

THE CIRCLE PRECINCT.

By ALFRED H. BROOKS.

INTRODUCTION.

The gold-bearing area tributary to Birch Creek, in the central Yukon region, is usually known as the Birch Creek district.^a Birch Creek lies, for the most part, in the so-called "Circle precinct," which embraces the Birch Creek and Preacher Creek basins, as well as Wood-chopper and other small gold-bearing streams. This whole region is tributary to the town of Circle, which is located on the west bank of the Yukon and contains several hundred inhabitants.

Means of communication are very inadequate throughout this region. Freight is delivered at Circle or other points by steamer in the summer and during the winter months is hauled to the various placer mines, distances varying from 10 to 50 miles, at a cost of 3 to 6 cents a pound. Wagon roads are almost entirely lacking, and during the wet weather of the summer the horse trails become well-nigh impassable. A system of wagon roads is the first need of this region. The difficulties of communication are also rendered greater here than in some of the other inland placer districts by the entire absence of telegraph or telephone lines.

In spite of the adverse conditions, the Birch Creek district stands to-day as one of the few placer camps which have been developed entirely without the aid of outside capital. Since the discovery, in 1894, step by step, through the efforts of the miners who have taken their capital out of the ground, advances have been made. Though this is one of the last of the Alaskan mining fields to be invaded by capital, this change is now in progress, for during 1906 several groups of claims passed into the hands of strong companies. This will eventually revolutionize mining methods and bring about a great increase of production. As the installation of mining plants will require several years, however, the production meanwhile will decrease.

The following notes are based largely on the writer's own observations during a journey in 1906 along the Yukon and through the Birch Creek district, which occupied about a month, but free use has

^a"District" has no legal significance as a territorial subdivision, for the units are officially known as precincts.

been made of the publications of Prindle,^a who has already described the general features of the geology and topography, and these will not be redescribed except so far as is necessary to an understanding of the description of the placers. The uniform courtesy and hospitality shown to the writer throughout the region greatly aided the investigation.

STATISTICS.

Data in regard to the gold production of this region are exceedingly scant, but the following estimates are based on the best evidence available. The error in the tables may be as great as 10 or 15 per cent.

Approximate value of gold production of Birch Creek district, 1894-1906.

1894.....	\$10, 000	1902.....	\$200, 000
1895.....	150, 000	1903.....	200, 000
1896.....	700, 000	1904.....	200, 000
1897.....	500, 000	1905.....	200, 000
1898.....	400, 000	1906.....	300, 000
1899.....	250, 000		
1900.....	250, 000		3, 560, 000
1901.....	200, 000		

Estimated value of gold production of Birch Creek district, by creeks.

Deadwood Creek ^b	\$700, 000
Mastodon and Mammoth creeks ^b	2, 060, 000
Eagle Creek ^b	600, 000
Other creeks ^b	200, 000
	3, 560, 000

The first three areas in the foregoing table continue to be the largest producers, probably in about the ratio of total output there given. Of less present importance, but also productive, are Harrison, Miller, Greenhorn, Woodchopper, and Fourth of July creeks. Gold has also been found on a number of other streams which have yielded only a small production and are too numerous to mention. It is estimated that values have thus far been found along a total length of 23 miles, but it is impossible to state what proportion of this pay streak has been worked out. There are but few claims in the entire district that have been entirely worked out, and, in fact, even these will, to a certain extent, probably be reworked by improved methods. In 1906 there were about 200 men at work in the district on about 60 to 100 claims.^c Most of the mining was by pick and shovel methods, but one small hydraulic plant was operated on Harrison Creek and another with a steam scraper on Mastodon Creek. There were also

^a Prindle, L. M., The gold placers of the Forty-mile, Birch Creek, and Fairbanks regions: Bull. U. S. Geol. Survey No. 251, 1905; Description of the Circle quadrangle (one of a series on the Yukon-Tanana region): Bull. U. S. Geol. Survey No. 295, 1906.

^b With tributaries.

^c Claims are 500 feet long in Birch Creek district.

a number of steam bucket hoists. Winter work is now usually done with the aid of steam thawers.

The placers here to be described fall into two groups that differ both geographically and geologically—(1) placers lying within the Birch Creek basin and (2) those along streams which discharge directly into the Yukon. The gold of the first group is derived from mica-schist and quartz-schist bed rock; that of the second group is, in part at least, derived from a conglomerate, where it is of secondary origin.

BIRCH CREEK BASIN.

GENERAL GEOLOGIC FEATURES.

The known auriferous portion of the Birch Creek basin embraces primarily those streams which head in an irregular northwest-southeast trending ridge, of which Mastodon (4,500 feet) and Porcupine (4,900 feet) domes form the highest summits. The radial arrangement of the gold-bearing streams from this watershed is a striking feature and is suggestive of the location of a zone of mineralization.

Schistose quartzite and mica schist form the prevailing bed rock throughout the area. Locally these rocks are found to be feldspathic, and these phases may be altered intrusives, but for the most part the formations appear to be of sedimentary origin. The rocks are closely folded and much sheared, and the prevailing strikes are east and west. Granite intrusives are not uncommon. Notably on Deadwood, Mammoth, and Miller creeks there are considerable areas of this rock. The central parts of the intrusives appear to be massive, but along some of their margins the writer observed evidence of deformation. Whether this is generally true he was unable to determine. Prindle has described some diabase dikes which occur in this region, but none came under the observation of the writer.

A general wide distribution of vein quartz is attested both by the bed-rock exposures and by the character of the fluvial deposits. This quartz is very frequently found to be iron stained, and one naturally turns to it to seek a source of the placer gold. There is but little direct evidence on this point. The presence of pyrite-bearing vein quartz in the auriferous alluvium is a characteristic feature of these deposits. On Eagle Creek a 4-foot gold-bearing quartz vein is said to have been encountered in the drift mining, but the writer did not see the exposure, as the drift had caved in. A specimen of the quartz showed it to be iron stained and broken by thin seams of gold. The gold of the adjacent placer was angular and carried much quartz. A mineralized fracture zone about 8 inches in width has been found on the upper part of Deadwood Creek. Within this zone the schist is permeated by stringer veins

carrying pyrite and galena, and it is reported to carry values of \$6 in gold and \$8 in silver.

Spurr^a reported the finding of gold-bearing quartz on Harrison Creek. He describes the occurrence as follows:

The best example of gold-bearing quartz found in the gravel is a rhomboidal block of quartz schist, about $4\frac{1}{2}$ by 5 by 2 inches, found on claim 91, on North Fork, about three-quarters of a mile above the forks. On one of the larger surfaces of this block is a quartz vein which is richly spotted with flakes and specks of gold, ranging from three-sixteenths of an inch in diameter to mere specks, which finally become invisible to the naked eye.

These facts indicate that the placer gold is derived from zones of mineralization in the schist series. The wide distribution of the placer gold is not a favorable indication that the values are sufficiently localized in the bed rock to afford commercial ore bodies. It must be said, however, that there is little evidence on this point, and workable lodes may yet be found when a systematic search is made.

The alluvium, like the bed rock, varies in character. Nowhere was any foreign material observed in the stream gravels, and as a rule there is a progressive increase in size of material toward the headwaters of any given watercourse. Where mining operations have been carried on the extreme depths to bed rock usually do not exceed 20 to 30 feet and probably do not average more than 8 feet. In most sections the material becomes very angular toward bed rock. The bed rock itself is in general deeply weathered, and the material excavated usually includes 2' or 3 feet of it. Along nearly all the creeks one or more benches occur on the valley slopes. Those that have been found to carry values are from 2 to 20 feet above the present stream floors. The character of the alluvium on the benches is similar to that of the valley bottoms, but much of it is deeply buried under talus, or "slide rock," as the miners call it. This talus has in many places so obscured the original topography that the benches are not found until they are developed by mining excavations. At several localities the writer observed still higher benches, 40 to 50 feet above the present stream floors, but these appear to be very local, and even if found to be auriferous are beyond the reach of the present water supply.

A feature repeatedly observed in this province by Prindle is the asymmetrical character of the valleys when viewed in cross section. One wall is usually steep, with benches entirely absent, while the other has a gentle gradient and is broken by numerous benches. The miners have taken cognizance of this fact in their prospecting, which has been devoted chiefly to the gentle slopes where the old channels and benches, if present, would be preserved.

^a Spurr, J. E., *Geology of the Yukon gold district, Alaska: Eighteenth Ann. Rept. U. S. Geol. Survey*, pt. 3, 1898, pp. 353-354.

The gold-placer deposits vary so greatly as to dimensions that few general statements can be made. In fact, the width and the thickness of the pay streak vary according to the cost of extracting it. For example, if values of \$2 to the cubic yard are the lowest that can be profitably mined, as is probably the case with present usage in mining throughout most of the district, it puts a limitation on the dimensions of the pay streak quite different from what it would be if the costs were reduced to \$1 per cubic yard. It is therefore very difficult to make any broad statement relative to the pay streak.

Throughout the gold-bearing region the alluvium can be said to be auriferous, inasmuch as it usually carries enough colors of gold to be found by the ordinary methods of panning. On the other hand, the pay streaks as now mined (i. e., with a probable minimum value of \$2 to the cubic yard) are confined to certain creeks and to certain channels in the creek floor or on the benches. With these limitations it is probably fair to state that the pay streaks do not average more than 40 or 50 feet wide through the district, though on some creeks, notably on Mastodon, a width of over 200 feet has been mined at a profit. Probably few single pay streaks are traceable for more than 1,000 or 2,000 feet, though a succession of them may give practically a continuous zone of placers for several miles.

The same limitations must be placed on any statement in regard to thickness. Gold may be distributed through the entire thickness of gravels, but appears to be more commonly concentrated in the 2 or 3 feet next to bed rock. It is usually found to a varying depth in the weathered bed rock. In general it appears to be true that where the gravels are well rounded the gold is more uniformly distributed than where the material is angular, but in the first case the values per cubic yard are likely to be less.

Most of the rich pay streaks have a lenticular form, with their longer axes parallel to the trend of the stream valley. The pay streak may be straight or may wind from one side of the valley to the other. It is more likely to be straight in the broader valleys than in the smaller ones. If the valley is asymmetrical, the pay streak may be crowded to the steep wall by the talus which comes down the gentle slope. The talus may also bury an older channel.

In distribution the gold follows the same general law as the gravel, being coarsest at the points farthest upstream and gradually becoming finer downstream. The several exceptions to the rule noted only prove that the gold has in some places a very local source, being probably derived from mineralized zones which cross the drainage courses.

The average value of the gold of the Birch Creek basin, as reported by operators, is \$17.73 per ounce, the Eagle gold being the purest and Deadwood the most impure.

Prindle has described the various creeks in detail, and it will not be

necessary here to repeat the descriptions. A few notes on development will, however, be appended. Harrison Creek will be described in more detail, as it has been developed since Prindle's studies were made.

NOTES ON DEVELOPMENT.

BIRCH CREEK.

The bars along Birch Creek have been found to be auriferous and were, in fact, the scene of the first discoveries of gold in the district. During low water some gold has been taken out of these bars with the aid of rockers. The wide extent of these deposits, their probably unfrozen condition, and the absence of bowlders have attracted the attention of those seeking dredging ground. It should be noted, however, in considering this form of deposit that the richness of the bars is not a criterion of the gold contents of the deeper alluvium. In the river bars the gold is in a concentrated form, and the balance of the alluvium may be almost barren. As there has been no excavation to bed rock in these large streams nothing is known of the depth of the alluvium or the values in it. Extensive prospecting with churn drills should precede the installation of dredges.

DEADWOOD CREEK.

One hundred and six 500-foot claims have been staked on Deadwood Creek and more or less work has been done on 67 of these. Gold has been found in commercial quantities from a point about a mile above the mouth throughout the length of the creek, a distance of nearly 9 miles. One considerable tributary, Switch Creek, has also yielded values. Nearly all the mining on Deadwood Creek has been carried on by small operators and by simple methods. Many a prospector who has been on the creek since its discovery has never attempted to gain more than a living wage from his holdings, and the creek can be called a stronghold of conservatism.

In the lower mile of its course the Deadwood Creek valley broadens out and gradually merges with that of Crooked Creek, and here the values are more disseminated than they are above and, therefore, are not susceptible to profitable exploitation by the crude hand methods. This part of the field is worthy of careful examination by those looking for dredging ground. Though it may be unsafe to predict the probable conditions to be encountered, yet the following suggestions can be made. It is very likely that the bed rock is slabby quartzite schist or soft mica schist, with possibly some granite. Probably the values are considerably disseminated, and it is not to be expected that the gold will be coarse. The alluvium will probably be found to be made up chiefly of well-rounded gravels, and it is, therefore, quite possible

that there are considerable areas of unfrozen ground. There is no measure of the thickness of the alluvium below a point one-half mile above the mouth of the valley, where it was only 10 feet to bed rock. However, it does not seem probable that the bed-rock floor slopes more than 25 feet to the mile, and, therefore, it is not to be expected that the alluvium will be found to be more than 35 feet thick.

Among other improvements which will undoubtedly come is the working of large groups of claims instead of individual holdings. There is no doubt that if the entire creek could be worked by one company there would be a great economy in costs and a greater percentage of the values could be recovered. There appears to be little hope of obtaining water outside of the basin, but the creek itself furnishes an adequate supply in most seasons for at least one large operation.

The gold output for 1906 is estimated to have been about \$120,000 in value, less than 50 per cent of which was taken out by winter drifting. It is estimated that 11 claims were worked during the winter by 35 men and 13 claims during the summer by 60 men.

BOULDER CREEK.

Though the gravels of Boulder Creek are auriferous, as would be expected, for it lies in the gold-bearing zone, yet so far the only placer values found have been on a small tributary called Greenhorn Creek. Here the gravels are only 4 feet deep, but although they carry good values, the lack of water often prevents mining during much of the open season.

MAMMOTH CREEK.

Mammoth Creek, which is formed by the junction of Independence and Mastodon creeks, has a broad flood plain, being 100 to 500 yards wide. The bed rock is probably chiefly schist, but in part granite. The granite yields some large boulders; the schist is as a rule deeply decomposed. The bed-rock floor slopes at a very low angle. The alluvium is probably 10 to 15 feet deep, and is made up of rather well-rounded material, much of which is frozen. In the excavations, boulders of 2 to 2½ feet are not uncommon, and some 3 to 4 feet in diameter were observed. The gold is reported to be fine and its distribution fairly uniform. Mammoth Creek has not been the scene of much mining except at its head and about halfway to its mouth. At the latter place a small steam shovel was installed and a pit of about 6,000 cubic yards capacity excavated some years ago. This was an experiment and the results are said to have been satisfactory to the operators. In 1906 the creek was under examination by dredging men, who seem to be justified in considering this dredging ground.

INDEPENDENCE CREEK.

Considerable gold has been taken out of Independence Creek, but during the last year there were only a few operators at work. At its mouth the valley floor is about 100 yards wide, but narrows rapidly in going upstream. The pay streak appears to be irregular and swings from one side of the creek to the other. The gravels are from 3 to 9 feet deep. There are some well-defined benches along the creek. In 1906 some work was done at half a dozen claims on this stream, but the aggregate output was small.

MASTODON CREEK.

Mastodon Creek contains the richest gravels yet discovered in the district and has been by far the largest producer. The bed rock is practically all quartz and quartz-mica schist, with many quartz veins. At the mouth of the creek the valley floor is about 400 yards in width and gradually narrows down to about 200 yards 2 miles above. The lowest 2 miles of the valley are the richest and contain the largest pay streak, which is about 200 feet wide and 7 to 10 feet thick. In this part of the creek there are well-defined benches some of which have yielded rich placers on the northwest valley slope. About 2 miles from the mouth the walls are steep and apparently have no benches, while the pay streaks are narrower and not so thick.

A part of the alluvium on Mastodon Creek is frozen and therefore could not be dredged unless the ground were first thawed. There are, however, considerable areas that are not frozen. The tailings from former mining operations probably contain enough gold to pay for rehandling with a dredge. The grade of the major portion of the stream is 100 or 200 feet to the mile.

Mining was actively pushed throughout the greater part of the creek during 1906. Most of the operations were by shoveling into sluice boxes, but several steam hoists and one small hydraulic plant with steam scraper were in operation. It is reported that considerable property changed hands during the year preparatory to more extensive operations.

MILLER CREEK.

Miller Creek, though never a large producer, has been worked more or less continuously since 1895. Its bed rock is chiefly schist, similar to that of Mastodon Creek, but the evidence of mineralization is not so strong. The gravels vary from 12 feet in thickness near the mouth to 4 or 5 feet near the head. The pay streak varies from 2 to 6 feet in thickness and 20 to 40 feet in width. The grade of the stream is about 150 to 200 feet to the mile. In 1906 mining was carried on in a small way at half a dozen localities.

HARRISON CREEK.

Gold was found on Squaw Gulch, a tributary of Harrison Creek, as early as 1894, and considerable work was done on the main stream up to 1896. As no high values were found, Harrison Creek was nearly abandoned for the richer placers which promised better returns. It is only within the last two years that the problem of working these relatively low grade deposits has been seriously considered.

The creek has two forks called North and South, on both of which gold has been found, but only the former is now being developed. One of the first discoveries of gold in the basin was at Pitkas Bar, at the junction of the two forks.

The writer visited only the upper 4 miles of North Fork. Here the valley floor is 200 to 300 yards wide, with flat bottom and steep slope on the south side. On the north the valley rises more gently and is deeply covered with talus. There are no excavations in this slope, and while no topographic evidence of benches was noted, it seems not impossible that they may exist beneath the slide material. Farther downstream the valley gradually contracts and is said to narrow down to a steep-walled canyon before it joins South Fork. The valley of South Fork is somewhat broader and appears to be more symmetrical. From the junction of the forks the valley continues to broaden until it merges with the Birch Creek valley 12 miles below.

The bed rock on North Fork is probably chiefly quartz-mica schist, but the occurrence of some granite pebbles in the alluvium indicates the presence of that rock within the basin. The writer saw very few bed-rock exposures, but the character of the alluvium indicates that the schists are cut by numerous quartz veins, many of which are stained with iron, indicating mineralization. A slab of schist cut by a gold-bearing quartz vein found near the forks has already been described.^a

Just above the canyon the bed rock is said to be 20 feet below the surface. From 6 to 7 miles above, near Discovery claim, the writer observed a depth of 8 to 9 feet to bed rock on the north side of the valley and near the center, but only 3 or 4 feet near the south wall. A mile or more upstream the bed rock was found to be 8 to 12 feet below the alluvial floor. In this part of the valley the grade of the stream is probably about 75 to 100 feet to the mile, and that of the bed-rock floor is approximately the same. Although no accurate data are available, the reconnaissance maps indicate about the same grade throughout this basin. Naturally the grade decreases near the mouth and in the canyon it is probably much steeper.

^a Spurr, J. E., *Geology of the Yukon gold district, Alaska*: Eighteenth Ann. Rept. U. S. Geol. Survey, pt. 3, 1898, pp. 353-354.

The alluvial floor of the valley varies in width, but is about 300 feet wide at Discovery claim, and probably this is not far from an average for the two forks. Below the forks, as has been indicated, the valley is much wider. Well-rounded gravels characterize the alluvial deposits so far as seen by the writer. Boulders of more than 2 feet diameter are uncommon, though some of 3 feet were observed. Much the greater part of the material is schist, with some quartz and a little granite. The gravels are well stratified, are loose, and so far as known are not frozen. It is this fact which has prevented the creek being thoroughly prospected, because the water flows in the gravels throughout the year.

There is little turf or muck on the gravels, and the whole section is in most places made up largely of sand and gravel. The bed rock is usually weathered and is broken by seams of clay, a secondary product, but so far as seen by the writer there is no well-defined stratum on the bed rock at the base of the gravels.

The gravels of both forks are known to be more or less auriferous. At a number of localities some gold has been mined by pick and shovel methods, but the values so far as determined are not high enough to make this a paying proposition. It is reported that as high as \$5 a day has been made on this creek. It appears that the values are rather evenly distributed, both horizontally and vertically. There is, however, a marked concentration in the lower 3 to 5 feet of the gravels, and much of the weathered schist carries gold to a depth of 1 to 2 feet. The gold is fine, flaky, and bright colored. The largest nugget reported, with a value of \$4, was found on the upper part of the creek. There has not been sufficient prospecting to determine the value of any considerable body of gravel. While 5, 10, and 30 cent pans are reported from bed rock, these, of course, can not be considered as average values. Near the Discovery claim thirteen pans taken from gravel near bed rock are said to have yielded about \$1 worth of gold. Considerable garnet and pyrite occur with the concentrates.

At the time of the writer's visit only two groups of claims were being developed. In the lower group, embracing several claims near Discovery, a dam had been put in, with a view of ground sluicing and thus concentrating the values, which are subsequently to be shoveled into sluice boxes. A small hydraulic plant has been established on another group of claims, embracing No. 3 to No. 17 above. The gravels here are 8 to 12 feet thick, and the tailings are handled by a small elevator. Water is brought from the creek above through a flume 2,700 feet long under a head of 100 feet. This plant was erected in the fall of 1905, and was run for a short time in the fall and again in the early summer of 1906. At the time of the writer's

visit in August the dry weather had caused a shortage of water, and the mine was not in operation.

Harrison Creek, with its thawed gravels and dissemination of values, would seem to be worthy of investigation by those looking for ground to be mined by steam shovels or dredges. The bed rock, so far as known, is soft and could be taken up by a dredge. Bowlders appear to be absent and the gravels are of a fairly uniform size. As it would require 3 or 4 feet of water to float a dredge it might be necessary to use steam shovels, which would considerably enhance the cost of installation and operation.

EAGLE CREEK.

Gold was discovered on Eagle Creek as early as 1895, but the wave of Klondike excitement, which carried many miners out of the country, retarded its development for several years. Since 1901 much profitable mining has been done on this stream.

Eagle Creek has two forks. The northern, called Miller Fork, does not appear to carry values, but on the southern, called Mastodon Fork, placers have been found. The main stream has a gravel-floored flood plain 100 to 400 yards wide, but the tributaries flow through V-shaped gulches. The bed rock appears to be chiefly schist, with an abundance of quartz.

The alluvium varies from 8 to 20 feet in thickness. Of this 5 to 15 feet is muck. The gravels are subangular, but are fairly well stratified and carry considerable clay. The bottom layer is usually made up of 1 or 2 feet of sticky clay. The gravels are not frozen below the surface and water circulates through them all winter. The grade of the stream is reported to be about 100 feet to the mile. The pay streaks are 4 to 8 feet in thickness and vary from 30 to 80 feet in width. In some places parallel pay streaks have been mined. Much of the gold is coarse and it has a bright color, with higher value than any other of the district.

Mining has been carried on for about 2 miles along the main creek and half a mile up Mastodon Fork. A large part of it has been done by drifting in winter. Though the pay streaks are rich, the cost of operating, in view of the fact that all drifts had to be timbered, has been great. It is reported that during the winter of 1905-6 about 25 men were at work on the creek. Recently a large group of claims has been bought up on this creek, and it is reported that a company contemplates working them by dredging methods.

OTHER CREEKS.

Besides those described above gold has been found on a number of other creeks, which have yielded very little. None of these were visited by the writer except Twelvemile Creek, where no values have

been found. On this stream the bed rock is made up of a slabby quartzite, together with schists. Twelvemile Creek has a broad flood plain, but nothing is known of the depth of gravels, though they do not appear to be deep. Other streams in this part of the Birch Creek basin are said to carry auriferous gravels. A little mining has been done on Porcupine Creek, a tributary of Crooked Creek near the mouth of Miller Creek. The valley of the stream is wide and the gold in the gravels appears to be much disseminated. The gravels are said to be 12 to 15 feet thick. Some excitement was caused during 1906 by the discovery of gold on Portage Creek, a tributary of Medicine Lake, in the southeastern part of the Birch Creek basin. Though about \$200 worth of gold was said to have been taken out of one claim, further prospecting failed to reveal any values.

At various times gold has been reported in the Preacher and Beaver Creek basins, but the presence of values has never been established. These basins appear to lie outside of the gold-bearing area, though details in regard to the geology are meager.

CREEKS TRIBUTARY TO YUKON RIVER.

GENERAL GEOLOGIC FEATURES.

The influx of prospectors in 1898, following the discovery of the Klondike, led to considerable prospecting along the streams tributary to the Yukon between the boundary and Circle. So far as known no placers have ever been found in the streams of this region entering the Yukon from the north. Mission and Seventymile creeks are referred to on page 38, and the present discussion will be confined to Washington, Fourth of July, and Woodchopper creeks, together with some smaller streams.

So far as known to the writer the gold that occurs on these streams is from a different formation than that found in the Birch Creek basin, and in at least one place it has its source in a conglomerate. Therefore the character and extent of the deposits are probably different from those of the placers above described. It must be admitted, however, that the evidence at hand is too incomplete to permit definite assertion in regard to the bed-rock geology of much of this belt.

The rocks exposed along the Yukon between Eagle and Circle do not anywhere include any of the older schists, such as are associated with the Birch Creek placers. In fact, over much of this belt the formations are slightly altered limestones, shales, slates, and conglomerates, which do not bear evidence of mineralization and will not attract the placer miner. Locally, however, some of these rocks are mineralized and contain more or less gold. Thus on Nugget Gulch,

a tributary of Washington Creek, slates of Cretaceous age are found which are permeated with quartz veins, some of which must yield gold, as the associated alluvium is auriferous. The writer was not able to study this locality, but it appears that the coarse gold occurs in small patches on the bed rock. 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.

The occurrence of gold in the conglomerate has an entirely different significance. 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.

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,^a 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.

The double concentration which must have taken place while the gold of these placers passed from its original source in the bed rock through the conglomerate and into the alluvium of the present streams is favorable to the formation of rich placers, yet none have

^a Spurr, J. E., *Geology of the Yukon gold belt, Alaska*: Eighteenth Ann. Rept. U. S. Geol. Survey, pt. 3, 1898, pp. 365-366.

been found. This is probably due in part to the fact that the conglomerate itself carries no great values and in part to the fact that much of the conglomerate has not been affected by erosion and therefore the gold in it has not been re-sorted.

The placers to be described here have little in common, and therefore few general statements can be made. So far as they have been opened up, neither high values nor extensive pay streaks have been found. It is by no means impossible that somewhere in the conglomerate belt erosion has found a rich layer in the conglomerate and that more valuable placers have been formed than any thus far discovered.

These placers have the advantage of being more accessible than most of those in the Yukon basin. Most of them are not over 10 or 15 miles from steamboat transportation on the Yukon. As they lie in the lower parts of the plains of considerable streams, they could probably be reached with water carried in ditches, provided there is a sufficient body of auriferous gravel to warrant the outlay.

NOTES ON DEVELOPMENT.

FOURTH OF JULY CREEK.

Fourth of July Creek was not studied by the writer. The best information obtainable indicates that the bed rock is limestone and slate with some conglomerate. The gold is said to have its source in the conglomerate. The deposits are reported to be from 10 to 20 feet thick, 6 to 15 feet being made up of muck and 4 to 5 feet of gravel, of which 3 feet is said to carry values. The gold is flat, fine, and bright colored. The largest nugget was valued at \$2.25. As a rule the bed rock is deeply weathered. One bench is reported to carry values, but the relations are obscured by the abundance of slide matter.

A trail 10 to 12 miles long leads from Nation, on the Yukon at the mouth of Fourth of July Creek, to these placers. Though many claims have been staked and considerable prospecting done, the ground thus far productive is limited to a small group of claims. The total output since the discovery in 1898 is estimated at between \$25,000 and \$30,000 in value. Plans are said to be under foot looking toward larger operations in this field. It is reported that half a dozen men were at work here in 1906.

WASHINGTON CREEK.

GOLD.

Washington Creek flows through a northward-trending valley, whose floor is from half a mile to a mile in width. The bed rock for the lower 3 miles of the creek is black slate or shale of Cretaceous age.^a

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

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 slate, which forms the bed rock 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 bed rock. Values are so irregularly distributed that it is questionable whether they 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 bed rock 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.

Washington Creek has been the scene of some ill-advised attempts at coal mining. Though there is considerable lignite in the basin, much of the money spent in development has been wasted on experiments in transportation rather than in testing the seams as to extent and quality. The coal openings are from 10 to 14 miles up the creek, and as the seams exposed appear to be of no better quality or greater thickness than others which lie much closer to the Yukon, the outlook for profitable exploitation is not hopeful. The seam examined by the writer, about 14 miles from the river, occurs in friable sandstone and shales, striking about east and west and dipping 30° N., and showed the following section. The exposure is on the north side of the valley, about 40 feet above the stream level.

Section of coal seam on Washington Creek.

	Ft. in.
Roof, soft blue-gray shale.	
Shaly lignitic coal.....	2 6
Clay.....	0 2
Shaly lignitic coal.....	2 0
Bone parting.....	0 2
Good lignitic coal.....	1 0
Clay.....	0 5
Good lignite.....	1 0
Clay shale.....	0 1
Impure coal (lignite).....	0 3

	Ft.	in.
Clay shale.....	0	2
Coal (lignite).....	1	4
Clay shale.....	0	2
Lignitic coal with some partings.....	2	0
Clay shale.....	0	3
Impure lignitic coal.....	1	0
Good coal (lignite).....	0	1
Clay shale.....	4	0
Good lignitic coal with bone partings.....	1	4
Clay shale with some bone partings.....	4	0
Covered, but probably no coal.		

The coal carries considerable sulphur. On burning it produces many clinkers. The ash has a reddish tinge. The following is an analysis of a sample taken from this same district a little lower down the creek:

Analysis of coal from Washington Creek.^a

Water.....	13.48
Volatile combustible matter.....	43.74
Fixed carbon.....	39.68
Ash.....	3.10
	100.00
Sulphur.....	.24

The remarkably low percentage of ash suggests that this sample was taken from one of the minor seams and was not an average of the entire section exposed. Such a grade of coal could probably only be secured by hand picking after mining.

During 1905 and 1906 a company attempted to establish a winter transportation system to the Yukon by the use of a 100-horsepower traction engine, which was expected to haul five sleds, each of 10 tons capacity. While such a scheme might be feasible with a good road-bed, it proved entirely impracticable without one. This plan involves the storage of the coal hauled in winter for consumption during the summer months—a doubtful experiment, because the lignite slacks readily after being exposed to the air.

In spite of the adverse conditions of mining and low grade of coals in this field, it shares with other fields of the Yukon a prospective value. There can be no question that with the present increase in the demand for fuel and the rapid destruction of the forests the time is not far distant when the Yukon lignites will play an important part in the commercial development of the inland placer districts.

COAL CREEK.

Coal Creek, together with its tributaries, Sam and Colorado creeks, which have yielded a little placer gold, was not visited by the writer, but to judge by the juxtaposition to Woodchopper Creek, it appears

^a Collier, A. J., Coal resources of the Yukon: Bull. U. S. Geol. Survey No. 218, 1903, p. 31.

probable that the conditions of occurrence of the placers are about the same. Apparently, however, from the reported discovery of a galena-bearing quartz vein on Colorado Creek, all of the basin is not underlain by conglomerate. It is not known to the writer whether this vein carries values or what its dimensions are.

Three or four claims are said to have been worked in this basin during 1906. Most of the gold is said to have been taken from bar diggings in the main creek.

WOODCHOPPER AND MINERAL CREEKS.

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 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 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 bed rock is taken up, depending on its looseness. Apparently gold occurs in bed rock beyond the depth to which it can be profitably extracted. The bed rock 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 bed rock 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 bed rock are reported, but there are no data available for the average tenor of the pay streak.

Though Mineral Creek was staked as early as 1898, actual mining did not begin until several years later. In 1906 eighteen men were engaged in mining on this creek and more or less work was done on seven claims. Most of the work was by "shoveling in" methods, but one small hydraulic plant was used for stripping and three steam hoists were operated. Most of the mining was done in winter with the aid of steam points. The total production for 1906 is estimated to have been \$18,000, of which four-fifths was taken out in winter.