted by Mr. Mertie, made brief visits to parts of the basins of Woodchopper, Coal, and Fourth of July creeks.

The region considered is bounded on the north by the Yukon Valley, which here has a winding course, resembling incised meanders. In this region the valley is from half a mile to a mile wide, but a few miles below the mouth of Woodchopper Creek it widens out to merge into the Yukon Flats. It is bounded by steep walls which rise to an upland about 800 to 1,200 feet above the water. Into this upland the streams, such as Woodchopper and Fourth of July creeks and their tributaries, have incised sharply-cut narrow valleys, and the interstream areas, which are remarkably even-topped, rise southward from the river. Along an irregular line from 10 to 25 miles south of the Yukon the flat-topped ridges give way to an upland of much stronger relief, made up of an intricate system of high ridges and spurs and some prominent peaks, of which Mount Sorenson (5,620 feet) and Twin Mountain (5,660 feet) are the highest. This part of the region has a minutely ramifying drainage system, the streams traversing open valleys whose slopes are much more gentle than those of the valleys nearer the Yukon.

All the area is drained to the Yukon by parallel streams which maintain northerly courses. Charley River, the largest of these, traverses the central part of the field, but most of its drainage basin lies outside the region here considered.

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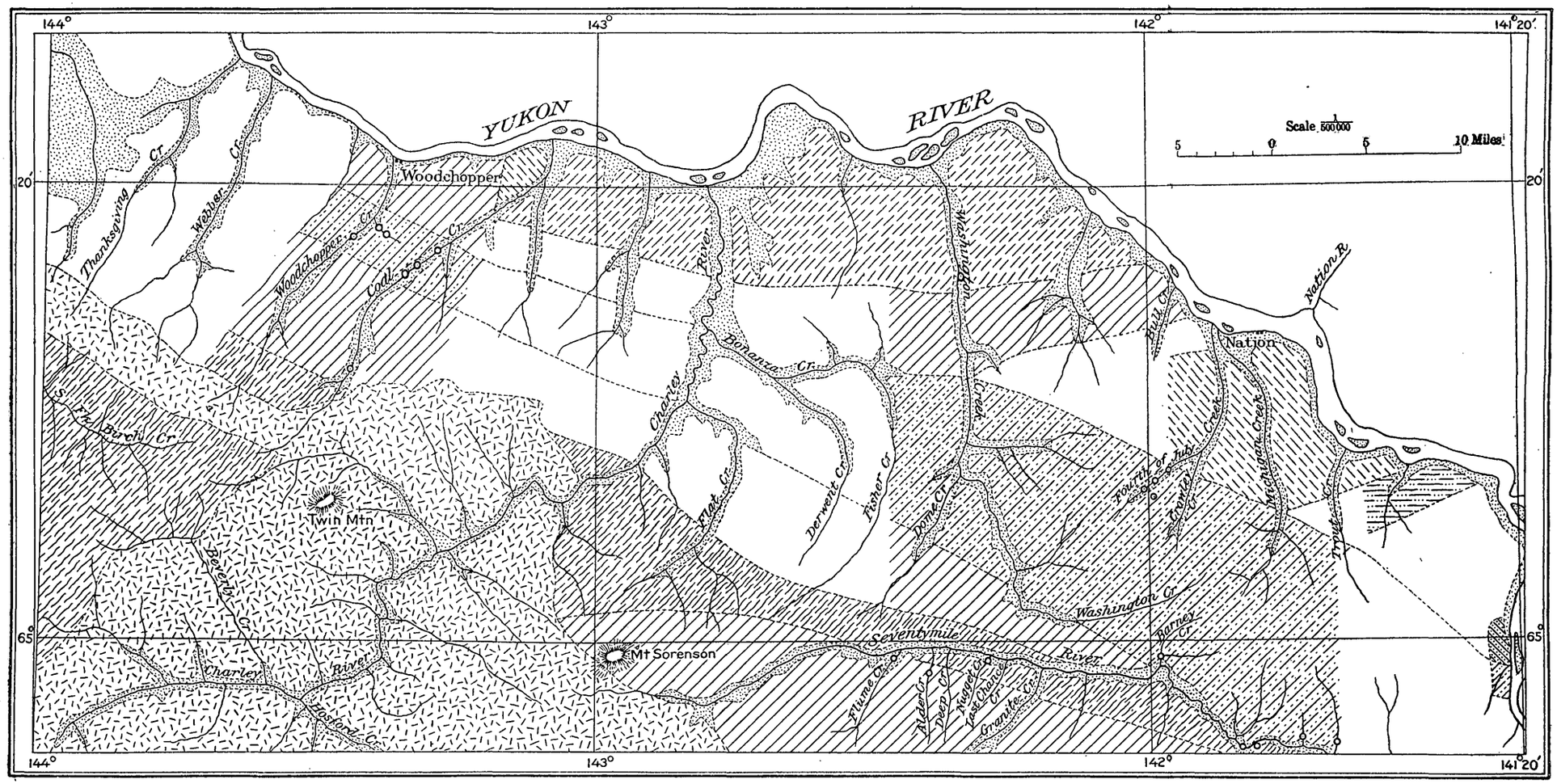
[1] Collier, Arthur J., The coal resources of the Yukon, Alaska: Bull. U. S. Geol. Survey No. 218, 1903, pp. 28-29.

[2] Brooks, A. H., and Kindle, E. M., Paleozoic and associated rocks of the upper Yukon, Alaska: Bull. Geol. Soc. America, vol. 19, 1908, pp. 255-314.

[3] Brooks, Alfred H., The Circle precinct: Bull. U. S. Geol. Survey No. 314, 1907, pp. 198-204.

[4] Prindle, L. M., Description of the Circle quadrangle: Bull. U. S. Geol. Survey No. 295, 1906.



QUATERNARY	TERTIARY	LOWER CRETACEOUS	CARBONIFEROUS			DEVONIAN	PRE-ORDOVICIAN	INTRUSIVE ROCKS	
Silt, sand, and gravel	Conglomerate, sandstone, shale, and clay	Slate and sandstone	White cherty limestone	Nation River formation (*Shale, conglomerate, and sandstone*)	Calico Bluff formation (*Shale, slate, and sandstone*)	Slate, conglomerate, chert, tuff, greenstone, and limestone	Quartzite schist, hornblende schist, and crystalline limestone	Granite, granodiorite, and quartz diorite	Gold placer

GEOLOGIC SKETCH MAP OF REGION BETWEEN WOODCHOPPER AND FOURTH OF JULY CREEKS.

VEGETATION.

A large part of the region stands above timber line, which is here at an altitude of about 2,500 feet. The valleys in the highland area to the south are but scantily timbered with spruce. The best timber is found in the valley bottoms, near the Yukon, where spruce trees up to 18 inches in diameter yield the timber needed for use in mining. The ridges near the Yukon are also forest-covered, but the spruce here is smaller and is serviceable chiefly for fuel.

Grass is abundant in the open valleys and also above timber line. This region, like other parts of the Yukon basin, will grow some crops, but its adaptability to agriculture has thus far been tested only by a few small gardens.

GEOLOGY.

The bedrock includes schists, regarded as pre-Ordovician; a variety of sedimentary and volcanic Devonian and Carboniferous rocks; Lower Cretaceous slate and sandstone; Tertiary conglomerate, sandstone, and shale; and Quaternary silt, sand, and gravel. Nearly a third of the area is made up of intrusive granitic rocks, which form one large mass in the southwest. The distribution of these rocks is shown on Plate X.

Pre-Ordovician rocks.—The pre-Ordovician rocks include quartzite schist, quartz-mica schist, hornblende schist, carbonaceous schist, and crystalline limestone. The occurrence in the western part of the area of garnetiferous and staurolitic varieties of quartz-mica schist is noteworthy.

The schists everywhere show complex structure. They have been so closely folded and overturned that many of the folds are nearly horizontal. The predominant characteristic, differentiating them from the rocks of the succeeding group, is their content of mica, which gives them a more or less glistening appearance. These rocks are to be correlated with the Birch Creek schist, which is so widely distributed in the Yukon-Tanana region. There is evidence that they were the bedrock source of some of the gold now found in the placers.

Paleozoic rocks.—Many kinds of Paleozoic rocks lie adjacent to the Yukon, both north and south of the river. These include shale, slate, chert, greenstone, conglomerate, and limestone. These rocks occupy a large part of the area shown on the map. Their structure is complex. They have been closely folded, but do not exhibit the metamorphism characteristic of the pre-Ordovician rocks. Some of them are definitely known to be of Devonian and Carboniferous age (the latter including Nation River and Calico Bluff formations), and it is probable that they include also Silurian rocks. The most prominent members of this group are greenstones, which form rough, irregular

ridges close to the Yukon, and massive limestones, also found in the vicinity of the Yukon, conspicuous both by their light color and by the precipitous slopes of the spurs in which they occur.

The areas occupied by the unaltered Paleozoic sediments have not, as a rule, been regarded as favorable localities to search for placer gold. On the other hand, some of the associated greenstones are known to be mineralized, and the sediments themselves may be mineralized where intruded by igneous rocks.

Mesozoic rocks.—The Lower Cretaceous rocks are closely folded slate, sandstone, and quartzite. Some of the slates in the lower part of the valley of Washington Creek contain quartz veins, which, according to Brooks, are most probably the source of some of the placer gold found on tributaries of Washington Creek.[1] The following statement is quoted from his report:

> This occurrence, though probably of small commercial import, has a far-reaching significance, as it indicates that there has been an intrusion of mineralized veins since these younger rocks were deposited. The writer is, however, of the opinion that this mineralization is not general enough to encourage the search for placers where these Cretaceous slates form the country rock.

Tertiary rocks.—The rocks of Tertiary age are predominantly conglomerate, but include less extensive beds of slate, sandstone, and interbedded lignitic coal. The conglomerate is the most conspicuous member of this division. It is composed principally of red, green, and black chert, quartzite, and vein quartz, though it contains some pebbles of schist or granite. The largest pebbles are about 5 inches in diameter. The beds of conglomerate are massive, and their total thickness probably exceeds 1,000 feet. Folding has been close, and in places along Seventymile River the beds are vertical. In other places the beds are nearly horizontal. The conglomerate weathers easily to gravel resembling stream gravels, and the surface of the high ridge between Seventymile River and Fourth of July Creek is composed of gravel derived from the underlying conglomerate. In this area the width of the conglomerate north and south is about 10 miles. The occurrence of the conglomerate also on Washington, Coal, and Woodchopper creeks suggests that it forms a continuous belt from Seventymile River to Woodchopper Creek and beyond toward Circle.

The economic importance of this conglomerate has been emphasized by Brooks,[1] who writes:

> There appears to be a fairly well defined belt of conglomerate running parallel to the Yukon from Seventymile Creek to Birch Creek, near the big bend. Both in the Seventymile basin and on Woodchopper Creek placers have been found which must have derived their gold from this rock. Therefore the conglomerate must, in part at least, be auriferous.

[1] Brooks, Alfred H., Bull. U. S. Geol. Survey No. 314, 1907, p. 199.

This conglomerate was probably laid down in Tertiary time, after the mineralization of the older rocks, and its gold content is comparable to that of the present placers. Such auriferous conglomerates have long been known in the Yukon region, having first been noted by Spurr, who termed them "fossil placers." There is no evidence that the conglomerate itself carries sufficient value to pay for milling, though this is not impossible. The fact that the associated placers are only of moderate richness argues against any considerable values being found in the parent rock.

Much of the conglomerate is only loosely consolidated and weathers so readily that it is easily mistaken for high-bench gravel. As a result prospectors sometimes assume that it marks an old river channel and expect to find very rich leads. Though it is not impossible that the conglomerate represents the deposit of an old watercourse, it by no means follows that such a deposit would be any richer than the placers of the present stream. The term "old channel" has a very alluring sound to those who are familiar with the occurrence of gold in California. Even if this conglomerate should locally be found rich in gold, only such parts of it as are decomposed could be mined by placer methods. Therefore the gold in it, except where it has served to enrich present streams, has now no commercial significance.

Quaternary deposits.—The unconsolidated materials include silt, sand, and gravel, separable into Pleistocene and Recent, according as they have been deposited on high benches, up to about 200 feet above the Yukon, or on the low benches and bottoms of the present valleys. The high-bench deposits are found mostly in the vicinity of the Yukon. The deposits of the present streams have been derived largely from the conglomerate and are described in detail under the heading "Gold placers" (pp 206-210).

Granitic rocks.—The large area of intrusive rocks shown on the map, in the southwestern part of the region, is only a part of a much larger mass. The predominant types are biotite granite, granodiorite, and quartz diorite. Some of these have cut Paleozoic rocks and have been the source of bowlders in conglomerates that are regarded provisionally as Cretaceous. It is probable that they were not intruded contemporaneously, but that some are pre-Cretaceous and some post-Cretaceous. Twin Mountain is one of the prominent points formed by these rocks. They occur near the heads of both Woodchopper and Coal creeks and have contributed material to the alluvial deposits of these streams. Garnets and staurolite, which are very abundant in the schists near the head of Woodchopper Creek, are doubtless due in part to their contact action.

A close genetic relation between the igneous intrusives and the auriferous mineralization in the Yukon-Tanana region has been established,[1] and the presence and distribution of the igneous rocks may therefore have important bearing on mineral resources.

[1] Prindle, L. M., Occurrence of gold in the Yukon-Tanana region: Bull. U. S. Geol. Survey No. 345, 1908. pp. 179–186.

GOLD PLACERS.

SOURCES OF THE GOLD.

So far as known no workable gold-bearing veins have been found in the region considered in this paper, so that the placers are the only mineral resource which need here be discussed. The placer gold has been derived in part from the Tertiary conglomerate, in part from the old schists, and in part from the Paleozoic sediments and greenstones. A little alluvial gold has also been found, which had its bedrock source in mineralized portions of the Mesozoic slates. This region therefore contains placer gold which has been derived from the four different bedrock sources of gold in the Yukon-Tanana region. The occurrences of placer gold on the different creeks will be described, so far as the data at hand will permit.

PRODUCTIVE CREEKS.

FOURTH OF JULY CREEK.

Fourth of July Creek rises about 12 miles from the Yukon, and flows northeastward throughout the greater part of its course. Crowley Creek, its largest tributary, enters it from the east about 6 miles below its head. About 4 miles farther downstream the creek leaves its valley, crosses the flat of the Yukon in a northwesterly course, and enters a slough of the Yukon. Michigan Creek, a neighboring stream on the east, which leaves its valley at about the same distance from the Yukon as Fourth of July Creek, is reported to enter the same slough only about a quarter of a mile farther upstream.

The main part of the valley of Fourth of July Creek is cut to a depth of about 2,000 feet below the level of the ridges. The stream flat throughout most of the valley is from 200 to 400 feet wide. The stream above the mouth of Crowley Creek flows close to the steep slope of the ridge limiting the valley on the east. A gentle benchlike slope on the west, about 1,000 feet wide, merges with the base of the ridge, limiting the valley on the west. The portion of the valley below Crowley Creek is mostly narrower, the upper valley being limited by steep slopes on both sides till the valley of the Yukon is approached, where the valley floor widens and merges with that of the Yukon. At this point there is a benchlike slope on the east a half mile or more in width. The grade of the creek is about 100 feet to the mile. The drainage area is comparatively small and the precipitation for this general area is low, the maximum averaging hardly more than 10 inches a year, so that the quantity of water is generally insufficient for use in mining. The timber resources are limited to a comparatively light growth of small spruce and a small amount of birch and poplar. Some larger spruce timber grows in the valley of the Yukon.

The bedrock of Fourth of July Valley from the mouth to Crowley Creek is predominantly limestone, which at the point where the creek enters the Yukon Valley forms picturesquely weathered cliffs that tower above the stream on its western side. Upper Carboniferous fossils are abundant in similar limestone near the mouth of Michigan Creek, and the limestones at both these localities are regarded as of the same age and are correlated with upper Carboniferous limestones on the north side of the Yukon above Nation River, described by Brooks and Kindle.[1] The limestones occur as massive beds, which at some localities have been so folded as to be in a vertical position, and at others, where cut by the Yukon, form conspicuous open folds.

The bedrock from Crowley Creek to the head of Fourth of July Creek and around all the headwaters, so far as observed, is conglomerate, which is continuous with the conglomerate of Seventymile River, whose age has been determined as Tertiary. Along the Seventymile these rocks have in places been closely folded and here and there the beds are nearly vertical. Their structure on the ridges is for the most part obscured by the gravel into which they have weathered. It has been rather definitely determined that the gold of the placers has been derived from this conglomerate, the only portion of the Fourth of July Valley and its tributaries where gold has been mined being those areas where the conglomerate is the bedrock and where the streams have had no access to any other bedrock.

Most of the work on the main creek has been confined to about six claims. The depth to bedrock averages about 9 feet and the thickness of gravel that is being mined is 5 to 6 feet. Most of the gravel is comparatively fine, the largest pebbles being about 6 inches in diameter, but it includes a few bowlders of quartzite and hard Paleozoic conglomerate, 3 feet or more in diameter. All pebbles and bowlders observed were well worn, and there is but little doubt that all have been derived from the Kenai conglomerate.

Most of the gold lies close to bedrock, the greatest part of it being found in the lowest foot of gravel. The width over which it is found had not been determined. Most of it is in flat and rather thick flakes, the largest one-fourth inch in diameter. It is reported to range in assay value from $18.89 to $18.91 per ounce, and is recovered in amounts reported to range from $8 to $75 per box length of 12 by 12 square feet, the average being about $25.

The most noteworthy feature of mining during 1911 was the introduction of mechanical means for working the gravels on a larger scale. An 86-horsepower steam scraper was put in operation during the first week in September, and those in charge of it expected to use it extensively during the summer of 1912. This scraper was trans-

[1] Brooks, A. H., and Kindle, E. M., Paleozoic and associated rocks of the Upper Yukon, Alaska: Bull. Geol. Soc. America, vol. 19, 1908, pp. 295–297.

ported during the summer under its own power from the Yukon a distance of about 10 miles over the brushy valley at an average speed of about half a mile a day. Holes were dug at regular intervals in the frozen ground. A large hook was used as a deadman, and the scraper was pulled forward on its foundation of logs by means of the cables attached to the drum.

Open-cut work was being done in 1911 on Ruby Creek, which enters Fourth of July Creek about 3 miles above the point where the scraper was in use. The bedrock of this valley, so far as observed, is only the conglomerate. The depth to bedrock where mining was in progress is 12 to 15 feet. The gravel is made up of material derived from the conglomerate. The gold is found in about 20 inches of gravel next to bedrock. Values are reported from $50 to $75 to the box length of 12 by 12 square feet. Operations had been at a standstill throughout most of the season on account of lack of water.

WASHINGTON CREEK.

Washington Creek was not visited, and therefore the following account is quoted from Brooks's report[1] based on his examination in 1906:

Washington Creek flows through a northward-trending valley whose floor is half a mile to a mile in width. The bedrock for the lower 3 miles of the creek is black slate or shale of Cretaceous age.[2] Farther upstream the creek cuts a greenstone and chert formation, probably of Devonian age, and 10 miles from the Yukon it crosses another belt of Cretaceous age which forms the bedrock in Nugget Gulch, a small southerly tributary. These rocks are succeeded to the south by a broad belt made up of a Tertiary conglomerate, sandstone, and shale series, which contains some lignitic coal seams. This belt of coal-bearing rocks has a width of at least 10 miles. Still higher up the valley older rocks are said to occur again.

Placer gold has been found at two localities in the Washington Creek basin—(1) in Nugget Gulch, about 9 miles from the Yukon, and (2) on Surprise and Eagle Creeks, about 10 miles above. The placers on Nugget Creek consist of very much localized accumulations of coarse gold on bedrock. Values are so irregularly distributed that it is questionable whether the placers can be mined at a profit. The gold appears to have its source in the Cretaceous slates, and it is worthy of consideration at least whether the mineralization of the bedrock is not sufficiently localized to pay the cost of extraction. The upper locality was not visited by the writer, but from the best accounts the gold here appears to be derived from a conglomerate. The value of the total production of Washington Creek does not exceed a few thousand dollars.

COAL CREEK.

Coal Creek is about 20 miles long. The placer deposits of the lower part of its basin probably derive their gold, as do those of the adjacent parts of Woodchopper Creek, from the Tertiary conglomerates. These placers were not visited.

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[1] Bull. U. S. Geol. Survey No. 314, 1907, pp. 200-201.

[2] Collier, A. J., Coal resources of the Yukon: Bull. U. S. Geol. Survey No. 218, 1903, pp. 28-32.

The most noteworthy discovery in the Coal Creek Valley has been made at a point about 15 miles from the mouth of Coal Creek, several miles south of the belt of conglomerate. The rocks in this portion of the valley are chert, shale, greenstone, and limestone, regarded as Paleozoic, forming a belt several miles wide. Still farther south are schists, regarded as pre-Ordovician, and intrusive granite.

The auriferous gravel found is near the southern extension of the Paleozoic rocks at a point about 1 mile below a narrow portion of the valley, referred to by the miners as the canyon. Gold was discovered in the spring of 1910. The depth to bedrock where ground was being prepared for working is only about 7 feet and the productive gravels are reported to be over 100 feet wide. Some of the gold is coarse, pieces worth $12 to $14 having been found. Only work preparatory to mining in 1912 had been done at the locality. The season had been very dry and scant opportunity had been given to work sufficient ground to determine the gold content of the gravels. Many garnets are mixed with the gold at this locality, and the gravels contain also fragments of garnetiferous schist like that forming much of the bedrock near the headwaters of Coal Creek. These facts suggest that the placer gold has been derived in part, at least, from the schists.

WOODCHOPPER CREEK.[1]

Woodchopper Creek, which is about 12 miles long, enters the Yukon from the west, about 30 miles above Circle. Its flood plain is about half a mile in width, and the alluvium is probably 8 to 15 feet deep. Five miles from the Yukon, Mineral Creek, the scene of some placer mining, joins Woodchopper Creek from the south. The floor of the Mineral Creek valley is 100 to 150 [feet] wide, and the slopes are broken by benches. Woodchopper Creek has a gradient of about 100 feet to the mile. Remnants of benches are to be seen along the creek, the highest of these being marked by the ridge on the northwest side, which is flat and slopes toward the Yukon.

In the lower mile of Woodchopper Creek only massive greenstones were observed. Above these is a belt of black slate and limestones about a mile wide that continues nearly to the mouth of Mineral Creek, where it is succeeded by friable conglomerates in a belt said to be several miles wide. Chert and quartz pebbles dominate in the conglomerate, which is only imperfectly consolidated and outcrops in few places. This fact often leads to its being mistaken for bench gravel by the prospector.

So far as known the gold-bearing alluvium is confined to those creeks that cut the conglomerate, which therefore appears to be the source of the gold. Mineral Creek and its tributary, Alice Gulch, are the only streams which have thus far been found to be productive. Prospects are reported from Grouse and Iron creeks.

At the mouth of Mineral Creek the alluvial floor of the valley is about 75 yards wide, but narrows upstream. A mile upstream, at the mouth of Alice Gulch, it broadens out again into a basin about 75 yards wide. On the south wall of Mineral Gulch three well-defined benches were observed having altitudes of about 20, 150, and 250 feet above the creek.

Muck is encountered on some claims to a depth of 30 feet; the gravels underneath vary in thickness from 2 to 5 feet and are made up chiefly of well-rounded quartz and chert pebbles. The pay streak lies in parallel channels 12 to 14 feet wide, as many

[1] Matter in smaller type quoted from Brooks, Bull. U. S. Geol. Survey No. 314, pp. 203-204.

as three of these channels having been found in a width of 80 feet. The pay streak under present systems of mining is from 1½ to 4 feet in thickness. A varying amount of bedrock is taken up, depending on its looseness. Apparently gold occurs in bedrock beyond the depth to which it can be profitably extracted. The bedrock appears to be chiefly conglomerate, but in some places a plastic clay which may be a weathered shale interbedded with the conglomerate has been encountered. Prospectors report that the values are found in the conglomerate but appear to be absent in the clay. The conglomerate bedrock is invariably iron stained, where found under the placers. Gold has been found in the lower benches of the creek, but the higher benches have not been prospected.

The gold in the creek bed is usually bright colored, but that of the benches is dark. Most of the gold is coarse, the largest nugget having a value of $30. The value of the gold as reported by the miners is $19.09 to $19.30 per ounce, which would make it the highest of all found in the Yukon Province. Values of 5 to 50 cents to the pan on bedrock are reported, but there are no data available for the average tenor of the pay streak.

Besides the areas on Mineral and Alice creeks, where mining was in progress in 1906 and also in 1911, the area of possibly productive gravel had been enlarged by the discovery of gravels in the Woodchopper Valley about 1 mile above the mouth of Mineral Creek and 8 miles from the Yukon.

West of the stream in this part of the valley there is a flat, a half mile or more wide, on which, several hundred feet from the creek, gold has been discovered. The bedrock is conglomerate; the depth to bedrock is about 22 feet, and the thickness of gravel is about 11 feet. In the lower part of the gravels there are a great many granite bowlders, the largest 2 feet or more in diameter. The gold is reported to occur in the lower 6 feet of gravel, next to bedrock. The productive ground is reported to have a width of about 70 feet and to carry as high as $1 to the square foot of bedrock surface. Sufficient work has not been done, however, to determine whether there is a persistent body of productive ground. If this deposit should prove to be economically workable its accessibility to the Yukon will be an important factor in its exploitation.

Auriferous gravels are distributed over a considerable area along Woodchopper Creek, but no very rich placers have been found, nor have any very extensive deposits of low-grade gravels been developed.

The relative accessibility of the placers to the Yukon is favorable to cheap mining, but the small amount of water available for sluicing is a drawback. With one exception all the operations have been of a primitive type, the steam shovel on Fourth of July Creek being the only machinery employed except a few steam hoists.