OCCURRENCE OF GOLD IN THE YUKON-TANANA REGION.

By L. M. Prindle.

INTRODUCTORY STATEMENT.

The placer-gold production of the Yukon-Tanana region up to 1907, inclusive, has been approximately $33,500,000, or nearly one-third the total gold production of Alaska; of this amount over two-thirds has been contributed by the Fairbanks district. The importance of this region has led to comprehensive work by the Geological Survey. The mapping of the region, commenced in 1898 by the mapping of the Fortymile district, has been carried on continuously since 1903, until at the present time the greatest part of it has been mapped on a scale of 1:250,000, or about 4 miles to the inch. Geologic work of a reconnaissance nature, commenced by Spurr, Goodrich, and Schrader in 1896,[a] has also been carried on continuously since 1903, and a body of material has been collected that has not yet been thoroughly studied. The following statements, therefore, being based on a very superficial study of the data, have only provisional value. A map (Pl. IV) has been prepared to show the distribution of known gold placers, of the main rock groups of sedimentary origin, of intrusive rocks so far as they have been approximately delimited, and of recent volcanics.

BED ROCK.

The rocks of sedimentary origin in this region include essentially two groups—one of metamorphic, complexly folded schists provisionally assigned to the pre-Ordovician, and another, supposedly in unconformable relation to the schists, of phyllites, greenstones, quartzites, and limestone belonging to the Silurian, Devonian, and Carboniferous. Besides these two groups there are areas of Lower Cretaceous slates along the Yukon, Upper Cretaceous sandstones and shales in the Rampart region, and several areas of Tertiary clays, lignites, sandstones, and conglomerates.

[a] Spurr, J. E., and Goodrich, H. B., Geology of Yukon gold district, Alaska: Eighteenth Ann. Rept. U. S. Geol. Survey, pt. 3, 1898, pp. 87-392.

Igneous rocks are present as intrusives and extrusives. There are many large areas of intrusive rocks in the eastern part of the region, and the portions of them that have been traversed are indicated on the map (Pl. IV). Isolated areas are scattered throughout the region and there are probably many more than are shown on the map. These rocks range in composition from acidic granite to peridotite. Granitic rocks and those of intermediate composition are most common. Some of the granites have been metamorphosed to granitic gneisses and have been intruded by later granites. The only age of intrusion that has been definitely established is that of rocks of intermediate composition in the vicinity of Rampart, where Paleozoic rocks and Upper Cretaceous sandstones have been intruded. The greenstones of Paleozoic age are largely altered diabasic and basaltic flows.

Areas of fresh volcanic rocks are indicated in the eastern part of the region, where they occur generally as masses capping the hills of schist or as plugs with a surrounding mass of volcanic material. In one place they occur as a small volcanic cone. The composition of the volcanic rocks parallels that of the intrusives to a certain extent; there are rhyolitic, andesitic, and basaltic types. The latest volcanic rocks are believed to be at least post-Tertiary and are possibly of Quaternary age.

ALLUVIAL DEPOSITS.

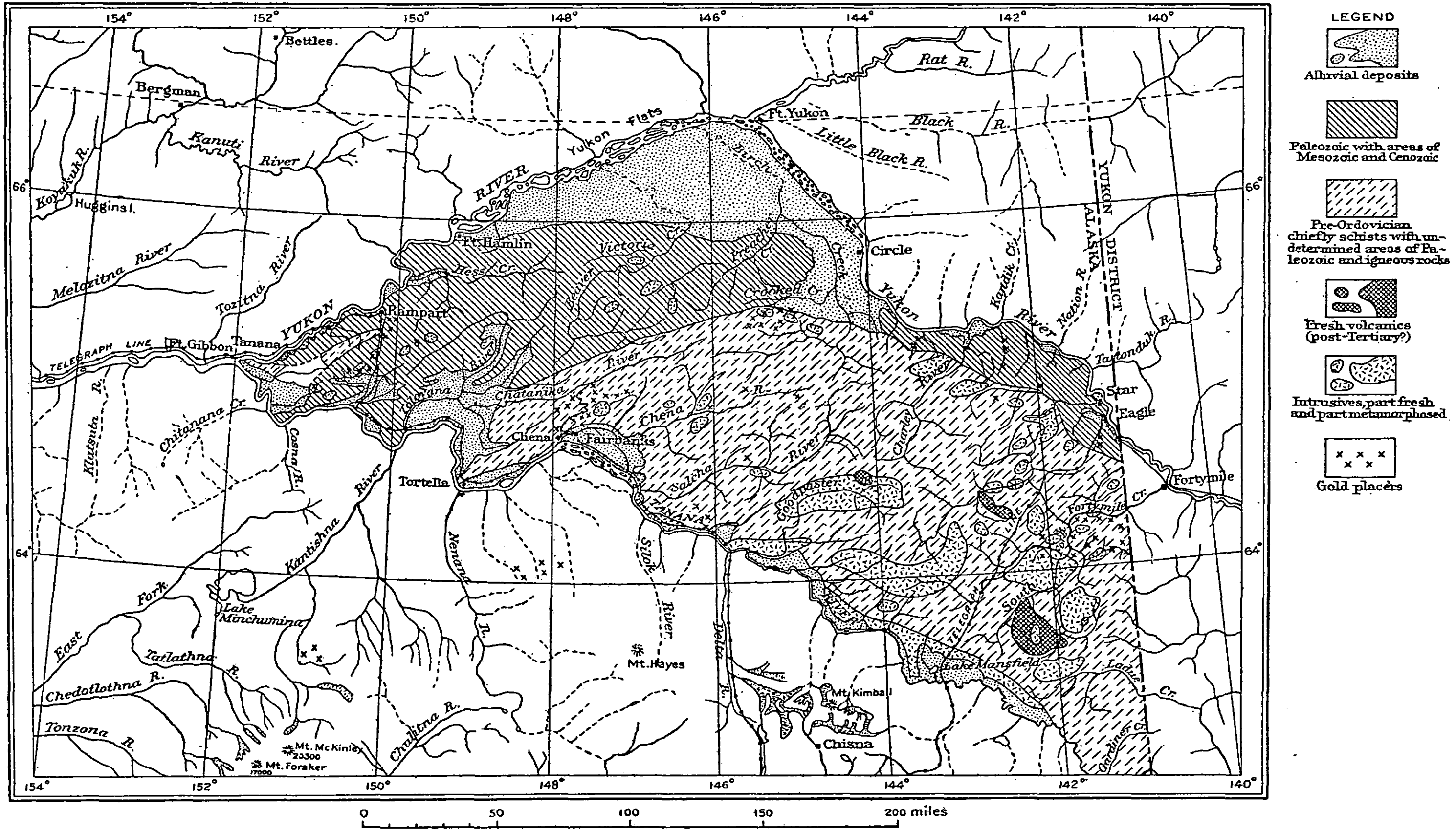
GENERAL CHARACTER.

The alluvial deposits comprise silts, sands, and gravels of Pleistocene and Recent age, and these are partly auriferous. The Fortymile, Birch Creek, Fairbanks, and Rampart districts have up to the present time produced most of the placer gold, but intervening areas have also proved somewhat productive and the causes of mineralization have evidently been in operation over a large part of the region. Though the alluvial deposits have furnished practically all the gold that has been produced, a few localities have been found where gold occurs in the bed rock.

The alluvial deposits containing gold include chiefly the present stream gravels and the bench gravels related to the valleys of these streams. Most of these deposits are frozen throughout the year. It is possible, also, that some of the Tertiary conglomerates have contributed a small part of the alluvial gold.

STREAM GRAVELS.

The extent and thickness of the stream deposits vary greatly in different valleys. Narrow valleys, like that of Franklin Creek in the Fortymile district or the upper part of Deadwood Creek in the Birch



GEOLOGIC SKETCH MAP OF YUKON-TANANA REGION.

Creek district, have a narrow deposit of gravels sufficiently shallow to be worked almost entirely by open cuts. Wider valleys, like those of Wade and Mastodon creeks, have wider and thicker deposits that are still, however, largely workable by the open-cut method. Open valleys, like that of Chicken Creek in the Fortymile district or those of the Fairbanks district, have a great extent of alluvial deposits that reach in parts of the Fairbanks district a thickness of more than 300 feet.

The alluvial deposits containing gold are, in general, separable into an overlying bed of muck, an intermediate bed of barren gravels, and an underlying bed of gravels containing the gold. These beds are in some places well defined; in others they grade into one another. The three are not everywhere present and some of the stream deposits have been invaded by slide rock from the valley sides. The auriferous gravels may have a thickness of several feet or the gold may be confined mostly to the surface of the bed rock. Where the bed rock is blocky, the gold is generally found also to a depth of a few feet in its cracks and crevices. The width over which gold is found differs greatly in different valleys; in some it is several hundred feet. In some valleys the pay streak is well defined and continuous; in others the distribution of values is very local and irregular.

The source of the stream deposits, in the absence of general glaciation in the Yukon-Tanana region, is referable to the bed rock in which the valleys of the streams have been cut.

BENCH GRAVELS.

Bench deposits at different levels from a few feet to several hundred feet above the present streams are common in many of the larger drainage areas. In the Fortymile district they occur on the high benches of Fortymile Creek and some of its tributaries to a level of at least 300 feet above that of the present streams. In the Rampart region there are bench gravels 500 feet above the valleys. The bench gravels occupy positions in the old valleys corresponding to those of the stream gravels in the present valleys. They are the remnants of the old valley deposits left behind in the downward cutting of the streams to their present level, and the gravels at different levels mark the pauses, with attendant deposition, in this process. Like the stream gravels, they reflect in their composition the character of the bed rock in the valleys to which they belong. They are of widely differing thickness in different areas, and at some localities, notably in the Chicken Creek area and in the Rampart district, they have been found rich in gold.

AURIFEROUS CONGLOMERATES.

Conglomerates regarded as Tertiary occurring in the Yukon-Tanana region are so much older than the stream and bench gravels that the conditions of their formation are obscure. The gravels forming them, however, were probably deposited under fluviatile conditions associated with or subsequent to lacustrine conditions, and since their deposition have been consolidated and folded. These rocks form a well-defined belt in the area between the Seventymile and the Yukon and westward toward Circle. The gravels of several creeks draining this area contain gold and have been mined for several years. Their gold content is regarded by Brooks[a] as evidence of the presence of alluvial gold in the conglomerates.

ORIGIN OF GOLD.

All the available evidence regarding the origin of the placer gold in the Yukon-Tanana region indicates that it has not been deposited in the placers from solution, but has been derived with the other constituents of the gravels by mechanical separation from the bed rock. Inasmuch as the material forming stream and bench gravels is definitely referable to the bed rock of the respective valleys, those auriferous valleys where there is the least variety of bed rock should throw some light indirectly on the origin of the gold. Furthermore, the immediate associates of the gold, or, better still, adherent pieces of other mineral or rock, bear definitely on this problem. If in addition to these indirect sources of information, localities can be cited where gold occurs in place in the bed rock, a considerable body of material will have been assembled that should prove illuminative of at least some phases of the origin of the placer gold.

There are few creeks in the Yukon-Tanana region where the geologic conditions are relatively simple. The variety of bed rock of sedimentary origin is further complicated by the intrusive rocks that are locally present in all the important placer-mining areas. Under what are apparently some of the simplest conditions, however—those on Wolf Creek in the Fairbanks districts, where the bed rock observed in the amphitheatral area at the head of the creek is quartzitic schist and quartz-mica schist with small quartz veins and where the gravels so far as observed are of the same material—the rough, gritty gold, some of it with quartz attached, must have been derived from the schist and most likely from quartz stringers cutting it. The conditions of origin are apparently the same in Fairbanks Creek, heading on the opposite side of the same ridge. On Harrison Creek, in the Birch Creek region, where the same bed rock prevails, a slab of similar schist was found in the gravels containing a gold-bearing

[a] Brooks, A. H., Report on progress of investigations of mineral resources of Alaska in 1906: Bull. U. S. Geol. Survey No. 314, 1907, pp. 198–200.

quartz seam. This occurrence was described by Spurr.[a] A similar association has been observed on Davis Creek, in the Fortymile region. The fact seems definitely established that in some of the most productive regions a part of the gold, at least, has been derived from the quartz veins in the schists, and as these schists are the most common rocks in the Fortymile, Birch Creek, and Fairbanks districts, it is probable that a large proportion of the gold has had this origin. That the mineralization of the schists has not been confined to the deposition of gold is shown by the facts that in the Fairbanks district stibnite (sulphide of antimony), cassiterite (oxide of tin), and bismuth have been found in association with the gold in the placer deposits and that veins of stibnite have been found in the schists.

Rocks regarded as Paleozoic are present in the Fortymile district and some of the gold occurrences are referable to these rocks. The same is probably true of the Rampart district, where the rocks are predominantly Paleozoic but where there are also pre-Ordovician schists and a few Mesozoic rocks of Upper Cretaceous age. In the Rampart region native silver is a common associate of the gold on some of the creeks, and native copper is also found.

The metals and minerals associated with gold in the placers of the Yukon-Tanana region include lead, silver, copper, bismuth, argentite (silver sulphide), stibnite (antimony sulphide), galena (lead sulphide), cinnabar (mercury sulphide), iron pyrites, copper pyrites, barite, cassiterite (tin oxide), rutile, garnet, magnetite, hematite, and limonite.

On creeks tributary to the Yukon a close relation has been observed by Brooks between the alluvial gold and Lower Cretaceous slates. and the following is quoted from his report:[b]

> 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.

[a] Spurr, J. E., and Goodrich, H. B., Geology of the Yukon gold district, Alaska: Eighteenth Ann. Rept. U. S. Geol. Survey, pt. 3, 1898, pp. 353–354.

[b] Brooks, A. H., Report on progress of investigations of mineral resources of Alaska in 1906: Bull. U. S. Geol. Survey No. 314, 1907, pp. 198–199.

Gold has been found in place at several localities within the Fortymile district, and these are described briefly in the succeeding paper. At the locality on Mosquito Fork about 2½ miles from Chicken Creek the gold occurs in a brecciated mineralized zone in a quartz diorite. There has been considerable silicification and an abundant introduction of iron pyrites. At the locality near the head of Chicken Creek the gold occurs in thin calcite veins that are associated with pyritiferous quartz veins in black phyllites regarded as Paleozoic. These are in contact with quartz diorite porphyry, the marginal facies of a rock like that on Mosquito Fork. The placer gold of Chicken Creek is derived in part, at least, from a deposit of this form. At Canyon Creek there is a brecciated mass of vein quartz and quartzitic schist. The rock here is very ferruginous and locally fragments have been found containing specks of gold visible to the eye. In the Flume Creek occurrence there are numerous small auriferous quartz veins penetrating a serpentinous igneous rock that is intruded by basic dikes. Other occurrences of gold in bed rock are reported, but have not been studied by the writer.

So far as definitely known, then, at the present time, the placer gold of the Yukon-Tanana region is traceable to quartz veins in the pre-Ordovician schists, apparently also to those in the Paleozoic phyllites, and possibly to those in the Cretaceous slates; to calcite veins in rocks regarded as Paleozoic in close contact with igneous rocks; and to quartz veins and silicified areas of secondary origin in igneous rocks.

A consideration of the map shows that igneous intrusives have a wide distribution over the entire region and are present in all the chief placer-mining districts. They are also of widely differing age. The Upper Cretaceous rocks in the vicinity of Rampart have been intruded by them and mark, so far as known, the last period of intrusion of plutonic rocks in the Yukon-Tanana region. Mesozoic rocks have not been found in other areas of intrusion and it is not known how many of the areas of fresh igneous rocks of granitic and intermediate composition are referable to this period. It is probable, however, that a large proportion of them were intruded at this time. Some of the granitic rocks and schists are cut by fresh basaltic dikes and the areas of fresh volcanic rocks attest the continuation of igneous activity. The question whether these volcanic rocks have taken part in the mineralization of the region has not been answered.

There are several hot springs in the region, and at least two of them are near the contact of granitic rocks with schists and with carbonaceous phyllites. The temperature of these waters is probably due to the residual heat of the igneous masses and indicates the long-continued operation of one of the factors influential in mineralization.

This region is regarded as one of large batholithic masses of intrusive rocks, now mantled by a comparatively thin shell of sedimentary rocks. Intrusions have taken place at different periods. Some of them have been accompanied or followed by numerous dikes and sills of an acidic character, and it is probable that at such times the depth of intrusion was so great as to favor, through increased pressure and temperature, a wide dissemination of the final products of the crystallizing magma through the surrounding rocks as acidic dikes and sills, as intrusive quartz veins, and finally as the ordinary quartz veins so common in the schists. Where the intrusives have penetrated to higher levels, as in the Upper Cretaceous rocks of the Rampart region, there was no opportunity for long-continued differentiation and distribution of the magma in such attenuated form and the action under such conditions has been confined to contact metamorphism and the release of the waters of intrusion to act as solvents, to mingle ultimately with meteoric waters, and to leave behind them the quartz or calcite or other substances carried in solution.

The acidic dikes and sills are very common in the Fortymile district. They have in places been crumpled and reduced to augen and exhibit generally cataclastic action. They are apparently most characteristic of the older intrusions. The occurrence of gold in the Fortymile district has not been traced directly to them, and they are not common in the Birch Creek, Fairbanks, and Rampart regions.

The intrusives of the Birch Creek, Fairbanks, and Rampart districts are comparatively fresh, and similar fresh intrusives are common in the Fortymile district. Many of these masses are surrounded by shatter zones of rock containing numerous dikes of the same material as the main mass, or a more basic marginal phase. The period of intrusion was one of great disturbance. The gold in the Chicken Creek area is in close relation with such intrusives and it is believed that in this locality at least they mark a period of mineralization accompanied by the deposition of gold derived primarily from the igneous rocks. The age of this period of mineralization is not known. The quartz veins in the Lower Cretaceous slates of Washington Creek regarded as auriferous by Brooks and ferruginous quartz veins in Upper Cretaceous rocks of the Rampart region that have been intruded by granitic rocks indicate a period of mineralization that is probably to be referred to such intrusions, and those of Chicken Creek may belong to the same period. There is as yet no direct evidence bearing on this point. The influence of igneous intrusion is far-reaching, especially in areas of such permeable rocks as siliceous schists, and in view of the widespread distribution of igneous rocks in the Yukon-Tanana region, both in space and time, and their relation to the facts at our disposal, it seems justifiable to ascribe to them the widespread mineralization of the region and to refer a part, at least, of this mineralization to the close of the Mesozoic. In this connection it is important to note the relation of mineralization to Mesozoic intrusion traced by Wright in southeastern Alaska.[a] It might be inferred, perhaps, that if the igneous intrusives have been responsible for the gold, the most productive areas should be found in the vicinity of the most abundant intrusives. Little, however, is known regarding the laws governing the occurrence of the gold in the bed rock. The composition of the intruding rock, the conditions of intrusion, and the character and physical structure of the intruded rock are among the factors in the problem. It is probable that extensive deformation at the time of intrusion, by rendering the surrounding rocks more permeable, facilitates the transportation of material from the igneous magma. It is perhaps true that in the vicinity of a cooling intrusive mass conditions favorable for solution may be maintained so long that gold derived from this source is carried in solution far into the surrounding rocks before reaching areas where conditions favorable for deposition prevail.

Some of the most productive placer areas lie within the pre-Ordovician schists and some within the Paleozoic rocks. Even in the Rampart region, where the Paleozoic rocks are abundantly developed, the older rocks are present, and the Birch Creek, Fairbanks, and Fortymile areas are not far removed from the present contact of the two groups. It seems probable, therefore, that these areas of gold deposition were adjacent to what before erosion was the contact plane of the two groups, and this plane may have afforded a favorable zone for circulating waters at the time mineralization was in progress.

SUMMARY.

So far as can be judged by present knowledge of the region, intrusion has been very general, especially in the schists, and continued to the close of the Mesozoic. Gold is very widely distributed in small quartz veins in the schists, and locally has been so abundant as to have proved richly remunerative in the associated placers. Gold is also present here and there in the Paleozoic rocks, and possibly also in later rocks, presumably in areas of intense deformation accompanied by intrusion. It has been found also in igneous rocks, where it has been introduced subsequent to the intrusion. It may be stated in conclusion that up to the present time no large body of bed rock carrying commercial values has been recognized, and that the areas of greatest and most extensive concentration in placers are in well-developed drainage systems, where there has been a long opportunity for the slow concentration of gold in the alluvial deposits.

[a] Wright, C. W., Bull. U. S. Geol. Survey No. 314, 1907, pp. 49–51.

THE FORTYMILE GOLD-PLACER DISTRICT.

By L. M. Prindle.

INTRODUCTORY STATEMENT.

The Fortymile quadrangle includes the area between the 141st meridian, which is the international boundary, and the 142d meridian, and the 65th and 64th parallels. The area is about 70 miles long from north to south, and 30 miles wide. It produced during 1907 approximately $150,000 in placer gold. The present brief paper gives some of its salient features. A more detailed description of the district is in preparation.

Fortymile Creek crosses the southern part of the district and in this region was located the first center of gold production in the Yukon basin. The knowledge of conditions acquired there was applied effectively in other regions that were afterward developed, and these in turn are having a reactive influence. The stage of mining in which the productive unit is a mining claim is giving place to that in which the productive unit is a group of claims worked by a process correspondingly efficient. Such methods are becoming increasingly necessary to meet the conditions that now prevail. To evaluate these conditions and to determine in a particular locality the sufficiency of a mining method to meet them successfully is the problem of the mining engineer. To state very briefly the main geographic and geologic facts and the mining developments of 1907 is the scope of the following description.

Considerable work has been done in this region by the Geological Survey. It was investigated by Spurr, Goodrich, and Schrader in 1896;[a] the quadrangle was mapped by Barnard in 1898 on a scale of about 4 miles to the inch; it was traversed by Brooks in 1899; and since 1903 parties from the Survey have been mapping adjoining areas and investigating conditions in the gold-placer regions. During the summer of 1907 the writer continued his work in the region by traversing the southern portion of the area covered by the map.

[a] Spurr, J. E., and Goodrich, H. B., Geology of the Yukon gold district, Alaska: Eighteenth Ann. Rept. U. S. Geol. Survey, pt. 3, 1898, pp. 87–392.

GEOGRAPHIC SKETCH.

RELIEF.

The country is one of undulating, rather even topped ridges separated by deep, relatively narrow valleys. Isolated domes rise above the general level of the ridges, which are locally of considerable prominence. Glacier Mountain attains 6,000 feet above sea level. The level of the Yukon at Eagle is about 800 feet. In general, the ridges are from 1,500 to 2,000 feet above the streams.

DRAINAGE.

The drainage of the northern part of the quadrangle is directly to the Yukon; that of the southern part to Fortymile Creek. Yukon River, crossing the northeast corner of the area, receives from the west Seventymile, Mission, and Boundary creeks. Fortymile Creek is a powerful stream and receives many important tributaries that have their sources far outside of the area covered by the map. There is considerable difference in valley development, but in general the valleys of the smaller streams are similar. Most of the larger streams have formed valley floors a few hundred feet in width. Benching is prominently developed in the larger valleys throughout the region at different levels, from a few feet to over 300 feet above the present streams. The Fortymile Valley is an example of the canyon type. The stream is deeply sunk and is still cutting downward, and the lower valleys of most of its tributaries are also narrow canyons. The streams in general head at about the same level and are cut to about the same depth. Any undertaking, therefore, involving water supply requires most careful preliminary measurements of available water and grades.

CLIMATE AND VEGETATION.

There are a few aspects of the climate that have an important economic bearing. The Yukon closes to navigation at dates ranging in different seasons from about October 10 to November 20 and does not open till dates ranging from about May 10 to May 20. Much of the ground is permanently frozen to bed rock and requires special treatment. Notwithstanding the extreme cold, there is much free water in the ground during the winter, and in many streams the water breaks through the ice already formed, causing overflows, which, although quickly frozen, are often a source of trouble and delay in travel. Constant repetition of this process throughout the winter results in the formation of thick deposits of ice in some of the smaller valleys, and these may linger till late in summer, thus further shortening the working season. Dams and other improvements are sometimes buried beneath such accumulations of ice and damaged beyond repair. This glaciering of streams is characteristic of the region, and must be taken into consideration in planning work.

The timber resources are moderate. Spruce grows abundantly in the valleys of the larger streams and is sparsely distributed over the hillsides throughout the area. It has been used generally for sluice boxes and to some extent for dredge building, the largest timber available for this purpose furnishing logs 12 to 15 feet long and a foot in diameter. Birch is common in some of the valleys, but is of minor importance. Timber for fuel is still abundant.

TRANSPORTATION.

Transportation to the creeks of the Fortymile region has always been difficult, and the situation has been rendered more complex by the presence of the international boundary with its attendant customs regulations. Most of the supplies are purchased in Dawson, Yukon Territory, and freighted up Fortymile Creek on the ice by horse sleighs during the winter months. The freighting was delayed to some extent during the winter of 1906–7 by the occurrence of glanders among the horses and by overflows to which the creek is subject. About 400 tons were shipped by this method for the dredge on Walker Fork and 100 tons for the dredge below Franklin Creek. The freight rate from Fortymile Post to the latter locality was $70 per ton in 1907. Summer freighting on Fortymile Creek is done by poling boats. It is a difficult stream to navigate, and boat loads of material are frequently lost or long delayed by low water. The rates from Fortymile to the farthest locality, Chicken Creek, are about 25 cents per pound. Cattle are frequently driven overland on the wagon road from Dawson to Glacier, a distance of 60 miles, and thence to the various creeks on the Alaska side, where they are sold.

The road commission has surveyed a Government wagon road from Eagle to the Fortymile country and has already practically completed about 9 miles of it, from Eagle to American Creek. Work is also being done on a road to make the Seventymile country more accessible from Eagle. During the fall of 1907 a road was constructed by private means from the head of Canyon Creek to Walker Fork, in order to save the long haul up the Fortymile in the winter.

Work was commenced in 1907 on the survey of the international boundary southward from the Yukon. This work includes also the topographic mapping of a strip of country 2 miles wide each side of the boundary. The work is carried on by representatives of both governments. The results will be final and will set at rest all doubt on the part of the miners as to the position of the boundary.

GEOLOGIC SKETCH.

The rocks of the Fortymile quadrangle are composed of highly metamorphosed schists with interbedded limestones, all assigned provisionally to the pre-Ordovician; of less-metamorphosed rocks including Devonian phyllites, greenstones and limestones, and Carboniferous slates and limestones; of Tertiary clays, lignite, sandstone, and conglomerate; of bench and stream gravels probably of Pleistocene and Recent age; and of intrusive igneous rocks, some of which have been metamorphosed with the schists.

PRE-ORDOVICIAN ROCKS.

The schists include essentially thin-bedded, little-altered quartzites, quartzite schist, quartz-mica schist, garnetiferous mica schist, hornblende schist, and carbonaceous schist. All these may occur in close alternation with each other. Crystalline limestones are interbedded with them in layers from a few inches to a hundred feet or more in thickness. The structure is most complex. Dips and strikes present much variability. In places the rocks are nearly horizontal, but such horizontality is in some localities the result of complex folding. In general the rocks lie in a highly inclined attitude. Closely appressed folds are common, and these in places pitch at high angles, even becoming vertical. Furthermore, there has been motion that has resulted in shearing planes at angles with these highly pitching folds. Thinly bedded quartzite and mica schist have been thus transformed into rods of quartzite a foot or more in length, with lenticular cross sections an inch or more in diameter. In a weathered cross section of such beds the eyes of quartzite in a micaceous matrix present the appearance of a metamorphosed quartzite conglomerate. The structure is further complicated by the abundant occurrence of intrusives, some of which have become so closely incorporated with the schists that they are not easily recognizable as of different origin. In spite of the complexity of the structure, a general strike is discernible, and this is nearly east and west, with variations to the north and south of this direction.

These schists with their interbedded limestones form the bed rock throughout the southern half of the Fortymile quadrangle, with the exception of an area to the southwest occupied by the other formations referred to above and several considerable areas of the intrusives. These rocks are finely exposed in the valley of Fortymile Creek from a point a short distance above Franklin Creek to the international boundary and beyond into Canadian territory. In the northern part of the quadrangle they are present on Seventymile Creek at the falls and above to the limits of the quadrangle.

A narrow belt of them lies at the base of the ridge adjoining Mission Creek on the north. They form also Fortymile Dome. The approximate northern boundary, with the exception of the Mission Creek occurrence, which is probably isolated, extends from the north end of Glacier Mountain to the international boundary near the head of Liberty Fork. The age of these rocks is at present unknown. They are probably at least pre-Ordovician.

PALEOZOIC ROCKS.

Green and black phyllites, greenstones, and limestones, regarded as for the most part of Devonian age, are present in the northeastern part of the quadrangle in the drainage areas of American and Mission creeks. They form the bluff at Eagle and those above Eagle on the left bank of the Yukon, and are abundant along the river below Eagle, where they are associated with Carboniferous rocks. In the southwestern part of the quadrangle they occur on Fortymile Creek from the mouth of Denison Fork to a point about 2 miles above Franklin Creek. The drainage area of Chicken Creek is formed partly of these rocks. They occupy a belt in the area about the headwaters of King Solomon and Champion creeks. There is a small area also on Canyon Creek above the mouth of Mariner Creek. These rocks have in places been closely folded, but the degree of metamorphism is much less than that of the schists, fossil fragments, chiefly crinoid stems, being of common occurrence in the limestones.

TERTIARY DEPOSITS.

Tertiary clays and sandstones with some interbedded lignitic coal and massive conglomerates with interbedded shales have a wide distribution in the northern part of the quadrangle, in the valleys of Seventymile and Mission creeks, and small patches are found at the southwest in the valleys of Napoleon and Chicken creeks. These rocks have in places, notably on Seventymile Creek, been tilted to a vertical position, but are otherwise little altered.

ALLUVIAL DEPOSITS.

The alluvial deposits consist of the bench gravels, partly auriferous, such as occur on the high benches of Fortymile Creek, on the Lost Chicken bench, and on benches of intermediate height, and the deposits of the present streams. The bench gravels have been found to a height of about 300 feet above the streams and have a thickness in places of about 50 feet. The stream gravels are in part auriferous and are in the main sufficiently shallow to be worked by open cuts. Chicken Creek is the only locality where the depth is considerable, reaching, in some of the ground that is being drifted, about 45 feet.

The alluvial deposits have been derived from the bed rock in the drainage areas in which they are found.

The material on the bars of Fortymile Creek has been derived from widely distant sources and a large variety of bed rock. The stream meanders in its course, leaving bars of this material deposited on the irregular planated surface of the schistose bed rock. Many of these deposits were rich in gold and the cleaned-out crevices of the bed rock on nearly every bar along the creek attest the thoroughness of the work done in the early days. On many of the bars the bed rock slopes very gradually upward until it is concealed by the overlying deposits; on other bars the slope is more abrupt, leaving but a narrow margin for work. All the most workable bars have inherited names, and at the present time many of those best known are being prospected with reference to dredges and values have been found in some of them averaging a cent to the pan. Some of the bars are backed by flats up to 1,000 feet or more in width, and the gravels of these flats are also being investigated.

IGNEOUS ROCKS.

The igneous rocks of the Fortymile quadrangle are predominantly intrusives, partly fresh and partly altered into gneisses. Altered diabasic and basaltic flows, with associated tuffs, are present in the areas occupied by the Devonian rocks.

The most common types of intrusives are granitic and dioritic rocks, but more basic rocks are also present. A large area in the northwestern part of the quadrangle, topographically emphasized by Glacier Mountain, is formed of quartz diorite. Numerous dikes and sills of the same rock and more basic varieties derived from the same magma penetrate the surrounding schists over a distance of several miles from the main mass. Another large area of similar rocks enters the southwest corner of the quadrangle, forming much of the bed rock in the Chicken Creek valley. Dikes and sills of biotite granite, hornblende granite, and diorite are abundant in the schists throughout the Fortymile country. A very common intrusive in this country is composed essentially of quartz and feldspar, and this rock with the disappearance of the feldspar forms quartz veins. A part of the quartz veins of the Fortymile region are thus of magmatic origin. This quartz-feldspar material has been intruded partly in the igneous rocks and partly as both dikes and sills in the surrounding schists. When the intrusions took place the intruded rocks were evidently at such a temperature as to allow the entrance and coarse crystallization of very thin sheets of the igneous material in both the crosscutting and concordant relation with the schists, and so extensively was this process in operation at some localities that a large proportion of the rock is composed of granitic material.

These magmatized schists have later been folded, and the acidic dikes have been crumpled and even torn apart into lenticular fragments. At a far subsequent period the granites and schists have been cut by a few dikes of basalt, the material of which is still practically unaltered.

ORIGIN OF GOLD.

At a few localities in the Fortymile region gold has been found in the bed rock. In the intrusive mass of quartz diorite that occurs in the southwestern part of the area, at a locality on Mosquito Fork about 2½ miles west of Chicken Creek, there is a zone about 6 feet wide that is partly brecciated and has been impregnated with quartz and pyrite. The weathered material pans fine flour gold and an average of two assays of surface material collected in 1903 gave a gold content of $9.70 per ton. Assays giving much higher value have been reported. Near the head of Chicken Creek black and greenish slates, with some limestone, occur in close relation with intrusive quartz diorite porphyry. These slates contain thin quartz and calcite veins. Iron pyrite is common in the quartz veins. In some of the thinner calcite veins there is a considerable proportion of gold, occurring as small lumpy masses and as thin plates along the cleavage planes of the calcite. The placers of Chicken Creek have probably derived at least a considerable part of their gold from such small stringers. Silver sulphide has been found associated with the gold in the placers below this locality. It is believed that in these two places the occurrence of gold is due to the after-effects of the igneous intrusives.

Gold has also been found in place in the ridge south of Kalamazoo Creek, a tributary of Canyon Creek. At this locality there is a conspicuous outcrop of brecciated quartzite and vein quartz that is in places very rusty from the large amount of iron content. Specimens have been obtained showing free gold in the rock. It is not known, however, whether gold is uniformly distributed through the rock or whether it is only of local occurrence. Placer gold is found in creeks draining this area and it is believed by the miners to have been derived from this locality.

In the Seventymile area gold has been found in place in a mineralized zone in serpentine. At this locality there are many intersecting small quartz veins containing considerable iron pyrites. Gold is reported in the weathered vein material, and the attempt has been made to save it by means of an arrastre.

The alluvial deposits of the streams, where mining is in progress, have been derived from the bed rock of the valleys in which they occur, and there has been in this area no interference by glaciation with the orderly deposition of material by stream action. The bed rock in some of these valleys is almost exclusively composed of schists of sedimentary origin containing many small quartz veins. Nuggets are frequently found with considerable quartz attached, and it is probable that they have been derived from such quartz veins. Small veins of barite also occur in the schists, and small rounded pebbles of this material accompany much of the gold, along with garnets, rutile, and black sand. Hematite and limonite pebbles are also common associates of the gold. Native lead has been found on Franklin Creek, and in the Seventymile area cinnabar pebbles are occasionally found.

MINING DEVELOPMENT.

Mining by the usual methods in the Fortymile quadrangle during the summer of 1907, partly on account of the prolonged dry weather, was not being carried on very extensively. Many of the bars of Fortymile Creek have been worked for years, and even during 1907 a few miners were found still making wages in the old way with the rocker. The prevailing low stage of water was especially favorable for this kind of work. Operations on Chicken Creek were practically at a standstill, but the field had been somewhat enlarged by the work on Ingle Creek and at the head of Chicken Creek. Sluicing was being done at the mouth of Napoleon Creek, and a few men were working intermittently on Franklin Creek. Ground was being tested at several localities along Fortymile Creek itself, and at Moose Creek a combined ditch and flume was being constructed to bring water about 3 miles to one of the Fortymile bars. Wade Creek was not visited, but the reports indicated more favorable conditions for work.

The greatest change of methods in the Fortymile region has been in the introduction of dredges. Four steam-power dredges were in process of installation or in operation during the season of 1907—one on Walker Fork, just above the mouth of Twelvemile Creek, and three on Fortymile Creek (about 2 miles below the mouth of Franklin Creek, at the international boundary, and about 4 miles above the mouth in Canadian territory). Plans were also under way for installing a dredge on the upper part of Walker Fork during the winter of 1907–8.

The ground to be worked by the dredge on Walker Fork near Twelvemile Creek was reported to range from 6 to 14 feet in thickness, with an average of about 9 feet. The muck was from 1½ to 4 feet thick. The bed rock is schist, with intrusive granite. The gold is said to be mostly on bed rock or within it to a depth of a few inches. The stream flat at this point is several hundred feet wide and the alluvial deposits are frozen. Steam points were in use to thaw ahead of the dredge. The dredge is a bucket open-connected dredge, with buckets having a capacity of 5 cubic feet. It was reported to be capable of working about 3 acres a month. The frozen character of the ground, however, made it impossible to use the dredge to advantage. It has been found necessary to prepare ground by stripping at least a year in advance in order to give it the best opportunity possible for thawing and thus save to a great extent the extra expense of thawing by steam points.

The dredge on Fortymile Creek at the international boundary is similar in character, with 2½-foot buckets and a capacity of about 1,500 cubic yards in twenty-four hours. The dredge was working on a bar where the average depth to bed rock is about 8 feet. While bowlders were somewhat troublesome, the ground was for the most part unfrozen.

The dredge on the Canadian side of the boundary has a capacity of 3,000 cubic yards in twenty-four hours. It has 5-foot buckets and can work ground to a depth of 35 feet. This dredge also was working on a bar of Fortymile Creek where the ground was not frozen and the bed rock soft.

The machine in process of installation on Pump Bar, below the mouth of Franklin Creek, is a dipper dredge. The machinery was being mounted on a scow 42 by 80 feet, built of native spruce lumber. The dipper has a capacity of 2½ cubic yards, and the machine was expected to handle about 1,000 cubic yards in ten hours. The ground to be worked was all unfrozen and averaged about 6 feet in thickness.

Some of the factors to be considered in the installation of dredges, aside from the great question of the values in the ground, which are sometimes barely investigated, are as follows: Remoteness of a region and absence of communication, entailing costly delays in installation, repairs, and procurement of supplies to keep a dredge in continuous operation; length of working season; water and fuel supplies; dimensions and character of alluvial deposits, with special reference to frost and bowlders; vertical and horizontal distribution of the gold in the deposits and the character of the gold; evenness or unevenness of the bed-rock surface, ridges of bed rock in some places interfering with the ability of the dredge to work all portions of the ground; hardness of bed rock; its receptivity for gold and adaptability for dredging; and, finally, the selection of a dredge best adapted to the conditions presented by the ground under consideration.

The Fortymile region comes well under the definition of remoteness. It is more unfortunate in this respect than the other mining regions in the Yukon-Tanana country. The length of the working season is limited to about four months. Most of the valleys are sufficiently timbered with spruce to have furnished up to the present time abundant fuel. The ground selected for dredging is in the valleys of the smaller tributaries of Fortymile Creek or along the bars of the creek itself. The deposits are such as have been worked by open cuts, and most of them are much under the maximum depths workable by the dredges already on the ground, 15 to 35 feet; some are even shallower than desirable. These deposits are of local origin, having been derived from the bed rock within the valleys, and are composed of gravels overlain by muck. They are, for the most part, frozen throughout the year. The gravels are composed of subangular or rounded fragments, up to a foot or more in diameter, and a large proportion of fine material, partly comminuted fragments of the same character as the coarser materials and partly products of decomposition. The proportion of bowlders is generally small, but at some localities it is so large as to become a troublesome factor. If it were not for the frozen character of the gravels, the conditions for dredging would be about as favorable as at some localities in the States. The overlying muck is removed by ground sluicing, and this process of stripping is one that requires a wide experience in the utilization of water to procure the best results. Although in some places the gold is found distributed through the lower part of the gravels, it is mostly on or within the bed rock. On some creeks there is a large proportion of nuggety gold. The greatest part of it, however, occurs as small flat pieces, and there is some very fine gold.

The bed rock in the Fortymile region is predominantly schist, with interbedded crystalline limestone and intrusive granitic rocks, either parallel to the structure or cutting it. Beds of more or less blocky material resistant to weathering are separated by softer material, and this characteristic gives rise in some places to an uneven bed-rock surface, the higher places of which may act as a hindrance to dredging. This emphasizes the need of a careful preliminary survey of the deposits and the underlying rock floor. Furthermore, the gold has a tendency to sink to a depth of several feet in the crevices and joint planes of the blocky bed rock.

Several plans have been under consideration for the utilization of the water supply in the Fortymile region, and during the summer of 1907 a dam was being constructed on Mosquito Fork near Kechumstuk for the purpose of bringing water by a ditch to the Chicken Creek area.

In the vicinity of Eagle mining operations were confined mainly to preparatory and assessment work. A dam with automatic gate was being constructed on American Creek. The new Government road is already proving of advantage to this locality. Work in the Seventymile area is also being helped by the construction of a road over the divide from Excelsior to Seventymile Creek.

PRODUCTION.

The largest part of the production of the Fortymile district is taken out of Alaska by way of Fortymile Creek. The following table has been prepared from records furnished to the Survey by the office of the United States customs service at the subport of Fortymile, Alaska. It shows the distribution and amount of production for the years 1904 to 1907, inclusive. Quantities are expressed in fine ounces, the value of the fine ounce being approximately $20.67, whereas that of the commercial dust of the Fortymile district averages about $17 to the ounce.

Production of gold in Fortymile region, 1904–1907.

Creek.	1904.		1905.		1906.		1907.	
	Amount.	Value.	Amount.	Value.	Amount.	Value.	Amount.	Value.
	Fine ounces.		*Fine ounces.*		*Fine ounces.*		*Fine ounces.*	
Chicken, Lost Chicken, Myers Fork, Stonehouse, and Ingle	6,819.74	$140,964	5,368.11	$110,959	4,269.32	$88,247	2,377.74	$49,147
Franklin	494.29	10,217	581.47	12,019	783.79	16,201	100.34	2,074
Wade	5,233.24	108,171	4,521.00	93,449	3,094.87	63,971	3,381.90	69,904
Walker Fork, Poker, and Davis	1,222.11	25,262	1,124.28	23,239	1,184.32	24,480	484.42	10,013
Squaw, Camp, Woods, and Canyon	156.27	3,230	103.62	2,142	63.32	1,309	123.36	2,550
Napoleon, Montana, Buckstein, Dome, Eagle, and Twin	51.00	1,054	46.06	952	13.11	272	11.51	238
Fortymile bars and commercial dust	886.60	18,326	637.40	13,175	437.54	9,044	266.47	5,508
	14,863.25	307,224	12,381.94	255,935	9,846.27	203,524	6,745.74	139,434

These statistics, together with incomplete data of production for 1907 from creeks in the vicinity of Eagle—about 400 fine ounces, or $8,245—indicate a total production for the year 1907 in the Fortymile district of approximately $150,000.

WATER SUPPLY OF THE FAIRBANKS DISTRICT. 1907.

By C. C. Covert.

INTRODUCTION.

During the season of 1907 the United States Geological Survey extended to the Fairbanks district the stream-gaging work started in the Nome region in 1906. The investigations were for the purpose of determining both the total flow and the distribution of flow during the open season, and of collecting data regarding the general conditions affecting the water supply and its development.

The success of any project for water-supply development is measured largely by the completeness of the information on which the engineer designs his work in accordance with the maximum efficiency of the available flow, and this efficiency can be determined with greater accuracy by the aid of long and continued records. It is for the purpose of procuring such records that the Survey has undertaken the study of stream flow in this district.

The field work in the Fairbanks district was carried on from June 20 to September 15. Owing to the lack of adequate funds the work was largely that of reconnaissance. However, the keeping of systematic records on some of the more important streams was made possible through the hearty cooperation of people interested. Among the many who rendered valuable assistance in procuring the data given in the accompanying tables, acknowledgment is due to Mr. John Zug, superintendent of the good roads commission; Mr. A. D. Gassaway, general manager of the Chatanika Ditch Company; Mr. Falcon Joslin, president of the Tanana Mines Railroad Company; Mr. Herman Wobber, Fairbanks Creek; Mr. C. D. Hutchinson, electrical engineer, Tanana Electric Company; and Mr. Martin Harris, Chena.

After making a careful study of the general topographic conditions of the mining district and its surrounding country, it was decided to establish a few regular stations at the most convenient points in the larger drainage areas, and to study the daily run-off, during the open season, from records thus obtained. This plan afforded greater opportunity for procuring comparative data than would that of covering a larger territory in a less definite way. In this country with-out storage daily records are an important factor, and such records could not have been obtained over an extended area. Outside of the producing creeks the country is practically a wilderness, and it is almost impossible to get observations, other than those made on the occasional visits of the engineer. No daily or even weekly records could have been assured, and the results obtained from the occasional measurements would have furnished no comprehensive idea as to what the daily run-off of the streams really was throughout the open season.

MEASUREMENTS.

Discharge measurements were made at 45 different stations as listed below. The detailed results are published in Water-Supply Paper No. 218, from which the accompanying summaries are taken.

Gaging stations in Fairbanks district.

1. Little Chena River about 2 miles above Elliott Creek.
2. Elliott Creek above mouth of Sorrels Creek.
3. Sorrels Creek above mouth.
4. Fish Creek above Fairbanks Creek.
5. Bear Creek near mouth of Tecumseh Creek.
6. Fairbanks Creek.
7. Miller Creek near mouth.
8. Miller Creek below Heim Creek.
9. Miller Creek above Heim Creek.
10. Charity Creek 1 mile above mouth of Hope Creek.
11. Hope Creek near mouth of Zephyr Creek.
12. Faith Creek at weir near mouth.
13. McManus Creek above Montana Creek.
14. McManus Creek below Montana Creek.
15. McManus Creek 1 mile below Idaho Creek.
16. McManus Creek 500 feet above mouth of Smith Creek.
17. McManus Creek below mouth of Smith Creek.
18. McManus Creek at mouth.
19. Smith Creek below mouth of Pool Creek.
20. Smith Creek above mouth of Pool Creek.
21. Pool Creek above mouth.
22. McManus Creek at weir near mouth.
23. Chatanika River below Faith and McManus creeks.
24. Boston Creek at elevation 800 feet.
25. McKay Creek at elevation 800 feet.
26. Belle Creek at elevation 800 feet.
27. Crooked Creek near mouth.
28. Kokomo Creek near mouth.
29. Poker Creek near mouth.
30. Poker Creek near elevation 800 feet.
31. Little Poker Creek above mouth.
32. Caribou Creek above mouth of Little Poker Creek.
33. Chatanika River below mouth of Poker Creek.
34. Cleary Creek near Cleary.
35. Little Eldorado Creek above trail to Dome Creek.
36. Dome Creek near Dome.

37. Goldstream Creek between claims 6 and 7 "B."
38. Fox Creek near elevation 900 feet.
39. Beaver Creek above mouth of East Branch.
40. East Branch of Beaver Creek above mouth.
41. Nome Creek 1 mile above mouth.
42. Bryan Creek at elevation 1,800 feet.
43. Trail Creek about 4 miles above mouth.
44. Brigham Creek 1 mile above mouth.
45. Fossil Creek near mouth.

Tables 1 and 2 show the monthly discharge of the streams where the daily flow could be computed. Table 3 gives the minimum daily flow of these streams. Table 4 gives the mean weekly supply. Table 5 is a list of miscellaneous discharge measurements made on different streams. All these results are given in second-feet, which can be reduced to miner's inches of 1.5 cubic feet by multiplying by 40.

TABLE 1.—*Monthly discharge of streams in Little Chena River basin, 1907.*

LITTLE CHENA RIVER ABOVE ELLIOTT CREEK.

[Drainage area, 79 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
July 22-31	80	42	49.3	0.625	0.23
August	157	53	85.4	1.08	1.24
September 1-10	95	66	86.2	1.09	.40
51 days	157	42	78.4	.993	1.87

ELLIOTT CREEK NEAR MOUTH OF SORRELS CREEK.

[Drainage area, 13.8 square miles.]

July 22-31	9	2.5	5.9	0.430	0.16
August	23	5.8	11	.797	.92
September 1-10	12.3	9	10	.724	.27
51 days	23	2.5	9.82	.711	1.35

SORRELS CREEK NEAR MOUTH.

[Drainage area, 21 square miles.]

July 22-31	14.7	6.0	10.5	0.500	0.19
August	32.1	10.3	18.2	.867	1.00
September 1-10	19	14.7	16	.762	.28
51 days	32.1	6.0	16.3	.777	1.47

FISH CREEK ABOVE FAIRBANKS CREEK.

[Drainage area, 39 square miles.]

July 22-31	24	18	22.5	0.577	0.21
August	155	24	36.8	.944	1.09
September 1-10	35	24	26.6	.682	.25
51 days	155	18	32.0	.820	1.55

TABLE 2.—*Monthly discharge of streams in Chatanika River basin, 1907.*

FAITH CREEK NEAR MOUTH.

[Drainage area, 51 square miles.]

Month.	Discharge in second-feet.			Run-off.	
	Maximum.	Minimum.	Mean.	Second-feet per square mile.	Depth in inches.
June 20-30	45.9	34.4	40.5	0.795	0.32
July	62.5	19.2	29.2	.572	.66
August	87.4	26.9	47.5	.932	1.07
73 days	87.4	19.2	38.5	.755	2.05

McMANUS CREEK NEAR MOUTH.

[Drainage area, 80 square miles.]

June 20-30	34.8	21.7	28.5	0.356	0.15
July	40	15.0	21.4	.268	.31
August	114	32.2	66.4	.830	.96
73 days	114	15.0	41.5	.510	1.42

CHATANIKA RIVER NEAR FAITH CREEK.

[Drainage area, 132 square miles.]

July 17-31	90	54	67	0.508	0.29
August	186	73	117	.887	1.02
September	1,770	110	297	2.18	2.43
76 days	1,770	54	178	1.31	3.74

KOKOMO CREEK NEAR MOUTH.

[Drainage area, 26 square miles.]

July 9-31	25.8	7.9	14.2	0.546	0.47
August 1-14	112	22.7	41.6	1.60	.83
37 days	112	7.9	23.8	.916	1.30

CHATANIKA RIVER BELOW POKER CREEK.

[Drainage area, 456 square miles.]

June 20-30	250	192	228	0.500	0.20
July	283	167	211	.463	.53
August	1,160	216	428	.939	1.08
September	3,160	300	954	2.09	2.33
October 1-14	860	232	506	1.11	.47
117 days	3,160	167	496	1.08	4.61

GOLDSTREAM CREEK NEAR CLAIM 6 BELOW.

[Drainage area, 28.6 square miles.]

June 20-30	30.2	4.9	13.4	0.469	0.19
July	34.4	2.2	13.1	.458	.53
August	32.2	10.8	20	.699	.81
September	41	15.4	24	.839	.94
October 1-7	24.4	17.1	20.7	.724	.19
110 days	41	2.2	18.5	.649	2.66

TABLE 3.—*Minimum daily flow of streams in Fairbanks district, 1907.*

	Elevation.	Date.	Minimum flow.	Drainage area.	Minimum run-off per square mile.	Duration of record.
	Feet.		*Sec.-feet.*	*Sq. miles.*	*Sec.-foot.*	
Little Chena River above Elliott Creek.	800	July 22-25, 29-31.	42	79	0.53	July 22-Sept. 10.
Elliott Creek above Sorrels	800	July 31	2.5	13.8	.18	Do.
Sorrels Creek above mouth	800	do	6	21	.28	Do.
Fish Creek above Fairbanks Creek.	925	July 30-31	18	39	.46	Do.
Faith Creek at mouth	1,400	July 10	19.2	51	.38	June 20.
McManus Creek at mouth	1,400	July 10-12	15	80	.19	Do.
Chatanika River below Faith Creek.	1,350	July 31	54	132	.41	July 17-Sept. 30.
Kokomo Creek near mouth	750	July 23, 30-31	7.9	26	.30	July 9-Aug. 14.
Chatanika River below Poker Creek.	700	July 4-7, 10	167	456	.36	June 20-Oct. 14.

TABLE 4.—*Mean weekly water supply, in second-feet, from Little Chena and Chatanika River basins, 1907.*

Date.	Available for use by diversion at elevation 1,350 feet.	Available for use by pumping at elevation 700 feet.	Available for use by diversion at elevation 800 to 900 feet.				Total, Little Chena drainage area.
	Chatanika River near Faith Creek.	Chatanika River below mouth of Poker Creek.	Little Chena River above Elliott Creek.	Elliott Creek above Sorrels Creek.	Sorrels Creek above mouth.	Fish Creek above Fairbanks Creek.	
June 17-23	86						
June 24-30	64	216					
July 1-7	44	178					
July 8-14	36	190					
July 15-21	64	250					
July 22-28	70	224	52	7	12	24	95
July 29-August 4	80	540	80	12	18	55	165
August 5-11	128	516	110	12	24	42	188
August 12-18	82	313	73	10	16	26	125
August 19-25	104	260	56	6	10	24	96
August 26-September 1	169	413	90	11	18	26	145
September 2-8	120	324	82	9	15	26	132
September 9-15	513	1,360					
September 16-22	376	1,480					
September 23-29	216	737					
September 30-October 6		655					
October 7-13		415					
Mean	143	504	78	10	16	32	136
Maximum	513	1,480	110	12	24	55	188
Minimum	36	190	52	6	10	24	95

TABLE 5.—*Miscellaneous measurements in Fairbanks district, 1907.*

LITTLE CHENA RIVER DRAINAGE BASIN.

Date.	Stream.	Locality.	Discharge.
			Sec.-ft.
July 20	Bear Creek	Near Tecumseh	8.4
August 22	do	do	7.0
June 24	Fairbanks Creek	Elevation 1,300 feet	1.4
Do	do	Elevation 1,250 feet	2.2
July 5	do	Elevation 1,375 feet	.72
July 20	do	Elevation 1,400 feet	1.3
July 6	Miller Creek	Near mouth	7.00
July 24	do	do	7.6
August 20	do	do	8.0
August 6	do	Below mouth of Heim Creek	8.0
August 7	do	do	8.0
Do	do	Above mouth of Heim Creek	4.9

CHATANIKA RIVER DRAINAGE BASIN.

Date.	Stream.	Locality.	Discharge.
July 11	Hope Creek	Near mouth of Zephyr Creek	7.7
Do	Charity Creek	1 mile above mouth of Hope Creek	5.7
July 10	McManus Creek	At mouth	15.6
Do	do	do	16.4
July 12	do	Above Smith Creek	10.2
Do	Smith Creek	Near mouth	7.8
Do	McManus Creek	do	15.6
July 13	do	¾ mile above Montana Creek	1.8
Do	do	Below Montana Creek	3.8
Do	do	1½ miles below Idaho Creek	6.5
Do	do	½ mile above mouth	[a] 21.4
July 14	do	500 feet above Smith Creek	12.4
Do	Smith Creek	Near mouth	8.7
Do	do	Above Pool Creek	5.4
Do	Pool Creek	Above mouth	2.4
Do	McManus Creek	do	[a] 19.4
August 15	Boston Creek	Elevation 800 feet	3.9
Do	McKay Creek	do	3.7
Do	Belle Creek	do	10.0
Do	Crooked Creek	Near mouth	6.3
July 27	Poker Creek	½ mile above mouth	22.3
July 30	do	do	22.6
August 9	do	do	36.6
August 10	do	do	37.8
Do	Caribou Creek	Above Little Poker Creek	10.4
Do	Little Poker Creek	Near mouth	3.9
Do	Poker Creek	1 mile above Caribou Creek	21.1
July 4	Cleary Creek	Near Cleary	2.9
June 26	Little Eldorado Creek	Above trail to Dome Creek	.45
June 27	Dome Creek	Near Dome	.84
July 6	Fox Creek	Elevation 900 feet	2.0

BEAVER CREEK DRAINAGE BASIN.

Date.	Stream.	Locality.	Discharge.
August 27	Trail Creek	Approximate elevation, 1,700 feet	39.9
Do	Brigham Creek	Approximate elevation, 1,500 feet	16
August 28	Fossil Creek	Approximate elevation, 1,300 feet	19.2
August 29	Bryan Creek	Approximate elevation, 1,800 feet	75.3
August 30	Beaver Creek above East Branch.	do	267
Do	East Branch of Beaver Creek above mouth.	do	124
Do	Nome Creek near mouth.	Approximate elevation, 1,700 feet	135

[a] Measurement approximate.

RAINFALL.

In connection with these investigations the following rainfall stations were established:

Summit Road-house near Pedro Summit, elevation 2,310 feet.
Cleary City, elevation 1,000 feet.
Chatanika River near mouth of Poker Creek, elevation 730 feet.
Chatanika River near mouth of Faith Creek, elevation 1,400 feet.

The results of the observations taken at these stations, together with records kept at Fairbanks in 1906 and 1907, are as follows:

Monthly precipitation in inches at stations in Fairbanks district, 1906–7.

	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
1906.													
Fairbanks [a]	1.75	0.37	0.33	0.10	0.36	1.05	2.82	1.50	0.25	0.30	0.65	1.15	10.63
	17.5	3.7	3.3	1.0	------	------	------	------	------	1.6	6.5	11.5	45.1
1907.													
Fairbanks [a]	3.3	.86	2.42	.03	.35	1.47	1.51	1.81	3.58	2.44	------	------	------
	33.0	8.6	24.2	.30	------	------	------	------	------	24.4	------	------	------
Summit Road-house	------	------	------	------	------	------	2.71	3.27	------	------	------	------	------
Cleary	------	------	------	------	------	.84	2.55	2.88	3.82	------	------	------	------
Poker Creek [a]	------	------	------	------	------	------	------	1.40	3.70	1.70	.25	------	------
	------	------	------	------	------	------	------	------	------	24.0	3.3	------	------
Faith Creek	------	------	------	------	------	------	1.87	3.00	2.97	------	------	------	------

[a] Rainfall or melted snow is given in the first line; snowfall in the second line.

HYDRAULIC DEVELOPMENTS.

In the Fairbanks district little work has been done as yet toward constructing ditch lines from larger drainage areas for additional water supply. Mining has been carried on entirely by means of the meager supply from individual creeks. The camp is rapidly approaching a stage of development that demands a greater water supply than these creeks can furnish.

In general, the relation of the mining camps to the surrounding country is not favorable to an outside water supply by gravity. The topography of the country is such that ditch lines from the larger drainage areas are not altogether practical. The camp lies in three drainage basins, or valleys, separated by high dividing ridges, and in order to supply the producing creeks in one valley with the water by ditch line from another the ditch must have a high elevation, which throws its intake so far into the headwaters that there is only a small drainage area from which to draw the supply and consequently but little water. The records kept during the season of 1907 prove conclusively that had the high-line ditch which the Chatanika Ditch Company proposed to build from the upper Chatanika basin to the mining camp been built, instead of a daily supply of 125 second-feet, as was estimated, it would have had less than half that amount during the greater part of the open season.

However, investigations are under way which may overcome these difficulties. It is proposed to construct, from the mouth of Faith Creek to the mining camp, a ditch which will supply water to the producing creeks directly tributary to Chatanika River. A project is also under way to develop electric power for transmission to the mining camp by using the waters of Little Chena River. This project will also supply water to Smallwood, Nugget, and other creeks in the vicinity.

The development of water power for electric transmission in the Fairbanks district seems worthy of consideration. This method of utilizing the water supply would dispense with many miles of ditch construction and would not only furnish the camp with water, but also with power for running the hoist, elevating the tailings, pumping water from the mines, lighting the underground work, pumping water to the sluice box, and, in some localities, running the dredge.