# LODE MINING NEAR FAIRBANKS.

By PHILIP S. SMITH.

## INTRODUCTION.

The inevitable depletion of easily mined placer deposits near Fairbanks and the consequent availability of both men and money for other enterprises has given an impetus to prospecting for lode deposits which has resulted in the opening of some productive mines. The writer visited the lode-mining district late in the open season of 1912 to study the conditions under which the veins occurred, and the results of that study are set forth in the accompanying report. Work in the field began September 7 and closed September 25, 1912. In spite of this short season the studies by Mr. Prindle and Mr. Katz furnished geologic data so complete that the investigations here recorded were devoted exclusively to mining developments.

The writer is under deep obligations to both Mr. Prindle and Mr. Katz not only for their published data but also for the assistance they have given by consultation and advice. Grateful appreciation of the many courtesies and privileges received in the field is expressed to the various mine owners, operators, and residents of the Fairbanks region. Although specific mention is necessarily incomplete, thanks are especially due J. L. Sales, of Fairbanks; the Cook brothers, of Too Much Gold Creek; the members of the Rexall Mining Co., of Wolf Creek; Nels Giske and the Quemboe brothers, of Chatham Creek; Allan Cunningham and Antone Goessmann, of Bedrock Creek; C. S. Sargent, of Willow Creek; Sterling, Zimmerman, and Nightingale, of Twin Creek; W. L. Spaulding, of Dome Creek; and W. C. Harp, the Hudson brothers, and Louis Sagan, of Ester Creek.

## GENERAL GEOLOGY.

The following summary of the bedrock geology of the Fairbanks district has been abstracted from a report by Prindle and Katz which should be consulted for more detailed descriptions.[1] The unconsolidated deposits have not been discussed here, as they have little or no bearing on the subject of the present report.

[1] Prindle, L. M., and Katz, F. J., Detailed description of the Fairbanks district: U. S. Geol. Survey Bull. 525, pp. 59–77, 1913.

The greater part of the bedrock of the Fairbanks district is formed of metamorphic rocks which have been grouped together and called the Birch Creek schist. These rocks include rather massive quartzites, quartzite schists, quartz-mica schists, hornblende schists (in part amphibolitic), carbonaceous schists, crystalline limestones, and altered calcareous rocks, with associated eclogitic rocks, andalusite hornfels, and a small amount of granitic gneiss derived from porphyritic intrusive granite.

All of these rocks are closely folded. Recumbent minor folds are common, and so far as observed the direction of overturning is toward the northwest. In places the folding is so close that the limbs are nearly parallel and cleavage and bedding planes become also parallel. The dips, therefore, indicate rather the dip of the predominant structural planes, which may or may not be the true dip.

The Birch Creek schist is unfossiliferous and its age has not been definitely determined. The earliest fossils found in passing from it into the overlying rocks in other parts of the Yukon-Tanana region are Ordovician in age, and therefore possibly the Birch Creek schist is in whole or in part Cambrian.

The igneous rocks of the Fairbanks district include several varieties of intrusive granular rocks and a small amount of igneous material regarded as extrusive. Intrusive granular rocks that penetrated the schist at such depths below the contemporary surface of the earth as to have cooled with sufficient slowness to become entirely crystalline are separable into quartz diorite, porphyritic biotite granite, light-colored persilicic granitic dikes, and altered porphyritic dikes related to granitic and dioritic rocks. All these have been shown on the map (Pl. VI) in one pattern.

The greater part of the intrusive rocks of the Fairbanks district belong to the granite and diorite group. The quartz diorite of Pedro Dome and the porphyritic biotite granite of the Smallwood-Gilmore ridge are distinct types, but there are several intermediate phases. Although the coarse porphyritic biotite granite was nowhere observed cutting the quartz diorite, fine-grained dikes like those which cut the biotite granite and which are closely related to it in composition and were only shortly subsequent to it in time of intrusion were observed to cut also the quartz diorite. Both the two main types are probably the products of the same general period of intrusion. The sericitized dikes of granite porphyry and quartz diorite porphyry are probably to be referred in origin to the main intrusive masses and have been in part altered by hydrothermal action. Passageways for various after-products of intrusion were afforded by an extensive shattering that took place in part at least subsequent to intrusion.

No definite age can be assigned to these intrusives. Conglomerates regarded as Tertiary contain numerous bowlders of granite whose ori-

gin is not definitely determined, but from what is known of Tertiary deposits in other parts of the Yukon-Tanana region probably these conglomerates are of Kenai age, which indicates that the granitic intrusion was earlier than the Kenai epoch. The nearest similar intrusive rocks whose age of intrusion is rather definitely known are those of the Rampart region, 90 miles to the northwest, which have intruded Upper Cretaceous rocks.

## PRESENT CONDITION OF LODE MINING.

### GENERAL FEATURES.

In the region adjacent to Fairbanks 2,000 lode claims have been recorded and of these probably 50 are being more or less extensively prospected. Practically all the veins that are being developed are free milling gold lodes, as deposits of this or other metals requiring metallurgical treatment for extraction can not be mined under existing conditions. Six of the properties have been developed to the producing stage and maintain their own mills. Six other mills are being constructed and should be in operation before the end of 1912, and still others are contemplated.

The six mills now in operation have a total of 24 stamps, of which 22 are of the Joshua Hendy type (fourteen 1,000-pound stamps; five 500-pound stamps, and three 250-pound stamps) and two are Nissen stamps of 1,300 pounds each. These stamps have an estimated crushing capacity of 1 to 5 tons of ore a day. Of the mills being built, two are to be equipped with seven stamps of the Hendy pattern, three with six Nissen stamps, and one with a Little Giant crusher having an estimated capacity of 6 to 15 tons of ore a day. According to these estimates the mills should be capable of crushing about 100 tons of rock a day.

According to Brooks[1] about $64,100 was produced by the lode mines in 1911 and about $60,000 had been produced previously. No reliable statements of the gold production from the lodes in 1912 have been received, but it is estimated to have been about $200,000. The discrepancy between this estimate and the amount that should have been produced as indicated by the theoretical capacity of the mills and the assumed tenor of the ore is due to three main causes, namely, many of the mills were built during the year and therefore lost more or less time on that account; few of the mines have been opened up sufficiently to yield a constant supply of mill rock; and many of the mills have been compelled to close down during the winter on account of the cold.

The trouble with cold is serious and is felt most acutely in its effect on the water supply. It is relatively easy to keep a mill so

[1] Brooks, A. H., The mining industry in 1911: U. S. Geol. Survey Bull. 520, p. 30, 1912.

warm that water will not freeze in the mortars or on the tables, but the cutting off of practically all sources of surface water during the six or seven winter months presents an almost insuperable difficulty. The larger streams, of course, afford ample water throughout the year, but these are at some distance from the mines and selection of a mill site on them involves additional charges for the transportation of ore. Attempts to gain a sufficient permanent water supply by boring holes a hundred or more feet in depth have so far met with indifferent success. At a few places seepage water pumped from the mine has been used at the mill, but the supply has not been adequate. In fact, one mill where this was tried was forced to abandon the experiment and was moved near to a creek at a considerable distance from the mine.

On the whole the camp has shown a rather healthy development, with less exaggeration and wildcatting than has been customary elsewhere. Most of the veins have been and are being opened by local men and capital, and some of the most productive have been made to pay from the start. In general this quiet, relatively inexpensive exploitation of the lodes has been beneficial, but the camp has had the disadvantage that many of the operators are not lode miners and consequently have made mistakes that might have been avoided. The need of proficient engineers and miners is already felt by the more enterprising operators and will become more urgent as mining increases. As a result of the absence of skilled management none of the mines employ the careful methods of sampling, investigation of mining costs, scrutiny of geologic data, and precise measurements that are necessary to reduce mining from a speculative venture to a more or less exact business enterprise.

## LODE MINES AND PROSPECTS.

### GENERAL DISTRIBUTION.

During the six or more years that prospecting for quartz has been in progress in the region a great number of prospect holes have been sunk. Many of these, for one reason or another, have been abandoned and their traces are no longer recognizable. In places, however, information about some of this old work was obtained from people living in the neighborhood, and such of this as appears reliable has been presented in this report. In the following descriptions many details concerning small and nonproducing properties have been given because they afford information as to the geologic history, mode of occurrence, and distribution of the veins. These descriptions, therefore, should be regarded not only as records of facts but also as clues to the character of deposits not yet exploited.

All parts of the area have not been treated with equal completeness, and some small prospect holes that were actually examined are undoubtedly described more fully than possibly extensive prospects that have been abandoned. Although there are many reasons for a good prospect lying idle, on the whole, other things being equal, the fact that no work is in progress on a certain property indicates that it is not so important as one on which work is in progress. Therefore the map (Pl. VI) indicates, by the distribution of the prospect and mine symbols, the most developed lode area. This map shows that most of the prospects occur near the head of Fairbanks Creek, on many of the headwater branches of Cleary Creek, at the head of Dome Creek, on Twin and Skoogy creeks, and in the vicinity of Ester Dome, in the extreme western part of the district. The prospects in each of these areas will be described in the order of their geographic positions in their minor basins. Mineralization has been found and prospecting carried on not only in these main areas but at a few other places, which have been described under the general heading "Miscellaneous prospects." (See p. 196.)

## TRIBUTARIES OF FISH CREEK.

### FAIRBANKS CREEK VALLEY.

#### EAST OF MOOSE CREEK.

The most eastern prospect noted in the Fairbanks Creek region is the Charles claim, near the head of Walnut Creek, which rises on the southwestern slopes of Coffee Dome. No work was in progress on this prospect in 1912 and it was not visited. Brooks,[1] however, states that in 1911 an 18-inch ledge of ore was reported on this claim, some of the vein material from which was milled at Chena. No data were furnished as to the amount of development work or the tenor of the ore.

Prindle [2] reported in 1909:

> At the head of Alder Creek, a tributary of Fairbanks Creek, at the [Dan] McCarthy property, including the Lime, Lemon, and North Star claims, is a vertical quartz vein striking about N. 40° E. and 12 to 13 feet wide. A tunnel has been driven parallel to the vein for about 120 feet and the lode has been crosscut at a depth of 50 feet. Along the margin of the vein and along the horses of schist that are found in it there is considerable mineralization and some values are reported. Two other similar quartz ledges parallel the one described, but had not been opened in 1909. The vein quartz of these localities is much fractured and the mineral-bearing solutions have apparently been introduced subsequent to the fracturing.

[1] Brooks, A. H., The mining industry in 1911: U. S. Geol. Survey Bull. 520, p. 31, 1912.

[2] Prindle, L. M., Auriferous quartz veins in the Fairbanks district: U. S. Geol. Survey Bull. 442 p. 227, 1910.

Brooks notes that in 1911 a 50-foot shaft showing 3 feet of ore was said to have been sunk on the Eureka claim and some of the ore milled at Chena. In 1912 the Alder Creek localities were not visited, as, according to report, no mining was then in progress.

### MOOSE CREEK.

Some prospecting has been done in the basin of Moose Creek on the western hill slope. The greatest amount of work has been done by Crites and Feldman, who have located several veins and have sunk a number of prospect pits all the way from a point at an elevation of 1,525 feet near the creek to a point on the divide between Too Much Gold and Moose creeks, at an elevation of about 2,150 feet. (See fig. 1.) The general trend of the line of pits is N. 65° W., but as the vein has been faulted this direction is not the actual course of the veins. The veins are from 1 to 3 feet wide. They cut across the lamination of the schist and stand nearly vertical. At an elevation of about 2,100 feet west of Moose Creek the main or southern vein appears to split, giving off a spur vein trending more nearly east and west. The southern vein is composed mainly of quartz and a small amount of stibnite and numerous particles of visible free gold. Near the junction of the northern and southern veins a large amount of stibnite forms a lens, in places over 3 inches thick, of well-crystallized stibnite, practically unmixed with other sulphides. At an elevation of 2,050 feet another vein, trending about N. 15 E. and dipping west, has been traced northward for a short distance, but its gold tenor was so low that work on it was abandoned.

The vein material from the southern lead is mainly a light-colored, glassy quartz, somewhat crushed, but showing in places druses into which well-formed crystals of quartz project. On exposed surfaces the quartz has a brown iron stain, but more commonly it is characterized by a greenish-yellow color, due to the decomposition of stibnite. Here and there sulphides and visible gold occur in the quartz, but the amount of sulphides is small, on the average being much less than 5 per cent of the vein material. Although stibnite is the most abundant of the sulphides recognized at this place, argentiferous galena occurs sparingly and also some arsenopyrite, pyrite, and sphalerite. In many specimens the stibnite near the surface has been altered into the antimony oxide, senarmontite. This mineral is particularly abundant in the spaces between the quartz grains.

The gold appears to be entirely native but occurs in two main modes. In one it is closely associated with the sulphides and appears to have been essentially contemporaneous with their deposition; in the other it does not seem to have been formed with the sulphides but occurs instead in the midst of the earlier-formed quartz. Even in specimens of quartz containing no gold that is visible to the

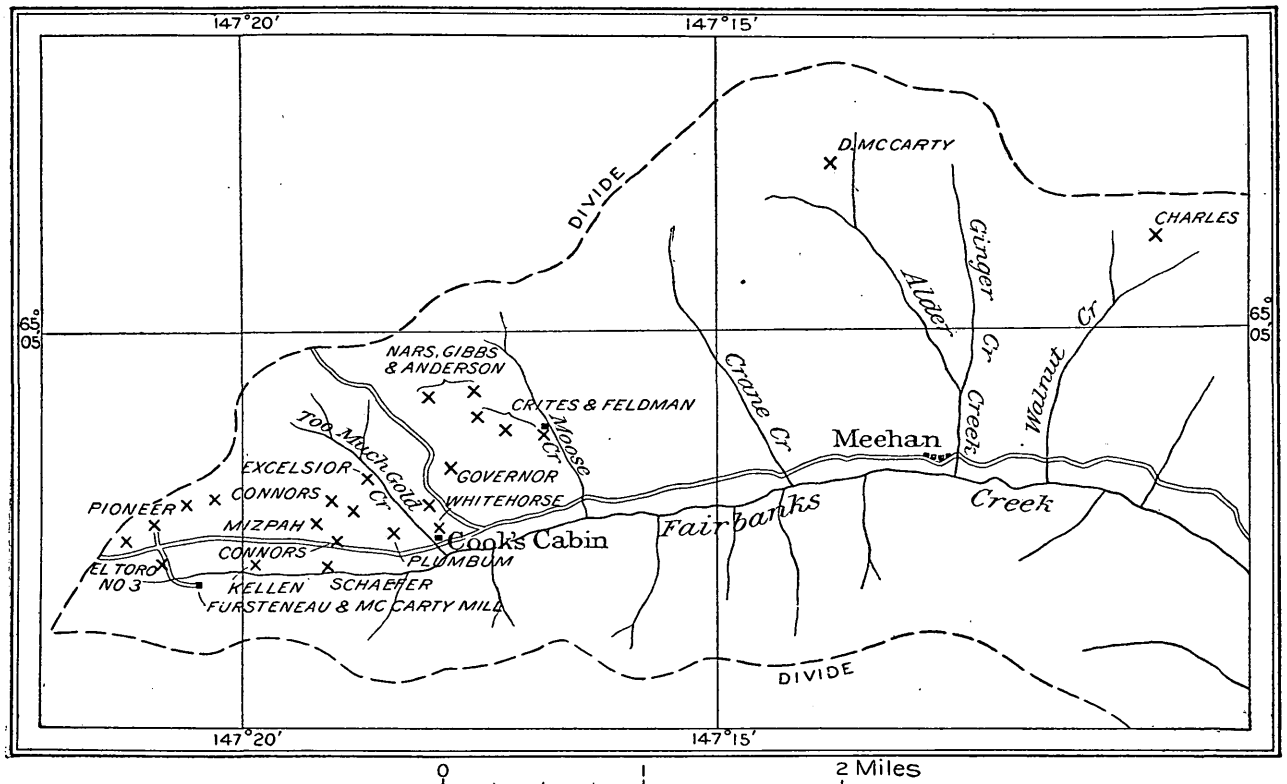



FIGURE 1.—Sketch map showing location of lode prospects in Fairbanks Creek valley.

unaided eye and no sulphides, small colors of gold may be found by panning the finely crushed vein material. Although the gold content of some of the surficial portions of the veins may have been increased by secondary enrichment, the larger part of the auriferous content is probably original and is an integral part of the vein. These veins have not been accurately sampled, and estimates of the tenor of material carrying so much free gold are of little value. The ore, however, is reported to contain from $50 to $75 a ton in gold.

Surface prospecting has been the only work yet done on the property, but the owners propose driving an adit northwestward from a point near the vein outcrop on Moose Creek. As the valley walls are rather steep, a considerable back of ore would be obtained above the adit level; thus in a horizontal distance of 1,000 feet the back would be nearly 300 feet.

About 200 yards above the Crites and Feldman cabin two shallow prospect pits have been sunk by another prospector. The schist exposed in these pits is heavily iron-stained, but in the lower hole no distinct vein was disclosed. In the upper hole, however, some quartz in irregular stringers was found, and a good deal of arsenical pyrites mineralized not only the quartz but also the adjacent schist. This material is said to yield gold on panning, but none was visible in the hand specimens examined. No ore from this property had been milled.

### TOO MUCH GOLD CREEK.

At the head of Too Much Gold Creek, at an elevation of about 2,225 feet (see fig. 1, p. 143), Nars, Anderson & Gibbs have done considerable development work on a vein that appears to be the same as or parallel to that of Crites and Feldman, on Moose Creek. The main vein has been traced by surface pits eastward to the limits of the claims. A smaller vein parallel to the main lead has been found, but has not been so fully opened up. The main vein is from 6 inches to 2 feet wide, though in a few places, owing to mineralization of the wall rock, a width of probably as much as 6 feet can be profitably mined. The dip of the vein at the surface is about 65° N., but it is said to steepen in depth.

The ore is essentially the same as that of the Crites and Feldman veins, already described, but contains somewhat less stibnite. The contact of the vein with the country rock on the hanging wall is marked by a smooth fault plane. Where the vein and country rock come to this plane their surfaces are strongly slickensided and polished. Some of the sulphide mineralization was earlier than this faulting, for the sulphides have been spread out and striated by the movement. On the footwall the vein, in its surficial portion, is frozen to the country rock, and although the junction between the

two is rather sharp, there is an intermingling of the ore and schist that differs notably from the abrupt transition on the hanging wall. The air in the shaft was too bad to permit the vein to be examined in depth, but the operators report that at 80 feet below the surface the footwall becomes smoother and the ore breaks away from the country rock better, which suggests that at depth the footwall may also mark a plane of movement.

The main underground development at this place has been the sinking of a 100-foot incline on the vein, from which short drifts, 15 and 25 feet in length, have been turned off at the 60-foot level. There has been no trouble with water, but the air has been so bad, possibly from the arsenical iron in the ore, that further sinking was abandoned until artificial ventilation could be provided. A small hoist and boiler have been installed at the shaft, and the owners plan to continue mining during the winter of 1912–13. Several mill tests of the ore made at Fairbanks are said to have yielded returns of about $60 a ton. Two and one-half tons were milled in the winter of 1911 and 4 tons in the spring of 1912, and about 2½ tons are sacked on the dump, ready for treatment.

On the ridge between Too Much Gold and Moose creeks, below the veins already described, there are several other prospect pits. At an elevation of 1,850 feet at a place nearly due north of the junction of the creek with Fairbanks Creek, on the Governor claim, a 70-foot shaft had been sunk on a vein trending N. 80° W. and dipping nearly vertical. The ore in general appeared similar to that from the veins already described, but in addition included a light-colored fine-grained rock, probably a fine-grained granite, that is said to carry from $10 to $15 a ton in gold. This rock contains many small vugs, which appear to have been formed by the leaching out of sulphides. Much of the ore has been strongly slickensided. At this shaft there is no permanent equipment, and no work has been done for some time.

At a point east of the Governor claim, at an elevation of about 1,600 feet, a ledge which may be the continuation of the Governor lead was reported to have been found, but at the time of the writer's visit it had not been opened up enough to allow adequate examination.

At an elevation of 25 feet above Cook's cabin, east of Too Much Gold Creek, some ore has been taken from a pit 18 feet deep. At the time of the writer's visit about half a ton of this ore had been sacked and was on the dump awaiting treatment. The footwall at this place is a much-brecciated mass of rock of unknown extent, cemented together by iron, stibnite, and galena. This mineralized mass is believed to be entirely distinct from and younger than the

auriferous vein near by, for it apparently contains fragments of the vein. The brecciation and mineralization at this place may have been produced by igneous intrusion, for an open cut at an elevation of 25 to 50 feet above the pit where this rock occurs contains float of a white porphyritic granite. So far as determined, however, the granite is not noticeably mineralized. The hill slopes near this place are too much covered with talus and turf to permit a determination of the direction or extent of the granite, but the men who have done most of the prospecting say that they have found several dikes here, one as much as 70 feet wide, which are more or less parallel with the larger quartz leads.

West of Too Much Gold Creek several claims have been prospected. (See fig. 1, p. 143.) On the Plumbum claim, which is the nearest to Fairbanks Creek, a quartz vein ranging in width from 3 inches to 2 feet has been exposed in a test pit 15 feet deep. The country rock is schist, striking nearly east and west, and dipping south at a low angle. The vein has nearly the same trend as the schist, but its dip is much steeper. The schist carries, in addition to the vein, which sharply cuts it, numerous quartz lenses, which are entirely distinct from the vein and are cut by it. The vein is composed mainly of a brownish-white, somewhat crushed quartz showing a few open spaces, practically barren of sulphides, and heavily iron stained on its upper surface. Some highly crystalline parts of the vein may, however, have been formed by later fracturing and infiltration. The well-formed quartz crystals in these crystalline parts are generally coated with iron oxide, which may have been derived from the decomposition of sulphides that were originally present in this more porous portion.

The westward continuation of this lead has been sought by sinking prospect holes along the ridge. Quartz veins have been exposed in many of these holes, so that the same or parallel leads have been found nearly to the limits of the claim. Several nearly vertical faults parallel to the vein were found in these pits, but the amount of displacement to which they gave rise was apparently slight. Faults transverse to the vein were not observed, but the failure to note them may have been due to the small extent of rock exposed, as the alignment of the pits suggests that the vein is not continuous. No production has been made from this claim, but about 1½ tons of ore are sacked on the dump awaiting shipment.

Farther up Too Much Gold Creek, on the Excelsior claim, at an elevation of about 1,625 feet, near the stream, two adits have been driven westward. The southern adit follows a small seam that dips steeply south. At a distance of 60 feet from the mouth of this adit a short drift has been turned off to the south on a small stringer that trends nearly north and south. The country rock is hard quartzitic

schist that dips at a much lower angle than the vein. Near the mouth of the northern adit the same kind of schist occurs, but farther in the adit it is succeeded by soft black shiny graphitic schist which in places is said to yield high silver assays. Specimens of this ore examined in the laboratory showed a small amount of sulphides—galena arsenopyrite, and stibnite—but the material does not appear to be much mineralized. This adit is about 60 feet long.

Near the Excelsior adit is an exposure of a light-gray fine-grained granitic rock containing small, irregularly distributed cavities surrounded by limonitic rings. This rock is considerably iron stained on its exposed surfaces but contains no visible metallic minerals. It has a fine-grained groundmass, mainly quartz and feldspar, through which quartz phenocrysts are scattered. This rock and the veins prospected on the Excelsior claim lie so close together at the surface as to suggest that they are genetically related, but the surface exposures are so small that such a relation can not be demonstrated.

On the hillside above the Excelsior adit numerous pits have been sunk on a vein called the "cross vein," which trends about N. 30° E. and dips southeast at a high angle. Most of the pits have caved to such an extent that the character and width of the vein is not determinable. On the whole, however, this vein appears wider than the east-west veins already described and contains rather more sulphides. These veins are currently reported to carry considerable silver, but specimens collected by the writer have not yielded any of this metal. The dark mineral probably confused with silver is, in every specimen so far examined, galena, stibnite, or arsenopyrite.

The N. 30° E. vein just described intersects an east-west vein which has been opened up on the Mizpah claim on the ridge between Fairbanks and Too Much Gold creeks, at an elevation of about 1,700 feet. The contact between the two was not well exposed, but prospectors report that the two merged—that one did not cut the other.

### WEST OF TOO MUCH GOLD CREEK.

The Mizpah vein, staked in 1910, is north of Fairbanks Creek about half a mile west of the mouth of Too Much Gold Creek, at an elevation of 1,800 feet. The vein strikes about east and west and dips more than 75° S. It has been developed by a shaft 120 feet deep, from which drifts have been turned off both to the east and to the west at the 80-foot level. No difficulty with water has yet been experienced. In the western drift numerous well-defined stringers composed mainly of quartz, with subordinate amounts of sulphides, carry free gold, apparently as an original constituent. The quartz has a sliced appearance, as if the vein had been subjected to considerable movement. In the eastern drift the vein made a slight roll, so that for a while it appeared faulted, but further work showed that

it persisted in the hanging wall. On the foot-wall a gouge a few inches thick, said to prospect well, probably marks a zone of movement.

The minable rock at the Mizpah claim ranges in thickness from 12 inches to 3 feet, the average being about 2 feet. A test of about 3 tons of ore at the Fairbanks mill is reported to have given a return of $92 a ton. This, without doubt, was selected material, so the test only shows that some of the ore is of high tenor. Little work is now in progress at the property. Plans are said to be under way for building a mill, but it will probably not be constructed until the mine is further opened, and this delay is advisable not only to determine whether a mill is warranted, but also to provide a sufficient reserve to keep it running.

Between the Mizpah shaft and Too Much Gold Creek are the Ohio and Mayflower claims of Connors & Stevens. The upper shaft, at an elevation of about 1,900 feet, is said to have been sunk about 45 feet. It opens up a vein that trends about northeast-southwest. The shaft was not accessible at the time of the writer's visit, but the country rock on opposite sides of the vein is reported to be dissimilar, which suggests that the vein occupies a fault plane. Specimens of the ore on the dump contain a large quantity of sulphides, notably galena and stibnite, associated with quartz. The quartz is sheared and many of the shearing planes exhibit sulphides or their oxidation products. In addition some quartz was apparently deposited contemporaneously with the sulphides and forms long hexagonal crystals in the midst of the galena.

The southern shaft on the Connors & Stevens property is near the road, at an elevation of about 1,675 feet. At this place there are two veins which are about 4 feet apart at the surface but more than 15 feet apart at the bottom of the shaft. The veins strike about northwest-southeast, but their direction is locally variable. The walls show strong slickensiding with striæ running practically vertical and the southern block relatively downthrown. The ore on the footwall merges into the schist, but that on the hanging wall abuts directly against the fault plane. No adequate measurement of the amount of displacement was obtained. About 15 feet above the bottom of the shaft a winze has been sunk to the northeast, at a low angle, on a stringer of ore which has been traced about 25 feet.

The tenor of the ore has not been tested by mill runs, and the few assays that have been made show a variation so great that they are of no service in estimating the average of the mine. The owners believe that the average value of the ore is at least $50 a ton, mostly gold, but partly silver.

On Fairbanks Creek, just below Connors & Stevens's prospect, is a short tunnel trending about north and south. At its mouth is a small amount of mineralized quartz, and beyond is graphitic quartzose

schist which dips northward at a low angle. The schist is reported to have yielded 60 ounces of silver and $4 in gold to the ton; but no indications of a silver-bearing mineral were seen. The quartz stringers are said to carry about $4 a ton in gold and no silver, but this tenor is too low for profitable mining.

A short distance upstream from this tunnel is another, driven by M. A. Schaefer, about 150 feet long, trending N. 5° E. In the breast is a rather flat-lying quartz stringer. Its position is unusual, for in general the veins are steep and the country rock is fairly flat, whereas at this place the situation is exactly the reverse. The tunnel is so near the surface, even at its inner end, that the rock is greatly decomposed and strongly iron stained. No production has been made from this property and no reliable estimate has been made of the tenor of the ore.

Half a mile above M. A. Schaefer's, on Fairbanks Creek, is Kellen's property, which has been prospected by a shaft and tunnel. The tunnel has been driven 80 feet northward on blocky schistose quartzite that dips south at an angle of 60°. Some quartz stringers said to carry gold were intersected by the tunnel, but they are too small to be mined independently and their tenor is too low to permit much country rock to be mined with them. A reddish iron-stained seam at the face of the tunnel dips steeply to the north and suggests that the vein is near, but does not seem to be the lead encountered in the shaft above. The shaft was sunk just above the north end of the tunnel and uncovered a narrow lead of crushed and recemented quartz having somewhat the texture of a quartzite. Long cavities in the vein appear to have been formed by the leaching out of a striated bladed mineral, such as stibnite. Stibnite in irregular patches is fairly common throughout the quartz and shows the usual oxidation stages to senarmontite or has even been completely removed, if the cavities noted above were really formed by the leaching out of this mineral. No ore has been produced at this property and work has been carried on only at intervals.

At the extreme head of Fairbanks Creek are a number of leads, and the ground has been blanketed by rival claimants and tied up with lawsuits. In consequence the ownership of the several properties is uncertain, and until the courts act many of the claims have two or more names. Without expressing any opinion on the issues raised by the litigation, certain claim names have been adopted here solely for convenience in description.

Between the road and the head of Fairbanks Creek, at an elevation of 2,150 feet, is "El Toro 3" claim. It has been developed by a 65-foot inclined shaft sunk on the vein. Near the surface the dip of the vein is 72°, but lower down it flattens to 51°, and continues on this slope to the bottom of the shaft. The vein matter consists almost

entirely of hard, rather glassy quartz, with a small amount of stibnite. The quartz is said to carry native gold, which is practically invisible until the ore is crushed and panned. No production has been made from this claim.

North of "El Toro 3," trending nearly east and west, five claims, named in order from west to east the War Eagle, the Leroy, the Pioneer, the Iron Mask, and the Black Warrior, extend between the road and the top of the ridge. The veins found on these claims have not yet been traced accurately, but they are all essentially contemporaneous and form a parallel series, having a nearly east and west strike and a dip of over 45° S. In physical appearance the vein matter from the different leads is practically indistinguishable, and, so far as determined, the gold tenor does not vary more in the different veins than it does in different parts of a single vein.

On the westernmost claim two leads have been found in five or six pits from 8 to 10 feet deep. The veins are 1 to 2 feet wide, and many pieces of the ore show free gold. On the next claim east two shafts have been sunk on a vein believed to be the continuation of one of the veins on the western claim. At this place the vein is about a foot wide. Little development work has been done on this lead.

Still farther east, on the Pioneer, the most extensive work on this group of claims has been done. Here a shaft 110 feet deep was sunk and the vein was drifted on both east and west for about 200 feet. East of the main shaft another, 75 feet deep, was put down and 50 feet of drift was driven eastward. About 75 feet east of this last shaft another, 38 feet deep, has been sunk. Still farther east pits 10 to 15 feet deep have been put down at intervals of 25 to 50 feet, and a lode has been uncovered. The vein is reported to have been proved in this manner for 800 feet, in which distance it shows an average width of about 18 inches. Gouge from 6 inches to a foot thick occurs on both walls.

A lode 3 feet wide has been uncovered just east of the Pioneer and is now being developed on a lease. On the hanging wall of the vein at this place is a white, thoroughly decomposed rock which appears originally to have been a fine-grained granular intrusive, but which is now a gritty gray mass of kaolin and quartz, the quartz occurring as irregular small particles in a groundmass of kaolin and finely crushed quartz. The underground workings at this place were inaccessible at the time of the writer's visit, owing to a cave-in, but this decomposed material is said to give place in depth to quartz carrying gold, a condition that seems doubtful, as a faulted relation between the two is more probable.

Still farther east, on the last claim of this group, a vein is said to have been traced for 400 to 500 feet by test pits, 12 to 15 feet

deep, sunk at intervals of about 50 feet. On this claim the vein averages from 8 to 10 inches in width.

In 1912 none of these properties were producing ore, but according to Angus McDougall, one of the owners, 107 tons have been mined and milled, mainly from the Pioneer property. Of this amount 22 tons is said to have yielded a return of $172 in gold to the ton, not including concentrates, and the rest carried from $125 to $150 a ton, also not including the concentrates. About 65 tons of ore are sacked on the dumps awaiting treatment. The owners estimate that this lot will yield about $65 in gold a ton. According to Frank W. Hawkins, formerly assayer for the Washington-Alaska Bank, the average fineness of the gold bullion so far received from this mine is 0.814½. All the ore has been milled at the Fairbanks custom mills, but the erection of a mill near the mine is contemplated.

#### PEARL CREEK VALLEY.

In the vicinity of the large mass of pegmatitic granite in the central part of the Pearl Creek valley many claims have been located by Michael Stepovitch and others, but the region has not been visited recently by members of the Survey, and no information concerning the results of the prospecting is available.

On the Smallwood-Pearl Creek divide Murphy and Perrault are reported to have been prospecting a vein on the American claim. A 50-foot shaft, the upper 8 feet of which was in talus, was sunk on this claim, and a vein from 18 inches to 4 feet in width, averaging 2 feet, is said to have been found. Several tons of ore were hauled to Fairbanks, and it is said yielded about $24 a ton in gold. On the adjoining claim to the south, the American Eagle claim, owned by the same men, is another vein, which the owners believe averages about 18 inches in width, and has a gold tenor of about $25 a ton. This vein has been opened up by a shaft 38 feet deep. According to report a dike cuts the lead, but its character was not learned, though the dike rock is said to have a gold content worth $15 a ton. Twenty tons of ore had been mined and was on the dump awaiting shipment in 1912.

### TRIBUTARIES OF CHATANIKA RIVER.

#### WOLF CREEK VALLEY.

##### PENNSYLVANIA MINE AND VICINITY.

North of the War Eagle–Black Warrior group of claims, on the Wolf Creek side of the divide, are several other claims, on one of which, the Pennsylvania, at an elevation of 2,100 feet, the most development work has been done. The strike of the main vein on this property is N. 76° W. and the dip is 56° S. Gouge 3 to 4

inches wide occurs on the hanging wall, and the striæ on the slickensided surface dip at low angles on the plane of the hanging wall to the east. The ore is essentially similar to that at the other properties described. In some specimens taken near the surface the gold occurs in cracks between fragments of fractured quartz in a yellowish decomposition product formed by the breaking down of an antimony mineral. In such occurrences the gold probably has been deposited later than the quartz and the vein secondarily enriched. This enriched zone, however, is reported not to extend more than a few feet below the surface. The width of the vein varies somewhat, but averages about a foot.

Underground developments at the Pennsylvania consist of a 92-foot shaft, from the 50-foot level of which drifts have been run east and west for 20 to 30 feet. In the western drift several upraises have been started, and one of these, near the end of the drift, connects with the surface, though, owing to surface caving, it does not afford a traversable passage. Little work was in progress at the time of the writer's visit, as the owners were awaiting the completion of the mill.

Several mill tests of selected ore from this mine, made at Fairbanks, yielded, it is said, very high returns. The owners, however, estimate that the average tenor of the ore is about $40. The ore will be milled in a Little Giant mill, which was being built on the south side of Fairbanks Creek, on the creek claim known as No. 17 above. (See fig. 1, p. 143.) A well-constructed road about half a mile long connects the mine and the mill, affording a down-hill haul for loaded teams. The ore will be dumped from the wagons into a bin at the mill, from which it passes over a grizzly and is fed by an automatic distributing device to the muller. The crushed material flows over plates below the mortar and is then carried through a launder to a Monarch table. The estimated capacity of the mill, as now constructed, is 8 to 20 tons of ore a day, but the building was planned so that, when necessary, two additional mullers could be installed without affecting the present equipment. The problem of obtaining sufficient water for the mill is believed to have been solved by damming Fairbanks Creek so as to form a small pond and by using seepage water. As the mill stands at an elevation of about 1,850 feet, the amount of water available is small and some doubt is felt as to its sufficiency during the winter. No special precautions have been taken to overcome the low winter temperature, with the exception of heating the mill by placing the boiler inside the mill building. The owners expect that this mode of construction will allow the mill to be run throughout the year.

Near the Pennsylvania claim, on the Wolf-Fairbanks Creek divide, are two other claims on which some work has been done. At the

Dorothy claim, west of the Pennsylvania, a 95-foot shaft had been sunk on quartz stringers that appeared promising, but work had stopped and the shaft had caved and become inaccessible. Between the Dorothy and Pennsylvania is an abandoned tunnel, in which a quartz vein dipping steeply toward the south was found.

Prindle[1] notes:

> Near the head of Wolf Creek, on the Willie claim [see fig. 2], 4 to 5 feet of ferruginous quartz and mineralized schist have been exposed, from which gold can be panned. The strike is N. 50° E. and the dip 80° SE. It is reported that the deposit has been traced by float along this strike for about 1,000 feet.

### HOMESTAKE MINE.

At the head of Wolf Creek, immediately south of the Nipsic claim (see fig. 2), the Homestake Mining Co. has been prospecting since 1908. In September, 1912, three men were at work on the property, which was being explored by means of a tunnel which at that time was over 650 feet long. At least five veins, which trend normal to the tunnel and which the tunnel is expected to intersect in depth, are known on the surface. These veins, like those on the Fairbanks-Wolf Creek divide, have a general east-west trend and dip southward at angles of 45° or more. Near the mouth of the tunnel is a small quartz stringer, which appears to dip steeply north, but this dip may be due to surface creep and may not be persistent in depth. A rich vein, on which 75 feet of drift to the east and 50 feet of drift to the west were driven, was found in the tunnel at a distance about 320 feet from its mouth. This vein is from 3 inches to a foot wide and carries much gold, 1,300 pounds of selected ore yielding, as reported, $308 in free gold. In addition the concentrates are said to have contained considerable gold and silver. Their reported high content of silver is surprising, as no distinct silver mineral was recognized in the specimens collected by the writer. Sulphides of antimony, copper, and iron form a small amount of the vein matter, but galena was practically absent and no silver sulphide was detected. The quartz is rather crystalline, though shattered here and there with open spaces into which well-terminated quartz crystals extend.

Some water has been struck in driving the tunnel, but it seems to occur mainly along fracture zones. Except for the fact that the ground has not stood well near these fissures and the personal discomfort of working in the wet places, the water has caused little or no trouble, as it is carried away by the grade of the tunnel. When mining deeper than the tunnel level is attempted pumping may be necessary. By the time the main lead is reached, and drifts

[1] Prindle, L. M., Auriferous quartz veins in the Fairbanks district: U. S. Geol. Survey Bull. 442, p. 227, 1910.

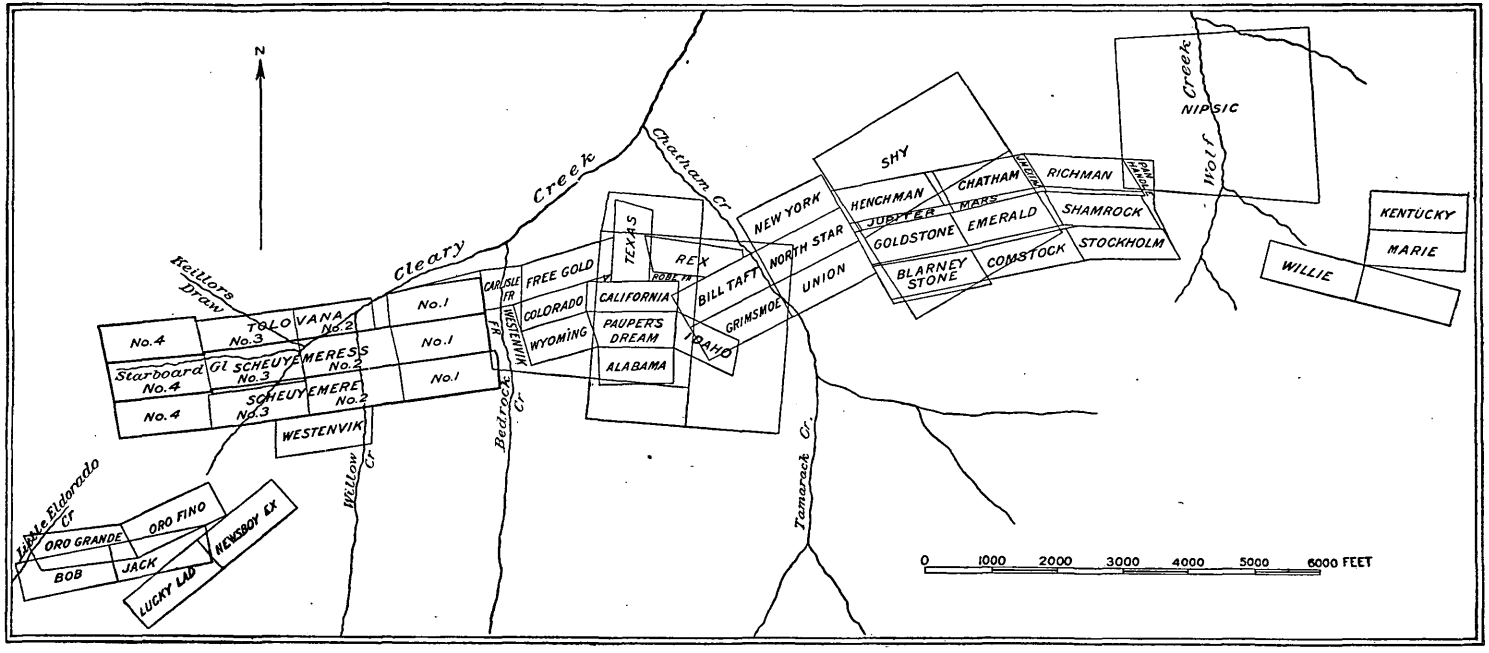



FIGURE 2.—Map showing location of lode claims in upper part of Cleary Creek valley, from map by L. S. Robe, 1909.

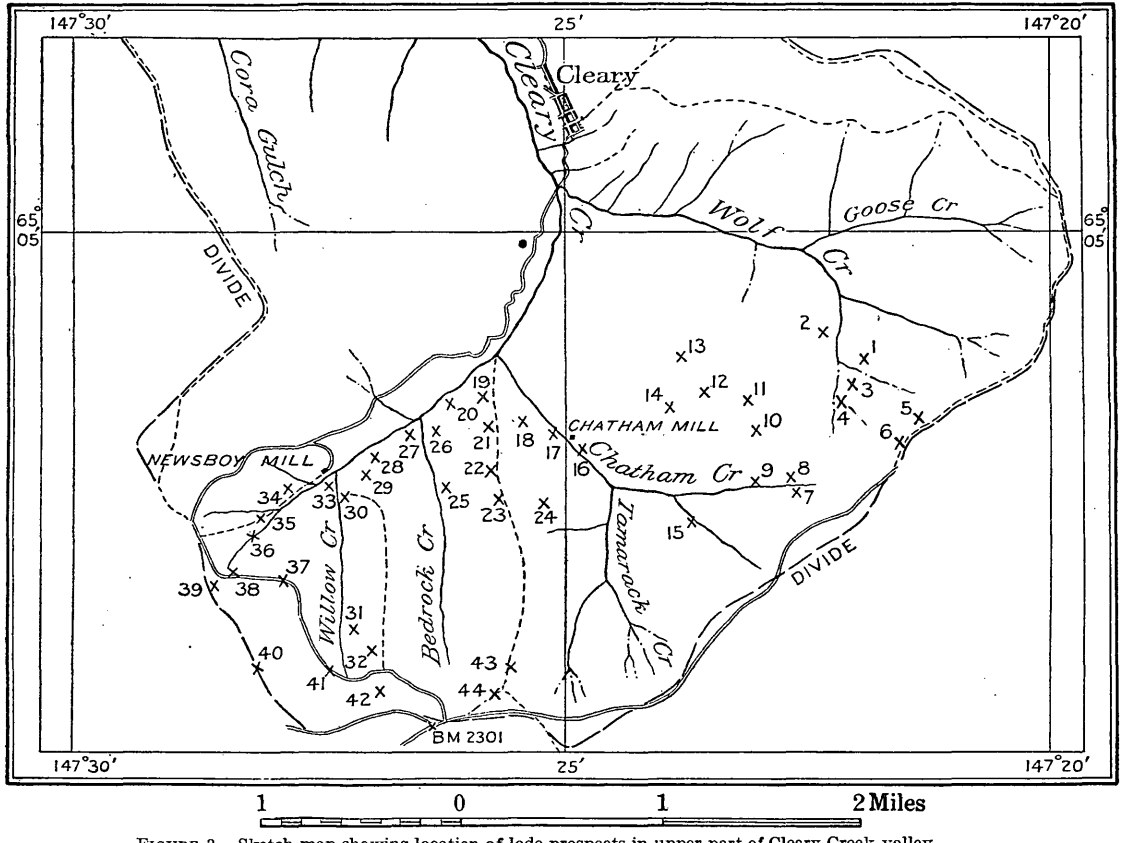
and stopes are turned off on the vein, sufficient information should be obtained to enable the owners to calculate closely the quantity of water to be handled, the cost of mining, and the tenor of the ore.

### REXALL MINE.

A few hundred feet north of the Homestake Mining Co.'s tunnel is the Rexall claim (fig. 3), which was being actively worked by a crew of 5 to 10 men during 1912. This claim was staked in the summer of 1910 and more or less continuous work has been done on it ever since. Mining started on a large quartz vein, from 3 to 5 feet wide, trending N. 25° E. and dipping about 25° W. The vein material consisted almost entirely of quartz, and its gold content is reported to be rather low. About 140 feet south of the mouth of the adit a small vein, trending nearly east and west and dipping 60° N., was struck and, being much the richer, was followed, work on the larger vein being temporarily abandoned. A winze was sunk to water level on the smaller vein.

Mining had so obscured the relations of the two veins that the contact could not be fully seen. The superintendent stated that the small vein was simply an offshoot from the large vein, an interpretation that seems questionable, for he also stated that the small vein offset against the large vein and that the large vein carried considerably higher values between the junctions of the small veins. The condition is diagrammatically shown in figure 4, in which A and A′ are the offset small vein, and B and B′ the large vein, and the stippled area the richest portion of the veins. Such a condition suggests that AA′ had been faulted along a plane in general parallel to BB′ and that subsequent mineralization, by which the large vein BB′ was formed, took place along the fault. According to this interpretation the rich part of the vein between A and A′ may mark the dragged material formed by movement of the small vein on the old fault plane. A further bit of evidence suggesting that the smaller vein is older than the larger is the fact that the former is cut by faults of small displacement roughly parallel to the hypothetical fault, whereas the big vein, so far as traced, is not faulted.

The small vein is from 1 foot to 18 inches in width and has been opened underground by about 340 feet of drift. Several upraises have been made and the ground has been blocked out so that stoping can be begun when desired. The back of ore above the adit level in the present workings is estimated to be about 140 feet. Midway in the drift on the small vein a winze has been sunk to water level. At this place the vein is about 18 inches wide, and the hanging wall, which is much slickensided, carries 1 to 2 inches of gouge.




1. Banner.
2. Solomon.
3. Rexall.
4. Homestake.
5. Pennsylvania.
6. Dorothy.
7–9. Chatham Mining Co.
10. Harris & Brown.
11. Quemboe Bros.
12. Furstenceau.
13. Quemboe Bros.
14. Jupiter Mars.
15. Roughneck.
16. Pioneer.
17. Rex.
18. B.-P.
19. Cunningham.
20. Lyons.
21. California.
22. Pauper's Dream.
23. Alabama.
24. Bobbie.
25. Wyoming.
26. Rhoads-Hall.
27. Stepovitch.
28. Crosscut.
29. Tolovana Stibnite.
30. Tolovana.
31. Overgaard.
32. Emma.
33. Stibnite.
34. Scheuyemere.
35. Eldorado.
36. Steil.
37. ?
38. Newsboy Extension.
39. Newsboy.
40. ?
41. Cornell.
42. Cheyenne.
43. 44. Jackson.

FIGURE 3.—Sketch map showing location of lode prospects in upper part of Cleary Creek valley.

In addition to these two veins, small stringers of vein quartz that when panned yielded gold were discovered while excavations were being made for a mill site and a blacksmith's shop.

It is reported that 25 tons of ore from the small vein, milled at Fairbanks, yielded an average gold content of $112 a ton. It is also said that 10 tons of this ore yielded an average of $166 a ton, and that a 3-ton sample from the large vein gave a return of $37 in gold to the ton. All of these figures represent the values of the content of free gold, for the concentrates were not saved. A determination of the fineness of the gold from the Rexall, furnished by Frank W. Hawkins, of the Washington-Alaska Bank, gave 0.780½ and 0.785½, but the gold had not been thoroughly cleaned, so the true fineness is probably higher.

At the time of the writer's visit (September, 1912) the operators at the Rexall were preparing to build a mill. The site had already been graded, the lumber was beginning to arrive on the ground, and the machinery was in Chena, so it was expected that the plant would be in operation before the close of the year. The mill is a 2-stamp Joshua Hendy mill and will be operated by a gasoline engine. Water for this mill has been procured by sinking a 35-foot shaft within the space to be occupied by the mill. This water supply is said to be more than sufficient during the summer, but it may not be adequate after the surface water is frozen.

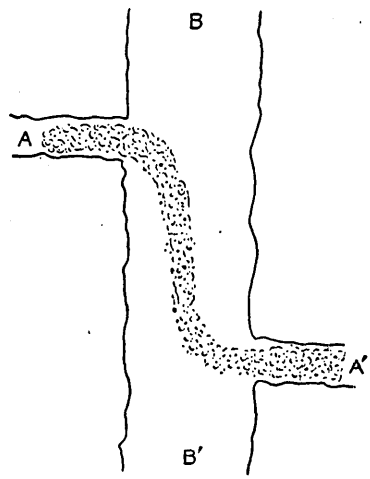


FIGURE 4.—Diagrammatic section of vein at Rexall mine, Wolf Creek.

MISCELLANEOUS PROPERTIES.

Above the Rexall cabin, at an elevation of 1,450 feet, a shaft has been sunk on the Banner claim. Work at this place has been abandoned for some time and the shaft had caved and partly filled, but ore carrying free gold is reported to have been found.

On the western slope of Wolf Creek valley, northwest of the Banner claim, prospecting has disclosed a 3 to 4 inch vein of quartz carrying a large amount of stibnite. The general trend of this vein is said to be northeasterly, but the pit had caved, and therefore the ledge was not examined by the writer.

In the small draw at the head of Wolf Creek, above the Homestake Mining Co.'s tunnel, are several shallow open cuts. On the dumps is a considerable amount of quartz, but all the work done

had been shallow prospecting, no underground development of the property having been attempted. No statements as to the results of this work were obtained, as the operator was absent at the time of the writer's visit.

On the Wolf Creek side of the Chatham-Wolf Creek divide, at an elevation of about 2,125 feet, the Quemboe brothers have discovered a vein trending N. 70° W. and dipping south. Development work at this place consists of a 60-foot shaft with a short drift to the east and another to the west. The dip of the vein and of the incline that follows it is steep near the surface, but flattens lower down. The ore shows some stringer banding and is much broken up. In parts of the vein the broken quartz fragments seem to have been cemented together by a subsequent infiltration of sulphides, the most abundant of which are stibnite, pyrite, and arsenopyrite. The rock is a rather soft schist and the vein appears to have been subjected to faulting by which its contact with the country rock on the hanging wall is marked by a plane of movement. Samples taken by the owners across the entire face of the vein are reported to have assayed $22.50 and $32 in gold a ton.

A peculiar fact reported in connection with the sinking of the shaft on this claim was that in its lower part considerable trouble with water was experienced and the shaft was temporarily abandoned. Some time later the water disappeared and the mine is now dry except for a little surface-water seepage down the shaft. The walls are a good deal cracked, owing to settling, and this cracking may account for the sudden disappearance of the water.

### CHATHAM CREEK VALLEY.

#### CHATHAM MINE.

The Chatham Mining Co. is developing a lead on the eastern slopes of the valley, at the extreme head of Chatham Creek, at an elevation of 1,825 feet. The vein was disclosed at the surface in 10 shallow pits, which are so spaced that the ore is traced for more than 500 feet. In order to avoid difficulty with water, a crosscut tunnel 200 feet long was driven to the vein and drifts were turned off both to the east and to the west. The trend of the vein is N. 60° W., and its dip is from 65° to 80° SW. The estimated difference in elevation between the tunnel level and the outcrop of the vein is 180 feet. The vein ranges in width from 6 to 18 inches and has physical aspects similar to the quartz veins of low sulphide content previously described. The hanging wall shows pronounced slickensiding, the striæ being practically horizontal on its steeply inclined surface. In addition to this strike fault, dip faults are by no means uncommon. The greatest displacement of the vein so far

noted is 14 feet. Apparently the throw of all the faults is toward the southwest.

At the mine several hundred feet of drift has been driven along the vein, and slopes have been started, so that the mine has reached a producing stage. The ore is broken down on canvas and stored in mill holes undergound. It is then trammed to the surface and dumped into an ore bin, from which it is drawn as needed. About 10 men were employed undergound in 1912 and each is estimated to be mining about a ton of ore a day. Precise figures as to the tenor of the ore are not available, but the average value of the free gold content is reported to be between $25 and $40 a ton.

Across the small stream at the head of Chatham Creek near an old cabin is an adit owned by the Chatham Mining Co. This adit is said to be about 60 feet long, but it has been abandoned and is now so caved as to be inaccessible. Little mineralization is said to have been found in the adit, and if a vein was discovered it must be south of the one which is being mined.

The ore of the Chatham Mining Co. is treated at the company's mill on the lower part of Chatham Creek about a mile from the mine and 700 feet lower. The mill consists of two batteries, each of two 1,000-pound stamps of the Joshua Hendy pattern, dropping from 100 to 105 times a minute. The ore is crushed to pass through 40-mesh screens and the pulp flows over amalgamated plates. The tailings from the plates are not saved, so that there is probably a considerable loss. Water for the mill is obtained from a small ditch that was formerly used by placer miners near the junction of Cleary and Chatham creeks. At the time the mill was visited an abundance of water was available, but whether this source will be ample throughout the year is questionable. The difficulty of milling with water in cold weather is shown by the fact that even as early as September 13 the mill was closed down for a while at night on account of ice. The mine and the mill are connected by a good wagon road, a little more than a mile in length, over which the ore is hauled by horses.

### PIONEER MINE.

Near the claims now held by the Pioneer Mining Co. on Chatham Creek, less than a mile above the junction of Chatham and Cleary creeks, the first quartz claim in the Fairbanks region was located on August 28, 1903, and recorded on November 24 of the same year by John C. Rose as the Blue Bell lode. Not much work was done on the ground until 1908–1909. Prindle,[1] who visited the property in 1909, made the following report concerning it:

> The Pioneer Quartz Mining Co. has done considerable work at this locality on a claim known as the North Star. A shaft was sunk near the creek to a depth of 24

[1] Prindle, L. M., Auriferous quartz veins in the Fairbanks district: U. S. Geol. Survey Bull. 442, p. 227, 1910.

feet, when water was encountered. A second shaft was sunk about 100 feet farther up the east slope of the valley to a depth of about 85 feet on a vein about 3 feet thick, striking northeast and southwest. This vein was found to intersect the smaller vein at nearly right angles. At the intersection the smaller vein, it is reported, follows the main vein for a short distance and then penetrates the country rock. The smaller vein is said to range from 4 inches to 2 feet 6 inches in thickness. Both veins carry free gold, but in the smaller vein there is considerable stibnite and arsenopyrite, with some sphalerite and iron pyrite. The distribution of the sulphides is irregular, but in the portion of the vein where they occur they are for the most part rather evenly distributed through the quartz. They show a slight tendency in some places, however, to form small seams in the quartz.

At the time of the writer's visit in 1912 no mining was in progress, as the men were engaged in building a mill, but the new shaft, which has been sunk 92 feet, starting about 20 feet above the level of the creek, was visited. Only a little water had been struck in the drifts turned off from the shaft, but the owners expect a stronger flow at a little greater depth. Drifts have been turned off both to the east and to the west of the shaft, the eastern one being much longer than the western; and stopes have been started, so that some ore is blocked out ready for mining as soon as the mill is completed. At the end of the eastern drift the vein is cut off by a fault, but the dislocation is slight, for the continuation of the lead has been picked up in surface pits beyond the fault with little offset.

A sample of the ore from the Pioneer Discovery claim was assayed by O. J. Tuschia, of the Monterey Mexico smelter, with the following results, the gold and silver content being omitted:

*Assay of ore from Pioneer Discovery claim.*

| | |
|---|---|
| Copper (Cu) | None. |
| Lead (Pb) | None. |
| Silica ($SiO_2$) | 95.1 |
| Iron (Fe) | 2.5 |
| Lime (CaO) | .9 |
| Zinc (Zn) | None. |
| Sulphur (S) | .3 |
| | 98.8 |

This analysis shows the high silica content and the small amount of metals other than iron. The sulphur content is so low that only a small amount is available to combine with the iron to form pyrite. Unless the low figure for sulphur is due to an error in analysis, it is probably to be accounted for by the oxidation of sulphides that originally may have been present.

Several shipments of ore have been made from this property for mill tests at Fairbanks, and returns of $30 to $90 a ton in gold are reported. From these tests the owners have felt justified in putting in a battery of five 1,000-pound stamps. The latter part of the summer of 1912 was spent in building the mill, which will probably be in

operation before the close of the year. Considerable difficulty in securing a suitable site for the mortar block was experienced, as at two places where excavations were started ground ice was found. Even at the place finally selected the foundation is none too good and a bed block 32 feet long containing more than 5,200 board feet of lumber was constructed to give sufficient support for the battery. Water for the mill will be obtained by pumping from the now abandoned shaft, over 100 feet deep, on the west side of Chatham Creek. No accurate estimates of the amount of water that can be obtained from this source have been made, but the fact that the earlier lode miners were unable to control the water is considered sufficient evidence that the supply will be adequate.

### PROSPECTS ON EASTERN SLOPE.

On the hillside above the Pioneer Co.'s shaft and between that property and the Chatham Mining Co.'s ground a number of veins have been located and some work has been done, but none had reached a producing stage in 1912. The Jupiter-Mars Consolidated Mining Co. has seven or eight claims on the eastern hillside, and on the Gladstone claim, at an elevation of about 1,700 feet, it has driven two tunnels a short distance on a flat-lying lead. The vein trends about east and west and dips southward into the hill at a variable though low angle. Several faults intersect the vein, which does not appear at all regular. The miners believe that the part now being mined may be a large piece of slide and that farther up the hill the vein may be more regular. Not enough development work had yet been done to show the true condition, but in the northernmost tunnel the vein is abruptly cut off to the left by well-rounded gravels and wash. The gravel is similar to an ordinary river deposit and consists of pebbles of schist and quartz in a fine-grained, rather dirty matrix. The gravels are frozen, and therefore hold together well in the mine, but are not well consolidated. East of this place a 66-foot shaft has been sunk, and several other pits have been put down to prospect the ground. Shipments of a ton or so of ore from several of the veins have been tested at Fairbanks, and the average gold tenor of the ore is said to be about $30 a ton. Sulphides form but a small part of the vein material.

Farther north, on the ridge between Wolf and Chatham creeks, at an elevation of 1,850 feet, is a short tunnel of the Sky High claim. The lead at this place is a very much decomposed brown, iron-stained material, 3 to 6 inches wide, dissimilar from any of the other leads in the vicinity. Not enough development has been done to show the extent and character of the vein, but it appears to lie very nearly horizontal and suggests an iron capping rather than

a vein. It is reported that the limonitic material affords gold on panning but that the amount is usually small. On the next adjacent claim a lead said to be 14 feet wide is rumored to have been opened by a short tunnel, but its gold content is small and little work has been done on it.

Southeast of the Sky High claim, at an elevation of 1,875 feet, in a now abandoned shaft, 60 feet deep, an east-west vein was discovered. No production, however, has been made from this place.

On the summit of the hill, between the two northernmost pinnacles of schist, at an elevation of about 2,050 feet, Harris & Brown have sunk a shaft 50 feet deep on a vein that trends N. 70° E. and dips at a high angle. The ore seems similar to that from the veins having a low sulphide content. One exceptional phase, however, was noted, in which the quartz was strongly brecciated and the fragments were cemented together by a matrix of crushed quartz. The cementation is so strong that the rock breaks across the large quartz fragments and the matrix appears like a quartzite. A somewhat similar rock, in which the matrix is formed of stibnite instead of quartz, was also seen. This rock shows that the sulphides were formed at a rather late stage in the vein filling. This phase is said to occur rather irregularly and forms but a small amount of the material cut by the shaft.

### PROSPECTS ON WESTERN SLOPE.

Less than half a mile above the junction of Cleary and Chatham creeks, on the west side of the latter stream, is the B. P. claim, which has been more or less continuously prospected since 1908, though during 1912 the property was idle. Prindle, who visited the prospect in 1909, describes it as follows:[1]

> At a level of 150 feet above the creek a tunnel was driven southwest for about 90 feet. At 50 feet from the mouth of the tunnel a shear zone was encountered, about 6 feet thick, striking northwest nearly at right angles with the strike of the schists. The operators drifted northwest and then sunk on the shear zone, which was found to dip from 45° to 70° SW. to a depth of 150 feet, where the thickness was about the same as in the tunnel. Later a raise was put in above the winze, connecting it with the surface. The second level is about 100 feet below the first and extends along the vein for about 40 feet on each side of the shaft.
>
> The mica schist of the shear zone was found to be impregnated with sulphides, chiefly iron pyrites and arsenopyrite, with some galena, sphalerite, and stibnite. These sulphides also occur in the numerous quartz veins that penetrate the shear zone. Free gold is found in the upper, more oxidized portions of the mineralized zone, but it is reported that in the less decomposed lower portions of the lode the values are in the sulphides. A noteworthy feature is the occurrence of tourmaline needles in the mica schist close to the contact of schist and quartz veins and in close association with iron pyrites and arsenopyrite.

[1] Prindle, L. M., Auriferous quartz veins in the Fairbanks district: U. S. Geol. Survey Bull. 442, p. 226, 1910.

Difficulty with water caused the abandonment of mining for a while, but later an attempt was made to determine the quality of ore below the water level by sinking an inclined shaft. The venture was soon abandoned, however, and failed in its object. It is to be regretted that this particular lead was selected, for it does not appear to be typical of the majority of auriferous quartz veins. It is, instead, as Prindle describes it, a shear zone with an abnormally large amount of sulphides, even near the surface, and the free gold it carries is confined mainly to its weathered superficial portion, where the sulphides have been broken down and decomposed. As might have been expected, therefore, a short distance below the surface the ore became base and its value decreased.

Near the creek, between the B. P. and Pioneer claims, is the Rex Mining Co.'s claim. Owing to legal difficulties, little work has been done at this place. According to Brooks,[1] some work was done on the Rex during 1911, but when visited in 1912 no work was in progress and the place was deserted.

On the Bobbie claim, west of the junction of Tamarack and Chatham creeks, at an elevation of 1,650 feet, several shallow pits have been sunk and a tunnel has been driven on a lode striking nearly north and south and dipping westward into the hill. No work has been done at this place recently, and most of the pits are too much caved to allow examination. Specimens of the ore, however, indicate that the vein belongs to the group having a high sulphide content. The ore consists mostly of stibnite and galena with other sulphides in smaller quantities. In the midst of the sulphides are numerous well-formed quartz crystals with uncorroded surfaces and random orientation. Several of the quartz crystals are more than an inch in length and a quarter of an inch in diameter.

In the short incline from the open cut on this claim is a narrow stringer of nearly pure galena. This vein shows well-marked banded structure near the walls, the center of the vein being completely filled with large crystals of galena. The galena is reported to carry considerable silver, but the charges for treating this kind of ore are so high that the property can not be commercially developed in the near future, even if a much larger body of ore than has yet been found should be discovered.

### BEDROCK CREEK VALLEY.

#### RHOADS-HALL MINE.

East of the lower part of Bedrock Creek (see fig. 3, p. 156), on the Free Gold claim, is the Rhoads-Hall mine, which was located in 1908 and is the largest mine in the region. It has been operated

[1] Brooks, A. H., The mining industry in 1911: U. S. Geol. Survey Bull. 520, p. 31, 1912.

more or less continuously since its location and was practically the only producing mine up to 1911. The main vein is from 1 to 3 feet wide. The ore shows many different phases, but consists essentially of quartz with little or no sulphides. In places it is so much crushed that it is almost like sand. The vein includes schist horses a few feet long. It cuts the structure of the schists that form the country rock at the mine at rather high angles. The dip is fairly constant, the highest dip noted being 63° S. and the lowest dip about 55° S. Owing to faulting the trend of the vein is not constant, but averages about N. 75° W. Parallel to the main vein at a distance of about 25 feet in both the hanging and foot walls, are narrower quartz stringers composed of ore of the same kind, though of somewhat lower tenor.

The underground development of the property consists of a main adit over 975 feet long, started about 50 feet above the creek; an intermediate adit about 140 feet farther up; and an upper adit 50 feet still higher. The walls stand well, so that little timbering is necessary. This is fortunate, for a set of round-pole timbers costs at the mine about $3 and square timbers about $6. Little machinery has been used, as all drilling and tramming are done by hand and pumping is not necessary, for the adits drain the workings. A winze sunk to a depth of 20 feet at a point about 800 feet from the mouth of the adit encountered but little water and is to be carried lower. An electric pump is on the ground ready to be installed if water in troublesome amounts is found.

The dislocation of the vein by faulting makes the deposit difficult to open up and materially increases the cost of mining. A short distance from the mouth of the main adit, in an area at least 200 feet on a side, the rock is so thoroughly broken and sheared that the vein in it is practically unrecognizable. Slickensides are so numerous, diverge so greatly, and have formed at so many different times that they are of little service in determining the direction of movement at any particular place. In fact, many specimens of rock less than 3 inches cube show slickensides in three or four directions. Outside this highly shattered region the faults cutting the vein are of relatively small displacement. There are two distinct sets of these smaller faults. One set trends transverse to the vein and has a high inclination; the other trends nearly parallel to the vein and is practically flat. The usual effect of these faults is to throw the vein toward the footwall; that is, toward the north.

Much of the gold is irregularly distributed through the vein material in visible particles uncombined with other elements. In some places the vein is richest immediately adjacent to its walls; in other places it is richest in its center. The ore is in large part free from sulphides, but here and there includes stibnite, some galena, and

arsenopyrite, as well as lesser amounts of pyrite, copper pyrites, and sphalerite. These sulphide-rich portions of the vein also contain gold, and Prindle [1] states that the gold sulphides and some quartz apparently have been introduced together at a period subsequent to that at which much of the quartz was formed. It therefore appears that the gold was introduced at two distinct times—first with the quartz and second with the sulphides. It is, however, by no means certain that the two events were separated by a long period.

According to the manager at the Rhoads-Hall mine, no material difference has yet been noticed in the tenor of the ore or in the amount of sulphides. In the highest level, near the surface, according to report, some sulphide enrichment was found, but none of the specimens seen indicated this process, although it may have taken place in the surficial portions of the deposit. Some oxidation of the sulphides has occurred to as great depths as have been reached by mining, but its amount is not great, as most of these minerals are hard and have the appearance and composition of unweathered material.

Three assays reported by F. W. Hawkins show that the gold from this property is 0.793, 0.820, and 0.830 fine and that the silver is 0.180, 0.164, and 0.164 fine. Silver is seldom actually determined by the Fairbanks assayers, and nine assays give only the fineness of the gold, namely: 0.802½, 0.810, 0.810½, 0.820, 0.822, 0.824½, 0.826, 0.827, 0.830. The average of these 12 determinations is nearly 0.818, which is equivalent to a gold value of about $16.89 an ounce. The fineness of the silver in the bullion, according to the usual method of estimating it as the difference between 0.990 and the fineness of the gold, is about 0.171½, which, with silver at 54 cents an ounce, would indicate a value of 9 cents.

No accurate figures as to the tenor of the ore are available. It is reported that 147 tons treated at the Chena mill in 1911 yielded $17,645, or an average of $120 a ton.[2] The conditions under which this ore was selected are not known, but the shipment was probably picked material.

For several years small shipments of ore were made from the Rhoads-Hall mine to the testing mills at Chena and Fairbanks, and it is reported that this mine furnished the first ore milled in the Tanana Valley. The development of the mine and the high charges for transporting the ore led the owners to put up a stamp mill on the property in 1911. After running about a month in 1911 the mill was closed on account of shortage of water until the spring of 1912. Since that

[1] Prindle, L. M., op. cit.

[2] These figures, together with others given on later pages, were furnished to the Geological Survey, but as they have subsequently been published in the Fairbanks newspapers (Alaska Citizen, June 3, 1912) no confidence is violated by using them in this report.

time it has been in more or less continuous operation and the owners hope that they will not be forced to close it down during winter. The mill has a single battery of five 1,000-pound stamps of the Joshua Hendy pattern, operated at present by steam from a wood-burning boiler. The estimated capacity of the mill is about 17 tons of ore (about 3⅓ tons per stamp) in a day of 24 hours. Water for the mill is supplied during the summer by a short ditch and flume, but will be pumped during the winter from a well recently sunk.

The milling practice at this mine is relatively simple. The crushed ore flows through a 40-mesh screen and over the amalgamated plates, from which the tailings run over a canvas-covered table, and the material that is discharged from it is distributed by launders to a settling pond near the creek. Most of the free gold is caught in the batteries or on the plates. Some of the gold contained in the sulphides is recovered on the canvas-covered table, but a large amount of it is carried to the settling pond. The owners intend to install a vanner soon and believe it will effect a material saving. A table is necessary not only to recover the gold in the sulphides, but also to recover some of the free gold which, in an ore containing much stibnite or arsenopyrite, is likely to be carried off, owing to the sliming of the plates. When much of the stibnite ore is being milled it is necessary to dress the plates about once in three hours, or large losses of native gold result.

The concentrates are scraped off the canvas table from time to time and saved until enough have accumulated to pay for shipping. As they come from the table they are nearly black, but in about a week they oxidize to an iron-rust brown.

### TANANA QUARTZ & HYDRAULIC MINING CO.'S CLAIMS.

A short distance south of the Rhoads-Hall mine are claims of the Tanana Quartz & Hydraulic Mining Co. and of men interested in that company. On this group of claims there are three leads, two trending about N. 75° W., and one trending nearly north and south.

The northernmost of the parallel veins, which has been prospected on the California and V claims, may be the continuation of the main lead at the Rhoads-Hall mine, with which it is nearly in line. The westernmost shaft on the vein starts from a point west of Bedrock Creek at an elevation of about 1,400 feet, with an inclination of 60° S., which about 20 feet below the surface decreases to 40° and continues at this angle for about 40 feet. A strong vein, from 1 to 3 feet wide, can be traced to a point near the bottom of the incline, where it is cut off by a fault. The ore appears similar to that of the richer veins of the region but is reported to be of low tenor, though little of it has been adequately tested.

Another shaft has been sunk somewhat farther east on the supposed continuation of this vein near the road on the Bedrock-Chatham divide, at an elevation of about 1,400 feet. Mining was not in progress at this place in 1912, and the underground workings were so full of water that they could not be examined. The material on the dump and descriptions given by those familiar with the place indicate that the vein is of the non sulphide-bearing type, and some tests showed it to carry gold. Fragments of a light-colored feldspar and quartz rock found on the dump and said to come from points close to the vein apparently belong to the granite family.

A number of shallow pits sunk on the same or parallel leads east of the old road have disclosed auriferous quartz. More than a thousand feet of prospecting with a Keystone drill has also been done in this region, but no rich veins have been discovered.

The southern east-west vein is on the Wyoming and Alabama claims, and has been most extensively opened up on the Wyoming claim by an adit 165 feet long, the mouth of which is on the eastern slope of the valley of Bedrock Creek, at an elevation of about 1,325 feet. A 50-foot winze, starting with an inclination of 60°, but flattening to 49° near its bottom, has been sunk on the vein near the center of the adit. These openings have disclosed a vein 1 to 2 feet wide, the crushed rock from which yields considerable free gold on panning. Some ore has been shipped to the custom mills at Fairbanks and is said to have yielded high returns in gold. The vein cuts the country rock at a steep angle and seems in part to occupy a fault fracture. The country rock in this part of the area is greenish and less laminated than that to the north, and in its physical features resembles a sheared and metamorphosed greenstone. The vein contains, just beyond the winze, several long, chimney-like vugs partly filled with crystals of quartz and calcite, the calcite being younger than and coating the quartz. The occurrence of calcite in the veins is rather unusual, and the vugs probably represent openings formed by late fracturing of the auriferous veins and the subsequent deposition of quartz and later of calcite. So far as could be learned these vugs carry no gold and do not affect the tenor of the vein. A peculiar feature noted in this mine was that though the surface of the main adit was heavily covered with ice crystals, some of them as much as 3 inches long, none occurred in the winze.

On the hillside above the adit, prospect pits have been sunk at intervals to a point on the crest of the divide at 1,825 feet, and in them quartz vein material, some of which yields free gold, was discovered. According to Antone Goessmann, one of the prospectors most familiar with the property, a panful of surface material taken practically anywhere on the hillside yields particles of gold, many of good size and all sharp and angular, as though untransported.

The north-south vein is exposed at the surface on the lower part of the crest of the divide between Bedrock and Chatham creeks, on claims called the Paupers Dream and the Texas—the former south of the latter—and crosses the California claim, already noted, which lies between the two. (See fig. 2, p. 154.) The southernmost opening on this vein is near the old ridge road at an elevation of 1,625 feet. The vein dips west at a high angle and is from 2 to 4 feet wide. Unlike the parallel east-west veins, this one carries a large amount of sulphides, mainly arsenopyrite, but it also contains free gold. Much coarse angular gold is reported to have been found in the weathered material overlying the vein. This vein appears to pass a little east of the shaft near the road on the California claim, previously described, but the relation of the two sets of veins is not determinable from the present exposures.

### MISCELLANEOUS PROPERTIES.

On the divide between Bedrock and Chatham creeks, at an elevation of about 1,300 feet, and nearly in line with the north-south vein on the Texas and Paupers Dream claims, a short tunnel has been driven into the hillside on a small vein carrying a large amount of arsenopyrite and some stibnite. From the tunnel a short winze has been sunk, but the property is now lying idle, and the workings are partly filled with water. The vein is well defined and has a smooth wall apparently due to faulting. Samples from this place are said to carry much gold, but no systematic sampling has been done, and no ore has been milled.

Near the rocky pinnacle at an elevation of 2,300 feet on the Bedrock-Chatham divide a small mass of quartz, galena, iron pyrite, arsenopyrite, and stibnite is interbedded in the schists. Nearly due south of this place, at an elevation of 2,400 feet, is a shallow shaft, now filled with water. On the dump is considerable galena. In a short tunnel driven into the hillside below the shaft similar ore has been found. It was reported that the deposit occurred in a blanket formation and that the vein in the tunnel and the one in the shaft were not the same, but were parallel. The exposures afforded no ground for a definite conclusion, but the apparent flatness of the deposit seems to be due to surface creep, and does not represent the true attitude of the vein. Further prospecting is much needed to determine the extent and size of the ore body. The only other lode carrying large amounts of galena, the Bobbie (see p. 163), which strikes nearly north and south and dips westward, lies less than a mile N. 10° E. of this shaft. The similarity of the ores at the two places and their nearness suggests that the two lodes are probably genetically related. The fact that this galena occurs only about one-eighth mile from a small area of intrusive rock that is exposed near the

2,301-foot bench mark, at the crossroads, is also significant. The galena from this claim occurs both in large, well-crystallized cubes and in fine-grained masses, the latter usually lying close to the walls and the former being more remote. Strong evidences of faulting are recognizable throughout the vein material and country rock. The galena is reported to carry much more gold than silver, but the tenor of the vein has not been accurately determined.

On the ridge about a quarter of a mile west of the 2,301-foot bench mark, near the western end of the mapped area of igneous rock, several shallow pits have been sunk into the frost-riven talus in attempting to locate the lead that furnished much of the quartz lying on the surface. The direction and character of the lead can not be determined from the present exposures. Assays of samples from this lead are said to have shown a gold tenor of about $10 a ton.

### WILLOW CREEK VALLEY.

#### TOLOVANA MINE,

At an elevation of 1,300 feet, or about 25 feet above Willow Creek, a little more than one-eighth mile upstream from its junction with Cleary Creek, is the Tolovana mine. The main development at this place consists of an adit that follows the vein for about 130 feet to a fault which throws the vein northward about 30 feet. Beyond this offset the adit continues eastward for about 200 feet. Short crosscuts have been turned off here and there on small stringers, and some ground has been stoped above the level.

About a hundred feet from the mouth of the adit an inclined winze has been sunk, from which a drift has been turned off 50 feet below the adit. The fault discovered in the adit was found also in this drift and offsets the vein to the north. An inclined winze near the east end of this lower level, said to have been sunk on the vein, was full of water in 1912 and could not be examined. In the western part of the lower drift some ore has been stoped and hoisted up the winze to the adit level and thence trammed to the mill. At the time of the writer's visit, however, a shaft with an inclination of 60° S. had been sunk near the mouth of the adit, had intersected the 50-foot level, and was being driven deeper. This shaft will be used for hoisting ore from the lower levels.

Water has caused some difficulty in the sinking of the shaft. According to the superintendent, it accumulates in the bottom of the shaft at the rate of about 2 feet per hour, making continuous pumping necessary. As the bottom of the shaft is now more than 40 feet below the level of the creek and as it is probable that the most pervious part of the ground has been passed through, no excessive increase in the amount of water is expected.

The vein at the Tolovana trends nearly east and west and dips about 60° S. It differs from the other veins so far described in that the quartz forms small stringers, 1 to 3 inches wide, separated by considerable thicknesses of schist. The quartz is commonly frozen to the wall rocks so firmly that blasting does not separate them. In many places the country rock close to the vein is heavily impregnated with sulphides, mainly of iron. These are especially abundant where the wall rock is somewhat calcareous. In the vein, however, iron pyrite is practically absent, the common metallic minerals being stibnite and gold. The stibnite generally occurs in more or less well formed crystals, many of which are small, isolated needles of nearly microscopic dimensions; no large masses have been found. In certain specimens stibnite lies along the granulation planes in the quartz, giving the rock a linear-parallel gneissic structure.

The gold is mainly native. Little or none is said to be contained in the stibnite, but some particles of gold are visibly in contact with the stibnite, and others bear all relations from close association to complete separation. In many specimens the gold occurs in crystalline aggregates in the midst of unfractured, somewhat glassy quartz and seems to have been introduced with the quartz and before the infiltration of the stibnite. It is reported, however, to be most abundant in ore containing some stibnite.

Determinations furnished by F. W. Hawkins show the gold to be 0.824, 0.821½, 0.819, 0.814, and 0.792 fine. The sample whose gold fineness is 0.792 contained 180 parts per thousand of silver.

The quartz is generally compact and rather milky. Here and there, however, small vugs occur in the vein, and these are usually coated with crystals of glassy quartz. Widespread shearing of the quartz has produced a structure resembling cleavage, causing glistening faces in parallel orientation to appear on fractured surfaces. A little feldspar is recognizable in some of the vein material; and Prindle[1] notes that a minute vein at this locality was found to be composed of quartz and fresh albite. In a few places a small amount of calcite is also associated with the quartz.

At two places on the Tolovana property veins carrying much stibnite have been found; one east of Willow Creek, at an elevation of about 1,325 feet; the other west of it, at about 1,300 feet. The eastern locality has been prospected by shallow pits, but the ledge has not been found in place. The stibnite occurs both in well-formed blades with characteristic pressure twinning and also in more or less massive form, intimately intermixed with other sulphides, notably those of iron. Red, yellow, and greenish-yellow oxidation products are common, but are more abundant on the well-bladed than on the

[1] Prindle, L. M., op. cit., p. 227.

massive ore. Below these pits a prospecting tunnel about 100 feet long has been run nearly due south, but has not yet reached the place where the stibnite vein is believed to occur. Possibly its course may be parallel rather than transverse to the vein, in which case it will yield no information concerning the vein. About 50 feet from the mouth of this tunnel a few small quartz stringers were found, but no well-defined lead was discovered. This method of prospecting appears to be much more expensive than surface trenching and sinking test pits on promising leads.

A shaft at the locality west of Willow Creek is now filled with water and can not be examined. It is reported to have been sunk 16 feet on a small stringer carrying large amounts of stibnite. Several shallower holes were also put down, but disclosed no material that warranted development at that time, and further prospecting at this place in the near future seems unlikely.

A Huntington mill was in operation at the Tolovana mine in 1911, but was found not to be adapted to the work and was closed down early in the summer of 1912 to permit the installation of two Nissen stamps of 1,300 pounds each. Operations were resumed in September. The old mill was closed down during the winter of 1911–12, but if possible the new one will be kept running throughout the year. Seepage water pumped from the new shaft was used during the summer, and it is hoped that water from a well just sunk will supply all needs during the winter. The rock is difficult to crush, the estimated capacity of the mill being less than 8 tons a day of 24 hours. The ore is trammed from the mine, dumped over a grizzly, the larger pieces being put through a small power crusher, and is delivered to a storage bin, from which it is automatically fed to the stamps. The pulp, passing through 40-mesh screens, flows over the amalgamated plates. The tailings are discharged at the lower end of the plates onto an endless conveyor with a slope opposite to that of the plates and with the belt moving in an opposite direction to the slope. By this arrangement the heavier minerals are concentrated and carried to the head of the belt, where they are dumped into a receptacle, from which they are taken when enough have accumulated to warrant metallurgical treatment.

### MISCELLANEOUS PROPERTIES.

At the head of Willow Creek some prospecting has been done on ground leased from the Newsboy Mining Co. by Dr. I. Overgaard. On the Emma claim, at an elevation of about 2,025 feet east of the creek, a shaft 60 feet deep has been sunk on a promising stringer 6 inches wide, and short drifts have been turned off at the bottom. The country rock differs on the two sides of the lead; on one side it seems to be a metamorphic igneous rock of the greenstone group. The dip

of the vein at the surface is steep to the south, but in depth it decreases to about 45°. Particles of gold are recognizable in some of the ore that has been sacked for shipment. According to the operator, 10 tons of selected ore milled at Fairbanks yielded an average gold tenor of $38 a ton.

A short tunnel into the compact unmineralized rock has been started at an elevation of about 1,775 feet. No valuable minerals have been found in the tunnel, but a short distance below it a strong quartz lead is exposed. Unfortunately, however, assays of the quartz are said to show little gold.

An ingenious hand mill capable of treating about 100 pounds of ore in five or six hours has been built at this place. It consists of a heavy iron bar, expanded at the base, which is raised by means of a lever with the necessary tackle and is dropped into a mortar box which has a one-way discharge. The pulp flows over amalgamated plates, and the concentrates in the tailings are not saved. Water is derived from the near-by stream. The entire apparatus was manufactured on the ground, and though it can handle only a small amount of ore, it could be of service in testing vein material in places remote from capable assayers.

Near the road west of the Overgaard property, at an elevation of 2,075 feet, is the abandoned Cornell tunnel, which is reported to have been driven as a crosscut to prospect the region. Apparently no ore was discovered.

A shallow prospect pit has been sunk in an area showing some disseminated sulphide mineralization on the ridge between Willow Creek and the head of Cleary Creek, just above the road, at an elevation of 1,900 feet. This pit, which has been abandoned for several years, is near the western margin of a small area of intrusive rock, which has a mottled porphyritic appearance and which on weathered surfaces is heavily covered with limonite. Probably the sulphides noted in the schist were introduced through its agency. Apparently the deposit at this place has no economic value.

### CLEARY CREEK VALLEY ABOVE WILLOW CREEK.

#### NEWSBOY MINE.

On the divide between Cleary and Last Chance creeks, at an elevation of about 1,875 feet, the inclined shaft of the Newsboy mine has been sunk nearly 350 feet and drifts turned off at the 60, 115, 215, and 315 foot levels. At the time of the writer's visit the mine had been closed down for some time, owing to alterations in the mill, and water that had collected in the bottom of the shaft made the lowest level inaccessible.

The Newsboy vein trends about N. 40° E. and dips about 73° NW. Its width ranges from less than 1 foot up to 9 feet, averaging between

2 and 3 feet. The ore is much sheared and consequently breaks down rather easily, leaving smooth walls; but the vein matter is tightly frozen to the country rock and therefore some ore is left in what are called the walls, or else some waste rock is mined with the vein material.

Large amounts of sulphides occur in the vein, but the ore differs from that seen at any of the mines so far described, though it is more closely akin to that of the Tolovana than to that of the more eastern veins. The sulphides are mainly pyrite and stibnite, though arsenopyrite, a little chalcopyrite, and sphalerite have been recognized. Quartz, although the most abundant mineral, forms a rather smaller proportion of the vein material than in most of the other mines. Most of the quartz simulates that in the quartzite rather than that in the normal veins and has a fine granular texture. Schist horses are fairly numerous in the vein and are not sharply separated from the vein material.

On the 215-foot level a drift has been run northeastward for about 200 feet, and midway in its length has been connected by an incline with the 115-foot level, thus blocking out a mass of ore for stoping. At the east end of this drift the vein is cut off by a transverse fault, and its eastward continuation has not yet been found. Most of the country rock is hard and very compact, suggesting affinity with the metamorphic greenstones, and throughout its extent is practically without any recognizable guide horizon. The fault plane is strongly slickensided; the direction of movement appears to have been sideways rather than vertical, but the rock does not preserve the scratches well enough to show toward which side the movement took place. Under these conditions the continuation of the vein can probably be found only by crosscutting beyond the fault.

Farther west on the same level a drift about 100 feet long, following the vein, cut another transverse fault similar to the eastern one, but dipping in the opposite direction.

On the 115-foot level a 40-foot drift has been turned off to the southwest and a 100-foot drift to the northeast. In the western drift the ore is said to be cut off by a fault, beyond which the vein has not been traced. In the eastern drift the vein is cut off by a transverse fault, which, if identical with that on the 215-foot level, may be expected to cut the vein on the 315-foot level about 300 feet from the shaft. It is doubtful, however, whether these two are the same fault, for if they are they should have displaced the vein above the 115-foot level, which apparently they have not done.

A raise has been driven from the 115-foot level to the 60-foot level. The 60-foot level runs northeastward for about 75 feet, and much of the ore above it has been stoped out. The ore has not been

traced southwestward from the shaft, and this suggests that it is cut off by the southwestern fault.

The average tenor of the ore is not known, for considerable parts of the several large shipments made were hand picked. Sixty-six tons of ore treated in 1911 at the Chena mill are reported to have given an average free gold content of $81.50, and 7½ tons treated at the Garden Island mill, at Fairbanks, are said to have yielded $104 in gold per ton. According to another report, the ore is said to run about $40 a ton in gold.[1] The causes for these differences are not fully known, but, so far as could be learned, the controlling factor is not depth below the surface.

For some time the ore from the Newsboy mine was shipped to the custom mills at Chena and Fairbanks, but late in the fall of 1911 a 5-stamp Hendy mill was built at the mine. Seepage water pumped from the mine was first used in the mill, but the supply was not entirely adequate, and in 1912 the mill was moved to a point on Cleary Creek near the mouth of Willow Creek, at an elevation of more than 600 feet below the mine. The work of removal had not been completed by the middle of September, but the mill was probably running again before the end of the year. The new site is over three-quarters of a mile from the mine, and it will be necessary to haul the ore by teams. Water will be supplied from a 6-inch drill hole 100 feet deep in amounts which the operators hope will be adequate throughout the year.

The mill is equipped with a battery of five 1,000-pound stamps, and a No. 2 Deister concentrator is used for saving the heavy minerals in the tailings. The mill superintendent estimates that 10 to 12 tons of ore can be milled a day, at a cost for both mining and milling of $7 a ton. If this estimate is correct, the cost will be much less than that at any of the other properties examined. Wood, costing about $15 a cord, is used for fuel.

### NEWSBOY EXTENSION MINE.

About 500 feet northeast of the Newsboy is the so-called Newsboy Extension shaft. The faulting of the vein at the Newsboy makes it impossible to tell whether the same vein is really continued in the Newsboy Extension. Certainly the strike of the two veins is not the same, for that at the Newsboy strikes N. 40° E. and dips 73° NW., whereas that at the Newsboy Extension strikes N. 15° E. and dips 77° W.

The Newsboy Extension mine has not been worked for some time, and in 1912 the shaft was nearly full of water, which prevented examination of the underground workings. The operators report

[1] Eng. and Min. Jour., vol. 93, No. 26, p. 1291, June 29, 1912.

that the shaft is about 115 feet deep and that short drifts have been turned off both to the north and south at the 60-foot level. The country rock and ore, as seen on the dump and in the bins, is apparently much the same as that from the Newsboy, except that it contains even less quartz. No accurate determination of the gold tenor of the ore has been made, but it is said to be about $15 a ton.

Connected with the shaft house at the Newsboy Extension is a 5-stamp mill built by a Fairbanks company. The stamps weigh about 500 pounds, and it is reported that the mill can crush about 8 tons of ore a day. The machinery, however, is very light to treat rock so hard to crush as that from this mine, and its operation has been difficult. The mill stands so high on the ridge that little water is available, and the supply, which has been obtained by pumping from the shaft, has apparently not always been adequate. The mill has not been in operation recently.

### MISCELLANEOUS PROPERTIES.

About a quarter of a mile above Willow Creek, at an elevation of 1,325 feet north of Cleary Creek, a short shaft and tunnel have been driven on the Scheuyemere claim. The country rock is of the usual schistose type, and the material on the dump shows many pieces of rather glassy quartz. As mining had ceased for so long a time that the pits had caved and as there were no outcrops, exposures of the vein were not seen, and not even its direction or extent could be determined. No ore was milled from this property.

On the ridge between the two small headwater branches of Cleary Creek, at an elevation of 1,375 feet, is a 30-foot shaft of the Eldorado Mining Co. No work has been done here for two years, and the shaft is filled to the surface with water. The ore on the dump does not appear to be very promising. It is mainly quartz, though some stibnite occurs in the seams. The trend of the lead, as indicated by the direction of the shaft, is about north and south. Limestone apparently forms part of the country rock, for it makes up a considerable proportion of the dump. Pieces of brownish-gray, rather crystalline limestone and of blue compact crystalline limestone were fairly numerous, and some fragments of schistose limestone, with considerable mica and chlorite on the cleavage planes, were also found. These limestones probably belong to the general group mapped by Prindle and Katz as occurring along the road northeast of the shaft and on top of the hill to the north. In none of the other prospects was any considerable amount of limestone noted.

South of the Eldorado shaft, at an elevation of 1,475 feet, is the Steil tunnel. The tunnel was closed and the vein could not be examined in place. The vein material on the dump, however, indicated

that it is more like that from the vein in the Tolovana mine than that from the more easterly veins. The quartz occurs in narrow veins that branch here and there through the country rock, which appears more compact and harder than the silvery schist and suggests relationships with the greenstones rather than with the sedimentary rocks. The veins are firmly frozen to the country rock and fracture with it. Some stibnite and less pyrite occur in the ore. A road has been built from the tunnel to the main road to the north, and small lots of ore will probably be hauled to one of the near-by mills for treatment. In 1912, however, the property had not reached the producing stage.

### ELDORADO CREEK VALLEY.

Little lode prospecting has been done in the Eldorado Creek basin, but the general geologic conditions there appear to be similar to those in regions that contain auriferous veins. On the Rose claim, which lies about a quarter of a mile south of the Newsboy mine, an adit 180 feet long has been driven on a quartz vein about 1 foot wide. Two tons of the ore, milled at one of the custom mills at Fairbanks, are said to have contained a large amount of concentrates, but no statement as to their average gold tenor has been published. The property, not being in operation at the time of the writer's visit, was not examined, so the direction and the character of the veins were not determined.

Prindle reported in 1909 that auriferous quartz had been found in a shallow prospect pit sunk at an elevation of 1,775 feet near the head of Last Chance Creek. No work has been done on this property recently. Farther west, at an elevation of 1,400 feet, near the forks of Little Eldorado Creek, Prindle noted in 1909 a short tunnel trending S. 15° E. Some work has been done at this place more recently, but the claim was not visited by the writer, and details concerning it are lacking. At an indefinitely located point near the head of Spruce Creek a lode said to carry about $12 a ton in gold is reported to have been opened up by a shaft 150 feet deep. This property was not seen by the writer, and no further information concerning it was obtained.

### DOME CREEK VALLEY.

#### RELIANCE MINING CO.'S CLAIMS.

The northern slope at the head of Dome Creek valley is covered by claims belonging to the Reliance Mining Co. and to people interested in that company. These claims form two parallel series. The northern series, named from west to east, comprises the La Rose, Wild Rose, Soo, Waterbury, Carnation, and Inspiration claims; and the southern series, which extends from a point near the middle of

the southern line of the Soo to the middle of the southern line of the Carnation, consists of the Waverly and Chief claims (fig. 5). Three main veins have been found on these properties, two trending nearly east and west and dipping north, and the third trending N. 50° E. and dipping 50° NW. The northern of the east-west veins is called the Soo vein and the southern the Wild Rose vein. The two converge toward the east, so that whereas near the west end line of the Soo claim they are 135 feet apart, at the east end line of that claim they are 60 feet apart, and at the end line between the Waterbury and Carnation claims they are said to be less than 20 feet apart.

Of these three veins the Wild Rose has been most developed and has yielded the greatest amount of gold. An inclined shaft on the end line between the Wild Rose and Soo claims has been sunk 100 feet and drifts have been turned off to the east at the 50-foot level and at the bottom. Much ore has been stoped from the upper level and milled. The vein followed by the drift at the bottom of the shaft is said to be a spur from the main vein, and the latter is supposed to be in the rock on the footwall side. Twenty-five feet east of the collar of the shaft an open cut has been made on the vein and the ore has been stoped out underhand.

A little southeast of the open cut a tunnel was driven eastward for about 100 feet, to a point where it intersected the vein exposed in the shaft and open cut, and from that point a drift was turned back at an acute angle westward on the vein and the ore stoped out for about 35 feet. The drift was carried eastward from the intersection of the tunnel and the vein for about 100 feet to a cross vein trending about northeast-southwest and dipping 40° SE. Where it was first cut this cross vein was very narrow, but at the bottom of a winze 20 feet deep, sunk near the intersection of the veins, it was 3 feet wide. The east-west vein is sharply cut off by the cross vein, and its continuation in the rock on the hanging-wall side of the latter has not yet been found. The wall rocks of the cross vein are much slickensided, but the amount of movement can not be determined.

The main openings on the northern vein, the Soo, are on the end line between the Waterbury and Soo claims and near the center of the Soo. At the end line a shaft 100 feet deep has been sunk and a short drift turned off to the west. The vein dips about 68° N. In the center of the Soo claim a tunnel, now caved, crosscuts the northern vein. On the end line between the Waterbury and Carnation claims, near the 1,800-foot saddle on the ridge running west from Pedro Dome, several shallow surface pits have disclosed quartz float that is believed to have come from the vein, but no mining has been done at this place.

The so-called Chief vein, which trends N. 50° E., traverses parts of the Waterbury, Chief, and Carnation claims. It has been opened up at several places by shallow surface pits, but these have caved so badly that the vein could be seen in only one of them—a 20-foot shaft at an elevation of about 1,900 feet. This vein is nearly parallel to the cross vein in the eastern tunnel near the shaft on the line between the Wild Rose and Soo claims, but it dips northwest, whereas the cross vein dips southeast.

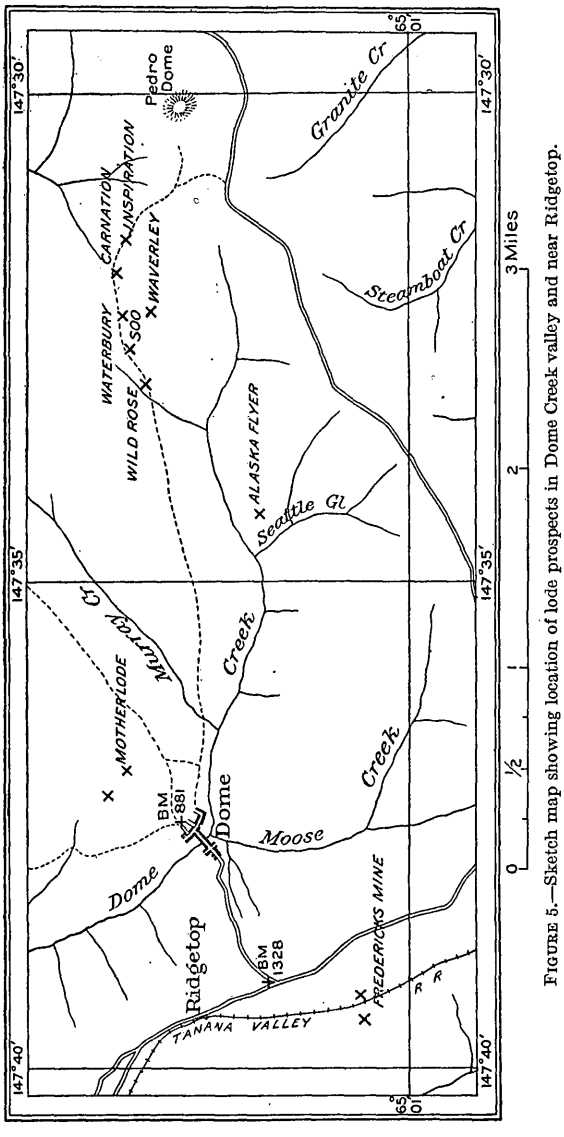



FIGURE 5.—Sketch map showing location of lode prospects in Dome Creek valley and near Ridgetop.

The specimens of ore taken from all these claims are strikingly alike, the ore from separate pits showing no greater differences than the ore from different parts of the same pit or drift. Much of the quartz has been subjected to shearing, so that it is "sliced" and its individual plates are elongated lenses. Crystalline quartz occurs in considerable amounts, not only in small drusy cavities, but also elsewhere in larger amounts, producing a typical "comb" structure. In one specimen, which was taken from the dump and whose location in place is consequently not known, a small stringer of crystalline quartz occurs between schist and a feldspar-quartz igneous rock.

Gold is practically the only valuable mineral in the ore. It is very bright and commonly occurs in crystalline aggregates, some of it in the midst of hard, glassy quartz, some in the more porous zones near

the schist, some in the cracks and crevices between the fractured quartz grains, and some on quartz crystals that project into drusy cavities. It appears to have been introduced at different times, but there is little question that much of it was deposited contemporaneously with the rest of the vein material as free gold and was not leached from sulphides by surficial processes. At several places where faults occur the gold has been dragged out and forms thin metallic plates on the slickensided surface, showing plainly that it was in the vein prior to the faulting.

The richest gold ore is reported to occur in shoots that pitch eastward. This is the direction of dip of the cross vein in the tunnel noted on page 177, and it is by no means improbable that the shattering incident to the movement parallel to the fault occupied by this vein may have opened up the older vein and permitted the access of new gold-bearing solutions. Whether or not this interpretation is correct, the older vein is said to be much richer near its contact with the northeast-southwest vein. These shoots, of which at least two are known in the present workings on the Soo, are reported to be about 20 feet wide.

Several determinations by local assayers and by the Selby Smelting & Refining Co., of San Francisco, show that the gold has a fineness ranging from 0.823 to 0.843. An assay made by the San Francisco firm of a 50-ounce sample of bullion gives 824½ parts of gold and 149 parts of silver. This indicates that the bullion is worth a little more than $17 an ounce.

Sulphides form but a small part of the vein material. A small amount of stibnite occurs in many places and some large masses are reported; none were seen, however, and their relations to the vein were not determined. In addition to the more usual sulphides, the vein contains small quantities of tetrahedrite (sulphide of silver, copper, and antimony), with which some gold is intimately mixed, the two having been deposited contemporaneously. Copper sulphides are extremely rare.

The gold tenor of the ore, estimated from the material now being mined, is very high. Much of the ore treated at the local mills has yielded $50 to $60 or even more to the ton, and mill runs on 8 to 10 tons of ore from the richest portions of the vein have given returns of over $250 a ton in gold.

The ore from this property was formerly treated at one of the custom mills, but in 1912 a small 3-stamp mill of local manufacture was installed. This mill, which is equipped with 250-pound stamps and has a capacity of only about 3 tons of ore a day, is situated near the Wild Rose–Soo shaft. Water is supplied mainly by pumping from a sump at the bottom of the shaft; and at that elevation so little is available that it has not been possible to run the mill more than a

few hours a day. The ore as delivered from the mine is cobbed by hand before it is delivered to the hopper for automatic discharge to the battery. It is crushed in the stamps to 30 mesh and is then passed over the plates. No appliance is used for collecting the concentrates, the pulp being discharged directly from the lower end of the plates.

According to the manager, nearly 80 per cent of the gold recovered is caught in the mortar box, the remaining 20 per cent being found on the plates. All the gold amalgamates readily, and little or no base material is present to contaminate the mercury. Though no determination of the amount of gold lost has been made, the amount of free gold lost in the tailings is probably small, for the lower end of the plates is very clean, but a good deal of the gold in the sulphides and other heavy minerals is probably lost.

The present site of the mill is so disadvantageous that a new site has been chosen on Dome Creek below the mine, and a new mill, equipped with two Nissen stamps, is expected to be in operation by the close of 1912. Although this situation will necessitate tramming the ore for some distance, the advantage of a continuous supply of water should more than offset this charge.

### MISCELLANEOUS PROPERTIES.

On the ridge between Dome Creek and the lower tributary of Seattle Gulch, at an elevation of about 1,200 feet, a 30-foot shaft has been put down on the Alaska Flyer claim. Not enough work has been done to indicate the nature of the ore, but it is reported that auriferous quartz has been found and that further prospecting will be done.

Half a mile northeast of Dome City, at an elevation of about 1,000 feet, some prospecting has been done at two shafts sunk on the Mother Lode and contiguous claims. The western shaft was 147 feet deep, and at its bottom a short crosscut was run eastward. The eastern shaft, 200 paces east of the western, was sunk 215 feet, the first 60 feet through muck and the rest through rock, no gravel intervening. In 1912 both shafts were almost filled with water, so that the underground workings were inaccessible, but the material on the dump indicates that no lodes similar to those now productive in the region have been found. The material is interesting, however, as it shows a somewhat graphitic limestone rather heavily impregnated with disseminated sulphides. The metallic mineral is mainly iron pyrite, but the rock also contains a little copper pyrite and some arsenopyrite. Some faulting has occurred subsequent to the deposition of the sulphides, for well-polished planes with mirror-like surfaces formed by both sulphides and country rock are by no means uncommon.

### VAULT CREEK VALLEY.

#### FREDERICKS MINE.

About a mile south of Ridgetop, on the eastern slope of Vault Creek valley, are claims forming what is locally known as the Fredericks mine. (See fig. 5, p. 178.) This property has been developed by two shafts—the western, at an elevation of about 1,225 feet, and the eastern, at an elevation of about 1,350 feet—both sunk on the same vein. The vein strikes approximately N. 70° W. and dips north at varying angles.

The western shaft is a little more than 300 feet deep. At the surface the dip of the vein is about 70° N., but at the bottom it is about 45°. On the 100-foot level a 50-foot drift has been turned off to the east. The vein in the face of the drift is about 3½ feet wide, but as the adjacent shattered schist is also mineralized, a somewhat greater thickness of rock may be profitably removed in mining. The junction between the vein and the schist on the hanging-wall side is a smooth fault plane. From the other side of the shaft, at the same level, in a 15-foot drift extending west, the width of the vein changes abruptly and much of the material mined seems to represent merely a shattered zone in the country rock. Some stibnite occurs in the ore and is apparently more abundant toward the foot than toward the hanging wall.

On the 200-foot level drifts have been run 120 feet east and 30 feet west. The vein appears rather weak and in places the quartz is merely of knife-blade thickness. The iron-stained shattered zone, however, continues with a width of several feet. A crosscut has been driven into the hanging wall and a granitic rock disclosed at a distance of about 50 feet from the shaft.

Below the 200-foot level the dip decreases greatly until, at the bottom of the shaft, as previously noted, it is about 45°. On the 300-foot level a short drift has been turned off to the west. A crosscut into the hanging wall, however, affords the best available information as to the geologic conditions. The wall of the lead, which was followed by the shaft, is, as in the upper levels, a smooth, slickensided plane developed on a hard quartzitic rock which appears to have been affected by contact metamorphism. A few feet north of this plane is a sharp break, marked by a much slickensided surface on which the striations are vertical, beyond which is a fine-grained granitic dike about 7 feet wide, bounded on the north by another fault plane. The granite is so much decomposed that it is almost impossible to pick up pieces of it. Most of it is light colored, but it weathers to a rusty yellow, small dark spots here and there representing the ferromagnesian minerals it originally contained. Beyond the northern fault is a dark, greasy, and somewhat graphitic schist showing innumerable small slip faults, which trend in all directions,

but are broadly parallel with the dike. Though the underground workings do not show the deposit sufficiently to permit the solution of many of the problems, they give the impression that much of the material regarded as ore has been mineralized through its propinquity to the granite.

In the eastern shaft, which is 100 feet deep, the dip of the vein is about 80° at the surface and does not materially decrease in depth. No granite was recognized underground or on the dump, but there is a hard compact rock that probably belongs to the group of greenstones. Mineralization seems to have taken place along a shattered zone and to have impregnated the rocks in the vicinity. This zone dips much more steeply than the country rock and consequently traverses different rocks in different parts of the mine. Most of the material penetrated by the shaft is a brown, heavily iron-stained quartzose rock. This rock is very different from the auriferous veins so far described and appears to be a brecciated and mineralized schist rather than a distinct vein. Here and there in this broken-up material are small vugs containing quartz crystals, many of which are coated with oxide of manganese.

#### MISCELLANEOUS PROPERTIES.

None of the other properties in the Vault Creek basin were examined by the writer during 1912. Brooks[1] writes:

> It is said that about 280 feet of shaft and 60 feet of drifting was done on a property near the divide between Wildcat and Vault creeks, owned by Hoel Bros., Johnson & Witmer. Current reports are to the effect that a 30-foot ledge carrying low gold values and a richer vein 8 inches to 2 feet in width have been found on this property.

Ore from a property near Ridgetop, owned by Charles Thrift, is reported to have been milled at Fairbanks and to have yielded $11 a ton in gold. No details of the manner of occurrence were learned. No active work appears to have been in progress during 1912.

In the basin of the first tributary of Treasure Creek from the south, west of Independence Creek, two lodes have been exploited, but according to available reports no considerable amount of development work has been done. Near the mouth of this creek, on the eastern slope of the valley, a gold lode is reported to have been located, and south of it, near the head of the basin, a lode carrying mainly stibnite was found. Specimens of the ore from both localities were seen and appeared to be of high grade. Some silver minerals are reported to occur in the lode, but their composition was not determined.

### GOLDSTREAM VALLEY.

#### WEST OF TWIN CREEK.

Several lode prospects were examined in the Goldstream basin at the head of Sheep Creek, near the summit of Ester Dome. (See

[1] Brooks, A. H., The mining industry in 1911: U. S. Geol. Survey Bull. 520, p. 32, 1912.

fig. 7, p. 190.) Interest in prospecting at this place was excited mainly by the finding at an elevation of about 1,950 feet, in the saddle nearly north of the triangulation signal on the summit of the dome, of a large quartz bowlder liberally splotched with gold. This bowlder, which lay on the surface, measured about 3 by 2 by 1 to 1½ feet. Most of it is hard, white, glassy quartz, which, according to reports of prospectors who have sampled it, carries no gold. On one face, however, it is peppered with particles of gold, some of which are a quarter of an inch in diameter. It is suggested that the auriferous part may represent one wall of a vein formed subsequently to the main mass of the quartz.

When the bowlder was found the region was visited and staked, and several pits were put down. In the same saddle two claims, the Blue Bonanza and the Midnight Sun, were located, and an inclined shaft with a slope of 35° has been sunk near the end line between them. In the upper part of the shaft an 18-inch vein of quartz was discovered, but it gradually narrowed with depth until at the bottom it was less than a quarter of an inch wide. There are several fractures, however, which the owners intend to follow farther, in the hope that the ore body will again widen.

Two distinct periods of quartz-vein formation are apparent at this place. The older quartz is considerably crushed and contains cavities opened since the crushing. The younger quartz is most readily recognized by its well-formed glassy crystals and by its banded structure, parallel to the walls. The younger veins contain considerable quantities of sulphides, mainly galena, pyrite, and some stibnite, which occur predominantly along the walls parallel to the vein and in the interstices between the well-formed quartz crystals. Where weathering has broken down the sulphides in the younger veins the quartz is covered with a thick coating of iron oxide. Gold is here and there visible in the rock both near to and remote from the areas of sulphides. Without doubt, the gold seen in some specimens of the ore was introduced contemporaneously with the sulphides, but that seen in other specimens was probably introduced earlier.

Considerable silver occurs in the ore. One of the owners reported obtaining 3 grains of silver and 1 grain of gold from an ounce of rock. Tests in the laboratory of the Survey prove the silver mineral to be tetrahedrite, a sulphide of silver, copper, and antimony.

Half a mile south of the shaft just described, at an elevation of about 2,325 feet, an open cut and an inclined shaft about 12 feet deep exposes what seems to be a large body of mineralized quartz, the tenor of which is probably low, although samples have not been carefully tested. The vein trends about north and south and dips about 45° E. Not more than a quarter of a mile south of this place, near the 2,375-foot pinnacle, more or less lens-shaped masses of quartz,

some of them over 6 feet in diameter, are exposed in a zone running north and south. The quartz is compact, little shattered, and glassy and does not look particularly promising. Little work has been done at this place, although a large amount of quartz has been broken down and scattered around.

Immediately west of the signal on the top of Ester Dome, at an elevation of about 2,425 feet, a vein known as the Farmer lode, trending north and south and dipping about 40° E., has been disclosed in an inclined shaft about 15 feet deep. The vein cuts the schists and is in turn cut by many small faults. It appears to be lens shaped, for it tapers out toward the bottom and toward the north wall of the cut. Sulphides, most commonly pyrites, are present, though not abundant. Gold is visible in the rock in a quantity which, though not accurately determined, is sufficient to warrant further prospecting and sampling.

A quartz vein reported to have been found on the southeastern slope of Sheep Creek valley at an elevation of about 1,500 feet was not visited by the writer, and no accurate data as to it were procured.

In the Goldstream basin between Big Eldorado and Twin creeks little lode mining has been done, and none of the several properties have been visited by the writer. In the Engineer Creek basin prospecting has been done near the divide between that stream and Columbia Creek and on Little Blanche Creek, a tributary of Engineer Creek. Near the head of Fox Creek Freeman & Sharf, it is reported, opened up a vein carrying considerable silver-bearing galena, as well as gold, and near the mouth of that stream a gold lode has been prospected. A lode has been located by Isaac Ogram on Rose Creek, a tributary of Gilmore Creek, and a lead carrying considerable galena and stibnite has been opened up by John Nightingale in Steamboat Creek valley. Near the head of Granite Creek Busch & Anderson have been prospecting a vein from which 4½ tons of ore are said to have been tested at one of the customs mills. No statement as to its gold tenor was procured.

### TWIN CREEK VALLEY.

*Rainbow mine.*—North of the junction of Skoogy and Twin creeks, at an elevation of 1,700 feet, a shaft has been sunk on the Rainbow claim (fig. 6) on a vein that trends nearly east and west and stands practically vertical, its dip being in most places more than 89° S. The lode has been prospected by means of shallow pits for several hundred feet, and in this distance it is apparently unfaulted and fairly uniform in character. Most of the country rock is schist, but in a pit 300 feet east of the shaft the vein clearly cuts fine-grained nonporphyritic granite with a sharply defined contact.

The shaft is vertical and is 100 feet deep, and drifts 125 feet and 145 feet long, respectively, have been turned off from it to the east and to the west. In the eastern drift the vein is very regular in width, direction, and composition. It cuts across the country rock, which here consists of schists and quartzites. Both walls are well defined and are marked by fault planes. The rock stands well, so that no timbering is necessary in the drift.

In the western drift the conditions are more complex. A short distance from the shaft a narrow granite dike, dipping 40° E., appears in the footwall. This dike cuts across a small quartz stringer, which dips westward, but the dike is in turn cut by the main lode and has not been found on the hanging-wall side. Evidently it was

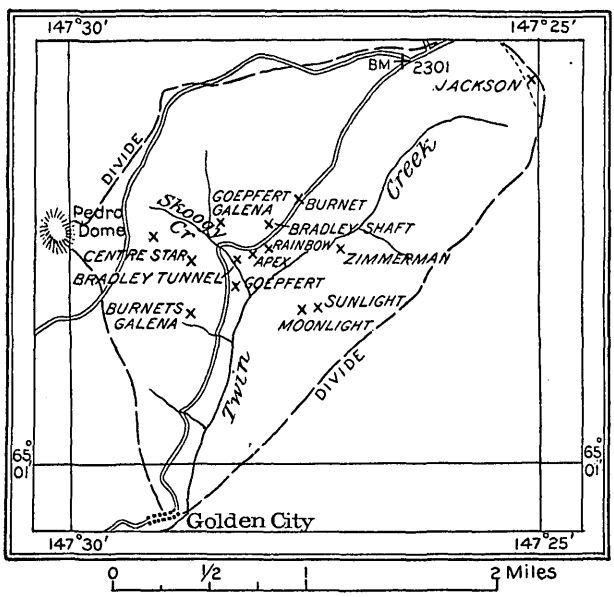



FIGURE 6.—Sketch map showing location of lode prospects in Twin and Skoogy Creek valleys.

faulted before the main vein was formed. On the walls of the dike is some quartz which marks the most acidic phase of the igneous rock. The granite is so badly decomposed that it falls to pieces when handled, and on account of its softness small slides have occurred at places where the ore rested on the granite as a footwall, leaving open spaces less than a foot wide and 2 to 3 feet long.

The country rock for a short distance west of the small granite dike is schist and quartzite, but for 40 feet farther west along the footwall it is a soft greasy white gougelike material which flows almost like clay. This material looks like a thoroughly decomposed granite, but tests show that most of it is a finely comminuted quartz and that only a small amount of it is aluminous. Still farther west

the main lode is transected by a small fault which offsets it about a foot to the south. Beyond this fault, which is near the end of the drift, granite, apparently part of a considerable mass, is seen in the hanging wall and in the roof on the footwall. Near the margin of the granite on the hanging wall is a border phase of quartzitic material which has apparently been produced by contact metamorphism. This granite clearly was earlier than the ore and had been cooled, consolidated, and faulted before the vein filling was introduced.

The richest ore of the Rainbow mine is reported to occur in a shoot which dips about 45° E. Too little development work has been done to show whether this dip is general or is characteristic only of the single shoot that has been found. The parallelism of the shoot and the small granite dike noted in the west drift near the breast, however, suggests some genetic connection between the two.

The vein material carries, in addition to the more or less glassy quartz, a considerable amount of sulphides. Pyrite, arsenopyrite, galena, and sphalerite have been recognized in it, and possibly some others might be detected by chemical tests. The sulphides are almost entirely confined to the vein material, but in a few places they occur in the country rock. In such places the sulphide is generally pyrite in sharply crystalline unoxidized cubes. Visible gold is rather rare, though the owners of the mine report that the value of the ore lies in its free gold and that the sulphides do not carry much gold. The average tenor of the ore is not known with certainty. A mill run of a sample of 19 tons of ore is reported to have shown a gold content worth $38 a ton, but this was probably selected material. The fineness of the gold as determined in two assays reported by F. W. Hawkins is 0.838½ and 0.839½.

The machinery for a two-stamp Nissen mill was expected to arrive before the close of 1912. Much more underground development will be necessary before the veins can furnish a constant supply of ore for the mill.

*Properties east of the Rainbow mine.*—A short distance northeast of the Rainbow mine, at an elevation of about 1,825 feet, a 10-foot shaft has disclosed a 2-foot quartz vein which appears favorable for further exploitation. The vein strikes nearly east and west and dips steeply south. The ore is mainly shattered and sheared milky quartz containing only a small amount of sulphides.

Near the road a quarter of a mile east of this shaft, at an elevation of 1,975 feet, is a small pit which has been abandoned for some time. Coarse gold is reported to have been found in the slide rock near the surface, but at the time of visit the pit had caved so badly that it was impossible to determine whether there was at this locality a definite lead in place.

On the Moonlight claim, at an elevation of 1,900 feet on the southern slope of the valley, is a shaft about 50 feet deep from which has been turned off a 15-foot drift. The vein here rolls a little, but has a fairly steep dip to the north. It is about a foot wide and is said to carry considerable gold in some of the slip seams. The quartz is broken into wedge-shaped blocks, the thin edges of which overlap. No faults were seen in the small portion of the vein so far uncovered. The vein material is mainly quartz with a large amount of sulphides, and the country rock is quartzite schist. Prospect pits have been sunk at intervals west of the shaft, and vein material can be traced to the granite area above the junction of Twin and Skoogy creeks. East of the shaft, along this same trend, the Sunlight claim has been staked. Little work has been done on this claim, though, according to report, the vein has been located on it by means of shallow prospect pits.

North of the Moonlight lode a claim has been staked by Zimmerman and others on the supposed continuation of the Rainbow lode, and a short open cut has been run into the hillside south of Twin Creek at an elevation of about 1,700 feet. The strike of the lode is not constant, appearing to swing from east-west toward north-south, and the dip also changes from north to east. Assays of ore from the dump containing considerable sulphide-bearing material are said to have given returns of $12 in silver and $4 in gold to the ton. Under present conditions ore of this tenor can not be profitably treated in this region.

At the extreme head of Twin Creek W. Jackson and others have sunk a number of prospect holes. In a pit above the road, at an elevation of about 2,500 feet, a large amount of quartz cuts the greenstone-like schists that form the country rock. The quartz shows almost no sulphide mineralization. No trustworthy determinations of the extent or tenor of this lead have been made. It is probable, however, that its gold tenor is low, for the quartz differs decidedly in appearance from that in the rich lodes.

*Properties west of the Rainbow mine.*—The Apex claim, which lies adjacent to the Rainbow mine on the west, has been prospected by shallow pits that have revealed a vein having an eastward-dipping shoot of ore, apparently the extension of the Rainbow lead. No ore has been produced from this property, and not enough development work has been done to expose the vein satisfactorily. The proximity of the lead to the granite indicates that granite will probably be encountered in the underground workings a rather short distance below the surface.

In the granite area, near its northern contact with the schist, at the mouth of Skoogy Gulch, Peter Goepfert has driven a short adit on a nearly vertical 2-inch stringer of quartz which appears to cut

the granite. No ore has been milled from this property, and although the material is said to carry some free gold, it looks barren.

A short distance up Skoogy Gulch, below the road crossing, a tunnel about 200 feet long has been driven N. 10° E. According to report, much of the material encountered in this tunnel is mineralized, but except for a few stringers and immediately at the face there is no distinct vein. The small stringers are transverse to the direction of the tunnel. At the end of the tunnel a strongly marked fault plane trends about east and west and dips steeply north. South of the fault there is from 6 to 8 inches of vein material, which, however, has not been tested for gold. Some gouge occurs along the fault.

Still farther up Skoogy Gulch, at an elevation of 1,750 feet, a short tunnel has been driven on a ledge said to carry considerable galena. This property was not examined in 1912, as no work was in progress. Another galena lode is said to have been found west of Skoogy Gulch at an elevation of about 1,725 feet, near the northern contact of the southern granite mass. The ore is reported to lie nearly flat, but this attitude is said to be due to downhill creep, and prospecting has not yet progressed far enough to disclose the real trend of the lead.

On the hillside west of Skoogy Gulch considerable prospecting has been done in the past, but during the summer of 1912 no mining was in progress on any of the claims. The shafts and tunnels were no longer accessible, and the following statements have been taken from reports by Prindle,[1] who visited the region in 1909, when some work was being done.

> The prospects in Skoogy Gulch, including the North Star, Center Star, S. S., and other locations, are all in schist close to intrusive rocks. * * * The rock in which the mining developments have been carried out is quartzite schist and quartz-mica schist striking northeast. The rock is somewhat metamorphosed by the contact influence of the intrusive rocks, an influence shown by the presence of a large amount of biotite and some andalusite. While some of the schist is very micaceous, much of it is a dense blocky quartzite schist. A small dike about half an inch thick in one of the tunnels shows the closeness of the igneous influence.
>
> Auriferous quartz veins are reported to have been traced on this [western] slope of Skoogy Gulch for 500 to 800 feet. At one locality, where surface prospecting in 1908 had discovered an auriferous stringer about 4 inches thick, together with several smaller auriferous stringers, some of them along the joint planes of the schist, a shaft about 65 feet deep and a tunnel about 200 feet long had revealed in 1909 a considerable number of stringers, some of them barren and some of them carrying high values.
>
> The vein regarded as the main lode strikes northwest and is said to average about 3 feet in thickness. Several hundred feet farther in the same direction a shaft has been sunk on a vein 10 to 12 feet thick, which carries values.
>
> The marginal portion of the porphyritic granite contains in places a large amount of iron pyrites in the granite itself and along the joint planes. Iron pyrites occurs simi-

[1] Prindle, L. M., op. cit., pp. 223-224.

larly along the joint planes of the schist at the locality of the auriferous quartz veins. The granite contains also some pegmatitic quartz and feldspar, occurring as feldspathic veins in quartz and quartz veins in feldspar. In some of these veins both margins are feldspar and the middle is quartz. The quartz present in these granitic products is gray and glassy. In the quartz veins that have been opened there is a similar gray, glassy quartz and this is apparently barren. The auriferous quartz is grayish white and opaque. The veins of both the barren quartz and the auriferous quartz contain a small amount of feldspar. This is mostly kaolinized, but so far as determined is like that of the pegmatitic granite dikes above mentioned. Cavities studded with quartz crystals are rather common in the quartz. The gold occurs partly in visible form embedded either with limonitized crystals of pyrite or in the quartz. The auriferous quartz contains a large number of microscopic liquid inclusions and so far as observed has been more or less shattered. Although it is possible that the auriferous pyrite and free gold were deposited synchronously with the quartz, it seems more probable that the deposition of gold was subsequent to a shattering of the quartz and synchronous with the deposition of pyrite along the joint planes in the schist and porphyritic granite.

## TRIBUTARIES OF CRIPPLE CREEK.

### ESTER CREEK VALLEY.

#### HUDSON MINE AND VICINITY.

In the Ester Creek valley (fig. 7) none of the prospects have yet been developed to a producing stage except the property locally known as the Hudson mine. This group of claims is on the ridge north of Ester Creek between Moose Gulch and Ready Bullion Creek, extending to an elevation of about 1,600 feet. The place where most of the mining has been done is at an elevation of about 1,500 feet. A shaft was sunk here, but in following the lead its course became so crooked that hoisting was difficult, so it was abandoned and a new shaft was sunk a short distance above. The new shaft is planned to intersect the old workings at a depth of 100 feet, but it will be continued below this depth and drifts will be turned off to open stoping ground. The new shaft, which is vertical, was sunk at the rate of about 3 feet a day.

Although the old shaft was no longer in use in 1912, it was still accessible and afforded the best insight into the character and mode of occurrence of the ore. To a depth of 40 feet the shaft is vertical, but from that depth downward the dip of the lead flattens, and an incline at an angle of 45°, turned off to the northwest, extends to a depth of about 94 feet. The lower part of the incline had caved a little and at the time of visit the ventilation was poor. Although all the rock is somewhat mineralized, there seems to be no well-defined lode. A fault plane on the east side of the shaft has apparently been taken as the footwall of the ore body, but so far as could be learned this plane is not a true footwall, for there is ore below it, and the only reason for considering it the footwall is that it forms a good surface to mine to. On this fault plane is a varying thickness

of gouge which shows well-marked striations, as does also the fault plane. Movement in many directions is indicated by the grooves and scratches.

The country rock is mainly a thinly laminated dark greasy-looking chloritic schist, with the laminæ minutely crinkled. Numerous small quartz veins, ranging from mere films, to stringers an inch or so thick, cut the schist at high angles. In addition to these narrow veins there are numerous larger masses of quartz having a more or less bowlder-

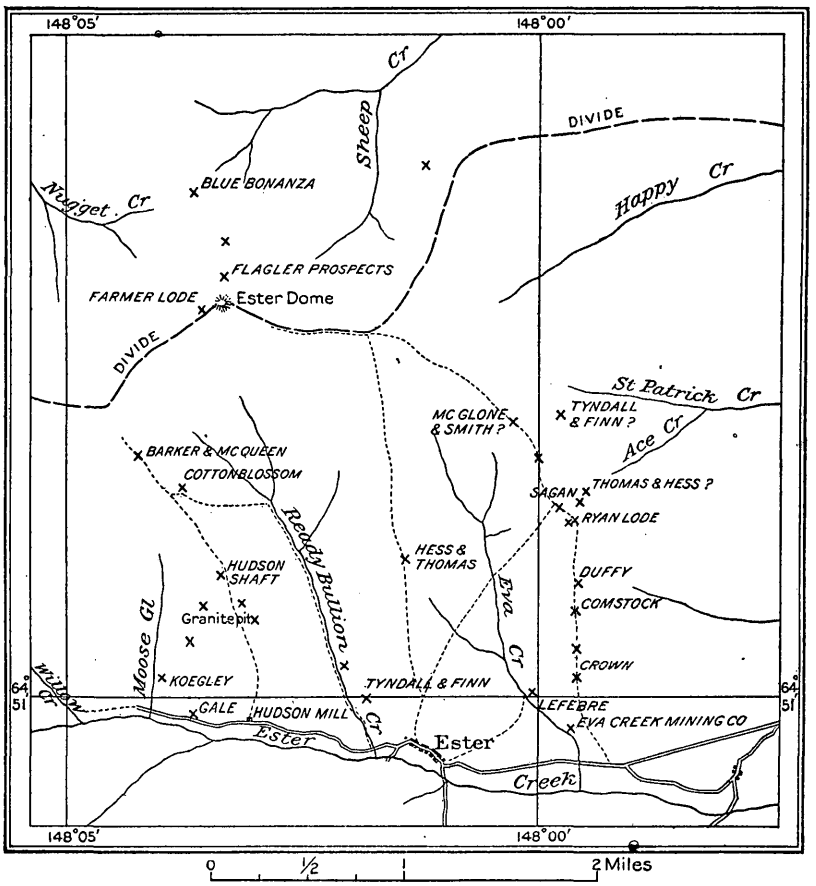



FIGURE 7.—Sketch map showing location of lode prospects in Ester Creek valley and vicinity.

like appearance. These masses are composed mainly of hard, glassy quartz, which is practically barren. Their surfaces are fairly smooth, are more or less completely enveloped in gouge, and are usually covered with slickensides. Probably many of these masses were formed by faulting, but some are probably old quartz lenses traversed by narrow younger veins.

At a few places quartzite forms the country rock. It is usually white or brownish and consists almost entirely of quartz. Silicifica-

tion has apparently affected the rock at a late stage, for recently deposited quartz covers many of the joint planes and extends from them into the rock. The brown quartzite is stained with limonite, formed apparently by the decomposition of pyrite, which is sparsely disseminated through the rock. All the quartzites suggest proximity to an igneous intrusive, but the evidence is by no means conclusive.

The richest ore of this mine occurs in the narrow quartz stringers which intersect the country rock in all directions. These stringers usually adhere firmly to the country rock, so that the whole material must be mined and milled. The gold in the stringers is usually in small particles, but in places these are large enough to be recognized, even underground, at a distance of 3 or 4 feet. Sulphides are practically absent from these veins and the gold occurs free. It is bright yellow and seems to be more abundant near the walls than in the center of a vein. In the centers of the small veins at many places are cavities into which perfectly formed quartz crystals project.

Although the gold occurs mainly in the narrow veins, numerous particles of gold were found by panning a sample of the country schist from which nearly all pieces of quartz had been picked. This result shows that some of the schist is auriferous, but most of it that lies remote from the small veins is believed to be practically barren.

No estimate of the tenor or extent of the material to be mined has been made. Although very high gold assays have been obtained from pieces of the small quartz veins, they are of little value in showing what the average ore will yield, for a large amount of schist and rock of low gold content must be treated when the mine is opened commercially. Before an expensive mining and milling plant is installed the tenor of the rock for the width that must be mined should be accurately determined.

At intervals on the hillside below the Hudson shaft are numerous prospect pits and several large quartz bowlders only partly buried in the moss. A prospect pit south and a little west of the main shaft at an elevation of 1,400 feet, shows at its west end dark schist similar to that in the mine. East of this schist is a reddish-brown, much-decomposed granitic rock, and this is followed toward the east by a seam of gouge and a well-marked fault plane, beyond which is more granitic material. The width of the exposure is only about 5 feet, so that the extent of the granitic rock to the east is not known, but apparently it is not great. Slickensides have been abundantly developed along the fault. The granitic material strongly resembles that at the Fredericks mine near Ridgetop, already described (pp. 181–182).

Although the underground workings have not yet been carried far enough to yield a constant supply of ore, a mill has been built on the north side of Ester Creek midway between Moose and Ready Bullion creeks. The construction work had been much delayed, but

the mill was expected to be in running order soon after the first of October. The building is large enough for twice the present installation, which consists of a battery of two Nissen stamps. Space has been reserved for concentrating tables, but they will not be put in for some time, as it is believed that most of the gold in the ore will be recovered in the mortar or on the plates. Water will be obtained from a well driven near the mill, which is believed by the owners to be capable of affording a sufficient supply throughout the year. The ore will be hauled by teams from the mine to the mill and stored in bins until required. The distance between the two places is about two-thirds of a mile and the difference in elevation is about 600 feet, the loaded wagons having a downhill haul.

On the north slope of Ester Creek valley, a fifth of a mile east of the mouth of Moose Gulch, a prospect pit 20 feet deep has been sunk on heavily iron-stained quartz and brown-weathering schist. The quartz is glassy and compact and appears to occur in small stringers in the schist, but many large pieces of quartz were seen on the dump. The material is reported to carry some gold.

A short distance above the ditch line on the eastern slope of Moose Creek valley, on the Koegley claim, a short tunnel has been driven in an area of mineralized schist cut by small quartz stringers. No strongly marked lead was followed, but here and there small quartz stringers and slips trending parallel with the tunnel have been found. According to men interested in the claim the small quartz stringers carry the most gold, but all the material traversed by the tunnel contains enough gold to warrant milling.

### EVA CREEK BASIN.

Practically the whole of the Eva Creek basin is covered with quartz claim locations, and a great number of prospect pits have been sunk, particularly along the ridge, where the overburden is thinnest. Most of the holes have caved, however, and no longer afford exposures of the bedrock, and natural outcrops are practically absent. In the following notes only the more accessible prospects are described.

Half a mile north of the mouth of Eva Creek a quartz vein which trends about N. 60° W. and dips 68° SW. has been prospected. The easternmost opening on this lead is an abandoned tunnel. A 75-foot shaft was sunk above this tunnel, and a narrow, well-defined vein was found. A little to the northwest, on the same vein, an open cut about 40 feet above the stream had exposed the vein for nearly 100 feet and the ore had been stoped out. Short tunnels near the creek level have been driven to cut the vein, and most of the ore that could be easily won has been removed. The walls stand well, even without timbering, but to continue mining it will be necessary to install

a pump. The occurrence of the ore is more like that of the mines and prospects in the Chatanika basin than that of most of the other prospects in the Cripple Creek region.

A short distance farther up Eva Creek Hegan & Lefebre have driven a tunnel about 25 feet above the creek, on a vein which trends nearly north and south. In the breast of this tunnel are numerous flat-lying quartz lenses which are much crushed. About 8 feet from the face is a crosscutting fracture zone with some broken-up country rock and quartz. This seam is very narrow, and no statement of its gold tenor was obtained, but the owners are sinking on it.

Prospect pits are scattered all the way up the ridge east of Eva Creek, but only on the Ryan lode, at an elevation of about 1,325 feet, has any considerable work been done. Two shafts have been sunk on this property. The northern shaft is shallow and has been abandoned for some time. Practically all the material on the dump is quartz; there are almost no fragments of schist. The southern shaft is said to be over 90 feet deep, but in 1912 it had caved so much that the lower 30 feet was filled. The maximum width of the vein is about 16 inches. Near the bottom of the shaft the vein has been faulted, and it pinched out to the west. To judge from the direction in which the schists near the fault have been dragged, the continuation of the vein should probably be sought in the hanging wall above the point where the vein is cut off.

The rocks abutting on the fault are strongly slickensided, and although the grooves run in all directions, apparently the main movement was horizontal on the nearly vertical plane. Near the fault is considerable gouge, which seems to be ground-up material derived from the vein and the country rock. More or less parallel with the fault is a white, much-decomposed rock that resembles a thoroughly weathered granite. It consists mainly of quartz with subordinate amounts of feldspar, now altered to kaolin.

In the saddle northwest of the Ryan lode a shaft 30 feet deep disclosed auriferous material. At this place the whole rock seems to be mineralized, but no distinct vein with well-defined walls was found. The country rock is dark, much broken-up schist, containing numerous small quartz stringers. Although faults are common, they appear to have effected but a small amount of displacement. Sulphides are not abundant, although some of the ore is stained with limonite, probably derived from the decomposition of disseminated pyrite. A little of the vein matter, consisting of fine-grained quartz and feldspathic material, simulates a marginal phase of granite. The extent and distribution of rock of this kind, however, were not determined. All the material from this shaft is reported to show small amounts of gold when panned.

Near the head of Eva Creek, at an elevation of 1,600 feet, Edward Hess and others have sunk a 60-foot shaft on a quartz vein carrying considerable stibnite and disseminated sulphides. The quartz is fine grained, is granular, and has a grayish color, due to the sulphides that occur throughout it. The vein matter is similar in appearance to that from many of the Cleary Creek prospects already described. Visible gold is reported to be fairly common.

On the divide between Eva and Ready Bullion creeks, at an elevation of about 1,500 feet, a vein was found and prospected by Hess & Thomas. The country rock is a rather decomposed, dark, greasy-looking chloritic schist, cut by small quartz veins. The material on the dump is similar to that in the deposits with disseminated mineralization, previously noted as being the most common type in the Ester Creek region. No mining has been done at this place for some time.

### READY BULLION BASIN.

In the lower part of the Ready Bullion basin several lode claims have been located by Tyndall & Finn, who have made many openings, most of which, except notably two adits near the creek, are now inaccessible. The southern of the two adits is east of the creek about a third of a mile above the mouth and is about 60 feet long. The vein it follows is small but well defined. The country rock adjacent to the lead is not much mineralized, and the gold is reported to occur entirely in the quartz vein. No work has been done at this place recently.

The northern adit lies about one-eighth of a mile farther upstream and is about 50 feet long. Not much ore was seen on the dump and no well-defined lead was found underground. After schist that was apparently in place had been penetrated for some distance, a mass of water-rounded pebbles an inch in diameter was found on the north side of the adit. The pebbles are overlain by flat-lying schist, which, though apparently in place, is probably a large piece of slide rock. The roof is not fissured, but the underlying rock is broken up and the fractures in it were evidently followed in prospecting. Many small quartz veins occur in the schist, but their gold tenor was not determined.

Some prospecting has been done on the Cottonblossom claim, west of Ready Bullion Creek, at an elevation of 1,750 feet. A 70-foot shaft was put down at this place, but in following the lead it became so crooked that it was abandoned, and in 1912 a new vertical shaft had been started and sunk 60 feet. Some trouble was experienced with water, but the ground is not very wet, as less than 20 buckets of water collects in over 12 hours. No definite lead was found at this

place, but there is a well-marked fault which is regarded as the footwall. Above the fault plane is several inches of gouge made of the comminuted country rock. The shaft was started on this material, but as the dip of the gouge flattened sinking was continued on small fractures and quartz stringers. Stibnite occurs in bunches near the surface and at the bottom of the shaft and is scattered sparingly through the quartz stringers. In the rock are numerous cavities left by the decomposition of sulphides, which probably originally carried some of the gold. A part of the gold, however, occurs in the very narrow quartz stringers. So far as can be seen at present the mineralization corresponds in general to that at the Hudson property, half a mile to the south, on the same ridge, though apparently the ore is not so rich.

At an elevation of 2,100 feet, on the same ridge, Barker & McQueen have prospected a quartz vein trending northwest-southeast and dipping steeply northeast. No work had been done on the property for more than a year, and although a good deal of quartz was seen on the dump its gold content is reported to be small. Sulphides are practically absent.

### ST. PATRICK CREEK VALLEY.

A number of claims have been recorded in the St. Patrick Creek basin, but no mining was in progress at the time of the writer's visit. Most of the claims are on Ace Creek, the southern headwater branch of St. Patrick Creek, and on the ridge to the north. In this region most of the prospecting has been done by Thomas & Hess, Tyndall & Finn, and McGlone & Smith. It is said that shafts 100 feet deep have been sunk on some of these properties and promising veins discovered, but no production is reported.

The only pits in the St. Patrick Creek basin that were visited by the writer in 1912 are at the head of Ace Creek, immediately below the Ryan lode claim. These pits trend a little east of north, and in each of them heavy quartz float and ledge were found. One pit at an elevation of 1,175 feet disclosed a wide lead of quartz, huge bowlders of which were seen on the dump. The quartz is much crushed and faulted, the faulting in places producing polished surfaces that simulate cleavage. Several generations of quartz are present, one of the oldest being a dark chertlike quartz which has been fractured and later infiltrated by light-colored quartz. This in turn has been broken, and still more recent quartz has been introduced into it. Some cavities formed by the leaching out of sulphides occur irregularly through the quartz. Tests of the vein material are reported to have shown a low gold content.

### MISCELLANEOUS PROSPECTS.

As has been stated, undoubtedly many places where lode prospecting has been carried on have been omitted from the foregoing description. There are, however, some claims whose location, though more or less indefinite, places them outside of the drainage basins already described. None of these claims were visited in 1912, but in order to make this report as complete as possible the few available notes on these properties are given.

Between the headwater branches of the tributary of Columbia Creek, at an elevation of about 875 feet, an adit 100 feet long is reported to have been driven on a quartz lead. The ore is said to be of low grade but free milling. Above this place are the prospectors who have been working at the head of Engineer Creek, in the Goldstream basin. According to report, the whole region forming the Columbia-Steele-Engineer divide has been covered with lode claim locations, and at least four different parties have been more or less actively prospecting for veins, but so far apparently without notable success.

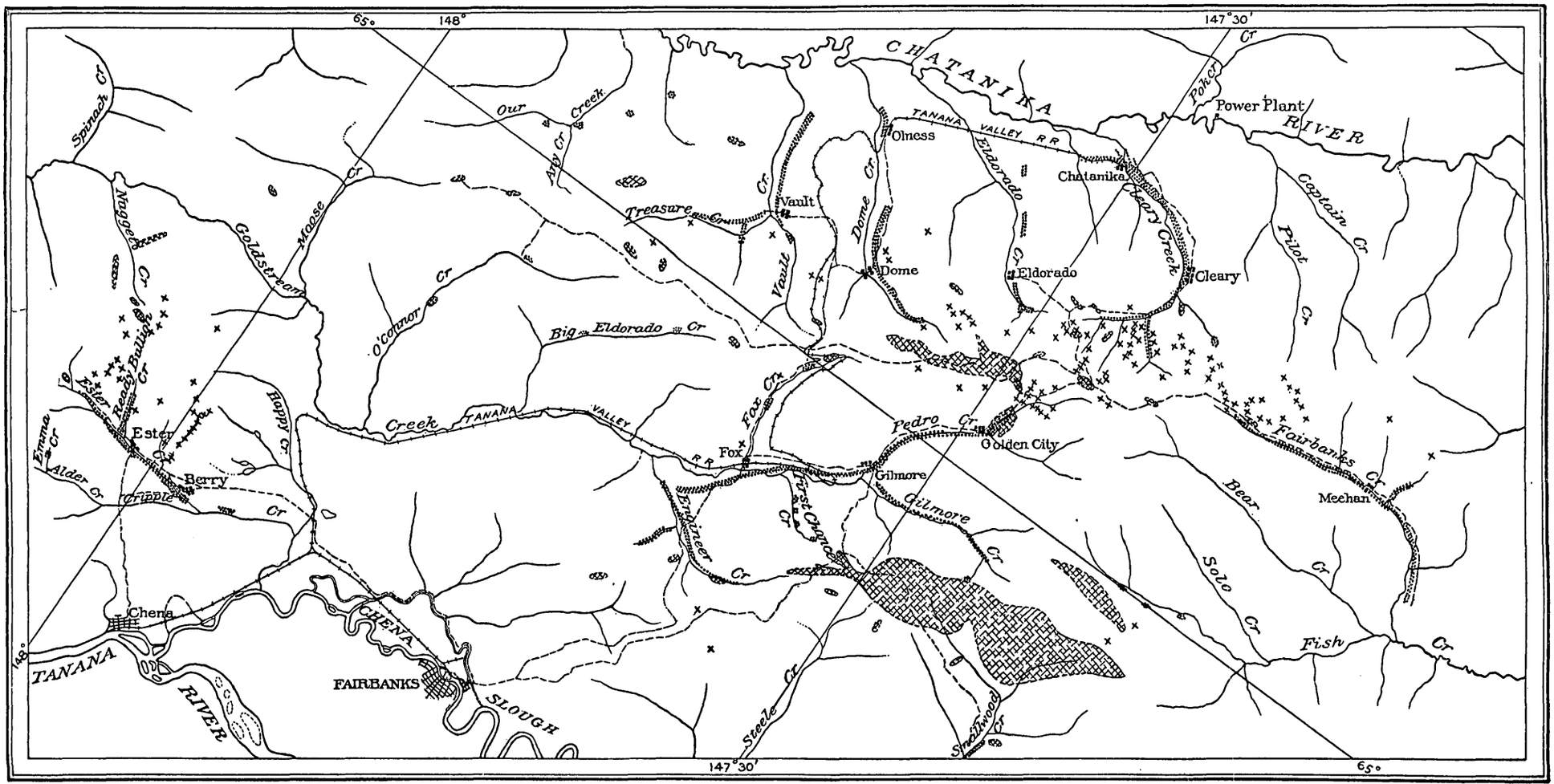
East of Steele Creek, on the ridge between that stream and Rex Creek, a tributary of Smallwood Creek, a little prospecting has been in progress. This work apparently was done mainly in the vicinity of the 1,825-foot hill. All the leads through this region are said to be wide, but the ore is of low grade and whether the properties can be profitably developed under present conditions is doubtful.

## FUTURE OF LODE MINING.

In the earlier part of this report the mining developments in the vicinity of Fairbanks have been described with particular reference to the physical features of the veins and the extent and character of the work accomplished. There are, however, many other phases of the subject concerning which miners in the region or prospective investors wish to be informed. Many questions relating to these phases can not be satisfactorily answered, but it seems desirable at this place to set forth the inferences that may be drawn regarding the probable conditions, both geologic and commercial, to be expected in the future development of lodes in this region.

### AREAL EXTENT OF MINERALIZATION.

Plate VI shows the places where gold-bearing lodes have been prospected and ore has been found. Whether this distribution of prospects truly represents the distribution of auriferous veins is a question of importance which can not yet be answered definitely. The two lines of available evidence lead to somewhat opposite conclusions. The rich placers are more or less closely con-




By L. M. Prindle, F. J. Katz, and P. S. Smith

MAP SHOWING LOCATION OF LODE MINES AND PROSPECTS IN FAIRBANKS DISTRICT.

fined to the streams that drain areas in which the most lode prospecting has been done, a fact which suggests that the auriferous lodes are more or less restricted to the prospected areas, though there are placers in parts of the Goldstream and other basins where lodes have not yet been discovered.

On the other hand, when deductions are based on the supposed origin of the auriferous lodes the conclusion is reached that the veins are much more widespread than the present lode prospecting. In order to explain why the origin of the veins throws light on the areal extent of mineralization, it is necessary to consider the theory advanced by Prindle.[1] According to this theory, the mineralization was closely connected in time with the intrusion of the granitic igneous rocks. It was due not only to the mechanical effects of the intrusion, which fractured the rocks and provided open spaces in which the minerals were deposited, but also to the introduction of the minerals, which were derived from a deep-seated source. If this explanation is correct, it follows that the areas near the intrusive granitic rocks are the places where lodes are most likely to occur. Outcrops of these igneous rocks are widely distributed throughout the Fairbanks region, and in many places where these rocks are not exposed they probably occur a relatively short distance below the surface. In fact, the territory adjacent to Fairbanks may reasonably be regarded as occupied by schists underlain by a large granitic mass from which igneous material protrudes in irregular apophyses, some of which have been revealed at the surface by erosion. It is believed, therefore, that auriferous veins may reasonably be expected to occur at many places where their presence has not yet been proved by prospecting.

### LOWER LIMIT OF MINERALIZATION.

Although the intrusion of granitic material was more or less closely associated with the mineralization, neither process was a single event, as there were several periods both of intrusion and of mineralization. Prindle[2] states that the sequence of intrusion was in general quartz diorite, porphyritic biotite granite, and persilicic dikes. From studies both by Prindle and by the writer it has been determined that mineralization of at least two types may be recognized—that producing a series of older auriferous quartz veins and that producing a later sulphide-bearing series. In addition there are veins of a much earlier period, with which the present investigations are not concerned, for so far as known they are not auriferous. The fact that all the veins and all the igneous rocks were not contemporaneous indicates that certain veins may cut certain of the igneous rocks. This

[1] Prindle, L. M., U. S. Geol. Survey Bull. 525, pp. 89–92, 1913.
[2] Prindle, L. M., U. S. Geol. Survey Bull. 442, p. 216, 1910.

conclusion is significant in determining the depth to which the veins may extend, for it suggests that they may persist into the areas occupied by the granite and are not necessarily limited to the country rock adjacent to the intrusive masses. This suggestion is in accord with the field observations, for at several of the mines veins were found occupying fissures along faults by which granite dikes have been offset. Therefore, although the veins probably did not extend as distinct veins to the zone where the rocks were in a state of flowage, there is no valid reason for placing the lower limit of vein formation above the surface of the granite, and some of the veins may reach a depth regarded by miners as considerable.

### CHARACTER OF MINERALIZATION IN DEPTH.

The tenor of the ore and its physical character in the accessible surface portions can be examined and the commercial return that can be obtained by development of the deposit may be calculated with some degree of mathematical precision. It is important, however, to determine to what depth the several factors bearing on the problem, notably the chemical composition of the ore, are applicable. This is particularly true of auriferous quartz veins, which near the surface carry gold mainly in the native state. From such veins the gold can be recovered by simple processes of crushing and concentration. If, on the other hand, the gold in the unweathered ore is mainly in a state of chemical combination or mechanical suspension in particles so finely disseminated that its recovery necessitates metallurgical treatment, it may not warrant mining, even though it may be as abundant as in the free-milling ore.

It has already been stated that at least two distinct types of mineralization have been recognized in the shallow surface portions of the veins so far exploited. Each of these types requires separate description and the facts concerning one do not necessarily apply to the other. Failure to discriminate between the two has led to certain misconceptions. Not enough data have yet been gathered to determine with finality the character of the ore in depth, and the following statements are therefore tentative.

So far as determined the non sulphide-bearing auriferous quartz veins contain gold in a native state as an original constituent, and this is interpreted as indicating that to a moderate depth below the surface these veins are of approximately uniform composition. In other words, it is believed that to the depth which will probably be reached in mining in the near future the gold in the older auriferous quartz veins is free milling.

In the sulphide-bearing veins visible native gold was introduced contemporaneously with the sulphides and probably these minerals also carry a considerable amount of gold so finely divided as to be

invisible. Under present milling practices the invisible gold is not recovered and its proportion to the visible gold is unknown. There are, therefore, no data as to the quantity of gold carried by the sulphides at different depths in the 300 feet to which mining has been carried below the surface, and deductions as to the conditions at still lower levels are therefore practically guesses. It should be realized that in veins of this type some of the gold in the surface portion is probably derived from broken-down sulphides and that this portion therefore contains more gold than can be recovered from unweathered ore from lower levels by milling without metallurgical processes, so that the average deep ore probably will not yield as much gold as that obtained nearer the surface.

In several of the mines examined veins of both types occur together. In some of these places the older vein had been fractured and later solutions of the sulphide-bearing type had been introduced. Where this happened the average gold content of the rock was increased and a rich shoot resulted. There is no reason why this condition should not occur also in the deeper parts of the deposit. In fact, it is possible that in the deeper parts the older quartz veins were more brittle than the other rocks, and therefore were especially susceptible to fracturing, and allowed the later solutions to pass through. This suggestion, however, is based on so many rather indefinite assumptions that it is of little practical value and should serve only to indicate that to a moderate depth there is probably no marked decrease in the number of intersections of veins belonging to the two different periods.

### TENOR OF THE ORE.

Statements of the value of the ore mined at the present time range all the way from a few dollars to more than a thousand dollars a ton. Many of these statements are based on assays of small selected specimens and have no general application. None of the private mills have made returns of the tenor of the ore that are available for publication, so that the average value of the ore mined is not known. The records of the Fairbanks test mill show that the average tenor of the 64 tons of ore from 24 different properties milled in the first three months of 1912 was $69.87. (See p. 165.) It was reported that the 292 tons from five different properties milled at the Chena mill in 1911 yielded an average gold content worth $106.80 a ton. These results undoubtedly represent selected ore and consequently are higher than would be obtained in ordinary commercial practice if the mines were in constant operation. It seems certain, however, that the average vein material from many of the mines now in operation, if kept reasonably free from waste in mining, will run about $50 a ton. This estimate includes the free gold only, for, except at two or three

mills, no concentrates are saved; though they undoubtedly contain additional gold.

Ore with these high gold values comes mainly from small quartz veins, many of which are only a foot or so in width. There are in the district, however, larger veins, some of which are as much as 15 feet wide. Some of these have been sampled and are said to yield from $10 to $15 a ton in gold. Under present mining costs ore of this low tenor can not be commercially developed in this region. With the reduction of expenses which may reasonably be expected, these low-grade deposits may possibly be developed profitably on a large scale.

It is undoubtedly true that at present only the richest parts of the veins are being mined. With the opening of the deposits on a large scale, undoubtedly the tenor of the ore milled will decrease. In large measure this will be due to improvements in milling practice through which lower-grade ore can be treated at a profit, but it will be due also to actual decrease in the tenor of the veins with increasing depth. The extent of this decrease is not known, though it now seems probable that, factors other than depth being eliminated, the veins should contain nearly as much gold at the depth which will be reached in the near future by mining as they do a few score feet below the surface.

## MINING COSTS.

### GENERAL EXPENSES.

At the present time, owing to the remote position of the district, its partial isolation during the winter, and its lack of productive occupations during the months when the surface water and the ground are frozen, the costs of supplies and wages are high. With the development of the region many of these disadvantages will be decreased or removed, so that a decided reduction in operating and living expenses is expected. Thus, when lode mining increases, many persons will find permanent employment throughout the year and will no longer be compelled to remain idle during the seven or eight months that the placer mines are closed. Moreover, if business increased, transportation facilities could be improved and charges could be reduced without affecting the profits. So many factors enter into the problem, and they interact so intricately, that the evaluation of the separate items which bear on the future mining costs in the district is impossible; but as a whole the costs will tend to decrease rather than increase.

### COST OF POWER.

Although, on the whole, the general trend of costs will be downward, special expenses to which small mines are not subject will become more and more necessary as larger mines are developed. The

most notable expense of this class is that for power. As long as the mines are shallow or are accessible from hillside tunnels little power other than that of man is necessary in mining, for underground drilling is done by hand drills, the ore and waste are removed by a man and windlass or by hand tramming, and water is kept away from the workings by allowing it to run off along the slope of the tunnel or by hoisting it with a windlass.

With increasing depth, however, power for pumping and hoisting becomes more and more necessary, not only on account of the larger amount of material that must be handled, but also of the longer distance the same amount of material must be moved. In the matter of pumping, which has given a number of operators concern, probably the greatest amount of water will be found in the surface zone. Proportionally more water will occur within the first few hundred feet than lower down, but with increased depth the water must be lifted a greater distance and will be more troublesome and more expensive to handle. Therefore, although existing conditions indicate that probably most of the mines will not be excessively wet, charges for pumping must be anticipated and provided for.

As the determination of the amount of water that may be expected in depth is a matter of considerable importance the following reasons for believing that under ordinary conditions the amount will not be excessive are given: First, the average mean annual precipitation at Fairbanks for the years 1906 to 1910, inclusive, was only 11.13 inches, and although precipitation is probably greater in the higher areas, it is nevertheless small; second, the frozen condition of the surficial parts of the deposits prevents much ground-water storage and increases the rapidity of run-off; third, except in the surficial portions the rocks are rather impervious and afford few channels for the passage of water underground; fourth, in practically all the underground work examined no considerable amount of water has been encountered.

At present power for various purposes at the mines and mills where machinery is used is produced from wood or gasoline as fuel. Timber near the mines is not abundant and is becoming scarcer, so that although in favorable places wood is sold for $5 a cord most of the mines pay about $15 a cord. All the gasoline used comes from the States and costs 60 cents or more a gallon at the mines. No coal is used as fuel, though there is a large amount of lignite 60 to 100 miles distant. Plans have been considered for utilizing this coal either by transporting it to Fairbanks or by transforming its latent power into electric power and transmitting it to places where it is needed, but uncertainty as to the Government's policy with regard to the coal lands has delayed this enterprise. Not enough water is available for use as a direct source of power at the mines and mills, and the

projects that have been proposed to utilize the more distant supplies required so large an investment and presented so many difficulties that they have been abandoned. With increased transportation facilities some decrease in charges for wood and gasoline may be expected, but decided reduction in the cost of power probably depends on the development of the known coal resources.

### MISCELLANEOUS SUPPLIES.

Increased development requires a more elaborate surface and underground equipment, and at those mines which are far from their mills cheap methods of intercommunication must be devised. All these matters demand careful consideration and can be most economically and satisfactorily determined through detailed examination by competent authorities. Ordinarily the looser methods practiced in many placer camps are not permissible in lode mining, and operators should obtain expert advice before undertaking the purchase of expensive machinery and similar equipment or laying out a system for future underground development.

In the shallower parts of the deposits visited little or no timber is now used. The walls stand well even down to 300 feet below the surface, and the few timbers seen were used more for lagging than for carrying weight. So little strength is required that most of the timber is merely 16-foot cordwood, much of which has been charred by forest fires. That not much support is necessary underground is fortunate, for a set of round pole timber (three pieces) costs $3 and a square set about $6, and very little good material for mine timbers can be found near at hand. The amount of timber used when more extensive openings are made underground will be much greater in proportion to the size of the openings than at present, and increasing difficulty and expense in getting a suitable supply should be expected.

# PLACER MINING IN THE YUKON-TANANA REGION.

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## SOURCES OF DATA.

The aim of this report is to gather together in brief form all available information of importance concerning placer mining in the Yukon-Tanana region in 1912. The writer visited the Fairbanks, Circle, Fortymile, Eagle, and Seventymile districts to study the water supply and incidentally gathered some information concerning the mining. Many of the data, however, were obtained from statements of operators and local press reports received at the Survey office in Washington.

## FAIRBANKS DISTRICT.

### GENERAL CONDITIONS.

The value of the production from gold placers in the Fairbanks district in 1912 was $4,150,000. No changes or improvements of importance in methods of recovering the gold were introduced. The production has been kept up largely by new discoveries and the widening of the known gold-bearing areas on creeks that have yielded some gold during past years.

The principal producing streams, arranged nearly in value of gold output, are as follows: Goldstream and Engineer creeks, Cleary Creek and Chatanika Flats, Dome Creek, and Chatanika Flats, Eva, Ester, Pedro, Fairbanks, Vault, and Little Eldorado creeks.

Labor conditions were fairly satisfactory and the usual wages of $5 a day and board prevailed. Many men left for other camps, particularly Ruby, and others shifted their efforts from placer to lode mining. New arrivals, however, supplied the demand fairly well and the number of men engaged in placer operations did not vary far from that of 1911. It is estimated that from 130 to 140 plants were in operation for either a whole or a part of the year and that the number of men employed ranged from about 900 in the winter to perhaps 1,500 in the summer.

The water supply was better in 1912 than in 1910 or 1911 and satisfied the needs of the miners as well as could be expected in a country of very low rainfall and rapid run-off.

The dredge on Fairbanks Creek is the only one yet installed in the district, but rumors are current that other dredges will be brought in, and options have been taken on ground deemed suitable for such methods. Hydraulic mining has not been undertaken except on a very small scale and probably never will be found adapted to the conditions in this district.

Recent press reports state that a hydroelectric power plant located on Chatanika River near Pilot Creek is contemplated. The plans involve the diversion of the water from the river and the construction of 11 miles of ditch.

### CHATANIKA RIVER BASIN.

*Dome Creek.*—From claim "No. 7 above" to "No. 6 below" on Dome Creek ten to twelve outfits employing about a hundred men were mining most of the summer of 1912. No data are at hand to show the amount of winter work accomplished, but it was probably less than that done in the summer. The production from that part of the creek for 1912 was probably equal to or greater than that of 1911.

In the Chatanika Flats near Olness, near the mouth of Dome Creek, about 250 men were employed at six or seven plants. The Niggerhead Association, which comprises the most important group of claims in that locality, had three large plants in operation and was perhaps the scene of the most extensive mining in the Fairbanks district in 1912. Considerable work was done on the Recorder Association claim and on the Shakespeare claim. On the Christmas Association claim good pay was reported at a depth of 177 feet.

*Cleary Creek.*—The fact that Cleary Creek continues to be one of the most productive creeks in the camp is due almost entirely to the extensive deposits of auriferous gravels that have been found near its mouth in the Chatanika Flats.

Nine to twelve outfits, employing a total of twenty-five to fifty men, were at work in 1912 from claim "No. 10 above" to claim "No. 10 below." A large number of these men were either rewashing the tailings from the old dumps or were hoisting the pillars and unworked portions that had been left in the mines during the more prosperous days of the camp.

Below claim "No. 10 below" about fifteen outfits were at work, employing perhaps 70 men in the winter and 275 in the summer. Much of the ground has been of rather low grade and very little of it has earned a profit unless worked under the most careful management. Early in the winter of 1912 a new line of pay gravel was found on the right bank of Cleary Creek opposite claim "No. 16 below" and was located by prospecting shafts for a considerable distance up and down the valley. Several plants of large capacity

were hurriedly installed. The ground, however, did not prove as rich or as widely extended as at first expected and several of the plants were unable to pay expenses, only three or four plants being worked continuously throughout the summer. The gold is said to be coarse and different in appearance from any previously found on the creek.

On Wolf Creek, a tributary of Cleary Creek, two men were mining in the winter and eight to ten in the summer. Very good returns are reported to have been obtained. On Chatham Creek, another tributary of Cleary, no placer mining was done in 1912.

*Vault Creek.*—In the summer of 1912 several large outfits were mining on Vault Creek, employing a maximum of about a hundred men. The principal group of claims was the Alabama. Other groups of importance were the Isabella, Oregon, Homestead, and Hard Luck.

On Treasure Creek, a tributary of Vault, four or five small outfits were working; and on Wildcat Creek, a small tributary of Treasure, two small plants were working.

*Little Eldorado Creek.*—Little Eldorado Creek has never satisfied the expectation of its earlier prospectors and promotors. In 1912 mining was being done at three or four different points, and considerable prospecting was in progress, the men employed varying from thirty in winter to sixty in summer. The principal claim was "No. 6 above." Bedrock lies at a depth of about 85 feet. It is said that sufficient pay gravel has been located to furnish work for one plant for several years.

*Homestake Creek.*—The hydraulic plant on Homestake Creek was not operated at any time during 1912. One man was mining by hand methods most of the summer.

### GOLDSTREAM BASIN.

*Goldstream Creek.*—Although the production from Goldstream for 1912 will probably not equal that for 1911 it will put the creek near the head of the list. The left-limit bench claim of "No. 9 below," owned by the M. B. Mining Co., has proved to be one of the richest claims in the camp. No mining was done below claim "No. 21 below," but prospecting has shown a considerable body of gravel farther down the valley with an average value of about 50 cents per square foot, not enough to pay for working at present costs. Two plants are now working on claim "No. 1 below," which is and has been for several seasons one the largest producers on the creek. Steam scrapers were used on claim "No. 6 below," the lowest claim on the creek that was worked by open cut. Steam scrapers were also used on "Nos. 4 and 5 below." The outlook for several more prosperous seasons on the creek is particularly good, as many of the

operators have sufficient pay gravel in sight to last one or more seasons and prospecting is continually revealing new deposits.

The number of outfits mining on the creek varied greatly during the year, ranging from about fifteen with 150 men in the winter to perhaps thirty with 250 men in the summer.

On First Chance Creek, a small stream entering Goldstream from the left near "No. 5 below," two or three small outfits were mining most of the year. On "No. 1 below" five or six men were employed on ground about 35 feet deep.

*Pedro Creek.*—The gravels of Pedro Creek are shallow, varying from 12 to 15 feet, and have been mined chiefly by open-cut methods. During the winter of 1911–12 about fifteen men were drifting on four claims. Summer mining was carried on more extensively, probably 75 to 125 men being employed in the open cuts. Several outfits were using bottomless scrapers. Other plants were using steam hoists, the dirt being conveyed to the buckets in wheelbarrows. A few men were working with a windlass. On Twin Creek fifteen to twenty men were employed in operating a Bagley bottomless scraper.

*Gilmore Creek.*—On Gilmore Creek four or five claims were mined by 12 to 15 men. The prevailing method of handling the gravel in the summer was by conveying it in wheelbarrows to a bucket which was raised by a steam hoist to the sluice boxes.

*Engineer Creek.*—In 1911 Engineer Creek was one of the busiest creeks in the district, several outfits on it operating on a very large scale. The year 1912, however, has seen a rapid decrease and the consensus of opinion of those personally familiar with the conditions is that the pay streak is about worked out. During the winter of 1911–12 two parties were at work on the Owl Association and one each on Discovery claim, "No. 1 above," and the Wild Goose Association claim. About thirty-five men were employed. The summer of 1912 was still less encouraging. One small outfit was mining on Discovery, which was the most promising claim; one party of four or five men was mining on the upper end of the Owl Association; and several men were resluicing tailings on the Wild Goose Association claim. Scrapers were used to raise the gravel to the sluice boxes.

## CHENA RIVER BASIN.

### LITTLE CHENA RIVER BASIN.

*Fairbanks Creek.*—Fairbanks Creek is the only stream in the Chena River basin on which gold in any considerable quantity has been found. It has been one of the most consistent producers of any of the creeks in the Fairbanks district. To the traveler passing through the valley during the past season there were very few signs of mining

being done. Nevertheless, the value of the production for 1912 will amount to over $200,000. In the winter thirty-five outfits were at work, employing a total of about 135 men. In the spring, as soon as sluicing water became available and seasonal conditions would permit open-cut mining, the number of outfits decreased to about twenty-five, and the number of men employed increased to approximately 225. Mining extended from claim "No. 17 above" to "No. 10 below."

The dredge which was constructed on claim "No. 8 above" in 1911 commenced operations about June 1. Its workings were watched with particular interest by the mining men of the camp, as it was the first dredge to be installed in the Fairbanks district and its success or failure would likely have considerable influence on future dredging in this section. During the early part of the season many factors contributed to its ill success. Later on, operating conditions improved, and as a whole the season's work is believed to have been very satisfactory. It is expected that it will not be necessary to suspend work for the winter until about December 1. At the time of the writer's visit, August 7, 1912, the dredge had moved a total distance of 1,320 feet upstream, through an average depth of 20 feet and a width of 100 to 110 feet. It is operated on two shifts of 11½ hours by five men (pilot, engineer, fireman, grizzlyman, and dump-boxman) per shift. Some difficulty was experienced during the early part of the season by frozen ground, and steam points were used to thaw the muck and gravel so that it might be easily handled by the buckets. A Keystone drill was used to determine approximately the boundary lines of the pay streak. The cost of wood for fuel has become so great that the installation of oil burners and the obtaining of crude oil from California is contemplated.

The extent of the known gold-bearing area in this valley has been considerably increased during the past year. In March, 1912, pay gravel was first located on the right limit of the creek, being found on the first tier bench on claim "No. 1 below." The ground is about 35 feet deep and averages $1.25 to $1.50 per square foot. Tunneling showed a pay streak at least 100 feet in width. During the latter part of July some exceptionally rich ground was found on claim "No. 3 below," and is thought to be an extension of the old Fairbanks Creek pay streak. Pans of gravel of $10 and upward in value were frequently found, and later developments proved that the area containing these high values was of considerable extent. A third discovery was made in August on the left limit bench, near the mouth of Walnut Creek, on claim "No. 2 below." The ground is said to carry values of $2 to $2.50 per square foot. On claim No. 3 of Walnut Creek, a small tributary of Fairbanks Creek, two men were working in open

cuts most of the summer. Some mining was also done on Alder Creek, another small tributary of Fairbanks.

A steam scraper was used on claim "No. 1 above" most of the summer. A self-dump hoisting plant was used in an open cut on claim "No. 3 above," the gravel being conveyed to the bucket by wheelbarrows. About twenty men were employed. Options have been obtained on several claims below those controlled by the Alaska Exploration Co., and it is rumored that an attempt will be made to organize a company and install a dredge on the property.

*Fish Creek and tributaries.*—Fish Creek has failed to come up to expectations during the past two years. Prospecting has proved the extension of large bodies of low-grade ground, but comparatively little of it has been found rich enough to pay for working by the methods employed. Five to ten outfits employing thirty to forty men were mining on the creek during the year.

On Pearl and Last Chance creeks, tributaries of Fish Creek, some open-cut mining was done during the summer months.

*Smallwood Creek.*—Several claims were mined on Smallwood Creek, where a deposit richer than ordinary is said to have been found during the year.

### SOUTH FORK OF CHENA RIVER BASIN.

On South Fork of Chena River considerable prospecting has been done. On Beaver Creek, an east branch of South Fork, ground averaging about $1 a square foot is said to have been found early in the winter of 1911–12. Several windlass dumps were taken out.

### MIDDLE FORK OF CHENA RIVER BASIN.

Middle Fork of Chena River and some of its branches have been known for several years to carry coarse gold, but the only locality at which the gravels are known to be rich enough to warrant mining is along the river bars above Shamrock Creek. Here considerable development work has been done, timber dams being built to divert the river and drain its channel, and considerable coarse gold has been recovered. The extreme high water of June, 1912, washed out the greater part of a dam nearly completed, and the remainder of the season was devoted to repairs and to excavating a larger side channel. Several men were prospecting on the Middle Fork and its tributaries during the winter of 1911–12, and a lesser number were similarly employed during the summer.

### CRIPPLE CREEK BASIN.

No mining was done on main Cripple Creek during 1912, although good prospects are said to have been found on the Golden Champion Association claim.

*Ester Creek.*—On claim "No. 8 below," on Ester Creek, about fifty men were employed most of the year. On "No. 3 below," about the same number were engaged during the summer, but only ten to fifteen were employed in the winter. One small outfit was mining on Discovery claim. On the right limit bench of Discovery two large plants were working throughout the year. A large plant worked on "No. 1 above" in the summer and another on "No. 2 above" in the winter. Five or six men were mining on "No. 4 above" during both summer and winter. The total number of men mining on the creek varied from about 150 in the winter to 225 in the summer.

Operations were somewhat curtailed, especially on the benches, during part of the summer, because of lack of sluicing water.

One outfit on Discovery bench began sluicing in the latter part of March, a date earlier than any known in the history of the camp, where sluicing with water from surface run-off has never before been accomplished previous to April 1.

Although several claims that have been productive in the past are worked out, new ones have been located, and the output for 1912, which is estimated at approximately $300,000, does not show much decrease from previous years.

*Eva Creek.*—Eva Creek has shown the most rapid increase in production of all the streams in the district, jumping from a few thousand dollars in 1911 to about half a million in 1912. Most of the prospecting was done with a churn drill. Exceptionally rich ground was found on the Daly Bench and Happy Home Association claims. In the winter of 1912 three plants, employing from eighty to ninety men, were in operation on the creek. The following July two plants, employing about forty men, were in operation. It is understood that later in the season the operations were more extensive.

*Ready Bullion Creek.*—One plant, employing about fifty men, was in operation on Ready Bullion Creek during the winter of 1911–12. No mining was done in the following summer because of the particularly unfavorable location of the mines for obtaining sluicing water.

### BEAVER CREEK BASIN.

Some prospecting was done in 1912 on various creeks in the Beaver Creek basin and pay dirt is reported to have been found on several of them.

The most encouraging results were obtained on the right limit of Nome Creek a short distance above the mouth of Ophir Creek, where several lines of holes were sunk to bedrock. Considerable open-cut work was done on the rim of the bench by using rain water caught on the hillside. More prospecting and development work is contemplated for 1913 than has previously been accomplished. The gold is

mostly coarse, and according to the judgment of the prospectors is "pay-streak gold."

On claim "No. 18 above association group" on Nome Creek two men were engaged during the spring and early summer in building diversion dams and ditches to drain the creek channel at spots where pay dirt was thought to be located or where it was desired to do further prospecting. Later in the season sluice boxes were set up and some gravel was washed. The ground averaged about 12 feet in depth.

Three or four men were working with a windlass on Discovery claim of Ophir Creek at times during the year. Returns are said to have been fair.

## CIRCLE PRECINCT.

### GENERAL CONDITIONS.

The value of the gold production from the Circle district in 1912 is estimated at $325,000. It was recovered by methods similar to those employed in 1911, with the exception of that contributed by a dredge on Mastodon Creek. The water supply was somewhat better than in 1911, but during July and part of August it was insufficient for continuous hydraulicking. In the winter of 1911–12 between twenty-five and thirty small outfits made up of about seventy-five men were engaged in mining. The following summer the number of men employed varied from 125 to 175, depending chiefly on the water supply, although, during periods when the water supply was sufficient, there was at times a shortage of men, particularly for the first few days immediately following a protracted period of dry weather. The open season of 1912 began about two weeks earlier than usual, but during June the weather was so cold and cloudy that the muck and gravel in the open cuts thawed very slowly and progress was considerably impeded. The Alaska Road Commission continued toward Miller House the construction of the wagon road previously completed as far as Central House. Just what progress was made is not known, but it was expected that by the end of the summer the road would be in such shape that wagons could be comfortably taken as far as Miller House.

### BIRCH CREEK BASIN.

*Mastodon Creek.*—Radical changes in mining methods have taken place on Mastodon Creek during the past two years. Hydraulicking and dredging have been largely substituted for the hand methods so long in vogue.

The first dredge in Yukon Territory was constructed on Stewart River in 1898. In 1901 it was moved to Bonanza Creek, a tributary of Klondike River. In the fall of 1912 the same dredge was floated

down the Yukon to Circle, where it was dismantled and during the winter hauled on sleds to Mastodon Creek. It was reconstructed on claim "No. 10 above" and commenced operations on May 28, 1912. It is of the Risdon type with buckets of 3½ cubic feet capacity. The hull is 32 by 70 feet. About twenty men were employed on and in connection with the machine. The greatest difficulty met by it was frozen ground. Boilers were not available for thawing in advance of the dredge, and when frozen ground was encountered it was necessary to stop the buckets and use the dredge boilers to furnish steam for the thawing points. Notwithstanding such serious delays fair progress was made and the operators expressed satisfaction with the results. Another season ample facilities for thawing will be provided and a particularly prosperous season is looked forward to. The wood used for fuel was obtained from the Porcupine Creek valley near Mammoth Creek at a cost of about $15 a cord.

The hydraulic plant on claim "No. 6 below" did very well during May and June, during which about twenty men were employed. For the remainder of the season the water supply was not sufficient to furnish a continuous working head and long delays resulted.

Probably the hydraulic plant on claims "Nos. 19 and 20 above" had the most successful season of any of the camp. The first cut of the season, measuring about 12,000 yards, was taken out in May and June under favorable conditions at a cost of 13½ cents a cubic yard, and the average cost for the season was estimated at somewhat less than 25 cents a cubic yard. From eight to sixteen men were employed. A working head of about 100 feet was available at the nozzle. About 1,000 feet of 14-inch and 1,500 feet of 10 and 8 inch pipe, four gates, two No. 1 and one No. 2 giants, and sluice boxes, 30 inches wide with block riffles, were used. One box was equipped with patent riffles and undercurrent to save the fine gold. A No. 2 giant was used to stack the tailings when there was sufficient water, and at other times a 1-yard bottomless scraper was used. The capacity of the plant under average working conditions was said to be about 400 cubic yards a day.

A. P. Clark plans to install a small hydraulic plant near the head of the creek in the spring of 1913. The equipment for the plant was received at Circle in the fall of 1912.

Only ten to fifteen men were mining on the creek during the winter and about seventy during the summer.

*Deadwood and Switch creeks.*—Mining was conducted on Deadwood Creek during 1912 by the usual hand methods and to about the same extent as in previous years. The number of men engaged in mining varied from twenty-five to thirty-five, divided into fifteen to twenty different parties.

On Switch Creek, a tributary of Deadwood, five outfits employing ten to twelve men were engaged in mining throughout the year. Some hydraulicking was done on the left-limit bench not far above the mouth of the creek. The water was diverted from the creek above by a short ditch and pressure at the nozzle was obtained by a canvas hose.

*Mammoth Creek.*—The hydraulic plant located on Mammoth Creek above the mouth of Miller Creek had a rather unfavorable season. A belt of relatively low rainfall extended across the headwaters of Porcupine and Bonanza creeks, from which the water supply for the plant is obtained. Delays due to other causes occurred at times of good water supply, when any loss of time was of the most serious consequence. About twenty men were employed by the owners, several of whom were engaged in the maintenance of the ditch. Near the pressure box the ditch was enlarged so that by closing the head gates when the natural flow was insufficient for hydraulicking, a small amount of storage was obtained. The giants could then be operated under full pressure for a period of half an hour or more, depending on the number and size of nozzles used. The time required to fill the reservoir, of course, depended on the water supply at the ditch intake and on the seepage and other losses incurred in transit.

This system permits the operation of the plant for a short time at short intervals, when otherwise it would be necessary to close down entirely. Apparently under proper management the men could ordinarily be engaged in dead work while the reservoir was filling, and the plant could be run on nearly as efficient a basis as when operating continuously.

*Eagle Creek.*—The hydraulic plant on Eagle Creek commenced work on May 13, about two weeks earlier than in any previous year. The water supply was somewhat better than ordinary. It is understood that the results of the summer's work were satisfactory. An average of about ten men were employed in connection with the plant. Some mining was done by hand methods by one man on the creek about a mile below the hydraulic plant. Another man was engaged in open-cut mining by ground sluicing and pick and shovel on Mastodon Fork of Eagle Creek.

*Independence Creek.*—On Independence Creek, on claims "Nos. 8 and 9 above," ten to twenty men were employed in conveying the auriferous material from an open cut in wheelbarrows to the buckets of a steam plant, which hoisted it to the sluice boxes. A shortage of men during part of the summer and insufficient sluicing water for a considerable period combined to produce a rather unsatisfactory season. Several other men were mining along the creek at times during the summer.

*Other creeks.*—One man was engaged in prospecting the right bench of Birch Creek about a mile below Twelvemile Creek. He constructed a small ditch to a near-by gulch, from which he obtained sluicing water, and made a large open prospecting cut for several hundred feet across the bench. Sluice boxes, canvas hose, and nozzle were used, but gold in paying quantities was not found.

Along Birch Creek and in the vicinity of Buckley Bar four or five men were mining during the summer. Some mining was also done on Bottom Dollar, Half Dollar, and Greenhorn creeks.

On Portage Creek, about 4 miles above Medicine Lake, two men constructed a large dam across the valley and did considerable ground sluicing by means of an automatic dump gate during the latter part of the summer. The creek at and above the claim cuts through a granite formation, and the accumulation of heavy bowlders makes mining very difficult and expensive.

Rich placers were found on Lawson Creek, but sufficient work was not done to prove their extent. A quartz vein that crosses the valley just above this discovery is believed to be the source of the placer gold.

### YUKON BASIN.

From seven to fourteen men were engaged in mining on Woodchopper Creek and tributaries during 1912. The principal branches of Woodchopper Creek on which gold has been found are Mineral, Alice, and Iron creeks.

On Coal Creek, including its tributaries Boulder and Rose creeks, ten to twenty men were either prospecting or mining. A few men, mainly prospectors, were working on Sams Creek, and some were working on Fourth-of-July Creek.

## FORTYMILE DISTRICT.

### GENERAL CONDITIONS.

For 1912 the estimated gold production of the Fortymile district is $230,000; for 1910 and 1911 it was $200,000 each year. The increase is attributed to the better water supply of 1912. The winter of 1911–12 was exceptional in its high mean temperature and its small precipitation. Consequently at the coming of warm weather in April and May the melting snow and ice did not cause the usual high run-off. No precipitation of any amount occurred before the latter part of May, and until then the creeks were abnormally low. At that time, however, a period of well-distributed precipitation began, and for the greater part of the summer the water supply was excellently suited to the requirements of the miners on the small creeks.

The chief methods of mining in the district are by drifting, open cut, and dredging, the greatest part of the production being by the last-named method. Except on Chicken and Wade creeks very little actual mining is done in winter, though considerable dead work is accomplished. No extensive hydraulic plants are in operation in the district, but it is believed that the construction of such is being seriously considered and that ultimately this method will be employed to a much wider extent.

The success of two or three miners on the benches of the lower Fortymile and the prospects that have been found there promise considerable gold production from a source which until recently had been considered unpromising. Further prospecting and careful study of the available water supply may show the feasibility of using hydraulic methods extensively in mining these benches.

Three dredges were in operation in the Fortymile basin on the American side of the boundary and one on the Canadian side. It is believed that they experienced a prosperous season. The most important change during 1912 was the dismantling of the Walker Fork dredge at the end of the season for removal over the divide to Miller Creek, in Canadian territory.

No further developments of importance have taken place in regard to the gold-bearing quartz on Mosquito Fork or the copper ore deposits at the headwaters of its tributary, Kechumstuk Creek. A little excitement was caused in August by the discovery of scattered copper ore in the drainage basin of Middle Fork, over the divide and about 8 miles from the copper deposit at the head of Kechumstuk Creek. Attempts were made to locate the lode at the head of Kechumstuk Creek, but it is believed the results were not very encouraging. The appearance of copper ore in these two places indicates that it is rather widely distributed. The remoteness of the locality from transportation facilities presents a difficulty which would prohibit profitable development, even if it were otherwise feasible.

The Fortymile district is likely to continue for many years as a fair gold producer. With the entrance of capital, the construction of good roads, and improved mining methods its importance will probably increase.

### SOUTH FORK OF FORTYMILE RIVER BASIN.

*Ingle Creek.*—On Ingle Creek five men worked throughout the year with good success. In the winter gravel dumps were taken out by drifting and in the spring were shoveled into the sluice boxes. In the summer considerable work was accomplished by means of open-cut methods.

*Chicken Creek and tributaries.*—Chicken Creek has a comparatively small drainage area and, in addition, certain natural features which

make it a poor conserver of water supply. Consequently its gold production is very dependent on weather conditions. During the summer of 1912 these conditions were more favorable than for several years past, and the miners were able to operate the greater part of the time. The Chicken Creek gravels are rich in gold and when there is sufficient water for sluicing very good results are obtained. About twenty-five men were working in this locality throughout the season—by drifts in the winter and mostly by open cuts in the summer.

*Denison Fork.*—A ditch about 2 miles in length was completed to divert the water of Deep Creek and other intercepted drainage to benches on the right limit of Denison Fork about one-third mile above its mouth. The ditch was completed in midsummer, but the owner was obliged to leave the work for the rest of the season. It is anticipated that the drainage which may be collected by this ditch will be sufficient for sluicing only during the early part of the season when the snow and ice are melting and for short periods after summer rains.

Prospecting was done about 40 miles above the mouth of South Fork of Denison Fork by one man, who reports placer gold to be very generally distributed and to be fine in character, though colors from 10 cents to 30 cents in value have been found. The gold near the mouth of Denison Fork is very fine. South Fork is so remote that it would be difficult to arouse much enthusiasm for any mine there that was not exceptionally good.

*Walker Fork.*—The Walker Fork dredge had a very good season. It worked up Walker Fork to the mouth of Poker Creek and a few hundred feet up the latter stream. It was dismantled about September 1 for removal over the divide to Miller Creek, in Canadian territory, where it will be operated on the claims of the North American Transportation Co. A cloudburst in late July caused considerable trouble at the dredge by filling the pond in which the dredge floated with gravel, which had to be scraped out before operations could be resumed. About 4 miles of claims on Walker Fork near the mouth of Cherry Creek, which it had been expected this dredge would work, remains untouched and will probably be mined by other methods.

Six men were working on Davis and Poker creeks throughout the season by open-cut methods. A prosperous season was reported.

*Wade Creek.*—On Wade Creek the results for the season were fairly satisfactory. Twenty-five or thirty men were engaged in mining on this creek during the winter and summer. A number left after the spring clean-up, but their places were filled by newcomers. In July operations were at a standstill because of low water, but for most of the summer the supply was ample. Wade Creek gold is characteristically large and coarse, and one of the interesting finds of the summer was a nugget weighing about 17 ounces. No new developments

were undertaken on this creek, though there were rumors of projects which may materialize in the future.

*Napoleon Creek.*—Four men were at work on Napoleon Creek all summer, one of them prospecting the benches about one-half mile above the mouth and the others engaged in open-cut mining near the mouth. Much work was accomplished, considerable ground being stripped preparatory to shoveling into the sluice boxes during the coming season.

*Franklin Creek.*—Six men were working on Franklin Creek most of the season. Mining on this creek was begun about 1885, antedating most of the Alaskan placer discoveries by several years, but it still continues profitable when the water supply is favorable.

*Buckskin Creek.*—One man worked on Forty-five Pass, a tributary of Buckskin Creek, for the entire season with very good success.

*South Fork of Fortymile River.*—The Atwater dredge had a successful season, excavating an area of about 4,000 feet on South Fork of Fortymile near the mouth of Buckskin Creek. The extreme high water in June necessitated the cessation of operations for a short time. The dredge draws 5½ feet and requires at least 7 feet of water to do effective work, and shallow gravel on the bedrock at some points and reefs at others compelled the building of many dams to give the required depth.

The bars of South Fork have been repeatedly worked and yielded very little gold to the dredge except where the gravels were under water and could not be reached by crude methods. The dredge will probably work seven or eight miles of river bed above its present location and will probably take as many years to do it. During the coming season it will probably be located between Buckskin and Franklin creeks.

### CANYON CREEK BASIN.

*Canyon Creek.*—Two men were working at the head of Canyon Creek most of the season and reported good success. Below the mouth of Squaw Gulch some work was done in 1910 and 1911, but nothing was accomplished in 1912.

*Squaw Gulch.*—Squaw Gulch was the scene of considerable activity throughout the season, about eighteen men being engaged in mining. At the head of the creek, near the mouth of Kalamazoo, three men worked at ground stripping, but were handicapped by lack of water from the small tributary watershed and stopped work in early August. A little mining was done on a bench above Baby Creek by utilizing the early run-off from the melting snow. On Squaw Gulch, just above the mouth of Baby Creek, two men were drifting. They reported good results and will probably continue work through the winter.

On a claim just below Baby Creek an outfit of six men worked for the entire season, using a very efficient method. A bottomless steam scraper of three-fourths yard capacity, made of manganese steel, and a boiler of 40 horsepower were used. The muck, which was variable in depth, was sluiced off and then 2 to 6 feet of gravel were thawed with steam points and scraped off. The last 1½ feet of the gravel next to the bedrock was scraped up an incline to a platform about 20 feet high and there dumped into the sluice boxes. According to the statement of the manager 200 yards of wet gravel or 250 yards of dry could be handled in a day, with a consumption of about one cord of wood. The scraper was said to have cleaned the bedrock very effectively, but this was probably due to the comparative evenness of the latter. Had it been uneven the cost would undoubtedly have been much greater. Much preliminary work had to be done, but nevertheless about 80 box lengths, or 11,520 square feet, of bedrock were cleaned. The results are believed to have been satisfactory.

On claim "No. 1 above" two men worked the entire summer, using a dump gate and ordinary open-cut methods.

### MIDDLE AND NORTH FORK OF FORTYMILE BASIN.

Three men worked most of the summer on Confederate and Montana creeks, tributaries of Hutchinson Creek. In August several men were prospecting on Fish Creek, which enters Middle Fork, but aside from this no other work is known to have been done in the North Fork drainage basin in 1912.

### LOWER FORTYMILE RIVER BASIN.

*Minor creeks.*—Very little progress was made on Dome, Flat, and Twin creeks, but considerable work is in prospect on Dome Creek for the coming season.

*Fortymile bars.*—The number of men engaged in mining on the bars of the lower Fortymile was greater than it has been in recent years, it being estimated that twenty-five or thirty men were working with rockers the whole or a part of the season. Green Island and Bonanza Bar were the points of the greatest activity. The stage of water was too high for the best results, and as much of the gravel had been worked repeatedly it is doubtful if very great quantities of gold were recovered.

*Fortymile benches.*—Bench mining was in operation or in prospect at two places on Bonanza Bar.

About 1½ miles above the mouth of Canyon Creek a man made a large excavation and was able to take out some gold, but the available water supply is poor and operations are very uncertain. Near the mouth of Canyon Creek a man spent the summer on a ditch which

will divert water about 2 miles above the mouth of Canyon Creek and will carry it to a bench on Fortymile River about three-fourths of a mile above Canyon Creek. The ditch will be about 2½ miles in length and is planned to furnish 3 or 4 second-feet at the bench with a head of about 75 feet on bedrock.

On Discovery Bar, about half a mile above the mouth of Discovery Creek, one man was mining on a bench, with results that were very encouraging while water was available. The water, however, was obtained from Discovery Creek, which is small and unreliable, and consequently much of the season was lost. A new ditch is contemplated which will utilize a storage reservoir and furnish a greater head for sluicing.

On Claghorn Bar, about 1½ miles above Moose Creek, a man was working throughout the summer and was said to have obtained good results. A 3-mile ditch, about half of which is flume, diverts water from Elmer Creek, a tributary of Moose Creek rising in American territory, and carries it up the valley to this bar. The capacity of the ditch is at present not much greater than a good sluice head.

The gold in these benches is fine and flaky. Undoubtedly its reconcentration has supplied the river bars.

The Canadian Securities Co. (Ltd.) operated two dredges on the lower Fortymile. A large dredge well adapted to the heavy work on this river worked in Canadian territory and is said to have had a favorable season. The second dredge was located on the American side of the boundary about half a mile below Moose Creek. It is small and light and handles the heavy bowlders with considerable difficulty, frequent stops being necessary to remove the large stones from the buckets. This dredge was held up for repairs for probably half of the summer.

## SEVENTYMILE DISTRICT.

### GENERAL CONDITIONS.

The combined output of gold in the Seventymile and Eagle districts for 1912 is estimated at $20,000, somewhat more than in recent years.

The miners in the Seventymile basin had abundant water throughout the summer. More men were at work than in 1911, and more work was accomplished, but in the main results were rather discouraging. There is much low-grade placer ground in this district, but little gold seems recoverable at a profit by the methods in common use by the small operator.

In the early summer men appeared in Eagle with a proposition for putting a dredge on the lower Seventymile, but it is not known that they were able to arrange any definite plan. The future success of

mining in this district depends on further prospecting and on the adoption of different mining methods, for which greater capital will undoubtedly be necessary.

### SEVENTYMILE RIVER BASIN.

*Flume Creek.*—In March some prospecting was done on Flume Creek about 3 miles above its mouth. About 200 feet of holes were sunk in the creek and in the high bench on the left, but no good prospects were found. The only valuable placers found on this creek thus far are near its mouth and on Arctic Creek, a tributary from the left. Representation work was done on the claim at the mouth of the creek, but conditions were unfavorable for the recovery of much gold.

*Alder Creek.*—Four men worked on Alder Creek for practically the whole season. The gold is coarse, and during the summer a number of nuggets valued at from $3 to $8 and one of $25 were found. Some of the gold is rough and other specimens are well worn. The deposits seem to be rather irregularly distributed.

*Barney Creek.*—Two men worked on Barney Creek and stripped a considerable area of bedrock, but did not obtain very encouraging results. The clay in the gravel and the deep muck caused much difficulty.

*Washington Creek.*—Two men used a dump gate to do ground-sluicing at the mouth of Washington Creek and had a fairly profitable season. Three men were prospecting on the upper portion of the creek during the early part of the summer. No placers of importance were reported.

*Sonickson Creek.*—The mining operations at the falls on Seventymile River for which the waters from Sonickson Creek have been used were vigorously continued until August 1, when it was decided that the natural conditions in the bench which was being worked were so inimical to success that it would be wise to discontinue operations. The principal difficulties were probably the great depth of overburden and the fact that the bedrock could not be drained with facility.

*Crooked Creek.*—Five men worked on Crooked Creek for the whole season and reported the results to be favorable. One man prospected in the vicinity of the mouth of Eldorado Creek.

*Fox Creek.*—Four men worked on Fox Creek. Two of them drifted on Lucky Gulch about half a mile above the mouth, and the other two groundsluiced with a dump gate and shoveled in over a considerable area below the mouth of Lucky Gulch. No rich gravels were found.

*Other creeks.*—One man spent the summer trying to mine in the bench a short distance above the mouth of Pleasant Creek. The water supply is obtained from the head of Washington Creek by a

ditch about 2½ miles in length which gave constant trouble because of the thawing of the ground over which it was built. Attempts at mining on this bench seem to have been discouraged for the present.

Mining was done on Canyon and Broken Neck creeks, two men being at work on each. On Nugget Creek three men took out a dump during the latter part of the winter and two or three men were at work on the creek most of the summer.

On Curtis Bar operations were continued by one man throughout the season, the favorable water supply affording an opportunity for doing more work than in any recent year.

At three different points on the Seventymile men were engaged in "sniping." Results are not believed to have been very encouraging.

## EAGLE DISTRICT.

A prosperous season was experienced on American Creek and Discovery Fork. The good water supply afforded an opportunity for doing a great deal of work and the ground was rich enough to make the results profitable. On American Creek two claims were being worked and the combined amount of ground stripped and shoveled in was about 17,000 square feet. At claim No. 8 an $80 nugget was found. On Discovery Fork about 11,000 square feet were sluiced off and shoveled into sluice boxes. About fifteen men were engaged in mining in this district throughout the season.

## HOT SPRINGS DISTRICT.

Incomplete reports from the Hot Springs district indicate that mining operations during 1912 were confined mainly to the Patterson and American creek basins.

### AMERICAN CREEK BASIN.

On American Creek, which is a small stream about 5 miles long entering Fish Lake from the northeast, gold prospects were found over a considerable area in 1911. Recent reports show that active mining is being carried on by ten to fifteen different outfits and that some very rich ground has been found. The Wild Goose Association claim will probably be the principal producer in 1912. It is reported that three pans of material taken at random from a particularly rich spot on this claim yielded about $100. A nugget valued at $1.25 was found and as high as $2 per square foot of bedrock has been reported. Supplies are shipped in summer by motor boat from Tanana River to points within 3 or 4 miles of the mines. Some machinery has already been installed, but at present most of the gravel is hoisted by hand. The average depth to bedrock is said to be about 14 feet and in many places it is only 10 to 12 feet. The claims are situated so near the head of the creek that water is not available for ground sluicing, and open-cut methods have not been employed.

### PATTERSON CREEK BASIN.

In the Patterson Creek basin the gold production for 1912 was probably less than in 1911, but prospecting during 1912 has increased the known gold-bearing area to an extent very encouraging to those interested in the future of the camp. Very little information regarding the Sullivan Creek mines has been received since early in 1912, at which time some work was being done on the Midnight Sun Association claim and on the Junction fraction just below. Two outfits were working on the Abe Lincoln claim; one had found good prospects in a 50-foot shaft at the upper end of the claim, and the other at the lower end had blocked out 100,000 square feet of ground, with an estimated value of $2 per square foot. On the right limit bench, opposite Discovery, pay gravel had been recovered from three shafts and plans were under way for work on a large scale. Rich ground is reported to have been found with a Keystone drill on the Hartner claim below Discovery. Considerable work was done on the claim next below the Hartner claim, also on the McVicar, Snyder, and Marshall claims. Open-cut mining was continued on Tofty Gulch. Considerable mining was done on Miller Creek and some on Cache Creek. Prospecting on Coonie Creek shows a considerable area of very low grade ground with the gold rather irregularly distributed.

Placer tin in larger quantities than formerly has been found in the Sullivan and Cache creek mines, and considerable time and money has been spent near the headwaters of these streams in the effort to locate its source. Conflicting reports as to the results are at hand.

### BAKER CREEK BASIN.

In the older section of the Hot Springs district, which includes streams tributary to Baker Creek the principal producers were Pioneer, Thanksgiving, and Eureka creeks. At the What Cheer Bar mines about the usual amount of work seems to have been done during the summer. Considerable open-cut work was in progress on Seattle Junior Creek.

### RAMPART DISTRICT.

Placer mining in the Rampart district during 1912 was conducted on about the same scale as in 1911. No new discoveries were reported. Open-cut methods were used exclusively during the open season. The number of men engaged in mining varied from about 20 in winter to about 60 in summer.

On Quail Creek, in the Hess Creek basin, four outfits employing nine men in the winter and seventeen in the summer were busy. Several splash dams were successfully used to remove the overburden and concentrate the values sufficiently to allow them to be profitably recovered by shoveling into sluice boxes.

On Hunter Creek two hydraulic plants employing from four to six men each were in operation during the summer. Three or four men were also mining on one claim most of the winter. On Dawson Creek three or four men were mining a greater part of the winter.

Three outfits employing about fifteen men were working on Little Minook Creek during the summer and one outfit employing three men during the winter.

Slate Creek showed more than usual activity during the summer of 1912. At various points along the valley from Discovery to "No. 10 above" eight men were groundsluicing and shoveling into sluice boxes.

On Little Minook Junior Creek one party of four men was engaged in mining most of the summer and some work was in progress during the winter.

On Chapman Creek a party of four men worked throughout the year.

Along the bars of Minook some gold was recovered by means of rockers.

## SALCHAKET AND TENDERFOOT DISTRICTS.

On Tenderfoot Creek two 40-horsepower hoisting plants, employing a total of about 30 men, were in operation during the summer of 1912. On Democrat Pup, which is a small fork of Banner Creek, one outfit employing eight men, with a 40-horsepower plant, was drifting most of the summer, and another employing four men was mining by open-cut methods. All four outfits were reported to have had a successful season.

No definite information is available concerning the amount of work done by the miners in the Salchaket basin, but it is believed that about the usual results were obtained.

# WATER SUPPLY OF THE YUKON-TANANA REGION, 1912.

By C. E. Ellsworth and R. W. Davenport.

## INTRODUCTION.

The present paper is the sixth annual report of water-supply investigations in the Yukon-Tanana region. Its purpose is to make available for immediate use the essential information that has resulted from the past season's work, in advance of the publication of the summary report that is now being prepared. The season of 1912 probably marks the close of water-supply studies in this region. The six years of records that are now available do not cover the area so well as might be desired and probably do not give the marginal limits of high and low stages that may occur on the streams investigated, but they do show that for a period of years the run-off has been uniformly low, and they should serve to guide development and should prevent unwise expenditures.

The writers received the hearty cooperation that has been so generally accorded to the work, and they regret that individual acknowledgment is not possible. Special thanks, however, are hereby extended to the following gage observers: Messrs. J. O. Anderson, C. N. Banks, John Barry, J. C. Brown, J. P. Carroll, Jack Clifford, Mrs. E. C. Curtis, Messrs. Earl Davis, Thomas Fitzgerald, Henry Friday, August Fritch, Arthur Froelich, H. M. Green, F. J. Herbster, Wm. Hugel, Alfred Johnson, J. A. Kemp, George Laughlin, John Lindguist, Jack McLin, E. D. Madison, Charles Martin, L. G. Michaels, Frank Miller, Frank Montgomery, James Murphy, John Olson, J. R. Parkin, John B. Powers, Charles Roan, John Roberts, Charles Rogers, Frank Rolf, Louis Schmidt, Henry Siemer, H. A. Stade, A. F. Stowe, F. C. Sutliff, W. P. Thrall, A. H. Turnbull, A. Van Curler, and E. D. Webster.

## DATA AND METHODS.

### DEFINITIONS OF TERMS.

The methods of carrying on the work and collecting the data were essentially the same as those used for similar work elsewhere in the United States, but were adapted to the special conditions found in Alaska.

In considering the water supply available for industrial or mining enterprises it is necessary to know the total amount of water flowing

into the streams, the daily distribution of the flow, and the conditions affecting the flow.

Several terms, such as second-foot, miner's inch, and gallons per minute, are used to describe the quantity of water flowing in a stream, the one selected depending on the use to be made of the data. "Second-foot" is in most general use for all classes of work, and from it the quantity expressed in other terms may be obtained. It is an abbreviation of cubic foot per second, and may be defined as the unit for the rate of discharge of water flowing in a stream 1 foot wide and 1 foot deep at the rate of 1 foot per second. It expresses a rate of flow, and to obtain the actual quantity of water it is necessary to multiply the number of second-feet by the time in seconds.

"Miner's inch," the unit used in connection with placer mining, also expresses a rate of flow and is applied to water flowing through an orifice of a given size with a given head. The head and size of the orifice differ in different localities, thus making it a most indefinite and unsatisfactory unit. Owing to the confusion arising from its use, it has been defined by law in several States. The California miner's inch is in most common use in the United States, and was defined by an act approved March 23, 1901, as follows: "The standard miner's inch of water shall be equivalent or equal to 1½ cubic feet of water per minute, measured through any aperture or orifice." This miner's inch corresponds to the so-called "6-inch pressure" and is one-fortieth of a second-foot.

"Sluice head," a term commonly used among placer miners in expressing a rate of flow, originated from the method of placer mining, in which water flowing through a series of sluice boxes is used for recovering the gold from the gravel. The rate of flow of water through the boxes is called a sluice head. This is not a definite term, because the rate of flow necessary for such mining methods varies with the size of the sluice boxes, the grade at which they are placed, and the character of the gravel. A sluice head under the varying conditions has been found to vary from 0.75 to 2.50 second-feet.

"Second-feet per square mile" is the average number of cubic feet of water flowing per second from each square mile of area drained, on the assumption that the run-off is distributed uniformly as regards both time and area.

"Run-off, depth in inches on drainage area," is the depth to which the drainage area would be covered if all the water flowing from it in a given period were conserved and uniformly distributed on the surface. It is used for comparing run-off with rainfall, which is expressed in depth in inches.

Gage heights and discharge measurements are the base data from which the daily discharge tables are computed.

Gage-height records show the fluctuations of the stream at a given point, and upon these depend the estimates of the discharge at the time the gage height was obtained.

## DISCHARGE MEASUREMENTS.

The determination of the quantity of water flowing past a certain section of a stream at a given time is termed a "discharge measurement." The quantity is the product of two factors—the mean velocity and the area of the cross section. The mean velocity is a function of surface slope, wetted perimeter, roughness of bed, and channel conditions at, above, and below the gaging station. The area depends on the contour of the bed and the fluctuations of the surface. The two principal ways of measuring the velocity of a stream are by floats and current meters.

The engineers of the Survey are accustomed to use the current meter, though under exceptional conditions floats are sometimes used. As float measurements can readily be made by the prospector, the method is described below.

The floats in common use are the surface, subsurface, and tube or rod floats. A corked bottle with a flag in the top and weighted at the bottom makes one of the most satisfactory surface floats, as it is affected but little by wind. In flood measurements good results can be obtained by observing the velocity of floating cakes of ice or débris. In all surface-float measurements the observed velocity must be multiplied by 0.85 to 0.90 to reduce it to the mean velocity. The subsurface and tube or rod floats are intended to give directly the mean velocity in the vertical. Tubes give excellent results when the channel conditions are good, as in canals.

If it is desired to estimate the discharge of a small creek or canal, a straight portion is selected in which the water runs smoothly and where the cross section of the stream is nearly uniform. This stretch is sometimes called the "run" and should be at least 50 feet in length if possible. Floats of any simple type may be used and the time of passage over this run is obtained. A number of determinations of the time of passage at different points across the stream are made and the average time in seconds required for one passage is computed. The length of the run, divided by this time in seconds and multiplied by 0.85, will give the approximate mean velocity in feet per second through the section. The average depth multiplied by the width of the stream gives the area of the cross section in square feet; this multiplied by the mean velocity gives the discharge in second-feet.

## COMPARATIVE DISCHARGE FROM DIFFERENT AREAS.

The relation of discharge from different areas in the Yukon-Tanana region is shown graphically on Plate VII, on which are plotted curves of daily discharge per square mile of Fortymile River at Steel Creek, Birch Creek at Fourteenmile House, Crooked Creek at Central House, and Chatanika River below Faith Creek. The curves show clearly the high run-off during June at all the stations and the relatively high run-off from Chatanika River above Faith Creek during the entire season. The continued low run-off from Crooked Creek during July and the first week in August is of particular significance because of the extensive hydraulic mining that was attempted on the headwater tributaries of that creek. In this basin, where under present mining methods greater quantities of water are required than in any other section of the Yukon-Tanana region, the discharge per square mile during July, August, and September was the least of any basin at which records are available for 1912.

## GAGING STATIONS.

In this paper the lists of gaging stations and measurement points are arranged in downstream order. The main stream of any river is determined by measuring or estimating the drainage area; that is, the headwater stream having the largest drainage area is considered the continuation of the main stream and local changes in name are disregarded. All stations from the source to the mouth of the main stream of the river are presented first, and the tributaries in regular order from source to mouth follow, the streams in each tributary basin being listed before those of the next basin below.

## ACCURACY AND RELIABILITY OF DATA.

The accuracy of stream-flow data depends primarily on the natural conditions at the gaging station and on the methods and care with which the data are collected.

Errors due to natural conditions are those caused by lack of permanency in the channel and in the relation between discharge and stage. Frequent changes in channel are characteristic of most Alaskan streams, because of their steep grades, great fluctuation in stage, and easily eroded beds. Therefore in a season when freshets are of frequent occurrence the channels are subject to changes which often make the estimate of daily discharge only roughly approximate.

Errors due to the methods and care in the collection of data are caused, first, by errors in observation of stage; second, by errors in measurement of flow; and, third, by errors due to misinterpretation of stage and flow data. The more important of these are probably the errors of observation in stage. In the sudden and wide

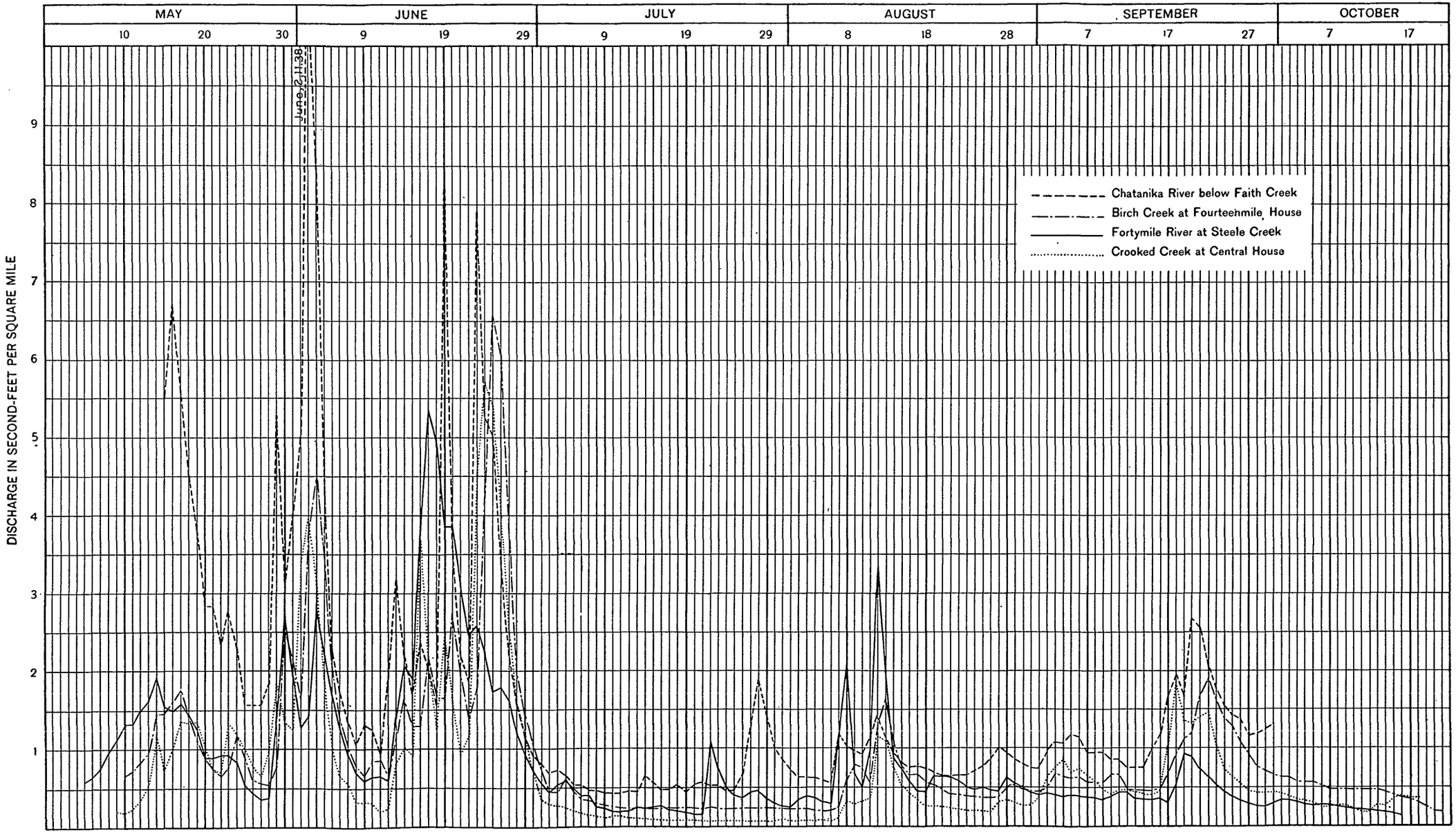



DIAGRAM SHOWING DISCHARGE, IN SECOND-FEET PER SQUARE MILE, OF STREAMS IN YUKON-TANANA REGION.

fluctuations peculiar to Alaskan streams, one or two observations of stage per day, which are all it is practicable to obtain at most of these stations, often do not give sufficient data for determining the mean stage for the day. In the mean discharge for the month, however, these errors are believed to be largely compensating.

The figure showing discharge per square mile and run-off in depth in inches may be subject to errors resulting from a drainage area which is not well defined by available maps and from the wide variation in contribution to run-off over the drainage area.

In the tables, "accuracy" shows the degree of reliability which, based on the above considerations, the record of the mean monthly flow is believed to possess. "A" indicates that the mean monthly flow is probably accurate within 5 per cent; "B," within 10 per cent; "C," within 15 per cent; "D," within 25 per cent. Special conditions are covered by footnotes.

### CONVENIENT EQUIVALENTS.

1 second-foot equals 40 California miner's inches (law of March 23, 1901).
1 second-foot equals 38.4 Colorado miner's inches.
1 second-foot equals 40 Arizona miner's inches.
1 second-foot equals 7.48 United States gallons per second; equals 448.8 gallons per minute; equals 646,317 gallons for one day.
1 second-foot for one year covers 1 square mile 1.131 feet or 13.572 inches deep.
1 second-foot for one year equals 31,536,000 cubic feet.
1 second-foot for one day equals 86,400 cubic feet.
1,000,000 United States gallons per day equals 1.55 second-feet.
1 foot equals 0.3048 meter.
1 mile equals 1,60935 kilometers.
1 mile equals 5,280 feet.
1 acre equals 43,560 square feet.
1 cubic foot of water weighs 62.5 pounds.
1 horsepower equals 550 foot-pounds per second.
1 horsepower equals 76.0 kilogram-meters per second.
1 horsepower equals 746 watts.
1 horsepower equals 1 second-foot falling 8.80 feet.
1½ horsepower equals about 1 kilowatt.

To calculate water power quickly: $\frac{\text{Sec.-ft.} \times \text{fall in feet}}{11}$ = net horsepower on water wheel realizing 80 per cent of theoretical power.

### PRECIPITATION.

The following table gives the monthly precipitation at all points in the Yukon-Tanana region where records have been kept subsequent to 1903. Such scattered records as were kept previous to these have been compiled by Abbe.[1]

[1] Abbe, Cleveland, jr., U. S. Geol. Survey Prof. Paper 45, pp. 189–200, 1906.

*Monthly precipitation, in inches, at stations in Yukon-Tanana region, 1903–1912.*

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

| Station. | Year. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. | Annual. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Central..... | 1906 | 0.56 | 0.06 | 0.05 | 0.47 | 0.86 | 4.91 | 4.82 | 1.85 | 0.52 | 0.70 | 0.80 | 0.35 | 15.95 |
| | | 6.1 | 1.0 | 1.4 | 4.7 | 2.0 | ..... | ..... | ..... | ..... | 7.0 | 8.0 | 4.0 | 34.2 |
| Do..... | 1907 | 1.04 | .42 | 2.57 | .93 | .57 | 2.21 | 1.40 | ..... | ..... | ..... | ..... | ..... | ..... |
| | | 10.0 | 4.0 | 4.0 | 8.0 | 1.5 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| Circle..... | 1906 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | .75 | ..... |
| | | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 9.5 | ..... |
| Do..... | 1907 | 1.02 | .57 | .28 | .15 | .29 | ..... | 1.36 | 2.79 | 1.73 | ..... | ..... | .63 | ..... |
| | | 8.5 | 7.8 | 3.25 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 8.2 | ..... |
| Do..... | 1908 | 1.23 | .25 | .76 | 1.45 | .29 | .20 | .87 | 1.08 | 2.21 | .40 | .75 | 1.11 | 10.60 |
| | | 9.2 | 2.5 | 6.8 | 8.0 | ..... | ..... | ..... | ..... | ..... | 3.0 | 8.5 | 11.2 | 51.2 |
| Do..... | 1909 | .44 | .47 | .17 | .75 | .60 | 2.24 | 3.25 | 1.02 | ..... | ..... | ..... | ..... | ..... |
| | | 4.5 | 5.2 | 1.0 | 3.0 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| Charity Creek. | 1908 | ..... | ..... | ..... | .11 | .27 | 1.33 | 2.80 | 2.33 | 2.28 | .20 | ..... | ..... | ..... |
| | | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 3.0 | ..... | ..... | ..... |
| Chicken Creek | 1911 | ..... | ..... | ..... | ..... | ..... | .45 | 1.08 | .68 | 1.02 | .50 | .09 | .09 | ..... |
| Do..... | 1912 | .18 | .70 | 0 | 0 | 1.02 | 2.38 | .68 | 2.51 | [a]1.40 | ..... | ..... | ..... | ..... |
| Cleary..... | 1907 | ..... | ..... | ..... | ..... | ..... | .84 | 2.55 | 2.88 | 3.82 | ..... | ..... | ..... | ..... |
| Crooked Creek | 1911 | ..... | ..... | ..... | ..... | ..... | ..... | 2.52 | 2.18 | 1.30 | ..... | ..... | ..... | ..... |
| Do..... | 1912 | ..... | ..... | ..... | ..... | .93 | 2.25 | 4.37 | 4.73 | .61 | ..... | ..... | ..... | ..... |
| Discovery Fork | 1911 | ..... | ..... | ..... | ..... | ..... | 1.24 | 2.36 | 2.33 | 1.15 | ..... | ..... | ..... | ..... |
| Do..... | 1912 | ..... | ..... | ..... | 0 | .53 | 1.81 | 2.32 | 2.47 | ..... | ..... | ..... | ..... | ..... |
| Eagle Creek... | 1908 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 2.99 | ..... | ..... | ..... | ..... | ..... |
| Fairbanks.... | 1904 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 1.10 | 2.00 | ..... |
| Do..... | 1905 | 0.92 | 0.05 | 0.50 | 0.20 | ..... | ..... | ..... | 2.63 | .86 | ..... | 1.20 | .60 | ..... |
| | | 9.1 | 5.0 | .5 | 2.0 | ..... | ..... | ..... | ..... | ..... | ..... | 12.0 | 5.1 | ..... |
| Do..... | 1908 | 1.75 | .37 | .33 | .10 | 0.36 | 1.05 | 2.82 | 1.50 | .25 | .30 | .65 | 1.15 | 10.63 |
| | | 17.5 | 3.7 | 3.3 | 1.0 | ..... | ..... | ..... | ..... | ..... | .6 | 6.5 | 11.5 | 44.1 |
| Do..... | 1907 | 3.30 | .86 | 2.42 | .03 | .35 | 1.47 | 1.51 | 1.81 | 3.58 | 2.44 | .35 | .59 | 18.71 |
| | | 33.0 | 8.6 | 24.2 | .3 | ..... | ..... | ..... | ..... | ..... | 24.4 | 3.5 | 5.9 | 99.9 |
| Do..... | 1908 | .42 | .21 | 1.10 | .11 | .52 | .96 | .73 | .71 | 1.57 | .47 | .51 | .65 | 7.96 |
| | | 4.2 | 2.1 | 11.0 | .8 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 8.1 | 26.2 |
| Do..... | 1909 | .90 | .08 | .05 | .66 | .38 | 1.64 | 1.90 | 1.73 | .39 | .80 | .52 | .80 | 9.85 |
| Do..... | 1910 | .70 | .14 | .02 | .36 | .39 | 2.16 | .46 | 1.69 | 1.91 | .66 | .50 | .76 | 9.75 |
| Do..... | 1911 | 1.50 | .80 | .06 | ..... | .12 | ..... | 2.16 | 2.30 | 1.60 | .22 | .29 | 1.23 | ..... |
| Do..... | 1912 | .10 | .10 | .95 | 0 | 1.22 | 3.15 | .96 | .82 | 1.16 | .54 | .24 | ..... | ..... |
| Faith Creek... | 1907 | ..... | ..... | ..... | ..... | ..... | ..... | 1.87 | 3.00 | 2.97 | ..... | ..... | ..... | ..... |
| Fort Egbert... | 1903 | .58 | .81 | .54 | .12 | 1.38 | .57 | 2.40 | .97 | 2.97 | ..... | ..... | ..... | ..... |
| Do..... | 1905 | ..... | ..... | ..... | ..... | .33 | 1.95 | 1.52 | 2.72 | 3.38 | 2.96 | .93 | .68 | ..... |
| Do..... | 1906 | ..... | .14 | 2.19 | .00 | .54 | .51 | 2.54 | 1.28 | .01 | 1.71 | .51 | .07 | ..... |
| | | ..... | 1.0 | 11.0 | ..... | ..... | ..... | ..... | ..... | ..... | .46 | 8.5 | 1.0 | ..... |
| Do..... | 1907 | 1.45 | .21 | 0. | .25 | .40 | 1.89 | 1.48 | 1.98 | 1.45 | 1.12 | .40 | .31 | 10.94 |
| | | 2.0 | 2.0 | 0 | .15 | .55 | ..... | ..... | ..... | ..... | 13.0 | 4.0 | ..... | ..... |
| Do..... | 1908 | .12 | .25 | .75 | .10 | 1.02 | 2.16 | 2.47 | 1.02 | 1.48 | .18 | .82 | 1.09 | 11.46 |
| | | 3.0 | 2.5 | 7.5 | 1.0 | ..... | ..... | ..... | ..... | ..... | 6.0 | 7.0 | 11.0 | 38.0 |
| Do..... | 1909 | .16 | .07 | .11 | .34 | .28 | 2.35 | 1.77 | .95 | .88 | .81 | .30 | .26 | 8.28 |
| | | 2.0 | 1.0 | 1.0 | 2.0 | ..... | ..... | ..... | ..... | 6.1 | 11.7 | 3.0 | ..... | ..... |
| Do..... | 1910 | .83 | .01 | .53 | .25 | .28 | 1.05 | 2.28 | 2.63 | 2.98 | .69 | .25 | .30 | 12.08 |
| Do..... | 1911 | .27 | .24 | .39 | .97 | 2.87 | 1.26 | 2.36 | 2.65 | 1.21 | .13 | .29 | .80 | 13.44 |
| Do..... | 1912 | ..... | .29 | .11 | Tr. | .43 | 2.09 | 2.52 | 2.48 | .76 | 1.66 | ..... | ..... | ..... |
| Fort Gibbon.. | 1903 | .37 | .73 | 1.14 | .23 | .16 | .38 | 1.76 | ..... | .48 | .22 | .33 | Tr. | ..... |
| Do..... | 1904 | .08 | .55 | .35 | .09 | .22 | .33 | 1.95 | 3.80 | .35 | .39 | .07 | .70 | 8.88 |
| Do..... | 1905 | .37 | .47 | Tr. | .32 | .84 | 1.50 | 4.90 | 3.02 | .59 | .50 | 1.10 | .18 | 13.79 |
| Do..... | 1906 | .65 | .20 | .30 | Tr. | 1.00 | ..... | ..... | ..... | ..... | [b]6.50 | .99 | .27 | ..... |
| | | 6.0 | 2.0 | 3.0 | ..... | ..... | ..... | ..... | ..... | ..... | [b]5.0 | 9.9 | 2.7 | ..... |
| Do..... | 1907 | 1.26 | ..... | .53 | 0 | .30 | ..... | 2.58 | 2.31 | 2.32 | 1.22 | .03 | .31 | ..... |
| | | 12.6 | ..... | 5.0 | 0 | ..... | ..... | ..... | ..... | 4.0 | 12.0 | 1.5 | ..... | ..... |
| Do..... | 1908 | .23 | .26 | .90 | 0 | 1.16 | ..... | .96 | 1.13 | 1.60 | .45 | .08 | .60 | ..... |
| | | 4.0 | 6.0 | 17.0 | 0 | ..... | ..... | ..... | ..... | 2.25 | 6.0 | ..... | 6.5 | ..... |
| Do..... | 1909 | .05 | .10 | .37 | .39 | 1.51 | .77 | 1.49 | 2.27 | .90 | .49 | .46 | .80 | 9.60 |
| | | .5 | .5 | ..... | 2.2 | ..... | ..... | ..... | ..... | ..... | 4.8 | 4.6 | 8.0 | 20.6 |
| Do..... | 1910 | 1.23 | .08 | .60 | .28 | .69 | .57 | 1.79 | 2.26 | .74 | .38 | ..... | .59 | ..... |
| Do..... | 1911 | .94 | 1.63 | .38 | .77 | 1.53 | .27 | 1.41 | 2.19 | 1.53 | .44 | .16 | ..... | ..... |
| Do..... | 1912 | .08 | .65 | 1.16 | .02 | 1.18 | 2.06 | 1.59 | 3.24 | 1.15 | ..... | ..... | ..... | ..... |
| Hot Springs... | 1909 | ..... | ..... | ..... | ..... | ..... | ..... | 1.76 | 3.19 | .25 | .44 | 1.10 | 2.26 | ..... |
| | | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 4.4 | 11.0 | 22.6 | ..... |
| Do..... | 1910 | 1.64 | .03 | .60 | .20 | .34 | .76 | [c]2.16 | ..... | 1.32 | ..... | ..... | ..... | ..... |
| | | 16.4 | .3 | 6.0 | 2.0 | 3.4 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| Kechumstuk.. | 1904 | ..... | ..... | ..... | ..... | 1.80 | .83 | 2.23 | .94 | .64 | .30 | .03 | .23 | ..... |
| Do..... | 1905 | .90 | .10 | .05 | .40 | .20 | 1.58 | .40 | 1.48 | 2.16 | 1.18 | .36 | .20 | 9.01 |
| Do..... | 1906 | .36 | .05 | .06 | .27 | 1.69 | 1.61 | 3.25 | 2.51 | .51 | .31 | .29 | .20 | 11.11 |
| | | 4.0 | .5 | 1.0 | 5.0 | ..... | ..... | ..... | ..... | ..... | 4.3 | .5 | 3.0 | 18.3 |
| Do..... | 1907 | .12 | .20 | .27 | Tr. | 1.30 | 2.03 | 1.60 | 2.14 | .49 | .72 | .40 | ..... | ..... |
| | | 2.0 | 3.0 | 4.0 | ..... | 12.0 | ..... | ..... | ..... | 2.0 | 9.0 | 4.0 | ..... | ..... |
| Do..... | 1908 | 0 | 0 | .41 | .40 | 1.78 | 1.77 | 2.30 | 2.22 | 1.35 | ..... | .90 | .20 | ..... |
| | | 0 | 0 | 5.0 | 4.0 | ..... | ..... | ..... | ..... | ..... | ..... | 9.0 | 2.0 | ..... |
| Do..... | 1909 | 0 | .30 | .10 | .20 | 0 | 3.66 | 3.39 | ..... | ..... | ..... | ..... | ..... | ..... |
| | | 0 | .5 | 1.0 | ..... | 0 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |

[a] Oct. 1–10. [b] Oct. 7–31. [c] July 16–31.

*Monthly precipitation, in inches, at stations in Yukon-Tanana region, 1903–1912*—Con.

| Station. | Year. | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. | Annual. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Miller House.. | 1909 | ..... | ..... | ..... | ..... | ..... | ..... | 2.98 | 1.26 | 0.60 | 0.93 | 0.30 | 0.30 | ..... |
| | | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 4.0 | 8.0 | 3.0 | 3.0 | ..... |
| Do..... | 1910 | ..... | ..... | ..... | 0.20 | ..... | 1.94 | 2.37 | .30 | 1.03 | ..... | ..... | ..... | ..... |
| North Fork... | 1905 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 1.91 | 1.86 | ..... | .50 | .20 | ..... |
| Do..... | 1906 | 0.70 | 0.50 | 0.10 | .80 | 1.98 | 2.74 | 2.69 | 1.01 | .72 | .42 | .55 | .38 | 12.59 |
| | | 7.0 | 5.0 | 1.0 | 8.0 | ..... | ..... | ..... | ..... | ..... | 3.2 | 4.5 | 4.5 | 33.2 |
| Do..... | 1907 | .69 | .28 | .27 | Tr. | 1.34 | 1.92 | 1.57 | 3.19 | 2.0 | 1.40 | .20 | ..... | ..... |
| | | 15.5 | 3.0 | 3.0 | ..... | 4.0 | ..... | ..... | ..... | 5.0 | 12.0 | 2.0 | ..... | ..... |
| Do..... | 1908 | .50 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| | | 5.0 | Tr. | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| Poker Creek... | 1907 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 1.40 | 3.70 | 1.70 | .25 | 1.09 | ..... |
| | | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 24.0 | 3.3 | 6.8 | ..... |
| Do..... | 1908 | ..... | 1.32 | ..... | .42 | .58 | 1.80 | 2.02 | .99 | 2.45 | .75 | .35 | .61 | ..... |
| | | ..... | 10.5 | ..... | 5.0 | ..... | ..... | ..... | ..... | 4.5 | 6.9 | 4.4 | 12.6 | ..... |
| Do..... | 1909 | .68 | .09 | .03 | .42 | 1.11 | 1.22 | 2.01 | 2.01 | ..... | ..... | ..... | ..... | ..... |
| | | 8.8 | 2.0 | .5 | 8.0 | 2.5 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| Rampart..... | 1905 | ..... | ..... | ..... | ..... | ..... | 1.33 | 1.99 | 2.19 | 1.70 | 1.20 | 1.43 | .33 | ..... |
| Do..... | 1906 | .63 | .08 | .17 | .04 | .40 | .15 | 1.86 | 2.40 | .59 | .61 | .95 | .33 | 8.21 |
| | | 7.2 | 2.0 | 1.8 | .5 | ..... | ..... | ..... | ..... | ..... | ..... | 10.2 | 3.5 | 25.2 |
| Do..... | 1907 | 1.17 | .44 | 1.17 | .02 | .44 | 1.64 | 2.29 | 3.38 | 2.52 | .65 | .55 | 1.26 | 15.53 |
| | | 12.0 | 4.5 | 12.8 | 2.5 | ..... | ..... | ..... | ..... | ..... | ..... | 6.3 | ..... | ..... |
| Do..... | 1908 | 1.08 | .52 | .81 | .58 | .82 | 1.38 | 1.13 | .46 | 1.56 | .39 | .73 | 1.14 | 10.60 |
| | | 11.5 | 6.9 | 8.1 | ..... | ..... | ..... | ..... | ..... | ..... | 5.1 | 3.6 | 16.8 | 52.0 |
| Do..... | 1909 | .09 | .10 | .37 | .51 | 1.04 | .85 | 2.01 | 1.41 | .36 | 1.14 | .35 | 1.99 | 10.22 |
| | | 1.4 | 1.2 | 6.2 | 5.6 | ..... | ..... | ..... | ..... | 1.5 | 14.4 | 3.6 | 20.2 | 54.1 |
| Do..... | 1910 | .84 | .08 | .36 | .07 | .20 | .98 | .71 | .62 | .43 | .45 | .26 | .32 | 5.32 |
| | | 11.1 | .8 | 4.7 | 1.0 | ..... | ..... | ..... | ..... | ..... | 6.0 | 3.5 | 5.0 | 32.1 |
| Do..... | 1911 | 1.05 | 2.20 | .31 | .75 | .48 | .34 | .43 | 1.12 | .79 | .57 | .21 | .85 | 9.10 |
| Do..... | 1912 | .13 | .45 | .81 | .01 | .86 | 3.03 | .54 | 1.52 | 1.50 | 1.21 | ..... | ..... | ..... |
| Summit road house..... | 1907 | ..... | ..... | ..... | ..... | ..... | ..... | 2.71 | 3.27 | [a]3.33 | ..... | ..... | ..... | ..... |
| Tanana Crossing..... | 1904 | ..... | ..... | ..... | ..... | .76 | ..... | .78 | .89 | 1.06 | .15 | .10 | .90 | ..... |
| Do..... | 1905 | .24 | .08 | .18 | .00 | .14 | ..... | .37 | 2.95 | ..... | 1.40 | .60 | ..... | ..... |
| Do..... | 1906 | .30 | .00 | Tr. | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |

[a] September 1-22.

The records for 1912 indicate that the annual precipitation throughout the Yukon-Tanana region was very nearly normal. The winter precipitation, or snowfall, was somewhat below the average of the previous years of record, but the deficiency was offset by a summer precipitation generally above the normal. Although a summer precipitation greater than the normal is apparent both from the Weather Bureau records and from the records of stream flow its distribution during that period was very uneven. In some localities most of the rainfall was concentrated into a comparatively brief period, and water for mining was short during a large part of the summer. In other localities the even distribution of the rainfall throughout the summer and its adaptation to the needs of placer mining was marked.

With the accumulation of data on which conclusions may be based regarding precipitation in the Yukon-Tanana region certain deductions may be made. The mean yearly precipitation at each station in the Yukon-Tanana region is uniformly close to the average of the means of all the stations—that is, the records show no uniform difference in precipitation throughout the area. The precipitation at the different stations for a particular year may be influenced to some slight degree by certain phenomena which are general in their effect, and yet the precipitation for the year at different stations may vary

very widely. Precipitation is uniformly greater in the summer than in the remainder of the year. The conditions producing precipitation appear to be very local in character, the run-off of a given drainage area for a certain period perhaps differing widely from that of a near-by or adjoining area. The local nature of the showers, to which this is due, is noticeable to summer travelers in interior Alaska.

## WATER POWER.

The records of stream flow gathered at points showing the greatest possibility for water-power development have been briefly summarized in the table below. In comparing the columns showing days of deficient discharge for several years on any stream, allowance should be made for difference in length of periods and also for the part of the season covered by the records. Ordinarily the longer the period the greater will be the number of days of deficient discharge for any given number of horsepower and the less favorable will be the comparison with years in which the records extend over shorter lengths of time. Also, the days of deficient discharge will be a greater percentage of the total number of days if the observations include only the low-water months.

The table gives the horsepower per foot of fall (80 per cent efficiency) that may be developed at different rates of discharge and shows the number of days on which the discharge and the corresponding horsepower were respectively less than the normal amounts, as given in the columns for "discharge" and "horsepower."

*Estimated discharge and horsepower for Chatanika River and Birch Creek for 1907–1912.*

| Discharge in second-feet. | Horsepower per foot fall (80 per cent efficiency). | Days of deficient discharge. | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Chatanika River below Faith Creek. | | | | | Chatanika River below Poker Creek. | | | | | | Birch Creek above Sheep Creek. |
| | | June 21 to Sept. 30, 1907. | July 13 to Sept. 30, 19 | May 25 to Sept. 25, 1910. | May 24 to Sept. 24, 1911. | May 15 to Sept. 30, 1912. | June 20 to Oct. 14, 1907. | May 16 to Oct. 21, 1908. | May 9 to Oct. 5, 1909. | May 17 to Oct. 29, 1910. | May 6 to Nov. 5, 1911. | June 13 to Oct. 26, 1912. | June 1 to Sept. 30, 1911. | May 8 to Sept. 22, 1912. |
| 22 | 2 | ..... | ..... | ..... | 0 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 28 | 2.5 | ..... | ..... | ..... | 6 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 33 | 3 | 0 | ..... | ..... | 14 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 44 | 4 | 13 | ..... | 0 | 22 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 55 | 5 | 16 | ..... | 14 | 25 | 0 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 66 | 6 | 29 | ..... | 29 | 36 | 12 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| 77 | 7 | 39 | 0 | 34 | 45 | 21 | ..... | ..... | ..... | ..... | 0 | ..... | 0 | ..... |
| 88 | 8 | 47 | 2 | 37 | 54 | 32 | ..... | ..... | 0 | 0 | 4 | ..... | 3 | ..... |
| 99 | 9 | 52 | 4 | 39 | 62 | 39 | ..... | ..... | 2 | 2 | 11 | ..... | 7 | ..... |
| 110 | 10 | 56 | 19 | 45 | 67 | 49 | ..... | ..... | 5 | 3 | 24 | ..... | 13 | ..... |
| 132 | 12 | 69 | 35 | 47 | 71 | 64 | ..... | ..... | 17 | 22 | 30 | ..... | 20 | ..... |
| 154 | 14 | 73 | 57 | 54 | 74 | 75 | 0 | ..... | 26 | 40 | 41 | 0 | 23 | ..... |
| 176 | 16 | 77 | 58 | 64 | 76 | 85 | 5 | 0 | 27 | 49 | 44 | 3 | 24 | ..... |
| 198 | 18 | 78 | 65 | 69 | 77 | 90 | 17 | 5 | 39 | 55 | 59 | 16 | 29 | 0 |
| 220 | 20 | 82 | 66 | 79 | 79 | 98 | 27 | 27 | 46 | 60 | 66 | 31 | 32 | 8 |

*Estimated discharge and horsepower for North Fork of Fortymile and Seventymile rivers for 1910–1912.*

| Discharge in second-feet. | Horsepower per foot fall (80 per cent efficiency). | Days of deficient discharge. | | | | | |
|---|---|---|---|---|---|---|---|
| | | North Fork of Fortymile River at "Kink." | | | Seventymile River at the falls. | | |
| | | July 9 to Sept. 23, 1910. | May 19 to Sept. 20, 1911. | May 5 to Oct. 13, 1912. | June 16 to Sept. 30, 1910. | June 20 to Sept. 5, 1911. | May 3 to Oct. 18, 1912. |
| 110 | 10 | ..... | ..... | ..... | ..... | 0 | ..... |
| 132 | 12 | ..... | ..... | ..... | ..... | 5 | 0 |
| 154 | 14 | ..... | 0 | ..... | ..... | 16 | 3 |
| 176 | 16 | ..... | 1 | ..... | ..... | 30 | 6 |
| 198 | 18 | ..... | 3 | ..... | 0 | 42 | 8 |
| 220 | 20 | 0 | 5 | ..... | 4 | 43 | 13 |
| 242 | 22 | 1 | 9 | ..... | 10 | 47 | 19 |
| 264 | 24 | 4 | 10 | ..... | 16 | 50 | 22 |
| 286 | 26 | 7 | 10 | ..... | 22 | 57 | 26 |
| 308 | 28 | 11 | 17 | ..... | 31 | 61 | 60 |
| 330 | 30 | 17 | 19 | 0 | 33 | 64 | 63 |
| 385 | 35 | 25 | 22 | 2 | 49 | 71 | 96 |
| 440 | 40 | 35 | 23 | 4 | 57 | 74 | 101 |

## FORTYMILE DISTRICT.

### GENERAL FEATURES.

In this paper the Fortymile district is considered as being the area drained by Fortymile River and its tributaries. This does not conform with the Fortymile precinct or recording district. The area has been topographically surveyed and is covered by three maps [1] separately published or in process of publication. The topography, geology, and gold placers of this area have been described by Prindle.[2]

Fortymile River is tributary to Yukon River at longitude 140° 30′ west and latitude 64° 30′ north, about 50 miles below Dawson, Y. T., and about the same distance above Eagle, Alaska. Some of the river's southern tributaries rise in Canadian territory, and the main river enters Canadian territory about 23 miles above its mouth. Of its total drainage area of 6,350 square miles, about 4 per cent lies in Canadian territory. The area is roughly fan-shaped, its extreme radial dimension being approximately 100 miles. The stream flow is predominantly from west to east. About 40 miles in an air line from its mouth the river divides into two main forks, designated North and South, and these in turn subdivide somewhat symmetrically into other forks.

The tributaries interlock on the north with those of Mission Creek and Seventymile and Charley rivers in high rocky ridges, of which

[1] Map of Fortymile quadrangle (No. 640); can be obtained from the Director U. S. Geol. Survey, Washington, D. C., at 10 cents a copy. Map of Circle quadrangle; contained in U. S. Geol Survey Bull. 295, which can be consulted at public libraries; also in print as a separate publication, which can be obtained from the Director, U. S. Geol. Survey, price 50 cents. Map of area south of Circle and Fortymile quadrangles; in process of compilation.

[2] Prindle, L. M., The gold placers of the Fortymile, Birch Creek, and Fairbanks regions, Alaska: U. S. Geol. Survey Bull. 251, 1905.

Glacier Mountain is the most prominent, and on the west with Goodpaster, Volkmar, and Healy rivers, in mountains equally rugged. On the southeast the streams head in a country of relatively low relief, only a few miles from Tanana River. A moderately low dividing range, accentuated by several large dome-shaped mountains, separates them from the heads of Ladue Creek and Sixtymile River.

A prominent feature of the lower Fortymile Basin is the well-defined bench which marks the elevation of an earlier valley floor. In the vicinity of Steele Creek the bench is about 500 feet above the stream bed. The plane of the present valley floor and that of the older one coincide near the mouth of Kechumstuk Creek at an elevation of about 2,000 feet above sea level.

The following list gives the locations at which gaging stations were maintained or discharge measurements made in the Fortymile Basin during 1912. The relation of the various streams is shown by the indention.

Denison Fork at mouth.
South Fork of Fortymile River above Franklin Creek.
Fortymile River at Steele Creek.
    Deep Creek above ditch intake.
    Mosquito Fork below Kechumstuk Creek.
    Mosquito Fork above Chicken Creek.
        Kechumstuk Creek at mouth.
        Chicken Creek at mouth.
    Walker Fork above Poker Creek.
    Walker Fork above Cherry Creek.
    Walker Fork below Wade Creek.
        Poker Creek at mouth.
        Davis Creek one-half mile above mouth.
        Wade Creek at claim "No. 10 above."
        Wade Creek at mouth.
    Napoleon Creek at mouth.
    Buckskin Creek above Fortyfive Pup.
    Buckskin Creek at mouth.
        Fortyfive Pup at claim No. 14.
    North Fork of Fortymile River at the "Kink."
        Slate Creek at mouth.
        North Fork of Fortymile River above Middle Fork.
            North Fork of Fortymile River above Slate Creek.
            Comet Creek at mouth.
            Champion Creek at mouth.
        Bullion Creek at mouth.
        Hutchinson Creek below Confederate Creek.
        Hutchinson Creek below Montana Creek.
        Hutchinson Creek at mouth.
            Confederate Creek at mouth.
            Montana Creek at claim No. 7.
    King Solomon Creek at Liberty Cabin.
        Liberty Fork at mouth.
        Dome Creek at Auburn Mining Co. camp.
    Steele Creek at mouth.

Fortymile River—Continued.
Woods Creek above Camp Creek.
Canyon Creek below Squaw Gulch.
Canyon Creek at mouth.
Camp Creek at mouth.
Hall Creek at mouth.
Squaw Gulch at claim "No. 1 above."
Marion Creek at mouth.
Discovery Creek at mouth.
Smith Creek at mouth.
Moose Creek at mouth.
Moose Creek ditch 2 miles below intake.

### SOUTH FORK OF FORTYMILE RIVER DRAINAGE BASIN.

The main stem of Fortymile River as determined by the area of drainage is, in downstream order, Denison Fork, South Fork, and Fortymile River, Denison Fork being joined by Mosquito Fork to form the South Fork.

Denison Fork has its source in a country characterized by wide swampy valleys which slope gently into fairly high mountains. The ridge separating its drainage from that of Tanana River parallels the Tanana at a distance of 4 to 10 miles. Its drainage area of 1,540 square miles is about equally divided between two forks, which unite to form the main stream about 12 miles above its mouth.

Mosquito Fork, the left branch of the South Fork, heads at an elevation of 3,000 to 4,000 feet in a ridge paralleling Tanana River and about 20 miles from that stream. Its general direction of flow is northeast for about 75 miles, and its drainage area comprises 1,120 square miles. Chicken Creek is the first tributary from the north, and although of small drainage area it is economically important as a gold producer. Gold Creek joins from the north about 12 miles above Denison Fork, and Kechumstuk Creek enters from the same side about 8 miles farther upstream. Near the mouth of Kechumstuk Creek, at an elevation of about 2,000 feet, the stream gradient abruptly decreases and the valley above this place is wide and swampy. The valley floor narrows again about 8 miles above, at a point where a spur from the south approaches the stream. This spur marks the lower end of the flat swampy area known as Mosquito Flats, which constitutes a large portion of the upper drainage area of Mosquito Fork. These flats extend along the stream for about 20 miles and at some places are 12 to 14 miles wide. They are a tangle of lakes and sloughs and during wet seasons are said to be practically covered with water.

The principal tributaries to the South Fork below the junction of Denison and Mosquito forks are Atwater Creek, Walker Fork, Napoleon, Franklin, Buckskin, Uhler, and Butte creeks. The largest of these is Walker Fork, which is also the most important, because of the placer gold produced by its tributaries—Poker, Davis, Cherry, and Twelvemile creeks, Liberty Fork, and Wade Creek.

*Monthly discharge of South Fork of Fortymile River at Franklin for 1910 to 1912.*

[Drainage area, 3,180 square miles.]

| Month. | Discharge in second-feet. | | | | Run-off (depth in inches on drainage area). |
|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | Mean per square mile. | |
| 1910. | | | | | |
| July 9–31 | 912 | 237 | 502 | 0.158 | 0.13 |
| August | 5,120 | 134 | 911 | .286 | .33 |
| September | 631 | 420 | 487 | .153 | .17 |
| The period, 84 days | 5,120 | 134 | 647 | .203 | .63 |
| 1911. | | | | | |
| May 19–31 | 7,000 | 1,780 | 3,600 | 1.13 | .55 |
| June | 3,240 | 340 | 970 | .305 | .34 |
| July | 4,140 | 340 | 932 | .293 | .34 |
| August | 495 | 200 | 326 | .106 | .12 |
| September 1–20 | 495 | 200 | 299 | .094 | .07 |
| The period, 125 days | 7,000 | 200 | 970 | .305 | 1.42 |
| 1912. | | | | | |
| May | 5,540 | 735 | 2,280 | 0.717 | 0.83 |
| June | 12,600 | 1,790 | 5,340 | 1.68 | 1.87 |
| July | 1,930 | 230 | 635 | .200 | .23 |
| August | 6,100 | 440 | 1,380 | .437 | .50 |
| September | 2,350 | 710 | 1,140 | .358 | .40 |
| October 1–13 | 820 | 370 | 532 | .167 | .08 |
| The period, 166 days | 12,600 | 230 | 2,020 | .635 | 3.91 |

*Daily discharge, in second-feet, of Denison Fork and South Fork for 1912.*

| Day. | Denison Fork at mouth.[a] [Drainage area, 1,540 square miles.] | | | South Fork of Fortymile River at Franklin.[b] [Drainage area, 3,180 square miles.] | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | June. | July. | Aug. | May. | June. | July. | Aug. | Sept. | Oct. |
| 1 | ..... | 970 | ..... | 735 | 3,260 | 1,380 | 440 | 820 | 820 |
| 2 | ..... | 650 | 135 | 930 | 4,170 | 1,260 | 520 | 820 | 820 |
| 3 | ..... | 515 | ..... | 1,060 | 7,600 | 1,190 | 660 | 820 | 660 |
| 4 | ..... | 396 | ..... | 1,320 | 7,180 | 865 | 710 | 820 | 610 |
| 5 | ..... | 324 | ..... | 1,320 | 5,960 | 550 | 710 | 710 | 010 |
| 6 | 2,360 | 260 | ..... | 1,450 | 4,800 | 450 | 875 | 710 | 520 |
| 7 | 2,080 | 240 | ..... | 1,580 | 3,680 | 450 | 1,150 | 710 | 480 |
| 8 | 1,840 | 220 | ..... | 2,210 | 2,840 | 550 | 1,150 | 820 | 440 |
| 9 | 1,420 | 203 | ..... | 3,540 | 2,350 | 500 | 1,150 | 930 | 440 |
| 10 | 1,240 | 190 | ..... | 3,120 | 2,070 | 450 | 1,040 | 1,040 | 405 |
| 11 | 1,020 | 180 | ..... | 3,610 | 1,790 | 405 | 2,350 | 1,100 | 370 |
| 12 | 1,420 | 170 | ..... | 3,540 | 1,790 | 360 | 6,100 | 1,260 | 370 |
| 13 | 1,780 | 160 | ..... | 3,540 | 2,770 | 360 | 4,310 | 1,200 | 370 |
| 14 | 1,720 | 148 | ..... | 3,680 | 4,240 | 290 | 2,490 | 1,100 | ..... |
| 15 | 1,840 | ..... | 820 | 3,400 | 6,900 | 290 | 2,000 | 875 | ..... |
| 16 | 4,960 | ..... | 615 | 2,910 | 8,560 | 290 | 1,560 | 765 | ..... |
| 17 | 6,500 | ..... | ..... | 2,700 | 12,600 | 290 | 1,260 | 765 | ..... |
| 18 | 5,400 | ..... | ..... | 2,420 | 11,700 | 290 | 1,150 | 1,500 | ..... |
| 19 | 4,280 | ..... | ..... | 1,930 | 9,040 | 230 | 1,260 | 1,930 | ..... |
| 20 | 3,260 | ..... | ..... | 1,930 | 9,040 | 230 | 1,150 | 2,350 | ..... |
| 21 | 2,940 | ..... | ..... | 1,930 | 7,180 | 230 | 1,150 | 2,000 | ..... |
| 22 | 2,780 | ..... | ..... | 1,720 | 7,040 | 1,930 | 1,040 | 1,860 | ..... |
| 23 | 2,780 | ..... | ..... | 1,450 | 6,900 | 1,100 | 930 | 1,500 | ..... |
| 24 | 2,640 | ..... | ..... | 1,320 | 5,400 | 1,040 | 930 | 1,320 | ..... |
| 25 | 2,080 | ..... | ..... | 1,190 | 4,310 | 930 | 930 | 1,100 | ..... |
| 26 | 2,500 | ..... | ..... | 1,190 | 3,960 | 820 | 930 | 1,100 | ..... |
| 27 | 2,360 | ..... | ..... | 1,060 | 3,680 | 710 | 1,040 | 1,100 | ..... |
| 28 | 2,640 | ..... | ..... | 930 | 3,610 | 610 | 1,040 | 1,100 | ..... |
| 29 | 1,600 | ..... | ..... | 3,750 | 3,330 | 520 | 1,040 | 1,100 | ..... |
| 30 | 1,240 | ..... | ..... | 5,540 | 2,490 | 520 | 930 | 1,040 | ..... |
| 31 | ..... | ..... | ..... | 3,680 | ..... | 610 | 930 | ..... | ..... |
| Mean | 2,590 | 330 | ..... | 2,280 | 5,340 | 635 | 1,380 | 1,550 | 532 |
| Mean, per square mile | 1.68 | .214 | ..... | .717 | 1.68 | .200 | .437 | .487 | .167 |
| Run-off (depth in inches on drainage area) | 1.56 | .11 | ..... | .83 | 1.87 | .23 | .50 | .54 | .08 |
| Accuracy | C. | A. | ..... | B. | B. | A. | A. | A. | A. |

[a] Daily discharges below 2,000 second-feet are believed to be accurate within 5 per cent.
[b] The rating curve is well defined for discharges below 10,000 second-feet.

*Monthly discharge of Fortymile River at Steele Creek for 1910 to 1912.*

[Drainage area, 5,890 square miles.]

| Month. | Discharge in second-feet. | | | | Run-off (depth in inches on drainage area). |
|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | Mean per square mile. | |
| 1910. | | | | | |
| June 28–30 | 13,900 | 11,500 | 12,900 | 2.19 | 0.24 |
| July | 8,480 | 570 | 1,830 | .311 | .36 |
| August | 7,740 | 470 | 1,750 | .297 | .34 |
| September 1–23 | 3,240 | 860 | 1,520 | .258 | .22 |
| The period, 88 days | 13,900 | 470 | 2,100 | .357 | 1.16 |
| 1911. | | | | | |
| May 16–31 | 33,400 | 5,840 | 12,900 | 2.19 | 1.30 |
| June | 17,100 | 1,360 | 5,680 | .965 | 1.08 |
| July | 7,020 | 900 | 2,300 | .390 | .45 |
| August | 2,620 | 420 | 997 | .169 | .19 |
| September 1–20 | 2,380 | 740 | 1,260 | .214 | .16 |
| The period, 128 days | 33,400 | 420 | 3,940 | .669 | 3.18 |
| 1912. | | | | | |
| May 5–31 | 15,800 | 2,080 | 6,750 | 1.15 | 1.15 |
| June | 31,400 | 3,480 | 11,800 | 2.00 | 2.23 |
| July | 6,300 | 900 | 2,070 | .351 | .40 |
| August | 19,500 | 1,310 | 4,290 | .728 | .84 |
| September | 5,400 | 1,560 | 2,500 | .424 | .47 |
| October 1–16 | 1,860 | 740 | 1,310 | .222 | .13 |
| The period, 165 days | 31,400 | 740 | 5,020 | .852 | 5.22 |

*Daily discharge, in second-feet, of Fortymile River at Steele Creek for 1912.*[a]

[Drainage area, 5,890 square miles.]

| Day. | May. | June. | July. | Aug. | Sept. | Oct. |
|---|---|---|---|---|---|---|
| 1 | ..... | 7,500 | 3,240 | 1,310 | 2,320 | 1,810 |
| 2 | ..... | 8,220 | 2,620 | 1,960 | 2,380 | 1,860 |
| 3 | ..... | 16,400 | 3,170 | 2,320 | 2,320 | 1,760 |
| 4 | ..... | 12,700 | 3,400 | 2,200 | 2,200 | 1,610 |
| 5 | 3,400 | 9,840 | 2,680 | 1,860 | 2,260 | 1,510 |
| 6 | 3,720 | 7,260 | 2,200 | 1,710 | 2,260 | 1,460 |
| 7 | 4,310 | 5,400 | 1,710 | 7,020 | 2,200 | 1,460 |
| 8 | 5,620 | 4,040 | 1,410 | 12,100 | 2,140 | 1,360 |
| 9 | 6,540 | 3,480 | 1,260 | 3,880 | 1,960 | 1,260 |
| 10 | 7,740 | 3,720 | 1,140 | 2,960 | 2,020 | 1,180 |
| 11 | 7,740 | 3,880 | 1,100 | 5,840 | 2,500 | 1,140 |
| 12 | 8,740 | 3,480 | 1,140 | 19,500 | 2,440 | 1,100 |
| 13 | 9,280 | 8,220 | 1,310 | 11,200 | 2,080 | 1,020 |
| 14 | 11,200 | 12,100 | 1,310 | 5,080 | 1,960 | 860 |
| 15 | 9,000 | 11,000 | 1,360 | 4,310 | 1,910 | 860 |
| 16 | 8,740 | 22,000 | 1,410 | 3,400 | 1,960 | 740 |
| 17 | 9,280 | 31,400 | 1,220 | 2,680 | 1,760 | ..... |
| 18 | 8,480 | 29,200 | 1,060 | 2,680 | 3,100 | ..... |
| 19 | 7,260 | 22,600 | 940 | 3,720 | 5,400 | ..... |
| 20 | 5,180 | 22,600 | 900 | 3,720 | 5,290 | ..... |
| 21 | 5,180 | 18,000 | 940 | 3,720 | 4,400 | ..... |
| 22 | 5,400 | 14,500 | 6,300 | 3,480 | 3,720 | ..... |
| 23 | 5,400 | 15,100 | 4,220 | 2,960 | 3,100 | ..... |
| 24 | 4,880 | 13,600 | 2,890 | 2,820 | 2,750 | ..... |
| 25 | 3,030 | 10,100 | 2,380 | 2,960 | 2,320 | ..... |
| 26 | 2,620 | 10,400 | 2,200 | 2,750 | 1,860 | ..... |
| 27 | 2,080 | 9,560 | 2,500 | 2,680 | 1,710 | ..... |
| 28 | 2,200 | 7,020 | 2,620 | 3,560 | 1,560 | ..... |
| 29 | 8,220 | 5,180 | 2,140 | 3,170 | 1,560 | ..... |
| 30 | 15,800 | 4,130 | 1,760 | 2,890 | 1,560 | ..... |
| 31 | 11,200 | ..... | 1,510 | 2,500 | ..... | ..... |
| Mean | 6,750 | 11,800 | 2,070 | 4,290 | 2,500 | 1,310 |
| Mean per square mile | 1.15 | 2.00 | .351 | .728 | .424 | .222 |
| Run-off (depth in inches on drainage area) | 1.15 | 2.23 | .40 | .84 | .47 | .13 |
| | A. | B. | A. | A. | A. | A. |

[a] The rating curve is well defined below 20,000 second-feet.

*Monthly discharge of Mosquito Fork below Kechumstuk Creek for 1910 to 1912.*

[Drainage area, 824 square miles.]

| Month. | Discharge in second-feet. | | | | Run-off (depth in inches on drainage area). |
|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | Mean per square mile. | |
| 1910. | | | | | |
| July 7–31 | 325 | 57 | 149 | 0.181 | 0.17 |
| August | 234 | 40 | 92.2 | .111 | .13 |
| September | 80 | 37 | 57.4 | .070 | .08 |
| October 1–3 | 49 | 37 | 42.3 | .051 | .006 |
| The period, 89 days | 325 | 37 | 94.8 | .115 | .386 |
| 1911. | | | | | |
| August 20–31 | 174 | 66 | 99.8 | .121 | .05 |
| September | 257 | 63 | 172 | .209 | .23 |
| October 1–15 | 185 | 52 | 95.2 | .116 | .06 |
| The period, 57 days | 257 | 52 | 136 | .165 | .34 |
| 1912. | | | | | |
| June 9–30 | 4,030 | 322 | 1,900 | 2.31 | 1.89 |
| July | 660 | 77 | 210 | .255 | .29 |
| August | 1,000 | 84 | 292 | .354 | .41 |
| September | 780 | 296 | 459 | .557 | .62 |
| The period, 114 days | 4,030 | 77 | 613 | .744 | 3.21 |

*Daily discharge, in second-feet, of Mosquito Fork and Kechumstuk Creek for 1912.*

| Day. | Mosquito Fork below Kechumstuk Creek.[a] [Drainage area, 824 square miles.] | | | | Kechumstuk Creek at mouth.[b] [Drainage area, 189 square miles.] | | | |
|---|---|---|---|---|---|---|---|---|
| | June. | July. | Aug. | Sept. | June. | July. | Aug. | Sept. |
| 1 | ..... | 660 | 100 | 356 | ..... | 84 | 27 | 102 |
| 2 | ..... | 460 | 100 | 378 | ..... | 72 | 27 | 102 |
| 3 | ..... | 322 | 100 | 378 | ..... | 80 | 27 | 102 |
| 4 | ..... | 257 | 92 | 400 | ..... | 72 | 27 | 102 |
| 5 | ..... | 232 | 92 | 400 | ..... | 77 | 27 | 102 |
| 6 | ..... | 152 | 84 | 400 | ..... | 61 | 27 | 102 |
| 7 | ..... | 152 | 100 | 400 | ..... | 44 | 40 | 102 |
| 8 | ..... | 132 | 100 | 400 | ..... | 24 | 40 | 102 |
| 9 | 400 | 132 | 100 | 460 | 91 | 16 | 40 | 80 |
| 10 | 356 | 116 | 400 | 460 | 93 | 16 | 240 | 130 |
| 11 | 322 | 132 | 1,000 | 400 | 84 | 27 | 600 | 102 |
| 12 | 540 | 132 | 620 | 460 | 284 | 24 | 420 | 80 |
| 13 | 1,020 | 132 | 540 | 460 | 492 | 24 | 335 | 80 |
| 14 | 1,610 | 174 | 460 | 460 | 778 | 21 | 236 | 80 |
| 15 | 1,180 | 185 | 378 | 460 | 492 | 16 | 205 | 80 |
| 16 | 4,030 | 152 | 296 | 460 | 2,230 | 16 | 116 | 80 |
| 17 | 3,790 | 132 | 198 | 460 | 1,450 | 16 | 102 | 80 |
| 18 | 3,020 | 198 | 244 | 460 | 694 | 8 | 205 | 80 |
| 19 | 3,120 | 220 | 244 | 400 | 946 | 8 | 196 | 102 |
| 20 | 2,720 | 270 | 270 | 356 | 568 | 8 | 175 | 130 |
| 21 | 2,720 | 270 | 296 | 296 | 420 | 8 | 145 | 130 |
| 22 | 2,420 | 270 | 296 | 780 | 420 | 12 | 116 | 252 |
| 23 | 2,520 | 270 | 322 | 700 | 736 | 16 | 160 | 74 |
| 24 | 2,420 | 296 | 339 | 660 | 420 | 24 | 175 | 84 |
| 25 | 2,330 | 244 | 322 | 540 | 335 | 27 | 130 | 67 |
| 26 | 2,420 | 244 | 296 | 540 | 284 | 29 | 160 | 64 |
| 27 | 1,700 | 163 | 296 | 460 | 278 | 29 | 130 | 64 |
| 28 | 1,340 | 132 | 322 | 460 | 214 | 26 | 102 | 63 |
| 29 | 1,020 | 100 | 339 | 460 | 145 | 23 | 102 | 61 |
| 30 | 820 | 77 | 339 | 460 | 116 | 20 | 102 | 60 |
| 31 | ..... | 92 | 356 | ..... | ..... | 25 | 102 | ..... |
| Mean | 1,900 | 210 | 292 | 459 | 525 | 307 | 146 | 94.6 |
| Mean per square mile | 2.31 | .255 | .354 | .557 | 2.78 | .162 | .772 | .500 |
| Run-off (depth in inches on drainage area) | 1.89 | .29 | .41 | .62 | 2.27 | .19 | .89 | .56 |
| Accuracy | B. | A. | A. | A. | B. | A. | A. | A. |

[a] The rating curve is well defined below 600 second-feet. Short periods in the first part of August are estimated.

[b] The rating curve is well defined for discharges below 500 second-feet.

*Daily discharge, in second-feet, of Walker Fork and Wade Creek for 1912.*

| Day. | Walker Fork, above Poker Creek.[a] [Drainage area, 7.39 square miles.] | | | Wade Creek at claim No. 10, above.[b] [Drainage area, 23.1 square miles.] | | | | |
|---|---|---|---|---|---|---|---|---|
| | July. | Aug. | Sept. | June. | July. | Aug. | Sept. | Oct. |
| 1 | | | 2.6 | | 1.0 | 15 | 10 | 25 |
| 2 | | | 2.6 | | .8 | 38 | 9.3 | 25 |
| 3 | | | 3.4 | | .8 | 9.3 | 9.3 | 21 |
| 4 | | | 2.6 | | .8 | 9.3 | 9.3 | 21 |
| 5 | | | 4.2 | | .8 | 6.9 | 9.3 | 18 |
| 6 | 4.8 | | | 10 | 1.0 | 21 | 9.3 | 18 |
| 7 | | | | 10 | 1.0 | 36 | 15 | 15 |
| 8 | | 10 | | 9.3 | 1.0 | 36 | 15 | 21 |
| 9 | | 10 | | 9.3 | 1.0 | 12 | 12 | 21 |
| 10 | | 10 | | 9.3 | .4 | 15 | 15 | 20 |
| 11 | | 20 | | 4.2 | 1.0 | 68 | 12 | 20 |
| 12 | | 25 | | 2.3 | 1.0 | 96 | 12 | |
| 13 | | 15 | | 21 | 1.0 | 84 | 12 | |
| 14 | | 15 | | 18 | 2.3 | 84 | 12 | |
| 15 | | 10 | | 21 | 2.3 | 36 | 12 | |
| 16 | | 10 | | 47 | 4.2 | 21 | 9.3 | |
| 17 | | 7.0 | | 21 | 4.2 | 18 | 29 | |
| 18 | | 7.0 | | 18 | 4.2 | 15 | 96 | |
| 19 | | 7.0 | | 21 | 1.0 | 18 | 36 | |
| 20 | | 5.6 | | 21 | 1.0 | 15 | 48 | |
| 21 | | 7.0 | | 18 | 2.3 | 18 | 29 | |
| 22 | | 5.6 | | 15 | 36 | 12 | 29 | |
| 23 | | 5.6 | | 21 | 34 | 10 | 29 | |
| 24 | | 5.6 | | 25 | 21 | 10 | 25 | |
| 25 | | 4.2 | | 21 | 15 | 9.3 | 18 | |
| 26 | | 4.2 | | 18 | 9.3 | 10 | 18 | |
| 27 | | 4.2 | | 9.3 | 9.3 | 15 | 15 | |
| 28 | | 4.2 | | 9.3 | 6.9 | 16 | 15 | |
| 29 | | 4.2 | | 2.3 | 6.9 | 15 | 13 | |
| 30 | | 4.2 | | 2.3 | 4.2 | 15 | 29 | |
| 31 | | 3.4 | | | 4.2 | 15 | | |
| Mean | | 8.50 | 3.08 | 15.3 | 5.8 | 25.7 | 20.4 | 20.5 |
| Mean per square mile | | 1.15 | .417 | .662 | .251 | 1.11 | .883 | .887 |
| Run-off (depth in inches on drainage area) | | 1.03 | .08 | .62 | .29 | 1.28 | .99 | .36 |
| Accuracy | | A. | A. | B. | B. | B. | B. | B. |

[a] The rating curve is well defined for all stages occurring during the period of the record.
[b] The rating curve is well defined for discharges below 25 second-feet.

*Daily discharge, in second-feet, of Buckskin Creek and Fortyfive Pup for 1912.*

| Day. | Buckskin Creek above Fortyfive Pup.[a] [Drainage area, 33 square miles.] | | | | Fortyfive Pup at claim No. 14.[b] [Drainage area, 9.1 square miles.] | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | June. | July. | Aug. | Sept. | May. | June. | July. | Aug. | Sept. |
| 1 | | | | | | 32 | 6 | 2.9 | |
| 2 | | 6.6 | | | | 49 | 6 | 18 | |
| 3 | | | | | | 23 | 4 | 24 | |
| 4 | | 5.2 | 17 | | | 20 | 4 | 21 | |
| 5 | | 3.8 | 13 | | | 20 | 4 | 30 | |
| 6 | | | | | | 18 | 4 | 43 | |
| 7 | | | | | 12 | 18 | 2 | 60 | |
| 8 | | | | | 12 | 16 | 2 | 27 | |
| 9 | | | | | 12 | 16 | 2 | 21 | |
| 10 | | | | | 12 | 14 | 2 | 18 | |

[a] The rating curve is well defined for all discharges reported.
[b] In June a shift occurred in the channel of this station, making prior records subject to considerable error. The rating curve for the remainder of the season is well defined below 20 second-feet. A considerable portion of the record for June and July is estimated.

*Daily discharge, in second-feet, of Buckskin Creek and Fortyfive Pup for 1912*—Continued.

| Day. | Buckskin Creek above Fortyfive Pup. [Drainage area, 33 square miles.] | | | | Fortyfive Pup at claim No. 14. [Drainage area, 9.1 square miles.] | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | June. | July. | Aug. | Sept. | May. | June. | July. | Aug. | Sept. |
| 11 | | | | | 23 | 14 | 2 | 118 | |
| 12 | 19 | | | | 32 | 14 | 1.8 | 50 | |
| 13 | | | | 19 | 42 | 12 | 1.8 | 27 | |
| 14 | | | | | 49 | 35 | 1.8 | 24 | |
| 15 | | 2.9 | | | 56 | 46 | 1.8 | 21 | |
| 16 | | | | | 42 | 77 | 1.8 | 15 | |
| 17 | | | 24 | | 38 | 77 | 1.8 | 10 | |
| 18 | | | | | 32 | 77 | 1.8 | 10 | 18 |
| 19 | | | | | 32 | 70 | 1.8 | 8 | |
| 20 | | | 19 | | 23 | 74 | 1.8 | 6 | |
| 21 | | | | | 29 | 40 | 24 | 6 | |
| 22 | | | | | 29 | 35 | 40 | 4 | |
| 23 | | | | | 23 | 30 | 24 | 4 | |
| 24 | | | | | 20 | 24 | 18 | 2.9 | |
| 25 | | | | | 17 | 60 | 12 | 2.9 | |
| 26 | | | | | 17 | 74 | 10 | 2.9 | |
| 27 | | | | | 12 | 40 | 8 | 4 | |
| 28 | | | | | 23 | 21 | 8 | 4 | |
| 29 | | | | | 46 | 14 | 6 | 4 | |
| 30 | | | | | 29 | 8 | 4 | 4 | |
| 31 | | | | | 17 | | 4 | 4 | |
| Mean | | | | | 27.2 | 35.6 | 6.8 | 19.2 | |
| Mean per square mile | | | | | 2.99 | 3.91 | .747 | 2.11 | |
| Run-off (depth in inches on drainage area) | | | | | 2.78 | 4.36 | .86 | 2.43 | |
| Accuracy | | | | | C. | C. | B. | B. | |

*Miscellaneous measurements in South Fork of Fortymile River drainage basin in 1912.*

| Date. | Stream and locality. | Discharge. | Drainage area. | Discharge per square mile. |
|---|---|---|---|---|
| | | *Sec.-ft.* | *Sq. mi.* | *Sec.-ft.* |
| August 16 | Deep Creek above ditch intake | 0.24 | | |
| July 13 | Mosquito Fork at Chicken, Alaska | 169 | 1,120 | 0.151 |
| July 15 | Chicken Creek at mouth | .80 | 16.3 | .049 |
| June 5 | Walker Fork, above Cherry Creek | 25 | 15.8 | 1.58 |
| June 10 | do | 20 | 15.8 | 1.27 |
| June 12 | do | 16 | 15.8 | 1.01 |
| July 6 | do | 8 | 15.8 | .506 |
| August 8 | do | 23 | 15.8 | 1.46 |
| July 7 | Walker Fork, below Wade Creek | 41.9 | 406 | .03 |
| July 6 | Poker Creek, at mouth | 1.86 | 3.1 | .600 |
| Do | Davis Creek, ½ mile above mouth | 1.2 | 1.5 | .800 |
| July 7 | Wade Creek, at mouth | 1.81 | 50 | .036 |
| August 21 | Buckskin Creek, at mouth | 41.1 | 73.7 | .558 |

## NORTH FORK OF FORTYMILE RIVER DRAINAGE BASIN.

North Fork of Fortymile River drains an area of 2,120 square miles. The stream has its source in high, rugged mountains of elevations from 3,000 to 6,000 feet. Near the headwaters the valleys are broad, with gentle slopes, but nearer the mouth they become canyon-like, with prominent benches, which are merely continuations of those of lower Fortymile River.

The principal tributary and that representing the main stem of the stream is Middle Fork, locally known as Granite Fork. Its drainage

area is 1,110 square miles, which is 52 per cent of the total drainage of the North Fork. Its headwaters drain a country with wide flat valleys somewhat similar to those of Mosquito and Denison forks.

North Fork, above Middle Fork, locally known as Eureka Creek, has for its principal tributaries Slate, Comet, and Champion creeks. Below the junction of the two forks Bullion and Hutchinson creeks enter from the west.

Very few people live in the North Fork basin and only very meager stream-flow records are obtainable. Four stations were maintained on Hutchinson Creek, and miscellaneous measurements were made of some of the branches.

About 3 miles below the mouth of Hutchinson Creek the river originally followed a large meander known as the "Kink." Although the distance around was 2¾ miles, the two channels at the neck of the meander were separated by only a sharp rock ridge about 100 feet high and about the same distance in width at the water level. Several years ago a channel was blasted through the rock ridge to divert the water, and thus drain the meander for mining purposes. A fall of about 17 feet is now concentrated in a horizontal distance of only a little over 100 feet, which gives possibilities for development of considerable water power. (See horsepower table, p. 231.) Daily discharges at the "Kink" have been calculated from the records of Fortymile River at Steele Creek and of South Fork at Franklin. The drainage area of North Fork at the "Kink" is 74 per cent of that of the Fortymile at Steele Creek minus that of the South Fork at Franklin; and daily discharges were obtained by taking 74 per cent of the difference in discharge between the former and latter stations. The daily results are subject to considerable inaccuracy, but the larger errors involved should be compensated in the monthly means, which should have a probable error not greater than 15 per cent.

*Daily discharge, in second-feet, of North Fork of Fortymile River at the "Kink" for 1912.*

[Drainage area, 2,010 square miles.]

| Day. | May. | June. | July. | Aug. | Sept. | Oct. |
|---|---|---|---|---|---|---|
| 1 | ..... | 3,140 | 1,380 | 644 | 1,110 | 733 |
| 2 | ..... | 3,000 | 1,010 | 1,070 | 1,150 | 770 |
| 3 | ..... | 6,510 | 1,470 | 1,230 | 1,110 | 814 |
| 4 | ..... | 4,090 | 1,880 | 1,100 | 1,020 | 740 |
| 5 | 1,540 | 2,870 | 1,580 | 851 | 1,150 | 666 |
| 6 | 1,680 | 1,820 | 1,300 | 618 | 1,150 | 696 |
| 7 | 2,020 | 1,270 | 932 | 435 | 777 | 725 |
| 8 | 2,520 | 888 | 711 | 8,140 | 733 | 681 |
| 9 | 2,220 | 836 | 563 | 2,020 | 600 | 607 |
| 10 | 3,420 | 1,220 | 511 | 1,420 | 725 | 574 |
| 11 | 2,320 | 1,550 | 514 | 2,600 | 962 | 570 |
| 12 | 3,110 | 1,250 | 577 | 9,910 | 873 | 540 |
| 13 | 3,510 | 4,030 | 703 | 5,100 | 651 | 481 |
| 14 | 5,570 | 5,820 | 755 | 1,920 | 637 | ..... |
| 15 | 4,140 | 3,040 | 792 | 1,710 | 766 | ..... |

*Daily discharge, in second-feet, of North Fork of Fortymile River at the "Kink" for 1912*—Continued.

| Day. | May. | June. | July. | Aug. | Sept. | Oct. |
|---|---|---|---|---|---|---|
| 16 | 4,310 | 9,950 | 829 | 1,360 | 885 | ..... |
| 17 | 4,180 | 13,900 | 688 | 1,050 | 736 | ..... |
| 18 | 4,490 | 13,000 | 570 | 1,130 | 1,180 | ..... |
| 19 | 3,940 | 10,100 | 525 | 1,820 | 2,570 | ..... |
| 20 | 2,400 | 10,100 | 496 | 1,900 | 2,180 | ..... |
| 21 | 2,400 | 8,000 | 525 | 1,900 | 1,780 | ..... |
| 22 | 2,720 | 5,520 | 3,230 | 1,810 | 1,380 | ..... |
| 23 | 2,920 | 6,070 | 2,310 | 1,500 | 1,180 | ..... |
| 24 | 2,640 | 6,070 | 1,370 | 1,400 | 1,060 | ..... |
| 25 | 1,360 | 4,280 | 1,070 | 1,500 | 903 | ..... |
| 26 | 1,060 | 4,770 | 1,020 | 1,350 | 555 | ..... |
| 27 | 755 | 3,610 | 1,320 | 1,210 | 452 | ..... |
| 28 | 940 | 2,520 | 1,490 | 1,860 | 341 | ..... |
| 29 | 3,310 | 1,370 | 1,200 | 1,580 | 341 | ..... |
| 30 | 7,620 | 1,210 | 918 | 1,450 | 385 | ..... |
| 31 | 5,570 | ..... | 666 | 1,160 | ..... | ..... |
| Mean | 3,240 | 4,740 | 1,060 | 2,150 | 1,010 | 661 |
| Mean per square mile | 1.61 | 2.36 | .527 | 1.07 | .503 | .329 |
| Run-off (depth in inches on drainage area) | 1.62 | 2.63 | .61 | 1.23 | .56 | .16 |
| Accuracy | C. | C. | C. | C. | C. | C. |

*Daily discharge, in second-feet, of Hutchinson Creek below Confederate and Montana creeks for 1912.*

| Day. | Hutchinson Creek below Confederate Creek.[a] [Drainage area, 16.6 square miles.] | | | | Hutchinson Creek below Montana Creek.[b] [Drainage area, 29 square miles.] | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | May. | June. | July. | Aug. | May. | June. | July. | Aug. | Sept. |
| 1 | ..... | 37 | 4 | 42 | ..... | ..... | ..... | ..... | 14 |
| 2 | ..... | 62 | 14 | 27 | ..... | ..... | 74 | ..... | ..... |
| 3 | ..... | 37 | 14 | 18 | ..... | ..... | ..... | ..... | ..... |
| 4 | ..... | 32 | 8 | 18 | ..... | 19 | ..... | ..... | ..... |
| 5 | ..... | 27 | 3 | 18 | ..... | ..... | ..... | 15 | 11 |
| 6 | ..... | 22 | 1.2 | 30 | ..... | ..... | ..... | ..... | ..... |
| 7 | ..... | 18 | 3 | 67 | ..... | ..... | ..... | 104 | ..... |
| 8 | ..... | 22 | 4 | 52 | ..... | ..... | ..... | ..... | ..... |
| 9 | ..... | 18 | 4 | 42 | ..... | ..... | ..... | ..... | ..... |
| 10 | ..... | 14 | 4 | 37 | ..... | ..... | ..... | ..... | ..... |
| 11 | ..... | 6 | 6 | 126 | ..... | 12 | ..... | 170 | ..... |
| 12 | ..... | 57 | 4 | 52 | ..... | 62 | 6.7 | 110 | ..... |
| 13 | ..... | 102 | 14 | 42 | ..... | ..... | ..... | ..... | ..... |
| 14 | ..... | 96 | 11 | 37 | ..... | 170 | ..... | ..... | ..... |
| 15 | ..... | 151 | 11 | 27 | ..... | ..... | ..... | ..... | ..... |
| 16 | ..... | 62 | 6 | 27 | 74 | 110 | 7.6 | ..... | ..... |
| 17 | ..... | 67 | 6 | 37 | ..... | 224 | ..... | ..... | ..... |
| 18 | ..... | 22 | 4 | 27 | 94 | ..... | ..... | 34 | ..... |
| 19 | ..... | 22 | 3 | 27 | ..... | ..... | ..... | ..... | ..... |
| 20 | ..... | 27 | 4 | 27 | 104 | ..... | ..... | ..... | ..... |
| 21 | ..... | 22 | 32 | 27 | ..... | ..... | ..... | ..... | ..... |
| 22 | ..... | 32 | 32 | 37 | ..... | ..... | ..... | ..... | ..... |
| 23 | 42 | 47 | 27 | 37 | 84 | ..... | 11 | ..... | ..... |
| 24 | 32 | 84 | 18 | 27 | ..... | ..... | ..... | ..... | ..... |
| 25 | 47 | 84 | 14 | 27 | ..... | 62 | ..... | 31 | ..... |
| 26 | 62 | 67 | 62 | 37 | ..... | ..... | 15 | ..... | ..... |
| 27 | 84 | 62 | 47 | 42 | ..... | ..... | 3 | ..... | ..... |
| 28 | 67 | 47 | 42 | 35 | ..... | ..... | ..... | ..... | ..... |
| 29 | 67 | 18 | 37 | 35 | ..... | ..... | ..... | 70 | ..... |
| 30 | 47 | 4 | 27 | 35 | ..... | ..... | ° 3 | ..... | ..... |
| 31 | 37 | ..... | 42 | 35 | ..... | ..... | ..... | ..... | ..... |
| Mean | 53.9 | 45.6 | 16.4 | 37.2 | ..... | ..... | ..... | ..... | ..... |
| Mean per square mile | 3.25 | 2.75 | .988 | 2.24 | ..... | ..... | ..... | ..... | ..... |
| Run-off (depth in inches on drainage area) | 1.09 | 3.07 | 1.14 | 2.58 | ..... | ..... | ..... | ..... | ..... |
| Accuracy | B. | B. | B. | B. | ..... | ..... | ..... | ..... | ..... |

[a] The curve is well defined for discharges below 40 second-feet.
[b] Discharges below 60 second-feet are probably accurate within 5 per cent.

*Daily discharge, in second-feet, of Confederate and Montana creeks for 1912.*

| Day. | Confederate Creek at mouth.[a] [Drainage area 9 square miles.] | | | Montana Creek at claim "No. 7 above."[b] [Drainage area 5.9 square miles.] | | | | |
|---|---|---|---|---|---|---|---|---|
| | June. | July. | Aug. | May. | June. | July. | Aug. | Sept. |
| 1 | ..... | ..... | 11 | ..... | 14 | 4.0 | 3.8 | 3.8 |
| 2 | ..... | ..... | 6.4 | ..... | 25 | 24 | 3.8 | 3.8 |
| 3 | ..... | ..... | 5.1 | ..... | 15 | 16 | 3.8 | 3.8 |
| 4 | ..... | ..... | 5.1 | ..... | 14 | 8.0 | 3.8 | 3.8 |
| 5 | ..... | ..... | 5.1 | ..... | 11 | 3.8 | 3.8 | 3.8 |
| 6 | ..... | ..... | 15 | ..... | 9.0 | 3.0 | 20 | ..... |
| 7 | ..... | ..... | 40 | ..... | 7.0 | 3.0 | 50 | ..... |
| 8 | ..... | ..... | 24 | ..... | 9.0 | 3.0 | 22 | ..... |
| 9 | ..... | ..... | 11 | ..... | 7.2 | 2.0 | 17 | ..... |
| 10 | 4.9 | ..... | 7.9 | ..... | 5.6 | 2.0 | 17 | ..... |
| 11 | ..... | ..... | 57 | ..... | 3.8 | 2.0 | 50 | ..... |
| 12 | ..... | ..... | 50 | ..... | 27 | 2.0 | 22 | ..... |
| 13 | ..... | ..... | 24 | ..... | 27 | 1.0 | 17 | ..... |
| 14 | ..... | ..... | 18 | ..... | 50 | 1.0 | 14 | ..... |
| 15 | ..... | ..... | 16 | 24 | 30 | 1.0 | 12 | ..... |
| 16 | ..... | 2.8 | 16 | 27 | 22 | 1.0 | 10 | ..... |
| 17 | ..... | 2.8 | 11 | 22 | 65 | 1.0 | 8.0 | ..... |
| 18 | ..... | 2.8 | 16 | 20 | 35 | 1.0 | 5.9 | ..... |
| 19 | ..... | 2.8 | 16 | 22 | 27 | .9 | 5.9 | ..... |
| 20 | ..... | 2.8 | ..... | 20 | 22 | .8 | 5.9 | ..... |
| 21 | ..... | 7.9 | ..... | 30 | 22 | 10 | 4.8 | ..... |
| 22 | ..... | 9.4 | ..... | 27 | 24 | 8.0 | 4.8 | ..... |
| 23 | ..... | 7.9 | ..... | 20 | 27 | 5.9 | 4.8 | ..... |
| 24 | ..... | 6.4 | ..... | 15 | 24 | 5.9 | 3.8 | ..... |
| 25 | ..... | 6.4 | ..... | 15 | 24 | 5.9 | 3.8 | ..... |
| 26 | ..... | 13 | ..... | 12 | 18 | 5.9 | 3.8 | ..... |
| 27 | ..... | 7.9 | ..... | 12 | 15 | 3.8 | 3.8 | ..... |
| 28 | ..... | 7.9 | ..... | 27 | 10 | 3.8 | 3.8 | ..... |
| 29 | ..... | 6.4 | ..... | 32 | 4.5 | 3.8 | 3.8 | ..... |
| 30 | ..... | 11 | ..... | 18 | 4.5 | 3.8 | 3.8 | ..... |
| 31 | ..... | 13 | ..... | 14 | ..... | 3.8 | 3.8 | ..... |
| Mean | ..... | 6.95 | 18.7 | 21.0 | 20.0 | 11.0 | 4.55 | 3.8 |
| Mean per square mile | ..... | .772 | 2.08 | 3.56 | 3.39 | .771 | 1.86 | .644 |
| Run-off (depth in inches on drainage area) | ..... | .46 | 1.47 | 2.25 | 3.78 | .89 | 2.14 | .12 |
| Accuracy | ..... | B. | B. | C. | C. | B. | B. | B. |

[a] The rating table for this station is believed to be accurate within 5 per cent.

[b] The rating curve is fairly well defined below 20 second-feet. A considerable portion of this record is estimated, but the error involved is believed to be small.

*Miscellaneous measurements in North Fork of Fortymile River drainage basin in 1912.*

| Date. | Stream and locality. | Discharge. | Drainage area. | Discharge per square mile. |
|---|---|---|---|---|
| | | *Sec.-ft.* | *Sq. miles.* | *Sec.-ft.* |
| July 17 | North Fork of Fortymile at "Kink" | 541 | 2,010 | 0.269 |
| July 19 | Slate Creek at mouth | 75.7 | 336 | .225 |
| July 18 | North Fork of Fortymile above Middle Fork | 250 | 724 | .345 |
| July 19 | North Fork of Fortymile above Slate Creek | 59.0 | 109 | .541 |
| Do | Comet Creek at mouth | 36.4 | 60.5 | .602 |
| Do | Champion Creek at mouth | 34.8 | 179 | .194 |
| July 18 | Bullion Creek at mouth | 5.54 | 34.3 | .162 |
| Do | Hutchinson Creek at mouth | 11.2 | 71.3 | .157 |

## LOWER FORTYMILE RIVER BASIN.

Below the junction of North and South forks Fortymile River flows in a V-shaped valley about 500 feet below an old valley floor, where it is joined by O'Brien, Flat, Steele, Twin, Nugget, Canyon, Smith, Moose and Uncle Sam creeks. The largest of these is O'Brien Creek, which has for tributaries King Solomon Creek, Liberty Fork, Columbia, Alder, and Dome creeks. Moose Creek is almost entirely in Canadian territory. All these streams have heavy gradients and at their mouths have cut deeply into the high bench lands.

*Daily discharge, in second-feet, of King Solomon Creek, Liberty Fork, and Dome Creek for 1912.*

| Day. | King Solomon Creek at Liberty Cabin.[a] [Drainage area, 54.2 square miles.] | | | Liberty Fork at mouth.[b] [Drainage area, 43.1 square miles.] | | | Dome Creek at Auburn Mining Co. camp.[c] [Drainage area, 24.9 square miles.] | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | June. | July. | Aug. | June. | July. | Aug. | June. | July. | Aug. | Sept. |
| 1 | ..... | 10 | 64 | ..... | ..... | ..... | ..... | 2.2 | 9.0 | 11 |
| 2 | 98 | 10 | 64 | 36 | 11 | 390 | 47 | 2.2 | 8.4 | 8.4 |
| 3 | 153 | 15 | 33 | ..... | ..... | 30 | ..... | 2.2 | 8.4 | 8.4 |
| 4 | 30 | 10 | 30 | ..... | ..... | 30 | ..... | 2.2 | 7.2 | 11 |
| 5 | ..... | 10 | 26 | ..... | ..... | ..... | ..... | 1.1 | 7.2 | 11 |
| 6 | ..... | 9 | 30 | ..... | ..... | ..... | ..... | 1.1 | 7.2 | 8.4 |
| 7 | ..... | 9 | 396 | ..... | 11 | ..... | ..... | 1.1 | 35 | 14 |
| 8 | 64 | 9 | 171 | ..... | ..... | ..... | ..... | 1.1 | 30 | 11 |
| 9 | ..... | 7 | 98 | ..... | ..... | ..... | ..... | 1.1 | 25 | 14 |
| 10 | 30 | 5 | 80 | ..... | ..... | ..... | ..... | 1.1 | 20 | 17 |
| 11 | 26 | 9 | 112 | 8 | 11 | ..... | ..... | 1.1 | 47 | 14 |
| 12 | 22 | 9 | 230 | ..... | ..... | ..... | ..... | 1.1 | 41 | 17 |
| 13 | ..... | 8 | 136 | 14 | ..... | ..... | ..... | 2.2 | 35 | 11 |
| 14 | 30 | 8 | 86 | 14 | ..... | ..... | 6.0 | 2.2 | 31 | 11 |
| 15 | ..... | 8 | 74 | ..... | ..... | ..... | ..... | 2.2 | 27 | 11 |
| 16 | ..... | 7 | 69 | ..... | ..... | ..... | ..... | 2.2 | 24 | 11 |
| 17 | ..... | 7 | 56 | ..... | 24 | ..... | ..... | 2.2 | 22 | 20 |
| 18 | 30 | 7 | 45 | ..... | ..... | ..... | 6.0 | 2.2 | 20 | 31 |
| 19 | ..... | 10 | 42 | ..... | ..... | ..... | ..... | 2.2 | 18 | 23 |
| 20 | ..... | 15 | 36 | ..... | ..... | ..... | ..... | 2.2 | 16 | 27 |
| 21 | ..... | 56 | 32 | ..... | 200 | ..... | ..... | 27 | 17 | 20 |
| 22 | ..... | 52 | 30 | ..... | ..... | ..... | ..... | 24 | 16 | 15 |
| 23 | ..... | 48 | 28 | ..... | ..... | ..... | ..... | 21 | 12 | 10 |
| 24 | ..... | 44 | 26 | ..... | ..... | ..... | ..... | 18 | 10 | 10 |
| 25 | ..... | 38 | 24 | ..... | ..... | ..... | ..... | 15 | 10 | 10 |
| 26 | ..... | 34 | 22 | ..... | ..... | ..... | ..... | 12 | 10 | 10 |
| 27 | ..... | 30 | 38 | ..... | 96 | ..... | 8.4 | 11 | 8 | 10 |
| 28 | ..... | 30 | 32 | ..... | ..... | ..... | ..... | 10 | 8 | 10 |
| 29 | ..... | 28 | 26 | ..... | ..... | ..... | ..... | 10 | 8 | 8.4 |
| 30 | ..... | 26 | 20 | ..... | ..... | 21 | ..... | 10 | 7.2 | 8.4 |
| 31 | ..... | 24 | 22 | ..... | ..... | ..... | ..... | 9.0 | 11 | ..... |
| Mean | 19.1 | 19.1 | 70.3 | ..... | ..... | ..... | 6.52 | 6.52 | 17.9 | 13.4 |
| Mean per square mile | ..... | .352 | 1.30 | ..... | ..... | ..... | ..... | .262 | .719 | .538 |
| Run-off (depth in inches on drainage area) | ..... | .41 | 1.50 | ..... | ..... | ..... | ..... | .30 | .83 | .60 |
| Accuracy | ..... | B. | B. | ..... | ..... | ..... | ..... | C. | B. | B. |

[a] The rating is well defined below 140 second-feet. A number of periods in the July record are estimated.
[b] The rating curve is well defined below 50 second-feet.
[c] The rating curve is well defined for discharges below 30 second-feet. A considerable portion of the record for July and August is estimated.

*Daily discharge, in second-feet, of Steele, Canyon, and Squaw creeks for 1912.*

| Days. | Steele Creek at mouth.[a] [Drainage area 12.5 square miles.] | | | | Canyon Creek below Squaw Creek.[b] [Drainage area 56.5 square miles.] | | | | Squaw Creek at claim No. 1 above.[c] [Drainage area 24.4 square miles.] | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | June. | July. | Aug. | Sept. | June. | July. | Aug. | Sept. | June. | July. | Aug. | Sept. |
| 1 | ..... | 1.3 | 1.8 | 3.7 | ..... | ..... | ..... | 27 | ..... | 14 | 79 | 14 |
| 2 | ..... | 1.0 | 4.6 | 3.7 | ..... | ..... | ..... | 27 | ..... | 14 | 67 | 10.5 |
| 3 | 38 | 1.3 | 2.3 | 4.6 | ..... | ..... | ..... | 23 | ..... | 10.5 | 47 | 14 |
| 4 | 6.6 | 1.3 | 2.3 | 3.7 | ..... | ..... | ..... | 31 | 24 | 5.5 | 39 | 14 |
| 5 | 9.6 | .8 | 2.3 | 3.7 | 46 | 7.8 | ..... | 27 | 24 | 2.2 | 57 | 18 |
| 6 | 5.5 | .8 | 3.7 | 3.7 | ..... | ..... | 195 | 36 | 18 | 2.2 | 79 | 18 |
| 7 | 3.7 | .8 | 26 | 3.7 | ..... | ..... | 155 | 67 | 18 | 2.2 | 57 | 24 |
| 8 | 3.7 | .6 | 11 | 3.7 | ..... | ..... | 99 | 67 | 18 | 2.2 | 24 | 24 |
| 9 | 4.6 | .4 | 7.8 | 3.7 | ..... | ..... | 67 | 99 | 18 | 2.2 | 24 | 24 |
| 10 | 2.3 | .4 | 7.8 | 5.5 | ..... | ..... | 67 | 113 | 14 | 2.2 | 24 | 18 |
| 11 | 2.3 | .2 | 87 | 5.5 | ..... | ..... | 300 | 106 | 14 | 3.0 | 120 | 18 |
| 12 | 1.8 | .2 | 46 | 4.6 | ..... | ..... | 171 | 67 | 18 | 3.7 | 108 | 14 |
| 13 | 2.3 | .3 | 9.6 | 5.5 | ..... | ..... | 148 | 36 | 24 | 5.5 | 79 | 14 |
| 14 | 14 | .4 | 6.6 | 6.6 | ..... | ..... | 106 | 51 | 24 | 5.5 | 62 | 10.5 |
| 15 | 11 | .4 | 7.8 | 5.5 | ..... | ..... | 73 | 36 | 31 | 7.7 | 47 | 10.5 |
| 16 | 30 | .3 | 6.6 | 6.6 | ..... | ..... | 67 | 27 | 39 | 7.7 | 39 | 10.5 |
| 17 | 18 | 4 | 5.5 | 7.8 | ..... | ..... | 51 | 41 | 31 | 10.5 | 31 | 18 |
| 18 | 14 | .4 | 7.8 | 97 | ..... | ..... | 51 | 235 | 24 | 10.5 | 35 | 175 |
| 19 | 14 | .4 | 7.8 | 92 | ..... | ..... | 67 | 106 | 24 | 10.5 | 39 | 100 |
| 20 | 14 | .4 | 6.6 | 38 | ..... | ..... | 51 | 141 | 31 | 10.5 | 31 | 100 |
| 21 | 14 | 1.0 | 3.7 | 26 | ..... | ..... | 41 | 106 | 52 | 24 | 14 | 80 |
| 22 | 14 | .20 | 5.5 | 20 | ..... | ..... | 41 | 61 | 62 | 57 | 14 | 79 |
| 23 | 11 | 5.5 | 5.5 | 11 | ..... | ..... | 41 | 41 | 47 | 67 | 10.5 | 47 |
| 24 | 5.5 | 5.5 | 4.6 | 7.8 | ..... | ..... | 31 | 51 | 35 | 57 | 10.5 | 39 |
| 25 | 3.7 | 3.7 | 4.6 | 5.5 | ..... | ..... | 27 | 36 | 24 | 57 | 10.5 | 31 |
| 26 | 4.6 | 2.3 | 3.7 | 5.5 | ..... | ..... | 23 | 67 | 24 | 47 | 16 | 24 |
| 27 | 3.7 | 23 | 3.7 | 5.5 | ..... | ..... | 41 | 61 | 18 | 47 | 24 | 18 |
| 28 | 2.3 | 5.5 | 4.6 | 5.5 | ..... | ..... | 41 | ..... | 14 | 39 | 24 | 14 |
| 29 | 1.3 | 3.7 | 3.7 | 4.6 | ..... | ..... | 36 | ..... | 14 | 39 | 24 | 10.5 |
| 30 | .8 | 2.3 | 4.6 | 3.7 | ..... | ..... | 27 | ..... | 14 | 47 | 18 | 10.5 |
| 31 | ..... | 1.3 | 3.7 | ..... | ..... | ..... | 36 | ..... | ..... | 57 | 14 | ..... |
| Mean | 9.2 | 2.8 | 7.4 | 13.3 | ..... | ..... | 79.0 | 66.1 | 25.9 | 21.6 | 40.9 | 33.4 |
| Mean per square mile | .736 | .222 | .592 | 1.06 | ..... | ..... | 1.40 | 1.17 | 1.06 | .885 | 1.68 | 1.37 |
| Run-off (depth in inches on drainage area) | .77 | .26 | .68 | 1.18 | ..... | ..... | 1.35 | 1.17 | 1.06 | 1.02 | 1.94 | 1.53 |
| Accuracy | A. | A. | A. | A. | ..... | ..... | C. | C. | B. | B. | C. | C. |

[a] Discharges below 50 second-feet are believed to be accurate within 5 per cent.

[b] The daily discharges at this station were determined by a gage height record taken at the mouth of Canyon Creek and by discharge measurements made at the point for which the record is given. The relation between the gages at the two points was obtained. The results are probably accurate within 15 per cent.

[c] The rating curve was well defined for the first half of the summer. Changes in the channel the latter part of the season affected the rating, but results are probably accurate within 15 per cent.

*Miscellaneous measurements in Lower Fortymile River drainage basin in 1912.*

| Date. | Stream and locality. | Discharge. | Drainage area. | Discharge per square mile. |
|---|---|---|---|---|
| | | *Sec.-ft.* | *Sq. mi.* | *Sec.-ft.* |
| August 26 | Canyon Creek at mouth | 49.2 | 86.5 | 0.569 |
| August 27 | ....do | 59.0 | 86.5 | .683 |
| July 5 | Woods Creek above Camp Creek | 1.01 | 6.1 | .166 |
| Do | Camp Creek at mouth | 2.00 | 5.4 | .370 |
| Do | Hall Creek at mouth | 3.90 | 12.0 | .325 |
| August 26 | Marion Creek at mouth | 2.5 | 11.0 | .227 |
| August 29 | Discovery Creek at mouth | 1.1 | 3.4 | .324 |
| August 28 | Smith Creek at mouth | 7.5 | 28.4 | .264 |
| Do | Moose Creek at mouth | 18.0 | ..... | ..... |
| Do | Moose Creek ditch 2 miles below intake | .70 | ..... | ..... |

## HYDROGRAPHS OF STREAMS IN THE FORTYMILE DISTRICT.

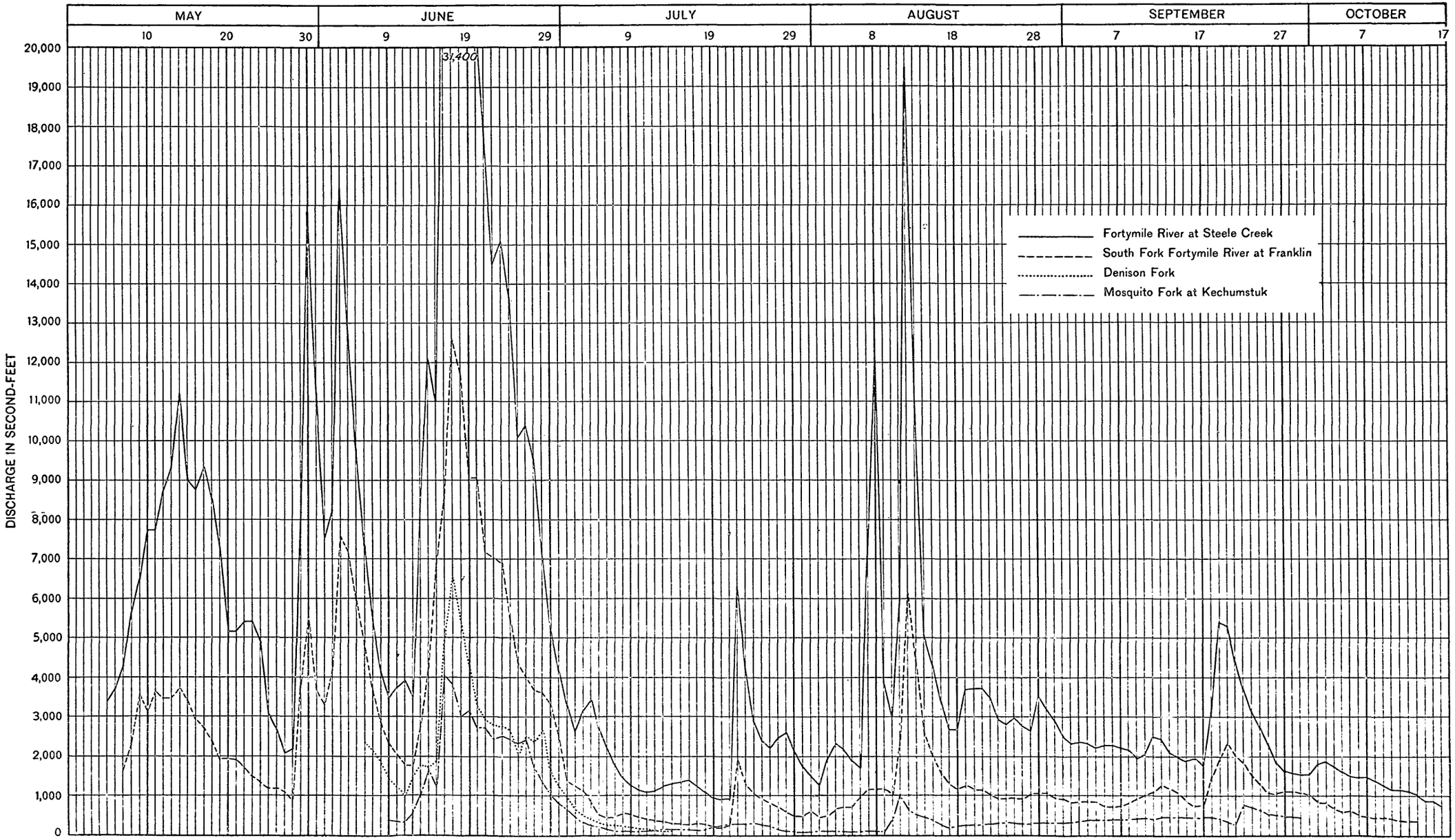
Hydrographs showing the daily discharge of Fortymile River at Steele Creek, South Fork of Fortymile River at Franklin, Denison Fork at mouth, and Mosquito Fork at Kechumstuk for 1912 are given on Plate VIII. These hydrographs show clearly the sudden and wide fluctuations peculiar to these northern streams. They show also that most storm waves extend over the entire Fortymile basin, though their intensity of precipitation may vary considerably with locality. It is interesting to note that although the drainage area of South Fork at Franklin forms more than half of that of Fortymile River at Steele Creek, the discharge from it is much less than half the discharge of Fortymile. This fact, which is also evident in the records for 1910 and 1911, is believed to be attributable to two causes: (1) South Fork basin contains an extensive flat swampy area, which affords much storage and a consequent large evaporation loss, whereas North Fork basin is more precipitous and drains more quickly, allowing less opportunity for evaporation; (2) the general elevation of the South Fork basin is less than that of the North Fork and therefore the precipitation is probably less. It is believed that these observations are verified by a study of the hydrographs.

## SEVENTYMILE DISTRICT.

The Seventymile district comprises the area drained by Seventymile River and its tributaries. It adjoins the Eagle district on the north and borders the lands drained by tributaries of North Fork of Fortymile River. It lies within the Eagle precinct, and Eagle is the supply point for all the mines. The area has been topographically surveyed and is shown on the Geological Survey maps of the Fortymile and Circle quadrangles.

Seventymile River drains an area of about 700 square miles, practically three-fourths of which lies south of the river. The headwaters of the main river lie in the high rugged divide separating the basins of Seventymile and Charley rivers. Seventymile River drains the eastern slope of this divide and flows eastward for about 60 miles to a point 4 miles from its mouth, where it makes a right-angle turn and flows northward, joining the Yukon about 20 miles below Eagle.

The principal southern tributaries of Seventymile River, beginning at its headwaters, are Diamond Fork, Flume, Alder, Deep, Nugget, Granite, Green, Sonickson, Mogul, and Bryant creeks. Of these streams, Granite and Mogul creeks furnish a steady supply of water to the main river. Both creeks have a heavy fall, but no workable placers have yet been found on them. The heavy timber on Mogul Creek now supplies some large saw logs to the district. The tributaries of the Seventymile from the north are small, short streams,




HYDROGRAPH SHOWING DAILY DISCHARGE OF FORTYMILE RIVER, SOUTH FORK OF FORTYMILE RIVER, DENISON FORK, AND MOSQUITO FORK 1912.

usually falling to a minimum as soon as the snow leaves the ridges. They are Barney, Washington, Broken Neck, Crooked, and Fox creeks—all containing workable placers.

Extensive bench formations occur throughout the Seventymile Valley. Above the falls, which are located about one-half mile below Washington Creek, the river flows through a rather broad gravelly flood plain, but below the falls it is more closely confined and along a considerable part of its course has cut a rock canyon 20 to 30 feet deep. At the falls the river has a drop of about 9 feet in a horizontal distance of less than 200 feet. From Diamond Fork to the mouth, a distance of 53 miles following the general trend of the valley, the river has a fall of over 2,000 feet. From Diamond Fork to Barney Creek the river falls 1,400 feet in 25 miles, and from Flume Creek to Barney Creek it drops 600 feet in 15 miles.

The following list gives the locations at which gaging stations were maintained or discharge measurements were made in 1912 in the Seventymile district. The relation of the tributaries is shown by the indention.

Seventymile River above Flume Creek.
Seventymile at the falls.
    Flume Creek one-fourth mile above mouth.
    Alder Creek at claim "No. 7 above."
    Deep Creek one-half mile above mouth.
    Nugget Creek at mouth.
    West Fork of Granite Creek 1½ miles above forks.
    Granite Creek at mouth.
        East Fork at Granite Creek 1 mile above forks.
    Barney Creek at mouth.
        Barney Creek ditch.
    Sonickson Creek above ditch intake.
    Washington Creek at mouth.
        Washington Creek ditch at intake.
    Broken Neck Creek at mouth.
    Mogul Creek at mouth.
    Crooked Creek below Eldorado Creek.
    Fox Creek at Rolf's claim.
    Bryant Creek 2 miles above mouth.
    Rock Creek at bridge.

*Monthly discharge of Seventymile River at the falls for 1910 to 1912.*

[Drainage area, 465 square miles.]

| Month. | Discharge in second-feet. | | | | Run-off (depth in inches on drainage area). |
|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | Mean per square mile. | |
| 1910. | | | | | |
| June 16–30 | 2,250 | 340 | 851 | 1.83 | 1.02 |
| July | 1,350 | 208 | 402 | .865 | 1.00 |
| August | 4,430 | 208 | 719 | 1.55 | 1.79 |
| September | 1,600 | 225 | 626 | 1.35 | 1.51 |
| The period, 107 days | 4,430 | 208 | 619 | 1.33 | 5.32 |
| 1911. | | | | | |
| June 20–30 | 1,050 | 410 | 737 | 1.58 | .64 |
| July | 1,550 | 130 | 344 | .739 | .85 |
| August | 1,130 | 110 | 306 | .659 | .76 |
| September 1–25 | 442 | 130 | 219 | .471 | .43 |
| The period, 98 days | 1,550 | 110 | 344 | .740 | 2.68 |
| 1912. | | | | | |
| May 3–31 | 1,560 | 254 | 435 | .935 | 1.01 |
| June | 1,670 | 148 | 603 | 1.30 | 1.45 |
| July | 3,400 | 148 | 573 | 1.23 | 1.42 |
| August | 8,150 | 376 | 1,180 | 2.54 | 2.93 |
| September | 376 | 300 | 329 | .708 | .79 |
| October 1–18 | 336 | 300 | 302 | .650 | .44 |
| The period, 169 days | 8,150 | 148 | 593 | 1.28 | 8.04 |

*Daily discharge, in second-feet, of Seventymile River at the falls for 1912.*[a]

[Drainage area, 465 square miles.]

| Day. | May. | June. | July. | Aug. | Sept. | Oct. |
|---|---|---|---|---|---|---|
| 1 | ..... | 528 | 214 | 642 | 376 | 300 |
| 2 | ..... | 584 | 227 | 737 | 376 | 300 |
| 3 | 336 | 584 | 584 | 622 | 376 | 336 |
| 4 | 336 | 318 | 399 | 473 | 376 | 300 |
| 5 | 300 | 214 | 268 | 392 | 376 | 300 |
| 6 | 268 | 168 | 202 | 486 | 376 | 300 |
| 7 | 254 | 148 | 168 | 8,150 | 376 | 300 |
| 8 | 254 | 190 | 168 | 2,980 | 376 | 300 |
| 9 | 336 | 399 | 148 | 1,930 | 336 | 300 |
| 10 | 318 | 612 | 148 | 1,440 | 336 | 300 |
| 11 | 284 | 528 | 214 | 4,170 | 336 | 300 |
| 12 | 300 | 1,670 | 376 | 2,780 | 336 | 300 |
| 13 | 356 | 1,300 | 300 | 1,450 | 336 | 300 |
| 14 | 474 | 1,560 | 254 | 912 | 300 | 300 |
| 15 | 336 | 1,170 | 336 | 635 | 300 | 300 |
| 16 | 336 | 1,170 | 227 | 629 | 300 | 300 |
| 17 | 399 | 727 | 190 | 541 | 300 | 300 |
| 18 | 356 | 584 | 227 | 527 | 336 | 300 |
| 19 | 318 | 528 | 240 | 777 | 336 | ..... |
| 20 | 300 | 474 | 214 | 640 | 300 | ..... |
| 21 | 336 | 448 | 3,400 | 528 | 300 | ..... |
| 22 | 422 | 698 | 2,100 | 474 | 300 | ..... |
| 23 | 474 | 474 | 1,250 | 474 | 300 | ..... |
| 24 | 556 | 448 | 1,300 | 698 | 300 | ..... |
| 25 | 268 | 474 | 1,020 | 698 | 300 | ..... |
| 26 | 300 | 640 | 786 | 528 | 300 | ..... |
| 27 | 336 | 640 | 816 | 474 | 300 | ..... |
| 28 | 422 | 356 | 612 | 474 | 300 | ..... |
| 29 | 1,560 | 240 | 474 | 422 | 300 | ..... |
| 30 | 1,250 | 214 | 422 | 376 | 300 | ..... |
| 31 | 816 | ..... | 474 | 376 | ..... | ..... |
| Mean | 435 | 603 | 573 | 1,180 | 329 | 302 |
| Mean per square mile | .935 | 1.30 | 1.23 | 2.54 | .708 | .650 |
| Run-off (depth in inches on drainage area) | 1.01 | 1.45 | 1.42 | 2.93 | .79 | .44 |
| Accuracy | A. | A. | B. | B. | A. | A. |

[a] The rating curve is well defined below 1,500 second-feet. The record for Aug. 1–19 is estimated by comparison with the hydrographs of Flume, Adler, Washington, and Crooked creeks.

*Daily discharge, in second-feet, of Flume and Alder creeks for 1912.*

| Day. | Flume Creek one-fourth mile above mouth.[a] [Drainage area, 36.7 square miles.] | | | | | Alder Creek at claim "No. 7 above."[b] [Drainage area, 11.8 square miles.] | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | May. | June. | July. | Aug. | Sept. | May. | June. | July. | Aug. | Sept. | Oct. |
| 1 | ..... | ..... | ..... | 43 | 30 | ..... | 12 | 5.5 | 26 | 9.3 | 7.3 |
| 2 | ..... | ..... | ..... | 53 | 30 | ..... | 17 | 7.1 | 26 | 11 | 8.6 |
| 3 | ..... | ..... | ..... | 40 | 30 | ..... | 13 | 9.5 | 16 | 12 | 9.8 |
| 4 | ..... | ..... | ..... | 33 | 33 | ..... | 7.9 | 8.5 | 12 | 12 | 7.3 |
| 5 | ..... | ..... | ..... | 27 | 33 | ..... | 5.9 | 7.1 | 9.5 | 12 | 8.6 |
| 6 | ..... | ..... | ..... | 33 | 33 | ..... | 5.2 | 5.5 | 12 | 11 | 7.3 |
| 7 | ..... | ..... | ..... | 735 | 33 | ..... | 4.1 | 4.1 | 162 | 9.8 | 7.3 |
| 8 | ..... | ..... | ..... | 280 | 33 | ..... | 9.5 | 3.8 | 76 | 10 | 7.3 |
| 9 | ..... | ..... | ..... | 190 | ..... | 12 | 16 | 3.8 | 42 | 10 | 6.9 |
| 10 | ..... | ..... | ..... | 98 | ..... | 2.5 | 16 | 12 | 28 | 11 | 6.3 |
| 11 | ..... | ..... | ..... | 379 | ..... | 3.2 | 22 | 12 | 88 | 9.8 | 5.3 |
| 12 | ..... | ..... | ..... | 264 | ..... | 3.8 | 82 | 9.5 | 66 | 12 | 6.3 |
| 13 | ..... | ..... | ..... | 120 | ..... | 5.2 | 42 | 7.5 | 40 | 12 | 6.3 |
| 14 | ..... | ..... | ..... | 68 | ..... | 6.5 | 32 | 7.1 | 28 | 9.8 | 5.7 |
| 15 | ..... | ..... | ..... | 40 | ..... | 5.2 | 30 | 5.5 | 22 | 9.8 | ..... |
| 16 | ..... | ..... | ..... | 44 | ..... | 7.5 | 21 | 5.2 | 21 | 9.8 | ..... |
| 17 | ..... | ..... | ..... | 40 | ..... | 6.5 | 13 | 5.2 | 17 | 9.8 | ..... |
| 18 | ..... | ..... | ..... | 36 | ..... | 7.9 | 10 | 4.6 | 16 | 9.8 | ..... |
| 19 | ..... | ..... | ..... | 48 | ..... | 5.2 | 9.1 | 3.8 | 15 | 9.8 | ..... |
| 20 | ..... | ..... | ..... | 40 | ..... | 5.5 | 7.9 | 4.6 | 13 | 8.6 | ..... |
| 21 | ..... | ..... | 396 | 33 | ..... | 6.5 | 7.1 | 130 | 12 | 9.3 | ..... |
| 22 | ..... | ..... | 174 | 33 | ..... | 7.5 | 7.9 | 76 | 11 | 9.8 | ..... |
| 23 | ..... | ..... | 146 | 30 | ..... | 9.1 | 11 | 38 | 11 | 9.8 | ..... |
| 24 | ..... | ..... | 133 | 40 | ..... | 5.9 | 13 | 42 | 17 | 7.3 | ..... |
| 25 | ..... | 30 | 68 | 40 | ..... | 5.9 | 13 | 24 | 16 | 6.3 | ..... |
| 26 | 19 | ..... | 48 | 40 | ..... | 5.5 | 15 | 16 | 14 | 7.3 | ..... |
| 27 | ..... | ..... | 36 | 33 | ..... | 7.1 | 14 | 12 | 12 | 8.6 | ..... |
| 28 | ..... | ..... | 30 | 33 | ..... | 9.5 | 9.5 | 9.5 | 12 | 7.3 | ..... |
| 29 | ..... | ..... | 30 | 30 | ..... | 47 | 7.1 | 9.1 | 10 | 6.9 | ..... |
| 30 | ..... | ..... | 33 | 30 | ..... | 32 | 5.9 | 8.5 | 10 | 7.3 | ..... |
| 31 | ..... | ..... | 40 | 30 | ..... | 14 | 16 | 16 | 10 | ..... | ..... |
| Mean | ..... | ..... | 103 | 96.4 | 31.9 | 9.6 | 16.0 | 16.5 | 24.9 | 9.6 | 7.2 |
| Mean per square mile | ..... | ..... | 2.80 | 2.63 | .869 | .813 | 1.36 | 1.40 | 2.11 | .814 | .610 |
| Run-off (depth in inches on drainage area) | ..... | ..... | 1.14 | 3.03 | .26 | .70 | 1.52 | 1.61 | 2.43 | .91 | .32 |
| Accuracy | ..... | ..... | B. | B. | B. | B. | B. | B. | B. | B. | B. |

[a] The rating curve is fairly well defined for discharges below 400 second-feet.
[b] The discharges for this station are probably accurate within 5 per cent.

*Daily discharge, in second-feet, of Barney Creek ditch, Sonickson and Washington creeks, for 1912.*

| Day. | Barney Creek ditch. | | | | | Sonickson Creek above ditch intake. [Drainage area 12.6 square miles.] | | | Washington Creek at mouth.[a] [Drainage area 15.6 square miles.] | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | May. | June. | July. | Aug. | Sept. | May. | June. | July. | May. | June. | July. | Aug. | Sept. |
| 1 | ..... | 5.1 | 0.3 | 0.7 | 1.4 | ..... | ..... | 3.7 | ..... | 5 | 0.8 | 5.2 | 6.5 |
| 2 | ..... | 5.1 | .3 | .7 | 1.4 | ..... | ..... | ..... | ..... | 34 | 51 | 11 | 8.8 |
| 3 | ..... | 4.7 | .3 | .6 | 1.4 | ..... | 14 | ..... | ..... | 10 | 21 | 11 | 11 |
| 4 | ..... | 3.1 | .3 | .5 | 1.4 | ..... | ..... | ..... | ..... | 13 | 10 | 8.8 | 6.5 |
| 5 | ..... | 3.1 | .4 | .3 | 1.4 | ..... | ..... | 7.7 | ..... | 5 | 8.2 | 6.5 | 6.5 |
| 6 | ..... | 4.1 | .3 | 3.1 | 1.4 | ..... | 4.8 | ..... | ..... | 5 | 3.3 | 11 | 4.5 |
| 7 | ..... | 4.1 | .2 | 7.9 | ..... | ..... | ..... | 4.2 | ..... | 5 | 1.3 | 99 | 2.5 |
| 8 | ..... | 3.1 | .3 | 6.2 | ..... | ..... | 8.6 | ..... | ..... | 16 | 1.3 | 46 | 2.5 |
| 9 | ..... | 3.1 | .5 | 6.1 | ..... | ..... | ..... | ..... | ..... | 34 | .8 | 28 | 2.5 |
| 10 | ..... | 2.2 | .7 | 5.1 | ..... | ..... | ..... | ..... | ..... | 15 | 1.3 | 19 | 2.5 |
| 11 | ..... | 2.2 | 1.4 | 4.1 | ..... | ..... | ..... | ..... | ..... | 10 | 6.3 | 64 | 2.5 |
| 12 | ..... | 1.4 | 2.2 | 3.2 | ..... | ..... | 36 | 8.6 | ..... | 18 | 6.3 | 34 | 2.0 |
| 13 | ..... | 1.4 | 2.2 | 3.1 | ..... | ..... | ..... | ..... | ..... | 10 | 4.8 | 25 | 2.0 |
| 14 | ..... | 1.4 | 2.0 | 3.1 | ..... | ..... | ..... | ..... | ..... | 8.2 | 8.2 | 16 | 2.0 |
| 15 | ..... | .7 | 1.5 | 2.9 | ..... | ..... | ..... | ..... | ..... | 6.3 | 6.3 | 11 | 2.0 |
| 16 | ..... | .4 | 1.4 | 2.2 | ..... | ..... | ..... | ..... | ..... | 3.3 | 4.8 | 8.8 | 2.0 |
| 17 | ..... | .3 | 1.0 | 2.2 | ..... | ..... | ..... | ..... | ..... | 2.3 | 10 | 6.5 | 2.0 |
| 18 | ..... | .5 | .8 | 2.6 | ..... | ..... | ..... | 11 | ..... | 1.3 | 10 | 11 | 2.0 |
| 19 | ..... | 3.1 | .6 | 3.1 | ..... | ..... | ..... | ..... | ..... | 1.3 | 12 | 19 | 2.0 |
| 20 | ..... | 3.1 | .7 | 4.1 | ..... | ..... | ..... | ..... | ..... | .8 | 10 | 16 | 2.0 |
| 21 | ..... | 4.1 | 6.7 | 3.1 | ..... | ..... | ..... | 135 | ..... | 1.3 | 100 | 14 | 2.0 |
| 22 | ..... | 4.3 | 6.1 | 3.1 | ..... | ..... | 9.8 | ..... | ..... | 3.3 | 28 | 16 | 2.0 |
| 23 | ..... | .3 | 5.6 | 3.1 | ..... | ..... | 7.7 | ..... | ..... | 6.3 | 22 | 11 | 2.0 |
| 24 | ..... | .3 | 5.1 | 2.6 | ..... | 4.8 | ..... | ..... | ..... | 8.0 | 16 | 8.8 | 2.0 |
| 25 | 0.3 | .4 | 3.2 | 2.5 | ..... | 4.2 | ..... | ..... | ..... | 10 | 11 | 6.5 | 2.0 |
| 26 | .3 | 1.4 | 3.1 | 2.4 | ..... | ..... | ..... | ..... | ..... | 10 | 11 | 11 | 1.5 |
| 27 | .3 | 5.1 | 3.1 | 2.2 | ..... | 4.2 | ..... | ..... | ..... | 12 | 8.8 | 8.8 | 1.5 |
| 28 | .3 | 4.1 | 2.2 | 1.8 | ..... | ..... | ..... | ..... | ..... | 8.0 | 6.5 | 6.5 | 1.5 |
| 29 | 1.4 | 2.2 | 1.8 | 1.6 | ..... | 55 | 6.8 | ..... | ..... | 6.0 | 5.2 | 8.8 | 1.5 |
| 30 | 5.1 | .3 | 1.4 | 1.6 | ..... | 27 | ..... | ..... | 25 | 3.0 | 4.0 | 8.8 | 1.5 |
| 31 | 4.6 | ..... | .8 | 1.4 | ..... | ..... | ..... | ..... | 10 | ..... | 4.0 | 6.5 | ..... |
| Mean | 1.76 | 2.49 | 1.82 | 2.81 | 1.40 | ..... | ..... | ..... | ..... | 9.0 | 12.7 | 17.7 | 3.1 |
| Mean per square mile | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | .577 | .814 | 1.13 | .199 |
| Run-off (depth in inches on drainage area) | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | .64 | .94 | 1.30 | .22 |
| Accuracy | B. | B. | B. | B. | B. | ..... | ..... | ..... | ..... | C. | C. | C. | C. |

[a] The channel at this station shifted considerably throughout the summer. The rating curve is believed to be fairly well defined below 25 second-feet. Beginning September 2, about 3 second-feet were diverted from the creek about one-half mile above the gage.

*Discharge, in second-feet, of Crooked and Fox creeks for 1912.*

| Day. | Crooked Creek below Eldorado Creek.[a] [Drainage area 17.2 square miles.] | | | | | Fox Creek at Rolf's claim.[a] [Drainage area 8.3 square miles.] | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | May. | June. | July. | Aug. | Sept. | May. | June. | July. | Aug. | Sept. |
| 1 | ..... | 5.0 | 3.0 | 16 | 10 | ..... | 2.4 | 1.0 | 7.0 | 5.3 |
| 2 | ..... | 24 | 5.0 | 19 | 10 | ..... | 11.5 | 2.9 | 6.0 | 5.3 |
| 3 | ..... | 24 | 10.8 | 17 | 9 | ..... | 5.4 | 5.4 | 6.0 | 5.3 |
| 4 | ..... | 9.5 | 6.0 | 16 | 10 | ..... | 2.9 | 2.9 | 6.0 | 5.3 |
| 5 | ..... | 7.0 | 4.0 | 14 | 10 | ..... | 1.6 | 1.6 | 6.0 | 5.3 |
| 6 | ..... | 5.0 | 3.0 | 16 | 9 | ..... | 1.0 | 1.0 | 6.0 | ..... |
| 7 | ..... | 3.0 | 2.0 | 208 | 9 | ..... | 1.0 | 1.0 | 21 | ..... |
| 8 | ..... | 22 | 1.0 | 38 | 9 | ..... | 5.4 | .8 | 15 | ..... |
| 9 | ..... | 41 | 1.0 | 26 | 10 | ..... | 10.2 | .8 | 10 | ..... |
| 10 | ..... | 26 | 2.0 | 23 | 9 | ..... | 6.2 | 1.6 | 10 | ..... |
| 11 | ..... | 14 | 4.0 | 86 | 9 | ..... | 3.4 | 4.7 | 18 | ..... |
| 12 | ..... | 16 | 9.5 | 47 | 9 | ..... | 2.9 | 4.7 | 18 | ..... |
| 13 | ..... | 14 | 5.0 | 30 | 8 | ..... | 2.9 | 2.9 | 14 | ..... |
| 14 | ..... | 9.5 | 8.2 | 23 | 8 | ..... | 2.4 | 6.2 | 11 | ..... |
| 15 | 7.0 | 9.5 | 8.2 | 21 | 8 | ..... | 2.9 | 4.7 | 10 | ..... |
| 16 | 6.0 | 14 | 6.0 | 19 | 9 | ..... | 4.7 | 2.9 | 10 | ..... |
| 17 | 5.0 | 9.5 | 8.2 | 17 | 10 | ..... | 2.4 | 2.9 | 10 | ..... |
| 18 | 4.0 | 7.0 | 7.0 | 15 | 12 | ..... | 1.6 | 3.4 | 10 | ..... |
| 19 | 4.0 | 6.0 | 6.0 | 33 | 12 | ..... | 2.9 | 2.9 | 11 | ..... |
| 20 | 4.0 | 6.0 | 8.2 | 23 | 10 | ..... | 2.0 | 4.0 | 9.0 | ..... |
| 21 | 3.0 | 6.0 | 173 | 23 | 10 | ..... | 1.6 | 23 | 10 | ..... |
| 22 | 3.0 | 9.5 | 45 | 21 | 10 | 1.6 | 2.4 | 16 | 9.0 | ..... |
| 23 | 3.0 | 8.2 | 27 | 17 | 9 | 1.3 | 2.4 | 11 | 8.0 | ..... |
| 24 | 3.0 | 7.0 | 23 | 17 | ..... | 1.0 | 3.4 | 12 | 8.0 | ..... |
| 25 | 2.0 | 10.8 | 17 | 15 | ..... | 1.0 | 4.7 | 9.0 | 7.0 | ..... |
| 26 | 2.0 | 22 | 21 | 15 | ..... | 1.0 | 5.4 | 12 | 6.0 | ..... |
| 27 | 2.0 | 12 | 17 | 14 | ..... | 1.0 | 3.4 | 10 | 6.0 | ..... |
| 28 | 2.0 | 7.0 | 16 | 14 | ..... | 1.3 | 2.0 | 8.0 | 6.0 | ..... |
| 29 | 22 | 5.0 | 17 | 12 | ..... | 11.5 | 1.6 | 8.0 | 6.0 | ..... |
| 30 | 14 | 4.0 | 16 | 12 | ..... | 5.4 | 1.0 | 8.0 | 5.3 | ..... |
| 31 | 7.0 | ..... | 14 | 10 | ..... | 2.9 | ..... | 6.0 | 5.3 | ..... |
| Mean | 5.47 | 12.1 | 15.9 | 28.3 | 9.52 | 2.80 | 3.45 | 5.85 | 9.37 | 5.30 |
| Mean per square mile | .318 | .704 | .924 | 1.65 | .553 | .337 | .416 | .705 | 1.13 | .639 |
| Run-off (depth in inches on drainage area) | .20 | .79 | 1.07 | 1.90 | .47 | .13 | .46 | .81 | 1.30 | .12 |
| Accuracy | B. | B. | C. | C. | B. | C. | C. | C. | C. | C. |

[a] The channel was subject to shifts during the latter half of the season. The results are believed to be accurate within 15 per cent.

*Miscellaneous measurements in Seventymile River drainage basin in 1912.*

| Date. | Stream and locality. | Discharge. | Drainage area. | Discharge per square mile. |
|---|---|---|---|---|
| | | *Sec.-ft.* | *Sq. mi.* | *Sec.-ft.* |
| June 25 | Seventymile River above Flume Creek | 156 | 129 | 1.21 |
| July 28 | ....do | 201 | 129 | 1.56 |
| August 18 | ....do | 188 | 129 | 1.46 |
| August 30 | ....do | 132 | 129 | 1.02 |
| September 8 | ....do | 116 | 129 | .899 |
| June 24 | Deep Creek one-half mile above mouth | 1.1 | 4.8 | .229 |
| September 7 | ....do | 2.68 | 4.8 | .559 |
| June 24 | Nugget Creek at mouth | .8 | 2.7 | .296 |
| July 20 | West Fork of Granite Creek 1½ miles above forks | 27.9 | 41.9 | .666 |
| June 26 | Granite Creek at mouth | 190 | 138 | 1.38 |
| July 20 | East Fork of Granite Creek 1 mile above forks | 25.2 | 45.6 | .553 |
| June 24 | Barney Creek at mouth | 2.2 | ..... | ..... |
| September 9 | Washington Creek ditch at intake | 3.51 | ..... | ..... |
| September 10 | Broken Neck Creek at mouth | 1.06 | 2.9 | .366 |
| June 23 | Mogul Creek at mouth | 67.2 | 64.4 | 1.04 |
| September 6 | ....do | 50.5 | 64.4 | .784 |
| June 21 | Bryant Creek at summer trail crossing | 16.0 | 21.4 | .748 |
| September 4 | ....do | 18.9 | 21.4 | .883 |
| June 21 | Rock Creek at bridge | 1.41 | 7.3 | .193 |
| September 4 | ....do | 2.19 | 7.3 | .300 |

## EAGLE DISTRICT.

### GENERAL FEATURES.

The name Eagle district as used in this report denotes the area adjacent to the town of Eagle. The streams included in this area are Mission Creek, with its tributaries, and Yukon River at Eagle. The entire district has been topographically mapped, and considerable mining has been done within it.

The following list gives the location at which gaging stations were maintained or discharge measurements were made in the Eagle district in 1912. The relation of the streams is shown by indention.

Mission Creek above Excelsior Creek.
  Excelsior Creek at mouth.
  Wolf Creek at Swanson's dam.
  Wolf Creek at Road Crossing.
  American Creek at claim "No. 8 above."
  American Creek at United States Pumping Plant.
    Discovery Fork of American Creek below Star Gulch.

### MISSION CREEK DRAINAGE BASIN.

Mission Creek drains a very unsymmetrical basin between the Fortymile and Seventymile basins and the Yukon. The water of the creek comes almost entirely from the northern and eastern slope of Glacier Mountains, flowing northerly to join the main creek at the very northern edge of its watershed. The main creek flows north to its junction with Excelsior Creek, about 8 miles above its mouth, where it makes a sharp bend and flows nearly directly east to its confluence with the Yukon at Eagle. Wolf Creek joins Mission Creek about 4 miles and American Creek about 1 mile from the Yukon.

American Creek, the largest tributary of Mission Creek, rises in the high ridges bounding the extreme northern part of Fortymile River. It flows northeastward and is about 10 miles in length. Discovery Fork is the main branch of American Creek and joins it about 8 miles above the mouth. Above Marion Creek, a small feeder from the east, American Creek flows through a narrow V-shaped canyon; below Marion Creek the valley widens until it finally merges in the flats adjoining Mission Creek. The creek has a steep grade, especially near the head, the average in that portion where mining is carried on being about 125 feet to the mile. American Creek has been an important gold producer.

*Daily discharge, in second-feet, of American Creek and Discovery Fork for 1912.*

| Day. | American Creek at claim "No. 8 above."[a] [Drainage area, 24.1 square miles.] | | | | | Discovery Fork below Star Gulch.[b] [Drainage area, 14.8 square miles.] | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | June. | July. | Aug. | Sept. | Oct. | May. | June. | July. | Aug. | Sept. |
| 1 | ..... | 5.9 | 20 | 11 | 11 | ..... | 6.6 | 2.2 | 3.9 | 3.9 |
| 2 | ..... | 4.4 | 20 | 11 | 11 | ..... | 8.0 | 2.2 | 3.9 | 3.9 |
| 3 | ..... | 4.4 | 20 | 11 | 11 | ..... | 9.4 | 2.2 | 3.9 | 3.9 |
| 4 | ..... | 3.4 | 16 | 14 | 11 | ..... | 8.0 | 1.8 | 3.9 | 5.6 |
| 5 | ..... | 3.4 | 20 | 14 | 11 | ..... | 5.6 | 1.8 | 3.9 | 4.6 |
| 6 | ..... | 2.4 | 20 | 17 | 11 | ..... | 4.6 | 1.8 | 5.6 | 3.9 |
| 7 | ..... | 2.0 | 108 | 19 | 11 | ..... | 3.9 | 1.8 | 9.4 | 3.9 |
| 8 | ..... | 1.6 | 53 | 19 | 11 | ..... | 13 | 1.8 | 6.6 | ..... |
| 9 | ..... | 1.6 | 38 | 21 | 11 | ..... | 9.4 | 1.4 | 5.6 | ..... |
| 10 | ..... | 1.3 | 38 | 25 | 11 | ..... | 6.6 | 1.8 | 6.6 | ..... |
| 11 | ..... | 2.4 | 103 | 21 | 11 | ..... | 6.6 | 2.2 | 26 | ..... |
| 12 | ..... | 26 | 77 | 21 | 11 | ..... | 6.6 | 2.2 | 20 | ..... |
| 13 | 18 | 22 | 53 | 17 | 9 | ..... | 5.6 | 2.7 | 9.4 | ..... |
| 14 | 18 | 12 | 48 | 17 | 9 | ..... | 4.6 | 2.7 | 9.4 | ..... |
| 15 | 34 | 5.9 | 38 | 17 | 9 | ..... | 3.9 | 2.7 | 6.6 | ..... |
| 16 | 26 | 4.4 | 34 | 17 | 9 | ..... | 15 | 2.2 | 6.6 | ..... |
| 17 | 22 | 3.4 | 25 | 25 | 9 | ..... | 5.6 | 2.2 | 5.6 | ..... |
| 18 | 18 | 2.4 | 25 | 29 | ..... | ..... | 4.6 | 2.2 | 5.6 | ..... |
| 19 | 15 | 2.4 | 34 | 25 | ..... | ..... | 3.9 | 2.2 | 6.6 | ..... |
| 20 | 15 | 2.0 | 25 | 25 | ..... | ..... | 3.9 | 2.7 | 6.6 | ..... |
| 21 | 22 | 26 | 25 | 25 | ..... | ..... | 3.2 | 13 | 6.6 | ..... |
| 22 | 26 | 39 | 25 | 25 | ..... | 11 | 3.2 | 15 | 5.6 | ..... |
| 23 | 22 | 37 | 25 | 21 | ..... | 8.0 | 3.2 | 5.6 | 6.6 | ..... |
| 24 | 18 | 24 | 21 | 21 | ..... | 6.6 | 2.7 | 4.6 | 6.6 | ..... |
| 25 | 18 | 20 | 21 | 17 | ..... | 6.6 | 8.0 | 4.6 | 5.6 | ..... |
| 26 | 18 | 20 | 17 | 17 | ..... | 6.6 | 4.6 | 4.6 | 4.6 | ..... |
| 27 | 15 | 20 | 17 | 14 | ..... | 6.6 | 2.7 | 5.6 | 3.9 | ..... |
| 28 | 12 | 16 | 17 | 14 | ..... | 6.6 | 2.2 | 4.6 | 3.9 | ..... |
| 29 | 9.7 | 16 | 17 | 14 | ..... | 32 | 2.2 | 3.2 | 3.9 | ..... |
| 30 | 7.4 | 20 | 14 | 11 | ..... | 13 | 2.2 | 2.7 | 3.9 | ..... |
| 31 | ..... | 20 | 14 | ..... | ..... | 9.4 | ..... | 3.9 | 3.9 | ..... |
| Mean | 18.6 | 12.0 | 33.2 | 18.5 | 10.4 | 10.6 | 5.7 | 3.6 | 6.8 | 4.2 |
| Mean per square mile | .772 | .498 | 1.38 | .767 | .432 | .716 | .385 | .243 | .460 | .284 |
| Run-off (depth in inches on drainage area) | .52 | .57 | 1.59 | .86 | .27 | .27 | .43 | .28 | .53 | .07 |
| Accuracy | B. | C. | C. | C. | B. | C. | C. | C. | C. | C. |

[a] The channel shifted July 22 and August 7. The rating curve is fairly well defined below 25 second-feet.
[b] There were shifting channel conditions at this station. The results are probably accurate within 15 per cent.

*Miscellaneous measurements in Mission Creek drainage basin in 1912.*

| Date. | Stream and locality. | Discharge. | Drainage area. | Discharge per square mile. |
|---|---|---|---|---|
| | | *Sec.-ft.* | *Sq. mi.* | *Sec.-ft.* |
| June 21 | Mission Creek above Excelsior Creek | 89.8 | 93.1 | 0.965 |
| September 4 | ....do | 68.9 | 93.1 | .740 |
| June 21 | Excelsior Creek at mouth | 16.2 | 31.1 | .521 |
| September 4 | ....do | 17.2 | 31.1 | .553 |
| June 19 | Wolf Creek at Swanson's dam | 9.6 | 19.5 | .492 |
| June 21 | Wolf Creek at road crossing | 10.8 | 28.4 | .380 |
| September 4 | ....do | 9.7 | 28.4 | .341 |
| May 20 | American Creek at United States pumping plant | 88 | 67.3 | 1.31 |
| May 22 | ....do | 88 | 67.3 | 1.31 |
| May 31 | ....do | 79 | 67.3 | 1.17 |
| June 19 | ....do | 28 | 67.3 | .416 |
| August 1 | ....do | 32 | 67.3 | .475 |
| September 4 | ....do | 28 | 67.3 | .416 |

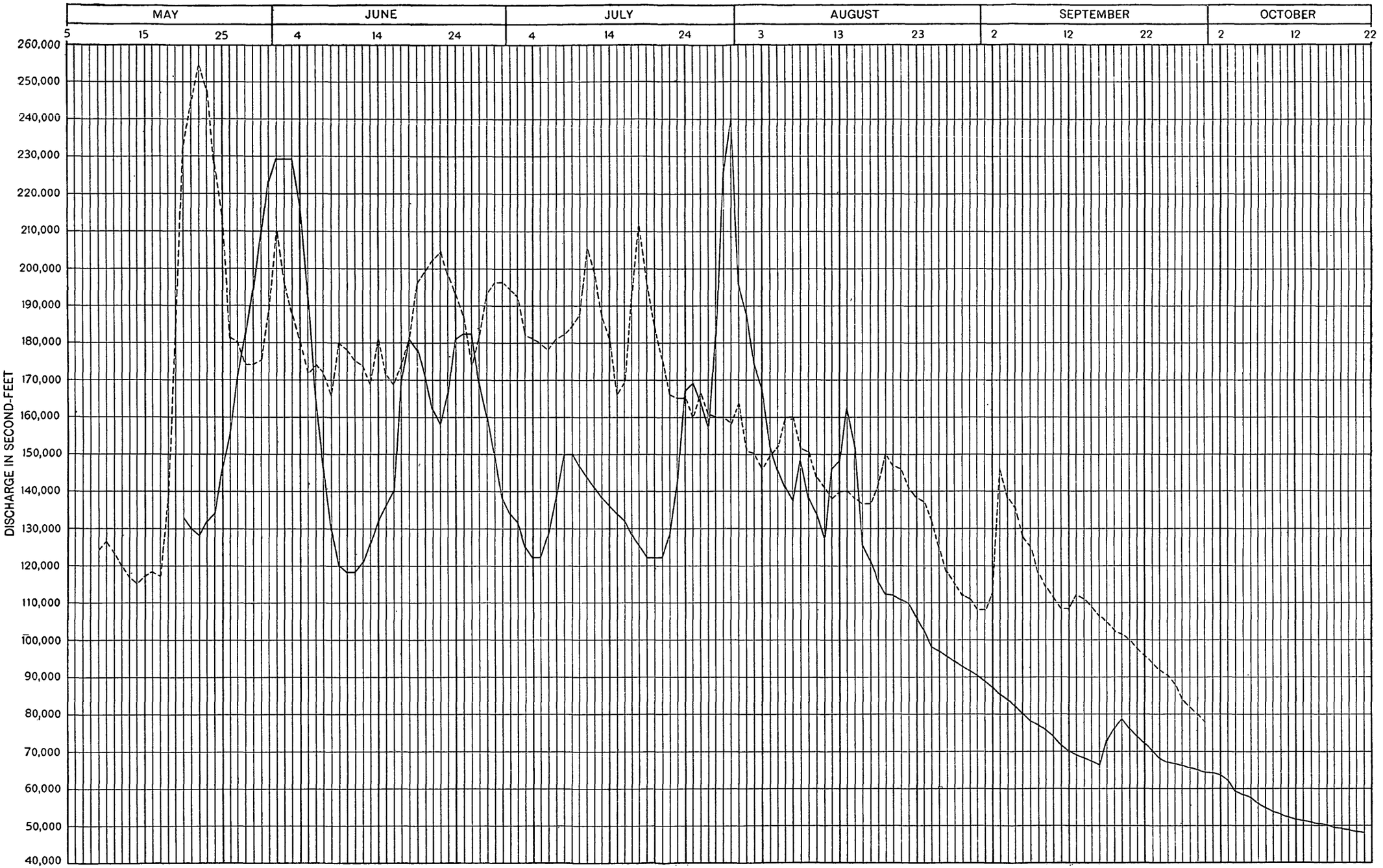
## YUKON RIVER AT EAGLE.

The recording of the discharge of Yukon River at Eagle, which was begun in May, 1911, was continued during the summer of 1912. In the Yukon drainage basin the winter season is long and the cold intense; it is called the "closed" season because the river is closed for navigation. During this period all precipitation remains in the form of snow, and the ground freezes deep, so the source of stream flow is limited to open springs and lake storage. Consequently the discharge during the closed season is very small, and far the greatest proportion of the run-off occurs during the open season or that portion of the year when the river is open for navigation. This season usually extends from about May 20 to October 20. The snow begins to melt the latter part of April. About May 10 a stage is reached at which the ice begins to break up and move, and it is usually about ten days before the stream is free of the floating ice.

The characteristic distribution of flow in the Yukon during the open season appears to be a high run-off during the first of the open season, caused by the melting snows, the discharge usually reaching a maximum late in May or early in June, then gradually decreasing through the summer as the supply of snow is exhausted. With the approach of the frozen season it falls rapidly. The precipitation during the summer causes wide fluctuations in the flow, but does not seriously affect the general trend as described. The winter of 1911–12 in the Yukon basin was peculiar in its exceptionally light snowfall. Consequently this source of stream flow was less noticeable in its influence during 1912 than in 1911, as is shown by the hydrographs for these two seasons. (See Pl. IX.) In the summer of 1912 the maximum discharge occurred the last of July.

The rating of the Yukon at Eagle is based on float measurements made by timing the passage of ice cakes or driftwood over a 500-foot run and locating them by range line and angle. The cross section at the place of measurement, which is about 1,400 feet in width, was obtained by sounding through the ice. In September, 1912, an accurate float measurement was made by means of bottle floats weighted with sand and carrying flags. These were dropped at intervals of about 75 feet across the stream and their passage timed over the run. Determinations were also made of the coefficient to be applied to surface velocities to reduce to mean velocities in the section. The results indicated a coefficient of 0.92, which is somewhat higher than in most streams. The record for 1911 has been recomputed, using this coefficient.

Hydrographs of the daily flow of Yukon River at Eagle for the season of 1911 and 1912 are given in Plate IX, and tables follow, giving the mean monthly discharge, the run-off per square mile, the run-off from the drainage area in depth in inches, and the maximum and minimum discharges for the month, for 1911 and 1912.




HYDROGRAPH SHOWING DAILY DISCHARGE OF YUKON RIVER, 1911 (BROKEN LINE) AND 1912 (SOLID LINE).

*Monthly discharge of Yukon River at Eagle for 1911 and 1912.*

[Drainage area, 122,000 square miles.]

| Month. | Discharge in second-feet. | | | | Run-off (depth in inches on drainage area). |
|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | Mean per square mile. | |
| 1911. | | | | | |
| May 9-31 | 254,000 | 115,000 | 169,000 | 1.39 | 1.19 |
| June | 210,000 | 166,000 | 184,000 | 1.51 | 1.68 |
| July | 211,000 | 158,000 | 178,000 | 1.46 | 1.68 |
| August | 160,000 | 108,000 | 139,000 | 1.14 | 1.31 |
| September | 146,000 | 78,000 | 106,000 | .869 | .97 |
| The period, 145 days | 254,000 | 78,000 | 155,000 | 1.27 | 6.83 |
| 1912. | | | | | |
| May 20-31 | 223,000 | 128,000 | 161,000 | 1.32 | .59 |
| June | 229,000 | 118,000 | 160,000 | 1.32 | 1.47 |
| July | 240,000 | 122,000 | 147,000 | 1.20 | 1.38 |
| August | 188,000 | 90,500 | 127,000 | 1.04 | 1.20 |
| September | 89,000 | 64,500 | 73,600 | .603 | .67 |
| October 1-21 | 64,000 | 47,500 | 53,900 | .442 | .35 |
| The period, 155 days | 240,000 | 47,500 | 120,000 | .984 | 5.66 |

*Daily discharge, in second-feet, of Yukon River at Eagle for 1912.*[a]

[Drainage area, 122,000 square miles.]

| Day. | May. | June. | July. | Aug. | Sept. | Oct. |
|---|---|---|---|---|---|---|
| 1 | ..... | 229,000 | 134,000 | 188,000 | 89,000 | 64,000 |
| 2 | ..... | 229,000 | 132,000 | 174,000 | 87,300 | 63,500 |
| 3 | ..... | 229,000 | 125,000 | 168,000 | 85,500 | 62,000 |
| 4 | ..... | 217,000 | 122,000 | 152,000 | 84,000 | 59,000 |
| 5 | ..... | 193,000 | 122,000 | 146,000 | 82,000 | 58,000 |
| 6 | ..... | 165,000 | 128,000 | 141,000 | 80,000 | 57,000 |
| 7 | ..... | 146,000 | 138,000 | 137,000 | 78,000 | 56,000 |
| 8 | ..... | 129,000 | 150,000 | 148,000 | 77,000 | 55,000 |
| 9 | ..... | 120,000 | 150,000 | 138,000 | 76,000 | 54,000 |
| 10 | ..... | 118,000 | 147,000 | 134,000 | 74,000 | 53,000 |
| 11 | ..... | 118,000 | 144,000 | 128,000 | 72,000 | 52,500 |
| 12 | ..... | 121,000 | 141,000 | 146,000 | 70,000 | 52,000 |
| 13 | ..... | 126,000 | 138,000 | 148,000 | 69,000 | 51,500 |
| 14 | ..... | 132,000 | 136,000 | 162,000 | 68,000 | 51,000 |
| 15 | ..... | 136,000 | 134,000 | 152,000 | 67,100 | 50,500 |
| 16 | ..... | 140,000 | 132,000 | 125,000 | 66,200 | 50,000 |
| 17 | ..... | 169,000 | 128,000 | 122,000 | 73,000 | 49,500 |
| 18 | ..... | 181,000 | 125,000 | 115,000 | 76,000 | 49,000 |
| 19 | ..... | 178,000 | 122,000 | 112,000 | 78,500 | 48,500 |
| 20 | 133,000 | 171,000 | 122,000 | 112,000 | 76,000 | 48,000 |
| 21 | 130,000 | 162,000 | 122,000 | 111,000 | 74,000 | 47,500 |
| 22 | 128,000 | 158,000 | 128,000 | 110,000 | 72,000 | ..... |
| 23 | 132,000 | 166,000 | 143,000 | 106,000 | 70,000 | ..... |
| 24 | 134,000 | 181,000 | 167,000 | 103,000 | 68,000 | ..... |
| 25 | 146,000 | 182,000 | 169,000 | 98,300 | 67,000 | ..... |
| 26 | 155,000 | 182,000 | 164,000 | 97,000 | 66,500 | ..... |
| 27 | 172,000 | 169,000 | 158,000 | 95,500 | 66,000 | ..... |
| 28 | 182,000 | 160,000 | 182,000 | 94,500 | 65,500 | ..... |
| 29 | 194,000 | 150,000 | 226,000 | 93,000 | 65,000 | ..... |
| 30 | 208,000 | 138,000 | 240,000 | 92,000 | 64,500 | ..... |
| 31 | 223,000 | ..... | 196,000 | 90,500 | ..... | ..... |
| Mean | 161,000 | 160,000 | 147,000 | 127,000 | 73,600 | 53,900 |
| Mean per square mile | 1.32 | 1.32 | 1.20 | 1.04 | .603 | .442 |
| Run-off (depth in inches on drainage area) | .59 | 1.47 | 1.38 | 1.20 | .67 | .35 |
| Accuracy | A. | A. | A. | A. | A. | A. |

[a] Rating curve well defined for all stages.

## CIRCLE PRECINCT.

### GENERAL FEATURES.

The area north of the Yukon-Tanana divide between longitude 143° 40′ and 146° 50′ is known as the Birch Creek district of the Circle precinct. Generally speaking, it consists of two geographic divisions—a low broad alluvial plain and a dissected plateau.

The northwestern portion of the low broad plain forms the bottom lands of the Yukon Flats north of Crazy Mountains; the southeastern portion is an irregular area surrounded by a low ridge along the Yukon, the Crazy Mountains, and the range of hills 20 to 40 miles farther south. This portion is cut by Birch and Crooked creeks; it is well timbered along these streams and contains large areas of meadow-like swamp land that furnish forage for both summer and winter use.

The plateau division, whose longer diameter trends east and west, lies between two distinct ridges—the eastern extensions of the White Mountains. The ridge to the south is high and barren and forms the main Yukon-Tanana divide; that to the north is lower, irregular, and barren, and separates the upper tributaries of the Birch Creek basin from the lower, and is itself divided by the deep canyon-like gorge through which Birch Creek flows on its way to the Yukon.

At elevations of 2,000 feet or more above sea level the country is as a rule barren and rocky; below this altitude, especially in the flats where Birch and Crooked creeks join, considerable timber is found.

The following list gives the locations at which gaging stations were maintained or discharge measurements made in 1912 in the Circle district.

Birch Creek drainage basin:

- Ptarmigan Creek at mouth.
- Birch Creek above Twelvemile Creek.
- Birch Creek below Twelvemile Creek.
- Birch Creek below Great Unknown Creek.
- Birch Creek above Sheep Creek.
- Birch Creek at Fourteenmile House.
- Eagle Creek at mouth.
- Golddust Creek, 3 miles above mouth.
- Golddust Creek at mouth.
- Fish Creek at mouth.
- Butte Creek at mouth.
- Bear Creek at mouth.
- Twelvemile Creek below South Fork.
- North Fork of Twelvemile Creek at mouth.
- Harrington Fork above Crooked Creek.
- Crooked Creek at mouth.
- Great Unknown Creek at mouth.
- Acme Creek, 2 miles above mouth.
- Clums Fork below Munson Creek.

Birch Creek drainage basin—Continued.
Clums Fork below Bear Creek.
Lawson Creek at mouth.
Bear Creek at mouth.
Buckley Bar Creek at mouth.
Sheep Creek at mouth.
Porcupine Creek below ditch intake.
Porcupine Creek below Bonanza Creek.
Crooked Creek at Central House.
Bonanza Creek below ditch intake.
Independence Creek at claim "No. 9 above."
Miller Creek at mouth.
Boulder Creek at road crossing.
Deadwood Creek above Switch Creek.
Circle Hot Springs.
Portage Creek, 4 miles above Medicine Lake.
Porcupine ditch at intake.
Bonanza ditch at intake.
Bonanza ditch below junction with Porcupine branch.
Bonanza ditch at outlet.

## BIRCH CREEK DRAINAGE BASIN.

Birch Creek flows into Yukon River at a point almost exactly on the Arctic Circle and about 25 miles directly west of Fort Yukon. Its mouth is about 5 miles west of the confluence of Chandalar River with the Yukon. Its basin is extremely unsymmetrical in outline, the drainage coming almost entirely from the south and west through a complex system of watercourses, whose headwaters interlock with those of Chena and Chatanika rivers.

Birch Creek is formed by the junction of Eagle and Ptarmigan creeks and takes a southwestward course for about 7 miles to the mouth of Twelvemile Creek, where it turns abruptly to the south and follows that direction for about 8 miles. It then receives the waters of Harrington Fork and runs eastward for about 45 miles to its confluence with the South Fork, where it makes a sharp turn to the north. About 12 miles farther on it leaves the mountainous country and enters the lowlands of the Yukon, through which it sluggishly meanders for over 100 miles, roughly paralleling the Yukon at a distance of 10 to 20 miles. Some of the tributaries from the right in downstream order are Fish, Bear, Twelvemile, Harrington Fork, Malburn, Acme, Clums Fork, McLean, Wolf, Sheep, and South Fork. From the left in downstream order they are Golddust, Butte, Fryingpan, Great Unknown, Harrison, Buckley Bar, Crooked, and Preacher creeks.

*Monthly discharge of Birch Creek at Fourteenmile House for 1908 to 1912.*

[Drainage area, 2,150 square miles.]

| Month. | Discharge in second-feet. | | | | Run-off (depth in inches on drainage area). |
|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | Mean per square mile. | |
| 1908. | | | | | |
| June 26–30 | 1,190 | 1,020 | 1,090 | 0.507 | 0.09 |
| July | 2,630 | 847 | 1,140 | .530 | .61 |
| August | 1,620 | 825 | 1,080 | .502 | .58 |
| September 1–29 | 6,070 | 900 | 2,150 | 1.00 | 1.08 |
| The period, 96 days | 6,070 | 825 | 1,423 | 1.48 | 2.36 |
| 1909. | | | | | |
| May 15–31 | 9,970 | 3,320 | 5,930 | 2.76 | 1.74 |
| June | 8,640 | 1,800 | 3,410 | 1.59 | 1.77 |
| July | 8,280 | 960 | 2,200 | 1.02 | 1.18 |
| August | 3,020 | 974 | 1,830 | .851 | .98 |
| September | 960 | 730 | 799 | .372 | .42 |
| October 1–2 | 792 | 792 | 792 | .368 | .03 |
| The period, 141 days | 9,970 | 730 | 2,510 | 1.17 | 6.12 |
| 1910. | | | | | |
| May 13–31 | 6,620 | 3,200 | 4,790 | 2.23 | 1.58 |
| June | 6,000 | 1,100 | 2,500 | 1.16 | 1.29 |
| July | 5,400 | 551 | 1,430 | .665 | .77 |
| August | 1,880 | 432 | 950 | .442 | .51 |
| September | 3,280 | 1,040 | 1,620 | .753 | .84 |
| October 1–6 | 1,140 | 1,080 | 1,090 | .507 | .11 |
| The period, 147 days | 6,620 | 432 | 2,010 | .935 | 5.10 |
| 1911. | | | | | |
| May 15–31 | 15,300 | 4,120 | 8,190 | 3.81 | 2.41 |
| June | 9,490 | 1,010 | 3,740 | 1.74 | 1.94 |
| July | 3,260 | 262 | 987 | .459 | .53 |
| August | 2,060 | 208 | 609 | .283 | .33 |
| September | 587 | 418 | 501 | .233 | .26 |
| October 1–23 | 614 | 198 | 379 | .176 | .15 |
| The period, 162 days | 15,300 | 198 | 2,050 | .953 | 5.62 |
| 1912. | | | | | |
| May 10–31 | 5,380 | 1,090 | 2,350 | 1.09 | .89 |
| June | 14,100 | 1,400 | 4,650 | 2.16 | 2.41 |
| July | 1,510 | 450 | 611 | .284 | .33 |
| August | 3,460 | 400 | 1,110 | .516 | .59 |
| September | 4,000 | 960 | 1,710 | .795 | .89 |
| October 1–21 | 1,290 | 350 | 924 | .430 | .34 |
| The period, 165 days | 14,100 | 350 | 1,910 | .888 | 5.45 |

*Daily discharge, in second-feet, of Birch Creek for 1912.*

| Day. | Birch Creek below Twelve-mile Creek.[a] [Drainage area, 141 square miles.] | | | | | Birch Creek below Great Unknown Creek.[b] [Drainage area, 376 square miles.] | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | June. | July. | Aug. | Sept. | Oct. | June. | July. | Aug. | Sept. | Oct. |
| 1 | 1,060 | 96 | 47 | 91 | 132 | ..... | 218 | 125 | 234 | 272 |
| 2 | 1,060 | 98 | 44 | 113 | 132 | ..... | 186 | 113 | 272 | 272 |
| 3 | 835 | 91 | 41 | 130 | 116 | ..... | 253 | 113 | 300 | 253 |
| 4 | 460 | 67 | 49 | 166 | 105 | ..... | 186 | 113 | 344 | 231 |
| 5 | 322 | 61 | 47 | 169 | 108 | 355 | 153 | 113 | 355 | 227 |
| 6 | 248 | 49 | 47 | 150 | 110 | 378 | 138 | 110 | 320 | 234 |
| 7 | 172 | 47 | 144 | 138 | 110 | 345 | 130 | 186 | 292 | 218 |
| 8 | 144 | 44 | 186 | 132 | 91 | 313 | 120 | 400 | 272 | 218 |
| 9 | 142 | 41 | 127 | 132 | 96 | 378 | 113 | 272 | 253 | 201 |
| 10 | 121 | 38 | 100 | 121 | 91 | 355 | 106 | 218 | 234 | 201 |
| 11 | 90 | 42 | 222 | 113 | 86 | 292 | 110 | 272 | 231 | 178 |
| 12 | 183 | 41 | 323 | 108 | 84 | 424 | 113 | 626 | 218 | 170 |
| 13 | 322 | 38 | 233 | 110 | 86 | 759 | 107 | 524 | 210 | 153 |
| 14 | 284 | 46 | 176 | 91 | ..... | 652 | 112 | 422 | 201 | 128 |
| 15 | 364 | 47 | 144 | 110 | ..... | 800 | 116 | 320 | 227 | 132 |
| 16 | 695 | 42 | 121 | 124 | ..... | 900 | 113 | 218 | 272 | 125 |
| 17 | 542 | 44 | 100 | 183 | ..... | 850 | 113 | 201 | 448 | 120 |
| 18 | 600 | 44 | 91 | 284 | ..... | 900 | 120 | 201 | 626 | 116 |
| 19 | 729 | 44 | 86 | 248 | ..... | 1,740 | 120 | 172 | 599 | ..... |
| 20 | 410 | 44 | 86 | 276 | ..... | 985 | 120 | 170 | 610 | ..... |
| 21 | 343 | 42 | 82 | 272 | ..... | 705 | 116 | 153 | 500 | ..... |
| 22 | 513 | 41 | 78 | 240 | ..... | 814 | 113 | 148 | 400 | ..... |
| 23 | 1,410 | 42 | 78 | 203 | ..... | 2,260 | 112 | 153 | 340 | ..... |
| 24 | 1,060 | 44 | 78 | 183 | ..... | 2,520 | 110 | 162 | 320 | ..... |
| 25 | 738 | 41 | 80 | 166 | ..... | 2,200 | 110 | 172 | 310 | ..... |
| 26 | 417 | 51 | 91 | 144 | ..... | 1,350 | 112 | 240 | 300 | ..... |
| 27 | 302 | 54 | 108 | 144 | ..... | 759 | 116 | 300 | 290 | ..... |
| 28 | 218 | 61 | 103 | 141 | ..... | 547 | 138 | 290 | 280 | ..... |
| 29 | 157 | 63 | 98 | 138 | ..... | 378 | 135 | 280 | 270 | ..... |
| 30 | 121 | 61 | 88 | 138 | ..... | 292 | 132 | 272 | 272 | ..... |
| 31 | ..... | 54 | 88 | ..... | ..... | ..... | 128 | 253 | ..... | ..... |
| Mean | 469 | 52.2 | 109 | 159 | 104 | 856 | 131 | 236 | 327 | 192 |
| Mean per square mile | 3.33 | .370 | .773 | 1.13 | .738 | 2.28 | .348 | .628 | .870 | .511 |
| Run-off (depth in inches on drainage area) | 3.72 | .43 | .89 | 1.26 | .36 | 2.20 | .40 | .72 | .97 | .34 |
| Accuracy | C. | A. | A. | A. | A. | D. | A. | B. | B. | B. |

[a] The gage was washed out by high water on June 25. The discharges previous to that date are rather uncertain. Since that date the discharges are based on a rating curve that is well defined below 200 second-feet.

[b] Discharges are well defined between 120 and 400 second-feet.

*Daily discharge, in second-feet, of Birch Creek for 1912.*

| Day. | Birch Creek above Sheep Creek.[a] [Drainage area, 873 square miles.] | | | | | Birch Creek at Fourteenmile House.[b] [Drainage area, 2,150 square miles.] | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | May. | June. | July. | Aug. | Sept. | May. | June. | July. | Aug. | Sept. | Oct. |
| 1 | ..... | 3,320 | 605 | 236 | 535 | ..... | 3,460 | 1,510 | 450 | 960 | 1,290 |
| 2 | ..... | 6,370 | 465 | 230 | 755 | ..... | 8,070 | 1,190 | 450 | 1,090 | 1,290 |
| 3 | ..... | 4,440 | 535 | 214 | 755 | ..... | 9,560 | 1,190 | 425 | 1,400 | 1,190 |
| 4 | ..... | 3,060 | 465 | 214 | 755 | ..... | 7,360 | 1,290 | 425 | 1,290 | 1,190 |
| 5 | ..... | 1,780 | 382 | 203 | 755 | ..... | 4,570 | 920 | 400 | 1,290 | 1,190 |
| 6 | ..... | 1,190 | 316 | 203 | 755 | ..... | 2,950 | 725 | 400 | 1,290 | 1,090 |
| 7 | ..... | 920 | 258 | 535 | 680 | ..... | 2,180 | 690 | 450 | 1,190 | 1,040 |
| 8 | 1,470 | 755 | 225 | 1,010 | 718 | ..... | 1,630 | 620 | 1,190 | 1,190 | 1,040 |
| 9 | 1,190 | 835 | 220 | 755 | 605 | ..... | 1,400 | 560 | 1,630 | 1,190 | 1,040 |
| 10 | 1,470 | 1,010 | 203 | 570 | 605 | 1,400 | 1,760 | 560 | 1,510 | 1,090 | 1,000 |
| 11 | 1,280 | 795 | 225 | 795 | 570 | 1,510 | 1,760 | 450 | 1,190 | 1,090 | 1,000 |
| 12 | 1,470 | 680 | 225 | 1,570 | 535 | 1,760 | 1,400 | 450 | 2,780 | 1,040 | 1,000 |
| 13 | 1,890 | 2,220 | 225 | 1,200 | 500 | 2,040 | 2,470 | 475 | 3,460 | 1,000 | 960 |
| 14 | 2,810 | 1,780 | 220 | 1,000 | 500 | 3,120 | 3,460 | 450 | 2,180 | 1,000 | 920 |
| 15 | 1,890 | 2,200 | 236 | 800 | 605 | 3,120 | 2,780 | 450 | 1,630 | 960 | 840 |
| 16 | 2,450 | 2,500 | 225 | 600 | 680 | 3,460 | 2,780 | 500 | 1,400 | 960 | 760 |
| 17 | 2,450 | 2,400 | 214 | 535 | 755 | 3,820 | 4,570 | 450 | 1,400 | 1,090 | 690 |
| 18 | 1,780 | 3,000 | 220 | 500 | 1,370 | 3,120 | 3,460 | 450 | 1,190 | 1,900 | 620 |
| 19 | 1,280 | 4,020 | 242 | 465 | 1,470 | 2,320 | 3,460 | 450 | 1,090 | 2,320 | 500 |
| 20 | 1,140 | 2,200 | 242 | 420 | 1,700 | 1,900 | 5,800 | 475 | 1,000 | 2,470 | 400 |
| 21 | 1,140 | 1,570 | 252 | 376 | 2,000 | 1,630 | 4,190 | 450 | 840 | 3,460 | 350 |
| 22 | 1,100 | 2,000 | 258 | 364 | 2,690 | 1,400 | 2,950 | 500 | 840 | 4,000 | |
| 23 | 1,570 | 5,020 | 242 | 340 | 2,450 | 1,630 | 3,820 | 450 | 800 | 3,460 | ..... |
| 24 | 1,280 | 8,100 | 236 | 340 | ..... | 2,470 | 9,060 | 450 | 800 | 2,950 | ..... |
| 25 | 795 | 7,940 | 214 | 376 | ..... | 1,900 | 14,100 | 450 | 760 | 2,780 | ..... |
| 26 | 642 | 4,440 | 198 | 406 | ..... | 1,290 | 13,000 | 450 | 760 | 2,320 | ..... |
| 27 | 680 | 2,330 | 220 | 642 | ..... | 1,190 | 8,070 | 450 | 760 | 2,040 | ..... |
| 28 | 680 | 1,470 | 304 | 718 | ..... | 1,090 | 4,190 | 450 | 1,000 | 1,630 | ..... |
| 29 | 2,810 | 1,100 | 340 | 680 | ..... | 1,630 | 3,120 | 500 | 1,090 | 1,510 | ..... |
| 30 | 2,930 | 680 | 316 | 570 | ..... | 5,380 | 2,180 | 450 | 1,000 | 1,400 | ..... |
| 31 | 1,670 | ..... | 274 | 535 | ..... | 4,570 | ..... | 475 | 960 | ..... | ..... |
| Mean | 1,580 | 2,670 | 284 | 561 | 989 | 2,350 | 4,650 | 611 | 1,110 | 1,710 | 924 |
| Mean per square mile | 1.81 | 3.06 | .325 | .643 | 1.13 | 1.09 | 2.16 | .284 | .516 | .795 | .430 |
| Run-off (depth in inches on drainage area) | 1.62 | 3.41 | .37 | .74 | .97 | .89 | 2.41 | .33 | .59 | .89 | .34 |
| Accuracy | A. | B. | A. | A. | A. | A. | A. | A. | A. | A. | A. |

[a] Discharges are well defined below 4,000 second-feet.
[b] Discharges are well defined below 2,000 second-feet.

*Daily discharge, in second-feet, of Great Unknown Creek, Clums Fork, and Lawson Creek for 1912.*

| Day. | Great Unknown Creek at mouth.[a] [Drainage area, 41.2 square miles.] | | | | Clums Fork below Munson Creek.[b] [Drainage area, 46.4 square miles.] | | | Lawson Creek at mouth.[c] [Drainage area, 21.6 square miles.] | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | June. | July. | Aug. | Sept. | July. | Aug. | Sept. | July. | Aug. | Sept. |
| 1 | ..... | ..... | 15 | 20 | 34 | 28 | 26 | 17.2 | 15 | 14.3 |
| 2 | ..... | ..... | 10.1 | 25 | 29 | 27 | 25 | 15.4 | 14 | 13.8 |
| 3 | ..... | 22 | 10 | 30 | 26 | 26 | 26 | 14.1 | 14 | 13.8 |
| 4 | ..... | 16.3 | 10 | 40 | 26 | 25 | 26 | 13.8 | 13.6 | 14.1 |
| 5 | ..... | 13.6 | 10.1 | 41 | 25 | 24 | 25 | 13.3 | 13.3 | 13.8 |
| 6 | ..... | 12 | 10 | 36 | 25 | 23 | 26 | 12.9 | 12.9 | 14.1 |
| 7 | ..... | 11 | 104 | 31 | 26 | 46 | 25 | 13.3 | 27 | 13.6 |
| 8 | 28 | 10 | 81 | 29 | 25 | 33 | 25 | 13.3 | 18.1 | 13.6 |
| 9 | 33 | 9.2 | 26 | 28 | 24 | 29 | 26 | 13.3 | 16.3 | 14.1 |
| 10 | 40 | 9.2 | 20 | 27 | 48 | 28 | 26 | 35 | 15.9 | 13.8 |
| 11 | 40 | 9.0 | 41 | 26 | 28 | 52 | 25 | 20 | 27 | 13.6 |
| 12 | 90 | 9.2 | 38 | 22 | 24 | 46 | 25 | 15.4 | 25 | 13.8 |
| 13 | 135 | 10 | 35 | 24 | 24 | 42 | 25 | 14.1 | 23 | 13.6 |
| 14 | 120 | 10.1 | 32 | 26 | 29 | 38 | 24 | 16.8 | 21 | 13.3 |
| 15 | 110 | 10 | 29 | 26 | 25 | 36 | 25 | 15.4 | 19 | 14.3 |
| 16 | 100 | 10.1 | 26 | 29 | 25 | 32 | 28 | 14.6 | 17 | 15.4 |
| 17 | 90 | 10 | 22 | 109 | 24 | 28 | 34 | 13.8 | 15.9 | 15.9 |
| 18 | 85 | 10 | 21 | 65 | 27 | 28 | 37 | 14.9 | 16.8 | 16.3 |
| 19 | 323 | 10.1 | 20 | 52 | 25 | 26 | 34 | 13.8 | 15.9 | 16.3 |
| 20 | 195 | 10 | 19.5 | ..... | 25 | 24 | 66 | 13.8 | 14.6 | 27 |
| 21 | 109 | 10 | 19 | ..... | 26 | 23 | 64 | 14.3 | 14.1 | 26 |
| 22 | ..... | 10 | 18 | ..... | 25 | 25 | 52 | 13.8 | 15.9 | 20 |
| 23 | ..... | 10.1 | 17.5 | ..... | 24 | 26 | 46 | 13.8 | 16.8 | 20 |
| 24 | ..... | 10 | 17.5 | ..... | 24 | 26 | 42 | 13.3 | 15.0 | 20 |
| 25 | ..... | 10 | 17 | ..... | 24 | 25 | ..... | 12.9 | 14.1 | ..... |
| 26 | ..... | 10.1 | 17 | ..... | 24 | 26 | ..... | 13.6 | 14.9 | ..... |
| 27 | ..... | 12 | 25 | ..... | 37 | 28 | ..... | 18.1 | 14.6 | ..... |
| 28 | ..... | 20 | 25 | ..... | 34 | 27 | ..... | 18.1 | 13.8 | ..... |
| 29 | ..... | 30 | 20 | ..... | 32 | 26 | ..... | 18 | 13.8 | ..... |
| 30 | ..... | 32 | 17 | ..... | 30 | 26 | ..... | 17 | 14.3 | ..... |
| 31 | ..... | 26 | 17 | ..... | 29 | 25 | ..... | 16 | 14.1 | ..... |
| Mean | 106 | 13.2 | 25.5 | 36.1 | 27.5 | 29.8 | 32.6 | 15.6 | 16.7 | 16.0 |
| Mean per square mile | 2.58 | .320 | .619 | .876 | .593 | .642 | .703 | .722 | .773 | .741 |
| Run-off (depth in inches on drainage area) | 1.34 | .35 | .71 | .62 | .68 | .74 | .63 | .83 | .89 | .66 |
| Accuracy | D. | B. | C. | C. | B. | B. | C. | C. | B. | B. |

[a] Gage was washed out June 22. Discharges previous to that date are only approximate. A new gage was installed July 3. The discharge rating curve for the new gage is fairly well defined below 60 second-feet.
[b] Discharges are fairly well defined below 40 second-feet.
[c] Discharges are fairly well defined below 20 second-feet.

*Daily discharge, in second-feet, of Buckley Bar Creek and Sheep Creek for 1912.*

| Day. | Sheep Creek at mouth. [Drainage area, 46.7 square miles.] | | | | Buckley Bar Creek at mouth. [Drainage area, 10.6 square miles.] | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | May. | June. | July. | Aug. | May. | June. | July. | Aug. | Sept. |
| 1 | | | | | | 22 | 2.6 | 0.61 | 6.3 |
| 2 | | | | 6.8 | | 39 | 2.2 | .60 | 8.0 |
| 3 | | | | | | 22 | 1.7 | .59 | 7.8 |
| 4 | | 67 | | | | 13.5 | 1.4 | .57 | 7.5 |
| 5 | | | | 8.3 | | 5.0 | 1.2 | .55 | 7.2 |
| 6 | | | | | | 3.6 | .90 | 1.0 | 5.9 |
| 7 | | | | 179 | | 4.0 | .82 | 8.0 | 5.0 |
| 8 | | 26 | | | | 4.6 | .70 | 7.8 | 5.0 |
| 9 | | | | | | 5.2 | .67 | 5.7 | 7.2 |
| 10 | | | | | | 3.4 | .75 | 9.0 | 6.5 |
| 11 | | | | | | 1.5 | .72 | 13.1 | 6.0 |
| 12 | | | | | | 3.4 | .69 | 33 | 5.5 |
| 13 | | | | | | 4.2 | .66 | 16.0 | 5.0 |
| 14 | | | | | | 4.0 | .63 | 10.0 | 6.0 |
| 15 | | | | | | 6.0 | .67 | 7.0 | 6.9 |
| 16 | 84 | | | | | 12.0 | .59 | 5.0 | 7.0 |
| 17 | | | | | | 17.0 | .63 | 5.0 | 7.0 |
| 18 | | | | 33 | | 12.0 | 1.0 | 4.6 | 7.5 |
| 19 | | 142 | | 31 | | 22 | 1.4 | 4.0 | 16.0 |
| 20 | 84 | | 9.8 | | | 12.0 | 1.2 | 3.4 | 25 |
| 21 | | 134 | | | 2.6 | 4.4 | 1.2 | 3.2 | 34 |
| 22 | 67 | | | | 2.0 | 7.8 | 1.1 | 2.9 | 43 |
| 23 | | | | | 5.9 | 12.0 | 1.1 | 2.8 | |
| 24 | | | 9.8 | | 3.6 | 30 | 1.0 | 2.6 | |
| 25 | | | | 18.6 | 2.8 | 41 | .98 | 3.9 | |
| 26 | | | 7.5 | | 2.0 | 26 | .86 | 5.2 | |
| 27 | | | | | 3.2 | 7.8 | .75 | 6.6 | |
| 28 | 25 | | | | 4.4 | 5.5 | .67 | 5.2 | |
| 29 | 193 | 60 | | | 34 | 3.9 | .65 | 2.9 | |
| 30 | 124 | | | | 17.0 | 3.6 | .63 | 2.8 | |
| 31 | | | 118 | 22 | 9.9 | | .62 | 2.6 | |
| Mean | | | | | 7.95 | 1.19 | .990 | 5.68 | 10.7 |
| Mean per square mile | | | | | .750 | .112 | .093 | .536 | 1.01 |
| Run-off (depth in inches on drainage area) | | | | | .31 | .12 | .11 | .62 | .83 |
| Accuracy | | | | | B. | B. | B. | B. | B. |

NOTE.—The above discharges are fairly well defined for all stages.

*Miscellaneous measurements in Birch Creek drainage basin, 1912.*

| Date. | Stream and locality. | Drainage area. | Discharge. | Discharge per square mile. |
|---|---|---|---|---|
| | | *Sq. miles.* | *Sec.-feet.* | *Sec.-feet.* |
| June 6 | Ptarmigan Creek at mouth | 19 | 29 | 1.53 |
| July 18 | do | 19 | 5.0 | .26 |
| Aug. 18 | do | 19 | 15.6 | .82 |
| July 18 | Birch Creek above Twelvemile Creek | 88 | 27 | .31 |
| June 6 | Eagle Creek at mouth | 15.5 | 17.0 | 1.09 |
| July 5 | Golddust Creek 3 miles above mouth | 10.0 | 5.0 | .50 |
| July 18 | Golddust Creek at mouth | 13.6 | 6.9 | .51 |
| Aug. 18 | do | 13.6 | 9.3 | .68 |
| July 18 | Fish Creek at mouth | 6.0 | .52 | .087 |
| Aug. 18 | do | 6.0 | 3.1 | .52 |
| July 18 | Butte Creek at mouth | 9.2 | 5.5 | .60 |
| Aug. 18 | do | 9.2 | 6.2 | .67 |
| June 6 | Bear Creek at mouth | 12.4 | 14.0 | 1.13 |
| July 18 | do | 12.4 | 2.5 | .20 |
| Aug. 18 | do | 12.4 | 7.2 | .58 |
| June 8 | Twelvemile Creek below South Fork | 23 | 14.3 | .62 |
| Aug. 17 | do | 23 | 6.8 | .30 |
| June 8 | North Fork of Twelvemile Creek at mouth | 22.9 | 23 | 1.00 |
| Aug. 17 | do | 22.9 | 7.7 | .34 |
| July 19 | Harrington Fork above Crooked Creek | 44.7 | 13.2 | .30 |
| Do | Crooked Creek at mouth (tributary of Harrington Fork). | 33.3 | 6.5 | .20 |
| July 3 | Acme Creek 2 miles above mouth | 27.7 | 7.0 | .25 |
| Aug. 25 | do | 27.7 | 3.8 | .14 |
| July 3 | Clums Fork below Bear Creek | 106 | 70 | .66 |
| Aug. 25 | do | 106 | 62 | .58 |
| July 3 | Bear Creek at mouth (tributary of Clums Fork) | 34.7 | 32 | .92 |
| Aug. 25 | do | 34.7 | 30 | .87 |

## CROOKED CREEK DRAINAGE BASIN.

Crooked Creek, which is formed by the junction of Mammoth and Porcupine creeks, meanders through a rather broad valley for about 30 miles and discharges its waters into Birch Creek about 10 miles above the Fourteenmile House. Not far below the Central House the valley loses its identity in the flats of Birch Creek.

Mastodon and Independence creeks unite to form Mammoth Creek, which receives Miller Creek from the west about 2 miles below this junction. The total length of that portion of the stream called Mammoth Creek is less than 4 miles.

Deadwood and Boulder creeks are tributaries from the south, below and above Central House, respectively. They follow parallel courses about 3 miles apart, with a length of about 18 miles.

Albert Creek, the principal tributary from the north, drains the southern slope of the Crazy Mountains.

Portage Creek rises in the divide between Birch and Crooked creeks, about 10 miles east of Deadwood Creek. It flows northeast for about 8 miles to Medicine Lake.

*Daily discharge, in second-feet, of Porcupine Creek, below ditch intake and below Bonanza Creek for 1912.*

| Day | Porcupine Creek below ditch intake.[a] [Drainage area, 17.8 square miles.] | | | | Porcupine Creek below Bonanza Creek.[b] [Drainage area, 39.9 square miles.] | | | |
|---|---|---|---|---|---|---|---|---|
| | June. | July. | Aug. | Sept. | June. | July. | Aug. | Sept. |
| 1 | ..... | 0 | 0 | 4.4 | ..... | 3.0 | 0.8 | 13.0 |
| 2 | 75 | 0 | 0 | 15.4 | 142 | 3.0 | .8 | 23 |
| 3 | 55 | 0 | 0 | 14.3 | 142 | 2.6 | .8 | 30 |
| 4 | 35 | 0 | 0 | 10.7 | 67 | 2.1 | .8 | 26 |
| 5 | 12.8 | 0 | 0 | 8.0 | 7.6 | 1.7 | .8 | 19.8 |
| 6 | 2.9 | 0 | 0 | 4.2 | 5.2 | 1.5 | .8 | 15.5 |
| 7 | 1.6 | 0 | 0 | 2.9 | 4.4 | .8 | .8 | 12.3 |
| 8 | 0 | 0 | 0 | 1.4 | 3.5 | .8 | .8 | 9.0 |
| 9 | 0 | 0 | 0 | 1.6 | 2.9 | .8 | .8 | 5.8 |
| 10 | 0 | 0 | 0 | 1.6 | 2.9 | .8 | .8 | 7.0 |
| 11 | 0 | 0 | 27 | .6 | 2.0 | .8 | 39 | 5.7 |
| 12 | 5.1 | 0 | 22 | .3 | 2.9 | .8 | 30 | 4.4 |
| 13 | 27 | 0 | 13.5 | 0 | 29 | .8 | 19.8 | 3.1 |
| 14 | 34 | 0 | 5.6 | 0 | 34 | .8 | 13.4 | 1.9 |
| 15 | 71 | 0 | 0 | 0 | 29 | .8 | 7.0 | 16 |
| 16 | 121 | 0 | 0 | 27 | 150 | .7 | 3.0 | 30 |
| 17 | 56 | 0 | 0 | 22 | 83 | .8 | 2.4 | 46 |
| 18 | 34 | 0 | 0 | 26 | 176 | .8 | 1.9 | 61 |
| 19 | 60 | 0 | 0 | 18.3 | 67 | .8 | 1.3 | 50 |
| 20 | 56 | 0 | 0 | 15.4 | 19.6 | .8 | .8 | 39 |
| 21 | 15.4 | 0 | 0 | ..... | 11.2 | .8 | .8 | ..... |
| 22 | 56 | 0 | 0 | ..... | 83 | .8 | .8 | ..... |
| 23 | 214 | 0 | 0 | ..... | 297 | .8 | .8 | ..... |
| 24 | 295 | 0 | 0 | ..... | 320 | .8 | .8 | ..... |
| 25 | 228 | 0 | 0 | ..... | 251 | .8 | .8 | ..... |
| 26 | 40 | 0 | 0 | ..... | 133 | .8 | .8 | ..... |
| 27 | 18.3 | 0 | 0 | ..... | 81 | .8 | 1.9 | ..... |
| 28 | 3.2 | 0 | 0 | ..... | 26 | .8 | 3.0 | ..... |
| 29 | 0 | 0 | 0 | ..... | 7.0 | .8 | 3.0 | ..... |
| 30 | 0 | 0 | 0 | ..... | 3.8 | .8 | 3.0 | ..... |
| 31 | ..... | 0 | 0 | ..... | ..... | .8 | 3.0 | ..... |
| Mean | 52.3 | 0 | 2.19 | 8.70 | 75.3 | 1.09 | 4.69 | 20.9 |
| Accuracy | ..... | ..... | ..... | ..... | D. | A. | B. | B. |

[a] The discharge rating curve for this station is fairly well defined below 75 second-feet. To obtain the natural flow of Porcupine Creek below ditch intake add the flow of Porcupine ditch at intake.

[b] Channel shifted considerably on June 23 and 24. New rating applied after June 23. Discharges well defined below 15 second-feet.

*Daily discharge, in second-feet, of Crooked Creek at Central House for 1912.*

[Drainage area, 161 square miles.]

| Day. | May. | June. | July. | Aug. | Sept. | Oct. |
|---|---|---|---|---|---|---|
| 1 | ..... | 546 | 55 | 7.5 | 55 | 69 |
| 2 | ..... | 635 | 44 | 8.6 | 98 | 64 |
| 3 | ..... | 503 | 41 | 8.6 | 118 | 55 |
| 4 | ..... | 293 | 39 | 8.6 | 132 | 48 |
| 5 | ..... | 164 | 30 | 8.6 | 106 | 41 |
| 6 | ..... | 106 | 26 | 8.6 | 113 | 41 |
| 7 | ..... | 89 | 19.7 | 12.2 | 106 | 39 |
| 8 | ..... | 52 | 17.8 | 48 | 89 | 41 |
| 9 | 30 | 48 | 14.5 | 41 | 72 | 41 |
| 10 | 26 | 48 | 17.8 | 48 | 64 | 36 |
| 11 | 32 | 30 36 | 17.8 | 52 | 69 | 30 |
| 12 | 52 | | 14.5 | 180 | 72 | 30 |
| 13 | 82 | 132 | 13.6 | 173 | 72 | 41 |
| 14 | 187 | 164 | 12.2 | 113 | 64 | 41 |
| 15 | 118 | 147 | 9.8 | 82 | 64 | 55 |
| 16 | 154 | 590 | 9.8 | 64 | 72 | 55 |
| 17 | 216 | 334 | 9.8 | 55 | 164 | 55 |
| 18 | 209 | 198 | 9.8 | 41 | 293 | 55 |
| 19 | 216 | 397 | 8.6 | 39 | 216 | ..... |
| 20 | 154 | 254 | 9.3 | 41 | 209 | ..... |
| 21 | 118 | 147 | 8.6 | 36 | 224 | ..... |
| 22 | 141 | 187 | 8.6 | 32 | 235 | ..... |
| 23 | 214 | 726 | 9.3 | 30 | 173 | ..... |
| 24 | 187 | 916 | 8.6 | 30 | 118 | ..... |
| 25 | 154 | 868 | 8.6 | 30 | 106 | ..... |
| 26 | 124 | 635 | 9.8 | 30 | 89 | ..... |
| 27 | 106 | 397 | 8.6 | 48 | 72 | ..... |
| 28 | 154 | 254 | 8.6 | 52 | 72 | ..... |
| 29 | 293 | 180 | 9.3 | 48 | 70 | ..... |
| 30 | 214 | 82 | 8.6 | 41 | 70 | ..... |
| 31 | 198 | ..... | 7.5 | 41 | ..... | ..... |
| Mean | 147 | 305 | 16.6 | 47.0 | 116 | 46.5 |
| Mean per square mile | .913 | 1.89 | .103 | .292 | .720 | .289 |
| Run-off (depth in inches on drainage area) | .78 | 2.11 | .12 | .34 | .80 | .19 |
| Accuracy | A. | B. | A. | A. | A. | A. |

NOTE.—The rating curve for the above discharges is well defined below 300 second-feet.

*Daily discharge, in second-feet, of Bonanza and Miller creeks for 1912.*

| Day. | Bonanza Creek below ditch intake.[a] [Drainage area, 7.9 square miles.] | | | | | Miller Creek at mouth.[b] [Drainage area, 105 square miles.] | | |
|---|---|---|---|---|---|---|---|---|
| | May. | June. | July. | Aug. | Sept. | June. | July. | Aug. |
| 1 | ..... | ..... | 0.4 | 0.3 | 0.3 | ..... | 2.5 | ..... |
| 2 | ..... | 51 | .4 | .3 | .4 | ..... | 14.7 | ..... |
| 3 | ..... | 44 | .3 | .3 | .4 | ..... | 4.1 | ..... |
| 4 | ..... | 5.3 | .3 | .3 | .4 | 38 | 3.0 | ..... |
| 5 | ..... | .6 | .3 | .3 | .4 | 23 | 3.0 | ..... |
| 6 | ..... | .5 | .3 | .3 | .4 | 14.7 | 2.5 | ..... |
| 7 | ..... | .4 | .3 | .3 | .3 | 12.3 | 2.0 | ..... |
| 8 | ..... | .4 | .3 | .3 | .3 | 10.3 | 4.1 | ..... |
| 9 | ..... | .5 | .3 | .3 | .3 | 8.3 | 3.0 | ..... |
| 10 | ..... | .4 | .3 | .3 | .3 | 6.8 | 3.0 | ..... |
| 11 | ..... | .4 | .3 | 2.4 | .3 | 6.8 | 2.5 | ..... |
| 12 | ..... | .6 | .3 | .6 | .3 | 34 | 2.5 | ..... |
| 13 | ..... | 1.3 | .3 | .5 | .3 | 20 | 2.0 | ..... |
| 14 | ..... | 2.9 | .3 | .7 | .3 | 12.3 | 2.0 | ..... |
| 15 | ..... | 25 | .3 | .4 | .3 | 76 | 2.0 | ..... |

[a] New rating used after June 22. Discharges are only approximate. To obtain natural flow past this station add the discharge of Bonanza ditch at intake.

[b] Station abandoned July 15 because of shifting channel. Discharges are only approximate.

*Daily discharge, in second-feet, of Bonanza and Miller creeks for 1912*—Continued.

| Day. | Bonanza Creek below ditch intake. [Drainage area, 7.9 square miles.] | | | | | Miller Creek ar mouth. [Drainage area, 105 square miles.] | | |
|---|---|---|---|---|---|---|---|---|
| | May. | June. | July. | Aug. | Sept. | June. | July. | Aug. |
| 16 | ..... | 45 | 0.3 | 0.3 | 0.3 | 38 | ..... | ..... |
| 17 | ..... | 1.2 | .3 | .3 | .5 | 23 | ..... | ..... |
| 18 | ..... | .8 | .3 | .3 | 3.7 | 23 | ..... | ..... |
| 19 | ..... | 30 | .3 | .3 | 1.6 | 30 | ..... | ..... |
| 20 | ..... | 1.9 | .3 | .3 | 2.4 | 14.7 | ..... | ..... |
| 21 | ..... | .6 | .3 | .3 | 11 | 38 | ..... | ..... |
| 22 | ..... | 19 | .3 | .3 | ..... | 65 | ..... | ..... |
| 23 | ..... | 90 | .3 | .3 | ..... | 87 | ..... | ..... |
| 24 | ..... | 46 | .3 | .3 | ..... | 50 | ..... | ..... |
| 25 | ..... | 44 | .3 | .3 | ..... | 38 | ..... | ..... |
| 26 | ..... | 26 | .3 | .3 | ..... | 23 | ..... | ..... |
| 27 | ..... | 12 | .3 | .4 | ..... | 20 | ..... | ..... |
| 28 | ..... | 12 | .3 | .4 | ..... | 17.1 | ..... | ..... |
| 29 | ..... | 1.6 | .3 | .4 | ..... | 12.3 | ..... | ..... |
| 30 | ..... | .4 | .3 | .4 | ..... | 5.2 | ..... | ..... |
| 31 | ..... | ..... | .3 | .3 | ..... | ..... | ..... | ..... |
| Mean | ..... | 16.0 | .31 | .41 | 1.17 | 24.9 | 3.53 | ..... |
| Mean per square mile | ..... | ..... | ..... | ..... | ..... | 2.37 | .336 | ..... |
| Run-off (depth in inches on drainage area) | ..... | ..... | ..... | ..... | ..... | 2.38 | .19 | ..... |
| Accuracy | ..... | D. | D. | D. | D. | D. | D. | ..... |

*Daily discharge, in second-feet, of Deadwood and Portage creeks for 1912.*

| Day. | Deadwood Creek above Switch Creek.[a] [Drainage area, 21.3 square miles.] | | | | | | Portage Creek 4 miles above Medicine Lake.[b] [Drainage area, 10.9 square miles.] | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | May. | June. | July. | Aug. | Sept. | Oct. | May. | June. | July. | Aug. | Sept. |
| 1 | ..... | 46 | 7.7 | 3.0 | 16.0 | 11.2 | ..... | 17.3 | 2.8 | 0.32 | 2.8 |
| 2 | ..... | 65 | 6.8 | 3.0 | 15 | 11.2 | ..... | 22 | 1.2 | .30 | 6.3 |
| 3 | ..... | 54 | 5.9 | 3.0 | 15 | 10.3 | ..... | 17.3 | 1.2 | .30 | 5.1 |
| 4 | ..... | 40 | 5.3 | 3.0 | 14 | 10.3 | ..... | 7.4 | 1.2 | .37 | 4.2 |
| 5 | ..... | 34 | 5.3 | 5.0 | 13 | 10.3 | ..... | 8.8 | 1.2 | .37 | 4.2 |
| 6 | ..... | 20 | 3.8 | 7.0 | 13 | 9.0 | ..... | 6.3 | .96 | .30 | 5.1 |
| 7 | ..... | 5.2 | 3.3 | 9.4 | 12 | 9.0 | ..... | 4.2 | .78 | 8.8 | 2.8 |
| 8 | ..... | 5.2 | 3.3 | 10.8 | 11.2 | 9.0 | ..... | 2.8 | .78 | 17.3 | 2.8 |
| 9 | ..... | 6.8 | 3.0 | 7.7 | 10 | 9.0 | ..... | 2.8 | .60 | 6.3 | 5.1 |
| 10 | ..... | 6.8 | 3.0 | 12.0 | 9.0 | 7.7 | ..... | 2.0 | .48 | 3.5 | 5.1 |
| 11 | ..... | 5.8 | 3.0 | 17.0 | 9.0 | 7.7 | ..... | 1.2 | .39 | 41 | 4.2 |
| 12 | ..... | 6.8 | 3.0 | 18.5 | 11.2 | 9.0 | ..... | 2.0 | .60 | 22 | ..... |
| 13 | ..... | 15.6 | 3.0 | 13.6 | 10.3 | 9.0 | ..... | 6.3 | .48 | 8.8 | ..... |
| 14 | ..... | 10.9 | 3.0 | 12.2 | 11.2 | ..... | ..... | 4.2 | .53 | 8.8 | ..... |
| 15 | ..... | 10.9 | 3.0 | 10.3 | 9.0 | ..... | ..... | 6.3 | .48 | 6.3 | ..... |
| 16 | ..... | 32 | 3.0 | 9.0 | 10 | ..... | ..... | 12.2 | .44 | 4.2 | ..... |
| 17 | 29 | 15.6 | 3.0 | 7.7 | 16.0 | ..... | ..... | 17.3 | .48 | 4.2 | ..... |
| 18 | 21 | 10.9 | 3.0 | 6.8 | 20 | ..... | ..... | 12.2 | .53 | 2.8 | ..... |
| 19 | 19.8 | 26 | 3.0 | 5.9 | 21 | ..... | ..... | 22 | .60 | 2.4 | ..... |
| 20 | 17.2 | 15.6 | 3.0 | 5.9 | 21 | ..... | ..... | 12.2 | .86 | 2.0 | ..... |
| 21 | 13.8 | 10.9 | 3.0 | 5.9 | 21 | ..... | ..... | 6.3 | .78 | 2.0 | ..... |
| 22 | 14.7 | 38 | 3.0 | 5.3 | 18.5 | ..... | ..... | 47 | .78 | 2.0 | ..... |
| 23 | 29 | 70 | 3.5 | 5.3 | 16 | ..... | ..... | 55 | .60 | 2.0 | ..... |
| 24 | 16.4 | 50 | 3.8 | 5.3 | 14 | ..... | ..... | 47 | .60 | 2.0 | ..... |
| 25 | 12.0 | 44 | 3.3 | 5.3 | 13 | ..... | ..... | 41 | .60 | 1.6 | ..... |
| 26 | 16.4 | 38 | 26 | 5.3 | 13 | ..... | ..... | 34 | .68 | 1.2 | ..... |
| 27 | 12.7 | 29 | 3.5 | 5.3 | 12.2 | ..... | ..... | 17.3 | .68 | 1.6 | ..... |
| 28 | 17.2 | 20 | 3.0 | 6.2 | 11.2 | ..... | ..... | 4.2 | .78 | 1.7 | ..... |
| 29 | 37 | 11.2 | 3.0 | 6.8 | 11.2 | ..... | ..... | 1.2 | .60 | 1.7 | ..... |
| 30 | 29 | 11.2 | 3.0 | 7.7 | 11.2 | ..... | 21 | .78 | .48 | 1.6 | ..... |
| 31 | 19.8 | ..... | 3.0 | 6.8 | ..... | ..... | 12.2 | ..... | .39 | 1.6 | ..... |
| Mean | 20.3 | 25.2 | 4.37 | 7.61 | 13.6 | 9.44 | 16.6 | 14.7 | .76 | 5.14 | 4.34 |
| Mean per square mile | .953 | 1.18 | .205 | .357 | .638 | .443 | 1.52 | 1.35 | .070 | .472 | .398 |
| Run-off (depth in inches on drainage area) | .53 | 1.32 | .24 | .41 | .71 | .21 | .11 | 1.51 | .08 | .54 | .16 |
| Accuracy | B. | D. | B. | B. | B. | B. | B. | B. | B. | B. | B. |

[a] From June 1 to 27 the discharges were applied indirectly because of shifting channel.
[b] Discharges are fairly accurate below 40 second-feet.

*Daily discharge, in second-feet, of Porcupine ditch and Bonanza ditch at intake for 1912.*

| Day. | Porcupine ditch at intake. | | | | Bonanza ditch at intake.[a] | | | |
|---|---|---|---|---|---|---|---|---|
| | June. | July. | Aug. | Sept. | June. | July. | Aug. | Sept. |
| 1 | ..... | 7.8 | 1.9 | 10.0 | ..... | 4.6 | 3.2 | 10.0 |
| 2 | ..... | 6.1 | 1.8 | 12.5 | 20 | 4.0 | 3.2 | 10.5 |
| 3 | ..... | 4.8 | 1.6 | 10.5 | 19.1 | 3.7 | 3.1 | 13.3 |
| 4 | 11.2 | 4.0 | 1.6 | 11.8 | 27 | 3.6 | 3.2 | 14.7 |
| 5 | 12.0 | 3.6 | 1.6 | 13.0 | 17.6 | 3.3 | 3.2 | 14.0 |
| 6 | 13.0 | 2.7 | 1.5 | 13.0 | 9.5 | 3.2 | 3.3 | 11.8 |
| 7 | 10.5 | 2.3 | 5.7 | 13.0 | 6.1 | 3.2 | 5.3 | 10.0 |
| 8 | 10.5 | 2.0 | 14.4 | 13.0 | 4.5 | 3.0 | 5.2 | 9.1 |
| 9 | 10.5 | 1.9 | 10.5 | 13.0 | 8.0 | 3.0 | 4.7 | 8.9 |
| 10 | 7.8 | 1.7 | 6.5 | 13.0 | 4.1 | 3.0 | 4.7 | 9.1 |
| 11 | 6.5 | 1.7 | 8.2 | 13.0 | 3.4 | 3.0 | 16.4 | 8.3 |
| 12 | 10.0 | 1.6 | 13.0 | 13.0 | 11.8 | 3.0 | 30 | 8.6 |
| 13 | 13.0 | 1.6 | 14.4 | 12.0 | 21 | 2.9 | 22 | 8.3 |
| 14 | 13.0 | 1.7 | 15.8 | 13.0 | 20 | 3.0 | 12.5 | 7.5 |
| 15 | 9.4 | 1.6 | 14.1 | 13.6 | 16.2 | 2.9 | 9.4 | 7.9 |
| 16 | 0 | 1.6 | 11.0 | 13.0 | 26 | 2.8 | 8.1 | 10.8 |
| 17 | 7.2 | 1.6 | 8.7 | 10.5 | 33 | 2.9 | 7.1 | 20 |
| 18 | 15.8 | 1.6 | 6.9 | 11.8 | 17.3 | 2.9 | 6.5 | 21 |
| 19 | 11.0 | 1.6 | 6.1 | 13.0 | 15.6 | 2.9 | 6.1 | 20 |
| 20 | 14.4 | 1.6 | 4.7 | 13.0 | 17.3 | 2.9 | 5.7 | 25 |
| 21 | 18.8 | 1.7 | 4.3 | 13.0 | 15.1 | 3.0 | 5.2 | 7.7 |
| 22 | 17.3 | 1.7 | 3.9 | ..... | 18.6 | 3.0 | 4.9 | ..... |
| 23 | 0 | 1.7 | 2.3 | ..... | 11.8 | 3.0 | 5.7 | ..... |
| 24 | 0 | 1.7 | 3.6 | ..... | 8.3 | 3.1 | 6.5 | ..... |
| 25 | 0 | 1.7 | 4.0 | ..... | 8.3 | 3.1 | 6.3 | ..... |
| 26 | 0 | 2.5 | 4.3 | ..... | 9.4 | 3.3 | 7.3 | ..... |
| 27 | 18.8 | 2.9 | 8.2 | ..... | 7.1 | 3.2 | 10.5 | ..... |
| 28 | 18.8 | 2.9 | 10.5 | ..... | 4.3 | 3.3 | 11.5 | ..... |
| 29 | 16.1 | 2.5 | 10.5 | ..... | 6.3 | 3.2 | 9.1 | ..... |
| 30 | 10.0 | 2.1 | 10.0 | ..... | 5.3 | 3.2 | 8.1 | ..... |
| 31 | ..... | 2.1 | 9.4 | ..... | ..... | 3.2 | 7.1 | ..... |
| Mean | 10.2 | 2.47 | 7.13 | 12.5 | 13.5 | 3.17 | 7.91 | 12.2 |
| Accuracy | A. | A. | A. | A. | C. | B. | B. | B. |

[a] New rating curve used after June 17 because of shifting channel. It is well defined below 15 second-feet.

*Daily discharge, in second-feet, of Bonanza ditch for 1912.*

| Day. | Bonanza ditch below junction with Porcupine branch.[a] | | | | Bonanza ditch at outlet. | | | |
|---|---|---|---|---|---|---|---|---|
| | June. | July. | Aug. | Sept. | June. | July. | Aug. | Sept. |
| 1 | ..... | 12.0 | 4.8 | 15.7 | ..... | 14.1 | 4.1 | 13.0 |
| 2 | 23 | 10.1 | 4.7 | 19.2 | 39 | 12.0 | 3.9 | 18.2 |
| 3 | 27 | 9.0 | 4.7 | 22 | 40 | 9.4 | 3.8 | 20 |
| 4 | 29 | 8.0 | 4.8 | 24 | 38 | 7.4 | 3.8 | 21 |
| 5 | 31 | 6.8 | 4.7 | 23 | 36 | 6.4 | 3.5 | 21 |
| 6 | 25 | 6.1 | 4.8 | 22 | 29 | 5.4 | 3.4 | 19.7 |
| 7 | 19.2 | 5.7 | 9.0 | 20 | 24 | 4.4 | 3.8 | 19.1 |
| 8 | 15.4 | 5.3 | 6.8 | 19.6 | 18.8 | 3.4 | 6.6 | 18.5 |
| 9 | 22 | 5.1 | 13.1 | 19.6 | 24 | 3.1 | 10.5 | 18.5 |
| 10 | 13.4 | 4.8 | 10.6 | 19.6 | 16.5 | 4.2 | 9.1 | 18.8 |
| 11 | 11.1 | 5.0 | 24 | 13.7 | 12.8 | 3.4 | 15.2 | 18.2 |
| 12 | 23 | 4.8 | 30 | 18.8 | 20 | 3.1 | 25 | 16.5 |
| 13 | 35 | 4.7 | 30 | 18.5 | 28 | 3.1 | 13.0 | 18.2 |
| 14 | 34 | 4.7 | 22 | 16.8 | 31 | 3.1 | 10.5 | 16.5 |
| 15 | 30 | 4.7 | 14.2 | 18.1 | 37 | 3.1 | 9.4 | 17.1 |
| 16 | 27 | 4.6 | 14.2 | 18.8 | 39 | 1.8 | 17.9 | 20 |
| 17 | 36 | 4.7 | 14.2 | 28 | 38 | 1.8 | 17.9 | 27 |
| 18 | 37 | 4.6 | 12.5 | 29 | 38 | 1.8 | 16.3 | 31 |
| 19 | 35 | 4.7 | 11.5 | 29 | 40 | 1.7 | 13.0 | 32 |
| 20 | 37 | 4.6 | 10.3 | 34 | 40 | 1.7 | 16.3 | 33 |

[a] Water from the Porcupine branch was turned off part of the day on Aug. 8, 12, and 15 and Sept. 11, and all day on Aug. 22.

*Daily discharge, in second-feet, of Bonanza ditch for 1912*—Continued.

| Day. | Bonanza ditch below junction with Porcupine branch. | | | | Bonanza ditch at outlet. | | | |
|---|---|---|---|---|---|---|---|---|
| | June. | July. | Aug. | Sept. | June. | July. | Aug. | Sept. |
| 21 | 36 | 4.5 | 9.7 | 19.2 | 34 | 1.7 | 7.6 | 31 |
| 22 | 40 | 4.5 | 6.0 | ..... | 34 | 1.5 | 3.5 | ..... |
| 23 | 22 | 4.5 | 9.3 | ..... | 31 | 1.5 | 6.4 | ..... |
| 24 | 12.5 | 4.5 | 10.1 | ..... | 22 | 1.4 | 7.8 | ..... |
| 25 | 11.8 | 4.6 | 10.1 | ..... | 21 | 1.4 | 7.8 | ..... |
| 26 | 12.5 | 5.1 | 11.5 | ..... | 22 | 1.6 | 9.6 | ..... |
| 27 | 15.4 | 5.3 | 16.8 | ..... | 20 | 2.6 | 13.3 | ..... |
| 28 | 18.8 | 5.5 | 20 | ..... | 23 | 2.9 | 18.8 | ..... |
| 29 | 20 | 5.3 | 18.1 | ..... | 25 | 3.1 | 12.0 | ..... |
| 30 | 14.8 | 5.1 | 15.7 | ..... | 17.9 | 3.8 | 10.5 | ..... |
| 31 | ..... | 5.1 | 10.6 | ..... | ..... | 4.2 | ..... | ..... |
| Mean | 24.6 | 5.61 | 12.5 | 21.4 | 28.9 | 3.87 | 10.4 | 21.4 |
| Accuracy | B. | B. | B. | B. | A. | A. | A. | A. |

## FAIRBANKS DISTRICT.

### GENERAL FEATURES.

The Fairbanks district extends about 60 miles to the north of Fairbanks and is from 40 to 50 miles wide. The greater part of it lies in the lower Tanana basin, but a portion to the northwest drains directly to the Yukon. Generally speaking, the district embraces three divisions—a low, broad alluvial plain, a moderately high dissected plateau, and a mountain mass.

The low, broad plain forms the bottom lands of the lower Tanana Valley, which in this section is divided into several parts by the Tanana and its sloughlike channels. The main slough starts near the mouth of Salcha River, about 30 miles above Fairbanks, and diverts a portion of the Tanana waters. Its course is northward along the foothills of the plateau, and it receives Chena River about 9 miles above Fairbanks. The plain is swampy and is well covered with timber along the banks of the streams. In the vicinity of Fairbanks it has a general elevation of about 500 feet above sea level.

The plateau is drained by streams tributary to Tanana River, which flow through rather broad, unsymmetrical valleys, chiefly extending in a northeast-southwest direction. Their bottom lands range in elevation from 500 to over 2,000 feet above sea level, and the dividing ridges are, in general, 1,000 to 3,000 feet above the stream beds. That portion of the plateau discussed in this report is drained principally by Little Chena and Chatanika rivers. The upper region of these drainage basins is crosscut by a zigzag range, which separates the Yukon from the Tanana basin.

The mountain mass north of this plateau forms what might be termed the apex of the divide between the Tanana and the Yukon drainage basins; its highest points reach altitudes 4,000 to 5,000 feet above sea level, and its corrugated slopes are drained principally by tributaries of Yukon River.

All drainage areas tributary to the Tanana are similar in character. The streams have little slope except near their source and flow over wide, gravelly beds in shifting and tortuous courses, keeping to one side of the valley. Most of the channels have rather steep banks that form approaches to broad, level bottom lands, which extend 1,000 to 4,000 feet or more before they meet the abrupt slopes of the dividing ridges. The drainage basins are 4 to 15 miles wide and are cut up by small tributary streams that flow through deep and narrow ravines.

A large portion of the area is covered with a thick turf, which is wet, spongy, and mossy and ranges in thickness from 6 inches to 2 feet. In some localities this lowland area is meadow-like, producing a rank growth of grass and a variety of beautiful wild flowers. Ground ice is found beneath the turf in many places, particularly on the northern slopes, where the scanty soil supports little timber or other vegetation. The soil of the southern slopes is for the most part clay, underlain by a mica schist, and affords suitable ground for ditch construction. When stripped of its mossy covering and exposed to the sun it thaws rapidly, so that the plow and scraper can be used to advantage.

Above altitudes of 2,000 to 2,200 feet practically the only vegetation is a scrubby, bushy growth, which attains a height of 2 to 4 feet. In general, the country below this altitude is timbered by spruce and birch, with scattered patches of tamarack and willow along the banks of the smaller streams. The timber increases in density and size toward the river bottoms, where the prevailing growth is spruce, much of which attains a diameter of 18 to 24 inches.

The Fairbanks mining district lies between Little Chena and Chatanika rivers. It embraces an area of about 500 square miles and extends 30 miles north of Fairbanks, which is situated on Chena Slough nearly 12 miles above its confluence with the Tanana. Most of the producing creeks rise in a high, rocky ridge, of which Pedro Dome, with an elevation of about 2,500 feet, is the center. At least half of the mines are located at an elevation of over 800 feet, and 25 per cent are over 1,000 feet above sea level.

The following list gives the locations at which gaging stations were maintained or discharge measurements made in 1912 in the Fairbanks district. Relation of streams is shown by indention.

Salcha River drainage basin:
Junction Creek above Moose Lake outlet.
Chena River drainage basin:
Chena River above Shamrock Creek.
Chena River above Little Chena River.
North Fork Chena River below Boulder Creek.
North Fork Chena River above Monument Creek.
North Fork Chena River below Monument Creek.
Monument Creek at Chena Hot Springs.
Frozenfoot Creek at elevation 1,500 feet.
Frozenfoot Creek 2 miles above mouth.
West Fork of Chena River, above Olympia Creek.
Olympia Creek at mouth.
Fish Creek below Solo Creek.
Chatanika River drainage basin:
Smith Creek above Pool Creek.
McManus Creek at mouth.
Chatanika River below Faith Creek.
Chatanika River below Poker Creek.
Pool Creek at mouth.
Hope Creek at mouth.
Faith Creek at mouth.
Charity Creek above Homestake Creek.
Homestake Creek at mouth.
Deep Creek at mouth.
Poker Creek above ditch intake.
Caribou Creek at mouth.
Beaver Creek drainage basin:
Nome Creek, 4 miles above Moose Creek.
Nome Creek above Ophir Creek.
Ophir Creek at Discovery claim.

## SALCHA RIVER DRAINAGE BASIN.

Salcha River rises opposite South Fork of Birch Creek, about 25 miles from the Yukon. The basin covers an area of 2,170 square miles and is bounded by the Goodpaster and Charley River basins on the south and east and the Chena and Birch Creek basins on the north. The length of the river from the headwaters to North Fork, following the general direction of the valley, is about 70 miles, and from the North Fork to the Tanana about 55 miles. The prevailing direction of flow is somewhat south of east. The Salcha roughly parallels the Chena at a distance of approximately 30 miles. The average fall of the river from the North Fork to the mouth is 10 feet to the mile, and from a point about 2 miles from the summit of the divide at the headwaters it averages 19 feet to the mile. At the mouth, which is 40 miles from Fairbanks, a ferry, post office, store, and road house are located. Redmond Creek enters the Salcha from the south about 15 miles above the mouth. Junction and Mosquito Creeks, which join to form Redmond Creek, drain an area 6 to 8 miles north of and parallel to Tanana River.

*Daily discharge, in second-feet, of Junction Creek above Moose Lake outlet for 1912.*

[Drainage area, 23.6 square miles.]

| Day. | June. | July. | Aug. | Sept. | Oct. | Day. | June. | July. | Aug. | Sept. | Oct. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 70 | 28 | 4.3 | 5.4 | ..... | 21 | 38 | 5.8 | 3.7 | 5.0 | ..... |
| 2 | 94 | 26 | 4.3 | 6.2 | ..... | 22 | 32 | 5.8 | 3.7 | 5.4 | ..... |
| 3 | 70 | 22 | 4.3 | 6.2 | ..... | 23 | 124 | 5.4 | 3.7 | 5.8 | ..... |
| 4 | 52 | 18 | 4.0 | 5.8 | ..... | 24 | 300 | 5.0 | 4.0 | 6.2 | ..... |
| 5 | 36 | 16 | 4.0 | 5.4 | ..... | 25 | 300 | 5.4 | 4.3 | 8.6 | ..... |
| 6 | 32 | 32 | 3.7 | 5.0 | ..... | 26 | 180 | 5.8 | 5.4 | 7.2 | ..... |
| 7 | 20 | 10.2 | 4.3 | 4.6 | ..... | 27 | 94 | 5.4 | 5.4 | 5.8 | ..... |
| 8 | 12 | 8.6 | 4.0 | 5.4 | ..... | 28 | 52 | 5.4 | 5.0 | 5.0 | ..... |
| 9 | 7.2 | 7.2 | 4.3 | 5.0 | ..... | 29 | 36 | 5.4 | 4.6 | 4.6 | ..... |
| 10 | 5.4 | 6.7 | 4.6 | 4.6 | ..... | 30 | 28 | 5.0 | 4.3 | 4.6 | ..... |
| | | | | | | 31 | ..... | 4.6 | 4.6 | ..... | ..... |
| 11 | 5.0 | 5.8 | 5.4 | 4.6 | ..... | | | | | | |
| 12 | 38 | 5.8 | 4.6 | 4.6 | ..... | Mean | 78.4 | 9.32 | 4.29 | 5.25 | ..... |
| 13 | 40 | 5.8 | 4.6 | 4.3 | ..... | Mean per square mile | 3.32 | .395 | .182 | .222 | ..... |
| 14 | 26 | 5.8 | 4.6 | 4.3 | ..... | Run-off (depth in inches on drainage area) | 3.70 | .46 | .21 | .25 | ..... |
| 15 | 103 | 5.4 | 4.3 | 4.6 | ..... | Accuracy | D. | D. | D. | D. | ..... |
| 16 | 250 | 5.4 | 4.0 | 4.6 | ..... | | | | | | |
| 17 | 82 | 5.4 | 4.0 | 4.6 | ..... | | | | | | |
| 18 | 43 | 5.4 | 3.7 | 4.6 | ..... | | | | | | |
| 19 | 124 | 5.0 | 3.7 | 4.6 | ..... | | | | | | |
| 20 | 58 | 5.4 | 3.7 | 5.0 | ..... | | | | | | |

NOTE.—The above discharges are based on a rating curve that was fairly well defined by five measurements made during 1909 and 1910. The station was not visited by a member of the Survey during 1911 or 1912. The relation between the gage heights of previous years with those of 1912 as a measure of discharge is unknown, but it is believed that no very great changes have occurred.

## CHENA RIVER DRAINAGE BASIN.

Chena River rises between the headwaters of Salcha River and South Fork of Birch Creek at an elevation between 4,000 and 5,000 feet. It has a length of about 100 miles and flows slightly south of west to the lowlands of the Tanana Valley, where it empties its waters into the Chena Slough 10 miles above Fairbanks. It drains an area of 1,860 square miles.

The principal tributaries are Munson Creek and the South Fork from the south, and North Fork and Little Chena River from the north.

That part of Chena River above the North Fork is sometimes known as Middle Fork. It has a catchment of 540 square miles, the major part of which lies to the south. Munson Creek is the largest tributary and enters from the south about 45 miles from the head. Ottertail Creek is the largest stream from the north and enters about 8 miles above Munson Creek. Salmonfoot, Shamrock, Palmer, Teuchet, and Blackshell, in downstream order, are small branches from the south.

North Fork takes its source in the Yukon-Tanana divide at the head of Chatanika River and Harrington Fork of Birch Creek, and it joins the main stream about 10 miles below Munson Creek at an elevation of a little over 800 feet. West Fork is the largest tributary of North Fork, entering from the right about 12 miles above the mouth of the latter. Monument Creek, the only branch of consequence from the left limit, unites with North Fork about 3 miles above West Fork. West Fork rises in the divide between Harrington Fork of Birch

Creek and Pool Creek. Its two main tributaries are Frozenfoot and Olympia creeks.

South Fork is confluent to the Chena about 20 miles below North Fork. It drains an irregularly shaped area somewhat smaller than the North Fork basin.

Little Chena River and its tributaries Sorrels and Fish creeks drain the southern slope of the divide between Chatanika and Chena rivers from the headwaters of Smith and Flat creeks to Pedro Dome, a distance of about 25 miles. The drainage basin is irregular in shape and is crossed by a network of small, ramifying streams with precipitous slopes in their upper courses. The upper portion of the main stream is also steep, having a fall of 100 to 150 feet to the mile, but this slope decreases rather abruptly to about 18 feet to the mile in the vicinity of Elliott and Fish creeks.

Above Fish Creek the Little Chena flows through a rather broad, unsymmetrical valley, but below that stream it takes the center of a deep, rather narrow channel for about 10 miles, to Anaconda Creek, an important tributary which enters from the left. Below this point the valley gradually widens again until the stream reaches the lowlands tributary to Chena River, with which it unites 3 or 4 miles above the confluence of Chena Slough.

The principal tributaries of Fish Creek are Bear, Fairbanks, and Miller creeks.

*Daily discharge, in second-feet, of Chena River and North Fork of Chena River for 1912.*

| Day. | Chena River above Shamrock Creek.[a] [Drainage area, 157 square miles.] | | | | Chena River above Little Chena. [Drainage area, 1,440 square miles.] | | | North Fork of Chena River above Monument Creek.[b] [Drainage area, 938 square miles.] | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | July. | Aug. | Sept. | Oct. | June. | July. | Aug. | June. | July. | Aug. |
| 1 | 193 | 193 | 201 | 178 | ..... | 2,500 | 1,200 | ..... | 56 | 40 |
| 2 | 178 | 178 | 197 | 164 | ..... | 2,130 | 1,090 | ..... | 50 | 37 |
| 3 | 308 | 170 | 193 | 161 | ..... | 1,930 | 1,040 | ..... | 50 | 36 |
| 4 | 212 | 178 | 212 | 156 | ..... | 1,860 | 1,020 | ..... | 45 | 36 |
| 5 | 170 | 164 | 193 | 156 | ..... | 1,780 | 944 | ..... | 40 | 34 |
| 6 | 150 | 156 | 170 | 150 | ..... | 1,680 | 896 | ..... | 36 | 34 |
| 7 | 146 | 772 | 178 | 150 | ..... | 1,430 | 866 | ..... | 34 | 56 |
| 8 | 150 | 429 | 178 | 150 | ..... | 1,290 | 855 | ..... | 34 | 43 |
| 9 | 140 | 336 | 164 | 146 | ..... | 1,170 | 1,150 | ..... | 33 | 45 |
| 10 | 137 | 325 | 164 | 146 | ..... | 1,090 | 1,290 | ..... | 33 | 45 |
| 11 | 140 | 702 | 156 | 146 | ..... | 1,040 | 1,160 | ..... | 36 | 50 |
| 12 | 135 | 528 | 156 | 146 | ..... | 1,000 | 1,110 | ..... | 34 | 63 |
| 13 | 135 | 461 | 156 | 146 | ..... | 974 | 1,160 | ..... | 33 | 81 |
| 14 | 161 | 366 | 161 | 144 | ..... | 944 | ..... | ..... | 36 | 63 |
| 15 | 164 | 336 | 164 | 144 | ..... | 914 | ..... | ..... | 45 | 63 |
| 16 | 146 | 291 | 193 | 140 | ..... | 968 | ..... | ..... | 40 | 56 |
| 17 | 156 | 280 | 212 | 140 | 5,270 | 1,030 | ..... | ..... | 43 | ..... |
| 18 | 164 | 308 | 256 | ..... | 5,500 | 968 | ..... | ..... | 40 | ..... |
| 19 | 150 | 308 | 193 | ..... | 4,030 | 920 | ..... | ..... | 43 | ..... |
| 20 | 161 | 291 | 366 | ..... | 5,780 | 992 | ..... | ..... | 43 | ..... |
| 21 | 193 | 193 | 461 | ..... | 6,180 | 980 | ..... | ..... | 48 | ..... |
| 22 | 201 | 193 | 325 | ..... | 4,530 | 980 | ..... | ..... | 43 | ..... |
| 23 | 178 | 178 | 308 | ..... | 4,080 | 1,080 | ..... | ..... | 40 | ..... |
| 24 | 164 | 187 | 280 | ..... | 6,900 | 1,080 | ..... | ..... | 30 | ..... |
| 25 | 156 | 178 | 256 | ..... | 9,050 | 1,060 | ..... | ..... | 36 | ..... |

[a] These discharges are well defined between 150 and 300 second-feet.
[b] These discharges are well defined for all stages.

*Daily discharge, in second-feet, of Chena River and North Fork of Chena River for 1912—* Continued.

| Day. | Chena River above Shamrock Creek, [Drainage area, 157 Square miles.] | | | | Chena River above Little Chena. [Drainage area, 1,440 square miles.] | | | North Fork of Chena River above Monument Creek. [Drainage area, 938 square miles.] | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | July. | Aug. | Sept. | Oct. | June. | July. | Aug. | June. | July. | Aug. |
| 26 | 161 | 232 | 243 | ..... | 8,920 | 968 | ..... | ..... | 36 | ..... |
| 27 | 325 | 256 | 230 | ..... | 7,100 | 932 | ..... | ..... | 40 | ..... |
| 28 | 397 | 232 | 217 | ..... | 5,930 | 872 | ..... | 119 | 66 | ..... |
| 29 | 325 | 212 | 204 | ..... | 3,440 | 1,030 | ..... | 99 | 63 | ..... |
| 30 | 308 | 193 | 191 | ..... | 2,880 | 1,100 | ..... | 70 | 50 | ..... |
| 31 | 193 | 193 | ..... | ..... | ..... | 1,310 | ..... | ..... | 43 | ..... |
| Mean | 190 | 291 | 219 | 151 | 5,690 | 1,230 | 1,060 | 96.0 | 41.9 | 48.9 |
| Mean per square mile | 1.21 | 1.85 | 1.39 | .961 | .395 | .854 | .736 | 1.02 | .447 | .521 |
| Run-off (depth in inches on drainage area) | 1.40 | 2.13 | 1.55 | .61 | .21 | .98 | .36 | .11 | .52 | .31 |
| Accuracy | B. | C. | B. | A. | D. | C. | B. | A. | A. | A. |

*Daily discharge, in second-feet, of North Fork of Chena River, Monument Creek, and Fish Creek for 1912.*

| Day. | North Fork of Chena River below Monument Creek.[a] [Drainage area, 129 square miles.] | | | Monument Creek at Chena Hot Springs. [Drainage area, 30.1 square miles.] | | | Fish Creek below Solo Creek.[b] [Drainage area, 21.5 square miles.] | | |
|---|---|---|---|---|---|---|---|---|---|
| | June. | July. | Aug. | June. | July. | Aug. | June. | July. | Aug. |
| 1 | ..... | 98 | 78 | ..... | 29 | 25 | ..... | ..... | ..... |
| 2 | ..... | 90 | 67 | ..... | 28 | 24 | ..... | ..... | ..... |
| 3 | ..... | 87 | 64 | ..... | 26 | 24 | ..... | ..... | ..... |
| 4 | ..... | 80 | 64 | ..... | 24 | 24 | ..... | ..... | ..... |
| 5 | ..... | 73 | 67 | ..... | 23 | 24 | ..... | ..... | 11.0 |
| 6 | ..... | 67 | 59 | ..... | 22 | 24 | ..... | 15.1 | 10.1 |
| 7 | ..... | 64 | 124 | ..... | 20 | 63 | ..... | ..... | ..... |
| 8 | ..... | 50 | 92 | ..... | 21 | 44 | ..... | ..... | ..... |
| 9 | ..... | 59 | 103 | ..... | 20 | 53 | ..... | 10.5 | ..... |
| 10 | ..... | 56 | 83 | ..... | 20 | 33 | ..... | ..... | ..... |
| 11 | ..... | 50 | 106 | ..... | 21 | 44 | ..... | ..... | ..... |
| 12 | ..... | 59 | 90 | ..... | 20 | 53 | 27 | 33 | ..... |
| 13 | ..... | 56 | 106 | ..... | 20 | 37 | ..... | ..... | ..... |
| 14 | ..... | 64 | 98 | ..... | 25 | 57 | 19.3 | 22 | ..... |
| 15 | ..... | 78 | 90 | ..... | 28 | 33 | ..... | ..... | ..... |
| 16 | ..... | 70 | 84 | ..... | 24 | 37 | ..... | ..... | 9.4 |
| 17 | ..... | 78 | ..... | ..... | 29 | ..... | ..... | 24 | ..... |
| 18 | ..... | 87 | ..... | ..... | 31 | ..... | 64 | ..... | ..... |
| 19 | ..... | 84 | ..... | ..... | 29 | ..... | ..... | ..... | ..... |
| 20 | ..... | 78 | ..... | ..... | 25 | ..... | ..... | ..... | ..... |
| 21 | ..... | 84 | ..... | ..... | 26 | ..... | ..... | 15.1 | ..... |
| 22 | ..... | 78 | ..... | ..... | 26 | ..... | 46 | ..... | ..... |
| 23 | ..... | 70 | ..... | ..... | 24 | ..... | ..... | ..... | ..... |
| 24 | ..... | 64 | ..... | ..... | 26 | ..... | 72 | 19.3 | ..... |
| 25 | ..... | 61 | ..... | ..... | 21 | ..... | ..... | ..... | ..... |
| 26 | ..... | 64 | ..... | ..... | 23 | ..... | 56 | ..... | ..... |
| 27 | ..... | 98 | ..... | ..... | 63 | ..... | ..... | ..... | ..... |
| 28 | 161 | 133 | ..... | 48 | 74 | ..... | ..... | 15.1 | ..... |
| 29 | 142 | 106 | ..... | 39 | 44 | ..... | 19.3 | ..... | ..... |
| 30 | 114 | 87 | ..... | 33 | 29 | ..... | ..... | 12.0 | ..... |
| 31 | ..... | 80 | ..... | ..... | 26 | ..... | ..... | ..... | ..... |
| Mean | 139 | 75.9 | 85.9 | 40.0 | 28.0 | 37.4 | ..... | ..... | ..... |
| Mean per square mile | 1.08 | .588 | .666 | 1.33 | .930 | 1.24 | ..... | ..... | ..... |
| Run-off (depth in inches on drainage area) | .12 | .68 | .40 | .15 | 1.07 | .74 | ..... | ..... | ..... |
| Accuracy | D. | D. | D. | A. | A. | A. | ..... | ..... | ..... |

[a] These discharges are only approximate because of inaccuracies in gage readings and poor measuring conditions.

[b] Discharge curve fairly well defined below 40 second-feet.

*Miscellaneous measurements in Chena River drainage basin, 1912.*

| Date. | Stream and locality. | Drainage area. | Discharge. | Discharge per square mile. |
|---|---|---|---|---|
| | | *Sq. miles.* | *Sec.-feet.* | *Sec.-feet.* |
| July 19 | North Fork of Chena River below Boulder Creek | 49.6 | 24 | 0.48 |
| July 22 | Frozenfoot Creek at elevation 1,500 feet | 21.0 | 7.9 | .38 |
| Do | Frozenfoot Creek 2 miles above mouth | 40.8 | 14.0 | .34 |
| Do | West Fork of Chena River above Olympia Creek | 106 | 32 | .30 |
| Do | Olympia Creek at mouth | 23.6 | 22 | .93 |

## CHATANIKA RIVER DRAINAGE BASIN.

Chatanika River is formed by the junction of Faith and McManus creeks, which drain the high divide between the lower Tanana and Yukon basins. The river flows southwestward in a winding course through a long and rather narrow valley and unites with the Tolovana from the east about 30 miles above the confluence of that stream with the Tanana. Its course lies mostly to the west side of the valley, which is from half a mile to 7 miles wide and about 80 miles long. The drainage area of the river above its mouth is approximately 1,300 miles.

Below the junction of Faith and McManus creeks the stream has a shifting, gravelly bottom. In low and medium stages it flows in a series of pools and rapids in a channel 75 to 200 feet wide; during the high-water period it may spread through several channels covering a width of 100 to 400 feet. This high-water channel is usually well defined by steep, alluvial banks ranging from 8 to 10 feet in height.

Below Poker Creek, a tributary from the right about 40 miles downstream from the junction of Faith and McManus creeks, the valley widens and the bottom lands become marshy and swampy. From the left the Chatanika receives Cleary, Eldorado, Dome, and Vault creeks and other less important streams from the mining district proper. Below these tributaries the valley narrows to a gorgelike channel, which it follows for about 10 miles; below this the dividing ridges disappear and the stream meanders through the low swampy grounds north of Tanana River. About 10 miles from its mouth Goldstream Creek, its largest tributary, joins it from the south.

The average elevation of the divides in the upper drainage area of the Chatanika is between 3,000 and 4,000 feet above sea level, and the altitude of the ridges bounding the valley on the east and west is about 2,000 feet. Below an altitude of 1,800 to 2,000 feet the slopes are heavily timbered.

The tributary streams from the north are short and precipitous, flowing through V-shaped valleys; those from the south have less

precipitous courses and broader valleys and gradually lose themselves in the rather broad expanse of swamplike bottom lands.

Smith Creek is the principal tributary of McManus Creek, entering it from the south about a mile above Faith Creek. Pool Creek joins Smith Creek from the east about a mile above McManus Creek. Hope, Charity, Homestake, and Deep creeks are headwater branches of Faith Creek.

*Monthly discharge of Chatanika River below Faith Creek for 1907–1912.*

[Drainage area, 132 square miles.]

| Month. | Discharge in second-feet. | | | | Run-off (depth in inches on drainage area). |
|---|---|---|---|---|---|
| | Maximum. | Minimum. | Mean. | Mean per square mile. | |
| 1907. | | | | | |
| July 17–31 | 96 | 55 | 67.8 | 0.514 | 0.28 |
| August | 205 | 72 | 125 | .947 | 1.09 |
| September | 1,990 | 119 | 342 | 2.59 | 2.89 |
| The period, 76 days | 1,990 | 55 | 178 | 1.31 | 4.26 |
| 1908. | | | | | |
| May 12–20 | 1,340 | 320 | 598 | 4.53 | 1.85 |
| July 13–31 | 200 | 82 | 131 | .992 | .70 |
| August | 270 | 95 | 137 | 1.04 | 1.20 |
| September | 530 | 102 | 208 | 1.58 | 1.76 |
| The period, 89 days | 1,340 | 82 | 241 | 1.82 | 5.51 |
| 1910. | | | | | |
| May 25–31 | 683 | 320 | 473 | 3.58 | .93 |
| June | 2,000 | 118 | 377 | 2.86 | 3.19 |
| July | 293 | 48 | 86.1 | .652 | .75 |
| August | 1,010 | 49 | 197 | 1.49 | 1.72 |
| September 1–25 | 430 | 141 | 233 | 1.77 | 1.65 |
| The period, 124 days | 2,000 | 48 | 235 | 1.78 | 8.24 |
| 1911. | | | | | |
| May 24–31 | 1,010 | 408 | 691 | 5.23 | 1.56 |
| June | 836 | 140 | 441 | 3.33 | 3.72 |
| July | 334 | 28 | 101 | .765 | .88 |
| August | 1,280 | 24 | 146 | 1.11 | 1.27 |
| September 1–24 | 125 | 53 | 79.8 | .604 | .54 |
| The period, 124 days | 1,280 | 24 | 228 | 1.73 | 7.97 |
| 1912. | | | | | |
| May 15–31 | 880 | 206 | 457 | 3.46 | 2.18 |
| June | 1,500 | 121 | 427 | 3.23 | 3.60 |
| July | 244 | 55 | 86.4 | .655 | .76 |
| August | 188 | 75 | 109 | .826 | .95 |
| September | 350 | 101 | 170 | 1.29 | 1.44 |
| The period, 139 days | 1,500 | 55 | 228 | 1.73 | 8.93 |

*Monthly discharge of Chatanika River below Poker Creek for 1907–1912.*

[Drainage area, 456 square miles.]

| | | | | | |
|---|---|---|---|---|---|
| 1907. | | | | | |
| 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 |
| The period, 117 days | 3,160 | 167 | 496 | 1.08 | 4.61 |
| 1908. | | | | | |
| May 16–31 | 4,120 | 1,730 | 2,730 | 5.99 | 3.56 |
| June | 2,280 | 283 | 984 | 2.16 | 2.41 |
| July | 942 | 204 | 332 | .728 | .84 |
| August | 455 | 192 | 284 | .623 | .72 |
| September | 1,160 | 266 | 461 | 1.01 | 1.12 |
| October 1–21 | 342 | 179 | 234 | .513 | .40 |
| The period, 159 days | 4,120 | 179 | 699 | 1.53 | 9.05 |
| 1909. | | | | | |
| May 9–31 | 3,620 | 474 | 1,870 | 4.10 | 3.51 |
| June | 1,220 | 152 | 416 | .912 | 1.02 |
| July | 833 | 219 | 414 | .910 | 1.05 |
| August | 1,740 | 179 | 530 | 1.16 | 1.34 |
| September | 219 | 130 | 151 | .331 | .37 |
| October 1–5 | 110 | 92 | 103 | .226 | .04 |
| The period, 150 days | 3,620 | 92 | 598 | 1.31 | 7.33 |
| 1910. | | | | | |
| May 17–31 | 1,900 | 600 | 944 | 2.07 | 1.16 |
| June | 3,260 | 248 | 686 | 1.50 | 1.67 |
| July | 822 | 104 | 196 | .430 | .50 |
| August | 2,720 | 95 | 481 | 1.05 | 1.21 |
| September | 1,410 | 298 | 553 | 1.21 | 1.35 |
| October 1–29 | 352 | 123 | 208 | .456 | .49 |
| The period, 166 days | 3,260 | 95 | 472 | 1.04 | 6.38 |
| 1911. | | | | | |
| May 6–31 | 3,500 | 1,170 | 2,550 | 5.59 | 5.41 |
| June | 1,760 | 283 | 818 | 1.79 | 2.00 |
| July | 566 | 109 | 276 | .605 | .70 |
| August | 1,740 | 88 | 372 | .816 | .94 |
| September | 422 | 147 | 262 | .575 | .64 |
| October | 330 | 87 | 167 | .366 | .42 |
| November 1–5 | 101 | 87 | 94.8 | .208 | .04 |
| The period, 184 days | 3,500 | 87 | 677 | 1.48 | 10.15 |
| 1912. | | | | | |
| June 13–30 | 3,470 | 441 | 1,490 | 3.27 | 2.19 |
| July | 441 | 175 | 256 | .561 | .65 |
| August | 394 | 175 | 243 | .533 | .61 |
| September | 872 | 210 | 340 | .746 | .83 |
| October 1–26 | 259 | 132 | 191 | .419 | .41 |
| The period, 136 days | 3,470 | 132 | 425 | .932 | 4.69 |

*Discharge, in second-feet, of McManus Creek and Chatanika River for 1912.*

| Day. | McManus Creek at mouth.[a] [Drainage area, 80 square miles.] | | | | | Chatanika River below Faith Creek.[b] [Drainage area, 132 square miles.] | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | May. | June. | July. | Aug. | Sept. | May. | June. | July. | Aug. | Sept. |
| 1 | ..... | 257 | 53 | 39 | 48 | ..... | 660 | 106 | 97 | 101 |
| 2 | ..... | 508 | 48 | 30 | 60 | ..... | 1,500 | 92 | 82 | 126 |
| 3 | ..... | 426 | 53 | 30 | 72 | ..... | 1,130 | 97 | 82 | 140 |
| 4 | ..... | 232 | 44 | 30 | 72 | ..... | 562 | 86 | 82 | 140 |
| 5 | ..... | 141 | 39 | 27 | 86 | ..... | 301 | 71 | 79 | 155 |
| 6 | ..... | 100 | 30 | 24 | 78 | ..... | 232 | 68 | 75 | 149 |
| 7 | ..... | 71 | 30 | 72 | 60 | ..... | 181 | 62 | 155 | 126 |
| 8 | ..... | 58 | 30 | 60 | 60 | ..... | 140 | 62 | 140 | 126 |
| 9 | ..... | 84 | 30 | 48 | 60 | ..... | 172 | 58 | 121 | 126 |
| 10 | ..... | 79 | 24 | 44 | 48 | ..... | 162 | 55 | 106 | 114 |
| 11 | ..... | 58 | 24 | 67 | 48 | ..... | 126 | 55 | 149 | 114 |
| 12 | ..... | 122 | 27 | 78 | 48 | ..... | 244 | 58 | 188 | 101 |
| 13 | ..... | 204 | 24 | 60 | 48 | ..... | 413 | 58 | 149 | 101 |
| 14 | ..... | 122 | 30 | 48 | 48 | ..... | 288 | 86 | 126 | 101 |
| 15 | 288 | 84 | 30 | 48 | 72 | 730 | 224 | 75 | 121 | 132 |
| 16 | 310 | 141 | 27 | 39 | 86 | 880 | 310 | 65 | 101 | 155 |
| 17 | 257 | 115 | 30 | 39 | 126 | 730 | 265 | 65 | 101 | 217 |
| 18 | 215 | 90 | 30 | 39 | 160 | 595 | 206 | 68 | 97 | 257 |
| 19 | 166 | 402 | 30 | 39 | 126 | 500 | 1,080 | 62 | 92 | 217 |
| 20 | 115 | 204 | 30 | 34 | 186 | 371 | 470 | 71 | 86 | 350 |
| 21 | 115 | 122 | 30 | 34 | 186 | 371 | 288 | 75 | 86 | 335 |
| 22 | 100 | 109 | 30 | 34 | 150 | 310 | 244 | 68 | 86 | 265 |
| 23 | 177 | 522 | 27 | 34 | 126 | 360 | 1,040 | 68 | 86 | 232 |
| 24 | 79 | 346 | 24 | 39 | 100 | 301 | 695 | 62 | 92 | 206 |
| 25 | 71 | 355 | 24 | 44 | 86 | 206 | 660 | 58 | 97 | 188 |
| 26 | 63 | 239 | 30 | 53 | 86 | 206 | 442 | 86 | 114 | 181 |
| 27 | 58 | 160 | 44 | 67 | 72 | 206 | 288 | 162 | 132 | 155 |
| 28 | 166 | 116 | 67 | 60 | 72 | 371 | 206 | 244 | 126 | 155 |
| 29 | 301 | 86 | 53 | 48 | 78 | 695 | 149 | 188 | 114 | 162 |
| 30 | 192 | 67 | 48 | 48 | 86 | 413 | 121 | 132 | 106 | 172 |
| 31 | 122 | ..... | 39 | 48 | ..... | 530 | ..... | 114 | 101 | ..... |
| Mean | 164 | 187 | 34.8 | 45.3 | 87.8 | 457 | 427 | 86.4 | 109 | 170 |
| Mean per square mile | 2.05 | 2.34 | .435 | .507 | 1.10 | 3.46 | 3.23 | .655 | .826 | 1.29 |
| Run-off (depth in inches on drainage area) | 1.30 | 2.61 | .50 | .58 | 1.23 | 2.18 | 3.60 | .76 | .95 | 1.44 |
| Accuracy | B. | C. | A. | A. | A. | B. | B. | A. | A. | A. |

[a] These discharges are fairly accurate below 400 second-feet.
[b] These discharges are well defined below 600 second-feet.

*Daily discharge, in second-feet, of Chatanika River and Faith Creek for 1912.*

| Day. | Chatanika River below Poker Creek.[a] [Drainage area, 456 square miles.] | | | | | Faith Creek, at mouth.[b] [Drainage area, 51 square miles.] | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | June. | July. | Aug. | Sept. | Oct. | May. | June. | July. | Aug. | Sept. |
| 1 | ..... | 330 | 228 | 188 | 259 | ..... | 334 | 59 | 59 | 50 |
| 2 | ..... | 293 | 214 | 200 | 244 | ..... | 780 | 56 | 54 | 56 |
| 3 | ..... | 276 | 228 | 214 | 228 | ..... | 589 | 59 | 50 | 56 |
| 4 | ..... | 259 | 214 | 259 | 214 | ..... | 254 | 54 | 50 | 56 |
| 5 | ..... | 214 | 200 | 259 | 228 | ..... | 142 | 44 | 46 | 63 |
| 6 | ..... | 188 | 200 | 259 | 228 | ..... | 118 | 44 | 44 | 59 |
| 7 | ..... | 176 | 312 | 259 | 228 | ..... | 91 | 39 | 78 | 56 |
| 8 | ..... | 153 | 372 | 228 | 228 | ..... | 87 | 39 | 73 | 56 |
| 9 | ..... | 153 | 259 | 228 | 214 | ..... | 84 | 36 | 59 | 56 |
| 10 | ..... | 153 | 228 | 214 | 200 | ..... | 73 | 34 | 56 | 50 |
| 11 | ..... | 153 | 259 | 214 | 200 | ..... | 56 | 34 | 70 | 50 |
| 12 | ..... | 176 | 330 | 200 | 200 | ..... | 107 | 34 | 91 | 44 |
| 13 | 1,140 | 176 | 312 | 200 | 200 | ..... | 210 | 34 | 73 | 44 |
| 14 | 815 | 200 | 259 | 188 | 176 | ..... | 177 | 59 | 63 | 44 |
| 15 | 585 | 244 | 259 | 200 | 176 | 254 | 129 | 50 | 59 | 50 |
| 16 | 815 | 228 | 228 | 228 | 176 | 334 | 190 | 42 | 56 | 56 |
| 17 | 1,220 | 200 | 214 | 293 | 176 | 293 | 134 | 42 | 50 | 73 |
| 18 | 715 | 214 | 200 | 498 | 176 | 334 | 118 | 42 | 44 | 84 |
| 19 | 3,450 | 228 | 176 | 470 | 176 | 247 | 538 | 36 | 44 | 111 |
| 20 | 2,580 | 228 | 176 | 470 | 164 | 210 | 236 | 42 | 44 | 111 |
| 21 | 1,220 | 259 | 164 | 850 | 164 | 200 | 142 | 44 | 44 | 107 |
| 22 | 885 | 228 | 164 | 650 | 164 | 168 | 129 | 44 | 44 | 87 |
| 23 | 2,580 | 214 | 153 | 498 | 153 | 377 | 421 | 44 | 44 | 73 |
| 24 | 3,350 | 214 | 153 | 470 | 132 | 154 | 254 | 39 | 44 | 70 |
| 25 | 2,130 | 214 | 153 | 372 | 132 | 134 | 247 | 36 | 46 | 70 |
| 26 | 1,780 | 214 | 176 | 312 | 132 | 129 | 160 | 56 | 54 | 67 |
| 27 | 1,300 | 259 | 200 | 293 | ..... | 118 | 125 | 118 | 59 | 63 |
| 28 | 850 | 351 | 214 | 293 | ..... | 210 | 97 | 177 | 56 | 63 |
| 29 | 585 | 419 | 214 | 276 | ..... | 334 | 73 | 134 | 56 | 67 |
| 30 | 419 | 372 | 200 | 259 | ..... | 168 | 67 | 78 | 54 | 70 |
| 31 | ..... | 276 | 200 | ..... | ..... | 293 | ..... | 70 | 50 | ..... |
| Mean | 1,470 | 234 | 221 | 318 | 191 | 233 | 205 | 55.5 | 55.3 | 65.4 |
| Mean per square mile | 3.22 | .513 | .485 | .697 | .419 | 4.57 | 4.02 | 1.09 | 1.08 | 1.28 |
| Run-off (depth in inches on drainage area) | 2.16 | .59 | .56 | .78 | .41 | 2.89 | 4.48 | 1.26 | 1.24 | 1.43 |
| Accuracy | B. | A. | A. | A. | A. | ..... | ..... | ..... | ..... | ..... |

[a] A ditch diverted water from the river above the gage from about May 15 to Sept. 30. The mean of five discharge measurements made during the summer was 26 second-feet, which was probably about the average diversion for the season and should be added to the above discharges to obtain the natural flow of the river. The discharges are well defined below 1,200 second-feet. Ice formed 3 feet from shore at the gage on Oct. 18. The river froze over on Oct. 27.

[b] Discharges are well defined below 400 second-feet.

*Daily discharge, in second-feet, of Charity Creek and Homestake Creek for 1912.*

| Day. | Charity Creek above Homestake Creek. | | | | Homestake Creek at mouth. [Drainage area, 5.6 square miles.] | | | |
|---|---|---|---|---|---|---|---|---|
| | June. | July. | Aug. | Sept. | June. | July. | Aug. | Sept. |
| 1 | ..... | 7.0 | 4.6 | 4.6 | ..... | 4.4 | 2.5 | 3.4 |
| 2 | ..... | 6.7 | 4.4 | 5.0 | ..... | 3.6 | 2.3 | 3.8 |
| 3 | ..... | 6.5 | 4.4 | 5.4 | ..... | 3.1 | 2.2 | 4.4 |
| 4 | ..... | 6.2 | 3.9 | 5.6 | ..... | 2.7 | 2.1 | 4.9 |
| 5 | ..... | 5.8 | 3.7 | 5.8 | ..... | 2.5 | 2.0 | 5.2 |
| 6 | ..... | 5.4 | 3.7 | 6.0 | ..... | 2.3 | 2.0 | 4.9 |
| 7 | ..... | 5.0 | 4.2 | 5.4 | ..... | 2.2 | 2.3 | 4.0 |
| 8 | ..... | 4.6 | 4.2 | 5.4 | ..... | 2.0 | 2.3 | 3.8 |
| 9 | 8.9 | 4.6 | 3.9 | 5.0 | 6.9 | 1.7 | 2.2 | 3.6 |
| 10 | 8.1 | 4.4 | 3.9 | 4.8 | 5.9 | 1.7 | 2.2 | 3.4 |
| 11 | 7.0 | 5.2 | 6.7 | ..... | 4.9 | 2.0 | 4.9 | ..... |
| 12 | 8.9 | 4.8 | 5.2 | ..... | 11.1 | 1.7 | 4.0 | ..... |
| 13 | 10.8 | 4.6 | 4.8 | ..... | 10.2 | 1.6 | 3.6 | ..... |
| 14 | 8.9 | 4.4 | 4.6 | ..... | 8.2 | 1.6 | 3.3 | ..... |
| 15 | 11.1 | 4.2 | 4.4 | ..... | 9.5 | 1.6 | 3.3 | ..... |
| 16 | 17.6 | 4.4 | 4.4 | ..... | 10.2 | 1.7 | 3.6 | ..... |
| 17 | 13.1 | 4.8 | 4.2 | ..... | 8.2 | 1.8 | 3.8 | ..... |
| 18 | 8.9 | 5.0 | 4.0 | ..... | 6.9 | 2.0 | 3.4 | ..... |
| 19 | 32 | 4.8 | 3.9 | ..... | 44 | 1.8 | 3.1 | ..... |
| 20 | 16.6 | 5.2 | 3.9 | ..... | 14.8 | 2.2 | 2.9 | ..... |
| 21 | 12.6 | 5.0 | 4.0 | ..... | 10.2 | 2.1 | 3.3 | ..... |
| 22 | 11.9 | 4.2 | 3.9 | ..... | 10.2 | 1.6 | 2.9 | ..... |
| 23 | 60 | 4.4 | 4.2 | ..... | 58 | 1.7 | 3.3 | ..... |
| 24 | 24 | 3.7 | 4.2 | ..... | 27 | 1.3 | 3.3 | ..... |
| 25 | 17.6 | 3.7 | 4.0 | ..... | 15.5 | 1.3 | 2.9 | ..... |
| 26 | 15.6 | 5.0 | 4.4 | ..... | 11.1 | 2.3 | 3.4 | ..... |
| 27 | 11.5 | 5.6 | 4.2 | ..... | 8.2 | 2.9 | 3.3 | ..... |
| 28 | 8.9 | 5.8 | 4.4 | ..... | 6.9 | 4.4 | 3.6 | ..... |
| 29 | 8.4 | 5.2 | 4.2 | ..... | 5.4 | 3.6 | 3.3 | ..... |
| 30 | 7.8 | 4.8 | 4.2 | ..... | 4.9 | 2.9 | 2.9 | ..... |
| 31 | ..... | 4.6 | 4.0 | ..... | ..... | 2.5 | 2.5 | ..... |
| Mean | 15.0 | 5.02 | 4.28 | 5.30 | 13.6 | 2.28 | 2.99 | 4.14 |
| Mean per square mile | ..... | ..... | ..... | ..... | 2.43 | .407 | 5.34 | .739 |
| Run-off (depth in inches on drainage area) | ..... | ..... | ..... | ..... | 1.99 | .47 | .62 | .27 |
| Accuracy | C. | A. | A. | A. | B. | A. | A. | A. |

NOTE.—Discharge rating curve for both stations well defined below 10 second-feet.

*Miscellaneous measurements in Chatanika River drainage basin, 1912.*

| Date. | Stream and locality. | Drainage area. | Discharge. | Discharge per square mile. |
|---|---|---|---|---|
| | | *Sq. miles.* | *Sec.-ft.* | *Sec.-ft.* |
| July 23 | Smith Creek above Pool Creek | 17.0 | 3.6 | 0.21 |
| Do | Pool Creek at mouth | 14.0 | 5.9 | .42 |
| June 10 | Hope Creek at mouth | 20.3 | 24 | 1.18 |
| July 24 | do | 20.3 | 20 | .99 |
| August 16 | do | 20.3 | 23 | 1.13 |
| Do | Deep Creek at mouth | ..... | 7.6 | ..... |
| June 21 | Poker Creek above ditch intake | 18.1 | 45 | 2.49 |
| Do | Caribou Creek at mouth | 17.7 | 28 | 1.58 |
| June 13 | Chatanika ditch near outlet | ..... | 21 | ..... |
| June 14 | do | ..... | 24 | ..... |
| June 20 | do | ..... | 14.5 | ..... |
| July 29 | do | ..... | 36 | ..... |
| August 11 | do | ..... | 33 | ..... |

## BEAVER CREEK DRAINAGE BASIN.

Beaver Creek drains an area of 5,360 square miles lying north of Chatanika River between Preacher Creek on the east and Tolovana River and Hess Creek on the west. It joins the Yukon from the south about 40 miles below Birch Creek and nearly opposite Hosiana River. It is formed by the junction of Big Champion and Little Champion creeks, whose headwaters interlock with those of Preacher Creek. It flows westward for about 25 miles and then makes a right-angle turn around the southern extremity of the White Mountains and gradually assumes a northeasterly course, which it follows until it leaves the foothills and enters the flats of the Yukon, where it makes an abrupt turn to the northwest and meanders in a tortuous course to its mouth.

The average fall between Nome Creek and Fossil Creek is about 12 feet to the mile. The principal tributaries, named in order downstream, are Roy, Bryan, Brigham, Fossil, Willow, and Mascot creeks on the right and Nome, Trail, Wickersham, and Victoria creeks on the left.

Ophir Creek is the largest branch of Nome Creek and enters it from the south about a mile above Beaver Creek.

*Daily discharge, in second-feet, of Nome Creek for 1912.*

| Day. | Nome Creek, 4 miles above Moose Creek. | | | | Nome Creek above Ophir Creek. [Drainage area, 76 square miles.] | | | |
|---|---|---|---|---|---|---|---|---|
| | June. | July. | Aug. | Sept. | June. | July. | Aug. | Sept. |
| 1 | ..... | 24 | 30 | 18.0 | ..... | 94 | 57 | 56 |
| 2 | ..... | 18.0 | 27 | 18.0 | ..... | 83 | 51 | 56 |
| 3 | ..... | 18.0 | 25 | 24 | ..... | 76 | 46 | 66 |
| 4 | ..... | 18.0 | 24 | 24 | ..... | 67 | 48 | 76 |
| 5 | ..... | 18.0 | 24 | 24 | ..... | 61 | 45 | 88 |
| 6 | ..... | 14.0 | 24 | 24 | ..... | 53 | 44 | 80 |
| 7 | ..... | 14.0 | 24 | 24 | ..... | 47 | 52 | 72 |
| 8 | ..... | 14.0 | 24 | 21 | ..... | 45 | 73 | 60 |
| 9 | ..... | 14.0 | 24 | 21 | ..... | 41 | 64 | 56 |
| 10 | ..... | 14.0 | 24 | 21 | ..... | 40 | 56 | 52 |
| 11 | ..... | 14.0 | 42 | 18.0 | ..... | 40 | 61 | 48 |
| 12 | ..... | 21 | 33 | 18.0 | ..... | 42 | 98 | 46 |
| 13 | ..... | 14.0 | 24 | 18.0 | ..... | 44 | 76 | 44 |
| 14 | ..... | 53 | 24 | 18.0 | ..... | 73 | 60 | 42 |
| 15 | ..... | 59 | 21 | 24 | ..... | 67 | 53 | 53 |
| 16 | ..... | 42 | 21 | 30 | ..... | 51 | 47 | 66 |
| 17 | ..... | 32 | 18.0 | 40 | ..... | 48 | 51 | 106 |
| 18 | ..... | 32 | 18.0 | 50 | ..... | 61 | 44 | 162 |
| 19 | ..... | 21 | 18.0 | 24 | ..... | 51 | 41 | 133 |
| 20 | ..... | 21 | 16.0 | 24 | ..... | 64 | 41 | 183 |
| 21 | ..... | 30 | 16.0 | ..... | 306 | 87 | 38 | 178 |
| 22 | ..... | 35 | 18.0 | ..... | 291 | 83 | 37 | 133 |
| 23 | ..... | 35 | 18.0 | ..... | 764 | 73 | 37 | 92 |
| 24 | ..... | 25 | 18.0 | ..... | 696 | 57 | 40 | 73 |
| 25 | 138 | 19.8 | 18.0 | ..... | 566 | 51 | 48 | ..... |
| 26 | 107 | 48 | 24 | ..... | 440 | 73 | 64 | ..... |
| 27 | 65 | 122 | 32 | ..... | 320 | 157 | 87 | ..... |
| 28 | 51 | 138 | 37 | ..... | 222 | 183 | 76 | ..... |
| 29 | 37 | 100 | 28 | ..... | 152 | 143 | 61 | ..... |
| 30 | 24 | 50 | 24 | ..... | 124 | 94 | 57 | ..... |
| 31 | ..... | 40 | 21 | ..... | ..... | 90 | 56 | ..... |
| Mean | 70.4 | 36.1 | 23.8 | 24.2 | 388 | 71.6 | 55.1 | 84.2 |
| Mean per square mile | ..... | ..... | ..... | ..... | 5.11 | .942 | .724 | 1.11 |
| Run-off (depth in inches on drainage area) | ..... | ..... | ..... | ..... | 1.90 | 1.09 | .83 | .99 |
| Accuracy | A. | A. | A. | A. | B. | A. | A. | A. |

NOTE.—The above discharges are well defined for all stages.

*Miscellaneous measurements in Beaver Creek drainage basin, 1912.*

| Date. | Stream and locality. | Drainage area. | Discharge. | Discharge per square mile. |
|---|---|---|---|---|
| | | *Sq. miles.* | *Sec.-ft.* | *Sec.-ft.* |
| June 22 | Ophir Creek at Discovery claim | 22.1 | 28 | 1.27 |
| Do | do | 22.1 | 62 | 2.81 |
| June 23 | do | 22.1 | 165 | 7.47 |
| July 27 | do | 22.1 | 22 | 1.00 |
| August 13 | do | 22.1 | 6.7 | .30 |