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WATER-SUPPLY PAPER 228

WATER-SUPPLY INVESTIGATIONS

IN THE

YUKON-TANANA REGION, ALASKA

1907 AND 1908

FAIRBANKS, CIRCLE, AND RAMPART DISTRICTS

BY

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WATER-SUPPLY INVESTIGATIONS IN THE YUKON-TANANA REGION, ALASKA, 1907 AND 1908.

By C. C. Covert and C. E. Ellsworth.

INTRODUCTION.

SCOPE OF WORK.

For a number of years the United States Geological Survey has made systematic measurements and studies of water supply as one of the great resources of the country. The data thus obtained are now available for many of the more important streams in the United States and are extensively used by engineers and others in problems involving water power, city water supply, irrigation, and manufacturing.

The development of the important placer-mining fields of Alaska, notably those of Seward Peninsula and the Yukon-Tanana region, is intimately associated with the successful utilization of their water supplies. A knowledge of the amount of water available in the streams would have prevented most of the failures that have been made in the past, and will be invaluable in connection with future development.

A strong tendency exists in Alaskan development work to push forward the construction of ditches before making sure of that primary requisite of their successful operation—an adequate water supply. The results of such a policy were shown during the summers of 1907 and 1908 in portions of the Yukon-Tanana region and in Seward Peninsula, where severe local droughts caused much loss and inconvenience to mining operators. As these conditions may not prove to be exceptional in any portion of the larger placer districts of Alaska, too much stress can not be laid on the importance of stream-flow data. Except during the low-water period, which ordinarily lasts only a part of the season, the water supply is sufficient; but in combination with other unfavorable conditions—the shortness of the season, the frozen ground, the distance from base of supplies, and the consequent high cost of transportation—a reduction of even two or three weeks in the working season may mean the difference between profit and loss.

Hydraulic developments are most advanced in the Nome region of Seward Peninsula, which has been an important producer of placer gold since 1899, and in which hundreds of miles of mining ditches have been built at great expense. Similar developments proposed for the Yukon-Tanana region should now be given careful consideration.

For this reason stream-measurement work, like that begun in the Nome region in 1906, was undertaken in the Yukon-Tanana region in 1907 by C. C. Covert, who was in the field from June 18 to September 23 of that year. During the season of 1908 the work was continued by Mr. Covert and C. E. Ellsworth. In March, 1908, Mr. Covert went to the Fairbanks district to gather data on the spring run-off from the melting snow, and later in the season he extended the work to the Circle and Rampart districts. In June Mr. Ellsworth and Mr. Covert met at Circle and made a reconnaissance trip across country to Fairbanks. On August 1 Mr. Ellsworth went to the Rampart district, where he continued the work until the middle of September. Mr. Covert and the rest of the party remained in the Fairbanks district until the end of August, when they made the return trip to Circle, arriving there September 15. Much credit for the amount of data obtained and the extended territory which the party was able to cover is due to George Neuner, jr., field assistant, who made many of the measurements, and Charles E. Anderson, who acted as cook and packer.

The work in the Yukon-Tanana region in 1907 was largely of a reconnaissance character, but a few regular gaging stations were established. In 1908 the work was continued along lines similar to those followed in the previous year, but the records cover a longer period (May 1 to October 15), and the area under investigation included about 4,200 square miles. Daily records were kept at a few regular stations established at convenient points in the different drainage basins, and miscellaneous measurements were made in the surrounding country. This plan afforded the best opportunities for procuring comparative data. In this region, where water storage is lacking, daily records are highly important, but are very difficult to obtain. Outside of the placer mining creeks the country is practically a wilderness, where it is almost impossible to get observations other than those made during the occasional visits of the engineer. In some localities daily or even weekly records could not have been assured, and the results obtained from occasional measurements would have furnished no comprehensive idea of the daily run-off of the streams throughout the open season.

The work of collecting the data and preparing this report was done under the direction of the water resources branch by the engineers detailed for the purpose. The expenses were paid out of the appropriation for investigating the mineral resources of Alaska, and the field work has been under the general supervision of Alfred H. Brooks, geologist in charge of Alaskan work.

COOPERATION.

The funds available for the work were inadequate for the thorough investigation of the region concerning which it was desirable to procure records. It was possible to obtain daily gage readings only through the cooperation of mining operators, ditch companies, and others. Special acknowledgment for such cooperation is due to Mr. John Zug, superintendent of the Good Roads Commission; Mr. C. W. McConaughy, chief engineer of the Chatanika Ditch Company; Mr. Falcon Joslin, president of the Tanana Valley Railroad Company; Mr. Herman Wobber, Fairbanks Creek; Mr. Martin Harrais, Chena Lumber and Light Company, Chena; Mr. W. H. Parsons, general manager Washington-Alaska Bank; Mr. Frank G. Manley, Baker Hot Springs; Mr. A. V. Thorns, general manager Manley Mines; Mr. M. E. Koonce, Rampart; and to the many individual miners who are personally interested in the work.

EXPLANATION OF DATA AND METHODS.

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

In the consideration of industrial or mining enterprises which use the water of streams it is necessary to know the total amount of water flowing in the stream, the daily distribution of the flow, and facts in regard to the conditions affecting the flow. Several terms are used—such as second-foot, miner's inch, gallons per minute, etc.—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 quantity of water flowing per second in a stream 1 foot wide and 1 foot deep at the rate of 1 foot per second. It should be noted that it is a *rate* of flow, and to obtain the actual quantity of water it is necessary to multiply it by the time.

"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 in inches" is the depth to which the drainage area would be covered if all the water flowing from it in a given period were con-

[a] See Water-Supply Papers U. S. Geol. Survey, Nos. 94, 95, and 201.

served and uniformly distributed on the surface. It is used for comparing run-off with rainfall, which is expressed in depth in inches.

"Acre-foot" is equivalent to 43,560 cubic feet, and is the quantity required to cover an acre to the depth of 1 foot. It is commonly used in connection with storage problems.

The "miner's inch," the unit used in connection with placer mining, also expresses a rate of flow, and is the quantity of water flowing through an orifice of a given size with a given head. The head and size of the orifice used in different localities vary, 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 $1\frac{1}{2}$ 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.

A list of convenient equivalents for use in hydraulic computations is given below:

1 second-foot equals 40 California miner's inches (law of March 23, 1901).

1 second-foot equals 50 "old California" miner's inches (used prior to law of March 23, 1901).

1 second-foot equals 7.48 United States gallons per second; equals 448.8 gallons per minute; equals 646,272 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 equals about 1 acre-inch per hour.

1 second-foot for one day covers 1-square mile 0.03719 inch deep.

1 second-foot for one day equals 1.983 acre-feet.

100 California miner's inches equal 15.7 United States gallons per second.

100 California miner's inches for one day equal 4.96 acre-feet.

100 United States gallons per minute equal 0.223 second-foot.

100 United States gallons per minute for one day equal 0.442 acre-foot.

1,000,000 United States gallons per day equal 1.55 second-feet.

1,000,000 United States gallons equal 3.07 acre-feet.

1,000,000 cubic feet equal 22.95 acre-feet.

1 acre-foot equals 325,850 gallons.

1 inch deep on 1 square mile equals 2,323,200 cubic feet.

1 inch deep on 1 square mile equals 0.0737 second-foot per year.

1 mile equals 5,280 feet.

1 acre equals 43,560 square feet.

1 acre equals 209 feet square, nearly.

1 cubic foot equals 7.48 gallons.

1 cubic foot of water weighs 62.5 pounds.

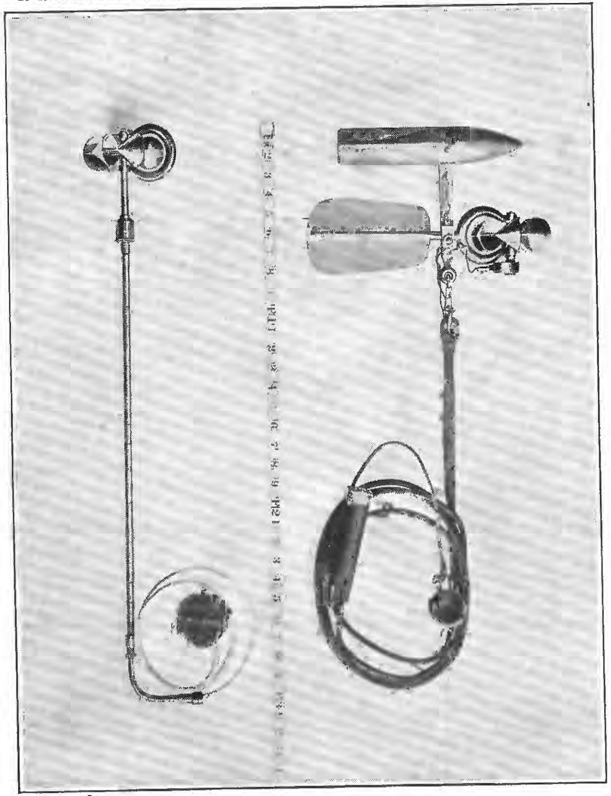
1 horsepower equals 550 foot-pounds per second.

1 horsepower equals 746 watts.

1 horsepower equals 1 second-foot falling 8.80 feet.

$1\frac{1}{3}$ 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.



A. PRICE CURRENT METERS.

B. MEASURING GRAND CENTRAL RIVER.

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 the channel conditions at, above, and below the gaging section. 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.

All measurements by the engineers of the Survey were made with the current meter; but 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.

In measuring velocity by a float, observation is made of the time taken by the float to pass over the "run"—a selected stretch of river from 50 to 200 feet long. In each discharge measurement a large number of velocity determinations are made at different points across the stream, and from these observations the mean velocity for the whole section is determined.

The area used in float measurements is the mean of the areas at the two ends of the run and at several intermediate sections.

The essential parts of the current meters in use are (1) a wheel of some type so constructed that the impact of flowing water causes it to revolve and (2) a device for recording or indicating the number of revolutions. The relation between the velocity of the moving water and the revolutions of the wheel is determined for each meter. This rating is done by drawing the meter through still water for a given distance at different speeds and noting the number of revolutions for each run. From these data a rating table is prepared, which gives the velocity per second for any number of revolutions. Many kinds of current meters have been constructed.

The small Price acoustic meter (Pl. I, *A*) was used exclusively in the work in Alaska. Measurements were made by wading, except on Chatanika River near Faith Creek and Little Chena River below mouth of Fish Creek, where a cable and car were installed for use during high stages, and on Birch Creek at Fourteenmile House, where the government ferry was utilized.

In making a measurement a tape line is stretched across the stream (Pl. I, *B*) and depth and velocity are measured at regular intervals (1 foot to 5 feet, depending on the size of the stream). The depths from which the area of the cross section is computed are taken by soundings with a graduated rod. The velocities are measured by a current meter.

Two methods of measuring the velocity were used. In the first the meter is held at the depth of the thread of mean velocity, which has been shown by extensive experiments to occur at about 0.6 of the total depth. In the second method the mean of the velocities taken at 0.2 and 0.8 depth is used. This method is not adapted to very shallow streams or to those with extremely rough beds.

One of the general laws of the flow of streams with permanent cross sections is that the discharge varies directly with the stage of the water, or the gage height, and that it will be the same whenever the stage or gage height is the same. Therefore, in order to determine the daily discharge of a stream, a gage on which the fluctuations of the surface of the stream may be noted is installed and read daily. As the discharge regularly increases with the stage, it is possible with a few discharge measurements taken at various stages to construct a rating curve which will give the discharge at all stages. The beds of most of the streams measured changed but little during the season and it was therefore possible to obtain the daily flow, as just stated.

GENERAL DESCRIPTION OF AREA.

The section of Alaska lying between the Yukon and Tanana rivers and reaching from their confluence to the international boundary, about 300 miles to the east, is known as the Yukon-Tanana region. It embraces about 40,000 square miles, of which about 4,200 are considered in this report. The gold placers of the Fortymile, Birch Creek, Rampart, and Fairbanks districts are situated in this region, and their economic importance has led the Geological Survey to devote several years to the work of making topographic and geologic maps of the area, and, in 1907 and 1908, to make a study of the water supply of a portion of the territory covered by the Circle, Fairbanks, and Rampart quadrangles. The location of the quadrangles surveyed in the Yukon-Tanana region and of the quadrangles in which lie the drainage areas of the streams studied is shown in the index map, figure 1.

Gold was discovered in the Fortymile district in 1886 and in the Birch Creek and Rampart districts in 1893, but not until the discoveries in the Klondike in 1896 did the rapid development of the interior of Alaska begin and Circle and Rampart become supply points for the mining camps along the Yukon. The Fairbanks district was brought into prominence by the discoveries in 1902, and it has since become the largest placer mining district in Alaska. The chief topographic features of the country, the absence of any well-defined divide separating the Yukon-Tanana drainages, and the irregular arrangement of the streams that make up the drainage systems of this region are clearly shown on the published maps (see fig. 1) which, except the Fortymile, are issued with bulletins[a] only.

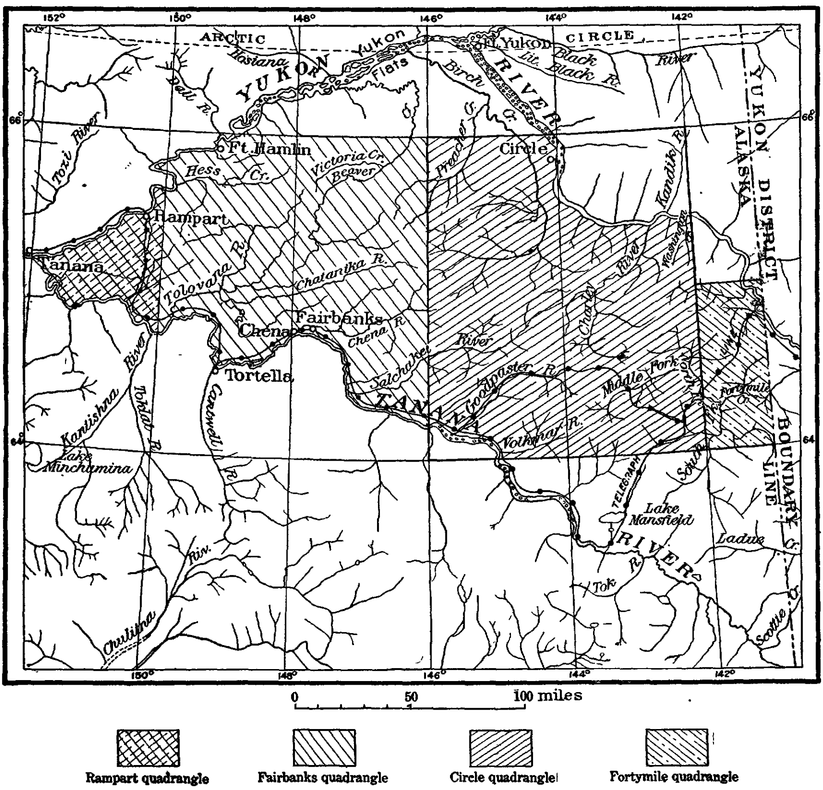


FIGURE 1.—Index map showing location of quadrangles in Yukon-Tanana region.

These drainage systems hold remarkably close relations. The headwaters of the larger streams interlock with one another, their numerous ramifying branches taking so many different directions that the traveler, unless provided with maps and compass, is often led astray by the similar even-topped ridges that separate the drain-

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[a] Prindle, L. M., The gold placers of the Fortymile, Birch Creek, and Fairbanks regions: Bull. U. S. Geol. Survey No. 251, 1905.

Topographic map, Fortymile quadrangle; scale, 1:250000; by E. C. Barnard, U. S. Geol. Survey, 1905. For sale at 5 cents a copy or $3 a hundred.

Prindle, L. M., The Yukon-Tanana region, Alaska; description of the Circle quadrangle: Bull. U. S. Geol. Survey No. 295, 1906.

Prindle, L. M., Hess, F. L., and Covert, C. C., The Yukon-Tanana region, Alaska; description of the Fairbanks and Rampart quadrangles: Bull. U. S. Geol. Survey No. 337, 1908.

ages of the headwaters of perhaps three or four different streams, which radiate from some one point, but belong to different drainage areas.

The most important streams tributary to the Yukon are Fortymile and Seventymile creeks, Charley River, and Birch and Beaver creeks; those tributary to the Tanana are the Volkmar, Goodpaster, Salcha, Chena, and Tolovna rivers. Besides these major streams many small tributaries, such as Minook and Baker creeks, are important, because they are the sites of large mining operations.

The entire area except the higher ridges was once well timbered, but the forests are fast disappearing before the woodman's ax and forest fires—a fact most deplorable for the future of the country.

The climate and vegetation of the Yukon-Tanana region have been described by Prindle[a] as follows:

> The temperature has a wide range of variation. Temperatures below 80° F. below zero have been reported, and those 90° or more above zero are not uncommon. The extreme continued cold of winter leaves so deep an impress that the streams become covered with a layer of ice 6 feet thick, which in places lingers till late in summer, and the ground remains for the most part permanently frozen. The long days of summer, often very warm, soon mantle with green luxuriance much of the deeply frozen surface, and the shadows of the ice-scarred spruces along the river banks become enlivened with patches of grass or glow with brilliant fire weed and clumps of roses. This extreme differentiation of the seasons entails much change in mode of living and methods of transportation, and the times at which the gradual change takes place from summer to winter and winter to summer are therefore the most important climatic periods of the year. The Yukon at Circle closes about the middle of October, soon after the mush ice begins to run, and opens again about the middle of May, when the breaking of the ice emphasizes most dramatically the advent of the open season.
>
> While the winters are in general similar in their essential characteristics, the summers vary greatly in temperature and rainfall. Some of them are characterized by long periods of beautiful weather with many days of great heat during June and July and the early part of August. The occasional thunderstorms or rainy days furnish insufficient water to meet the demands of mining, and work is thus frequently brought almost to a standstill. In other seasons thunderstorms may be of almost daily occurrence for several weeks. A third season may be unusually wet with frequent cold rains accompanied by snow in the higher hills.
>
> The snowfall is generally light, and the total precipitation is much less than that of the southeast coast. The lowlands are comparatively free from frost during the latter part of June and the months of July and August, and ordinarily mining can be carried on from the middle of June to the middle of September, and in a favorable season may be continued much longer.

It should be added that the region is characterized by wide local variations in rainfall during the summer months.

Transportation facilities are of vital importance to the future development of this region. During the open season, from June to October, steamers ply up and down the Yukon; during the winter

[a] Prindle, L. M., The Yukon-Tanana region Alaska; description of the Circle quadrangle: Bull. U. S. Geol. Survey No. 295, 1906.

travelers must follow the trails from Valdez or White Horse. While travel, either in winter or summer, is so slow, tedious, and expensive, development on a large scale will require enormous expenditures of both time and money; and the region can not be economically and completely developed until it can be reached by rail from the seacoast towns. Most of the mining camps using Fairbanks for their base of supplies are readily reached by either steam or wagon road, or both. From Circle, Rampart, and the other supply points the camps are reached by wagon or pack train over trails that are difficult, especially in wet weather.

The Alaska Road Commission is doing much to facilitate development by constructing wagon roads which make it feasible to deliver the heavy machinery that is absolutely essential to the economic working of the mines and that can not be handled by pack trains.

CONDITIONS AFFECTING WATER SUPPLY.

GENERAL CONDITIONS.

Water for mining purposes in the Yukon-Tanana region is drawn entirely from the normal flow of the streams at the point of supply. During the sluicing period, which usually extends from about May 20 to September 10, the daily flow is derived from three sources—the slow melting of snow and ice accumulated chiefly in the form of "winter glaciers" at the heads of the streams, the melting of ground ice and frozen earth, and the summer rains. Very little of the snow melts and runs off before the spring break-up, which in this district begins about the middle of April. The winter run-off, especially in the upper basins, accumulates with the ice and snow in the stream beds. The rise in the streams begins about the middle of May and continues intermittently until about May 30, when the maximum discharge occurs, but ice and snow do not entirely disappear before the middle or last of July. Mr. A. D. Gassaway, of the Chatanika Ditch Company, estimated the maximum flow of Chatanika River near the mouth of Faith Creek at about 1,250 second-feet in 1907, and stated that this discharge occurred about May 30. After that date the flow gradually decreased until the minimum stage was reached, about July 10. In 1908 the maximum discharge occurred from May 20 to 25, and was about 1,340 second-feet, while the minimum discharge of 82 second-feet was recorded July 20 and 21.

MELTING OF FROZEN GROUND.

The melting of frozen ground affords a slight additional supply of water to the streams. On the northern slopes and in the deep canyons which are protected from the rays of the sun, the ground never thaws more than a few inches, even during July and August, when the sun shines nearly twenty-four hours a day; but on the southern slopes and in the lowlands the imprisoned moisture is liberated through the combined influence of abundant sunshine and occasional warm rains. This gradual thawing of the frozen ground serves to increase the minimum flow during a low-water period, as in the season of 1908. (See fig. 3, p. 85.) The only natural storage for rainfall in this country is that afforded by the ubiquitous moss, which absorbs much of the moisture that otherwise would quickly pass beyond use, and distributes the melting of the ground ice over a longer period; but, on the other hand, to a certain extent, it prevents the ground from thawing during the summer and thus does away with any natural underground storage. This covering is saturated from ground thaw, and consequently any rainfall flows off the steep slopes very quickly and finds its way to the streams, causing them to rise and fall rapidly. (See fig. 2.) Because of this lack of ground storage the streams depend largely on rainfall for their supply after the snow and ice have disappeared in the spring break-up.

PRECIPITATION.

Precipitation records kept at Fairbanks since 1905 show that snowfall in this section amounts to about 40 inches. In connection with its investigations of stream flow the Geological Survey established four precipitation stations in the Yukon-Tanana region in 1907 and three in 1908. All records are kept by voluntary observers. The names and locations of these stations, the names of observers, and the dates of establishment are given in the following table:

Rainfall stations in Yukon-Tanana region.

Station.	Letter on Pls. II, IV, and V.	Latitude.	Longitude.	Elevation in feet—		Observer.	Date established.
				Above sea level.	Above ground.		
Baker Hot Springs	T	64° 58′	150° 40′	370	3	V. L. Bevington	Aug. 5, 1908
Charity Creek	N	65° 24′	146° 16′	2,800	3	H. R. Burke	
Cleary	K	65° 05′	147° 26′	1,000	4	Charles Sinclair	June 25, 1907
Eagle Creek	R	65° 26′	145° 27′	2,590	3	A. R. Garner	July 7, 1908
Faith Creek	M	65° 17′	146° 23′	1,400	4	M. T. Kerrick	July 1, 1907
Poker Creek	L	65° 08′	147° 28′	750	5	G. M. Sabean	Aug. 3, 1907
Summit Roadhouse	H	65° 02′	147° 26′	2,310	3	Mrs. Annie M. Walsh.	July 3, 1907

The table following gives the monthly precipitation at points in the Yukon-Tanana region for 1907 and 1908. Records for earlier years have been given by Abbe[a] and by the writer in a previous report.[b]

[a] Abbe, Cleveland, jr., Geography and geology of Alaska: Prof. Paper U. S. Geol. Survey No. 45, 1906, pp. 189-200.

[b] Henshaw, F. F., and Covert, C. C., Water-supply investigations in Alaska, 1906-1907: Water-Supply Paper U. S. Geol. Survey No. 218, 1908, pp. 139-149.

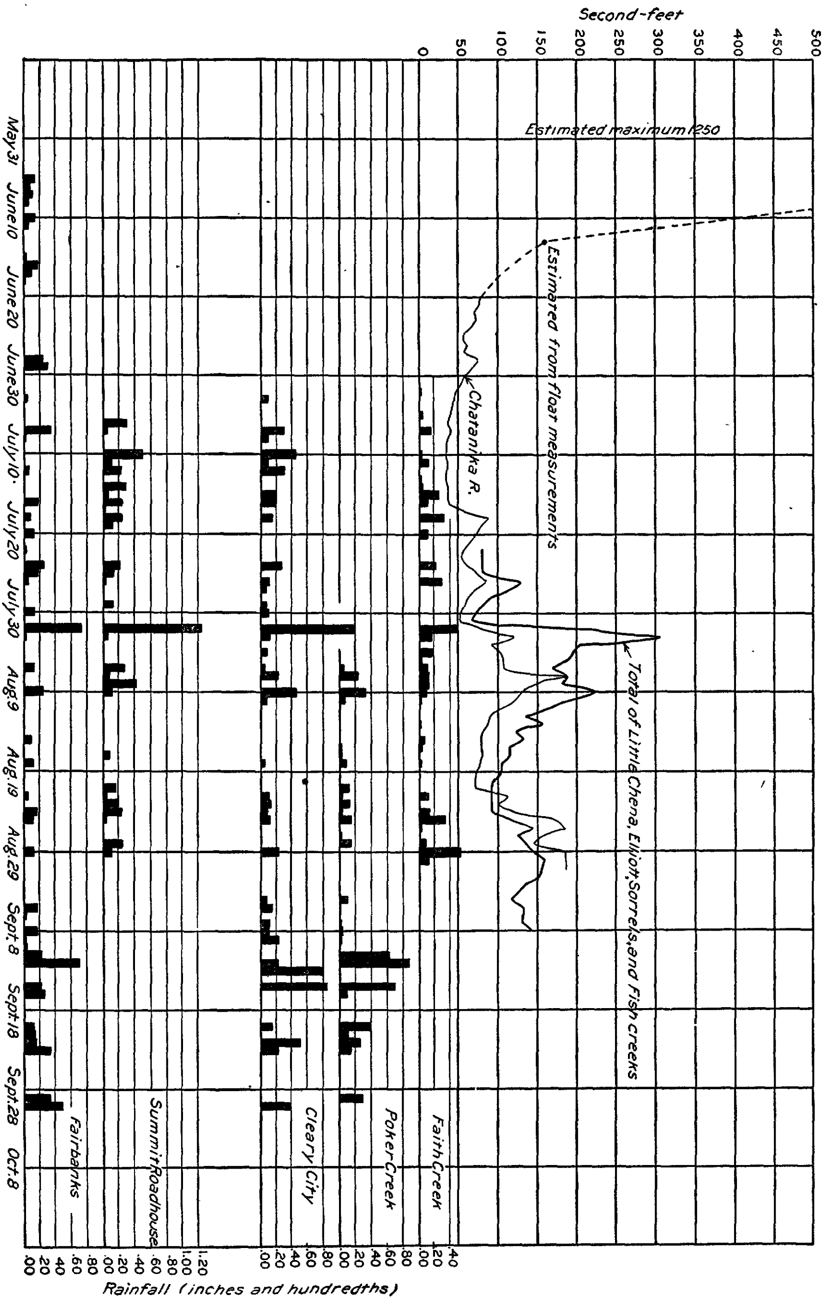


FIGURE 2.—Diagram showing flow of Chatanika River and total flow of Little Chena River and its tributaries in 1907.

Monthly precipitation, in inches, at stations in Yukon-Tanana region, 1907–1908.

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

	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
Baker Hot Springs, 1908	......	......	......	......	......	......	......	......	......	0.41	0.20	......	......
	......	......	......	......	......	......	......	......	......	4.1	2.0	......	......
Circle, 1907	1.02	0.57	0.28	0.15	0.29	......	1.36	2.79	1.73	......	......	0.63	......
	8.5	7.8	3.25	......	......	......	......	......	......	......	......	8.2	......
Circle, 1908	1.23	.25	.76	1.45	.29	0.20	.87	1.08	2.21	.40	.75	......	......
	9.2	2.5	6.75	8.0	......	......	......	......	......	3.0	8.5	......	......
Charity Creek, 1908	......	......	......	.11	.27	1.33	2.80	2.33	2.28	.20	......	......	......
	......	......	......	......	......	......	......	......	......	3.0	......	......	......
Cleary, 1907	......	......	......	......	......	.84	2.55	2.88	3.82	......	......	......	......
Eagle Creek, 1908	......	......	......	......	......	......	......	2.99	......	......	......	......	......
Fairbanks, 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
Fairbanks, 1908	.42	.21	1.1	.11	.52	.96	.73	.71	.15	.47	.51	......	......
	4.2	2.1	11.0	.8	......	......	......	......	1.53	......	4.0	......	......
Faith Creek, 1907	......	......	......	......	......	......	1.87	3.00	2.97	......	......	......	......
Fort Egbert, 1907	1.45	.21	.75	.25	.40	1.89	1.48	1.98	1.45	1.12	.40	......	......
	2.0	2.0	7.5	.15	.55	......	......	......	......	13.0	4.0	......	......
Fort Egbert, 1908	.12	.25	.75	.10	......	2.16	2.47	1.02	1.48	.18	.82	......	......
	3.0	2.5	7.5	1.0	......	......	......	......	......	6.0	7.0	......	......
Fort Gibbon, 1907	1.26	......	.53	0	.30	......	2.58	2.31	2.32	1.22	.03	......	......
	12.6	......	5.0	......	......	......	......	......	4.00	12.0	1.5	......	......
Fort Gibbon, 1908	.23	.26	.90	0	1.16	......	.96	1.13	1.60	.45	......	......	......
	4.0	6.0	17.0	0	......	......	......	......	2.25	6.0	......	......	......
Kechumstuk, 1907	.12	.20	.27	Tr.	1.30	2.30	1.60	2.14	.49	.72	.40	......	......
	2.0	3.0	4.0	......	12.0	......	......	......	......	9.0	4.0	......	......
Kechumstuk, 1908	0	0	.41	.40	1.78	1.77	2.30	2.22	1.35	......	......	......	......
	......	......	5.0	4.0	......	......	......	......	......	......	......	......	......
North Fork, 1907	.69	.28	.27	Tr.	1.34	1.92	1.57	3.19	2.00	1.40	.20	......	......
	15.5	3.0	3.0	......	4.0	......	......	......	5.0	12.0	2.0	......	......
North Fork, 1908	.50	......	......	......	......	......	......	......	......	......	......	......	......
	5.0	Tr.	......	......	......	......	......	......	......	......	......	......	......
Poker Creek, 1907	......	......	......	......	......	......	......	1.40	3.70	1.70	.25	1.07	......
	......	......	......	......	......	......	......	......	......	24.0	3.3	6.8	......
Poker Creek, 1908	......	1.32	......	.42	.58	1.80	2.02	.99	2.45	.75	......	......	......
	......	10.5	......	5.0	......	......	......	......	4.5	6.9	......	......	......
Rampart, 1907	1.17	.44	1.17	.02	.44	1.64	2.29	3.38	2.52	.65	.55	......	......
	12.0	4.5	12.8	2.5	......	......	......	......	......	......	6.3	......	......
Rampart, 1908	1.08	.52	.81	.58	.82	1.38	1.13	.46	1.56	.39	......	......	......
	11.5	6.9	8.1	......	......	......	......	......	......	5.1	......	......	......
Summit Roadhouse, 1907	......	......	......	......	......	......	2.71	3.27	[a] 3.33	......	......	......	......

[a] September 1–22.

Precipitation records for May to August, inclusive, at various points in the Yukon-Tanana region, may be summarized as follows:

Summary of precipitation in Yukon-Tanana region.

Station.	Maximum.		Minimum.		Mean.	Duration of records.
	Inches.	Year.	Inches.	Year.	Inches.	
Fairbanks	5.73	1906	2.92	1908	4.60	1906–1908
Circle	4.15	1907	2.44	1908	3.30	1907–1908
Rampart	7.75	1907	3.79	1908	5.58	1905–1908
Fort Egbert	6.31	1908	4.87	1906	5.75	1903, 1905–1908
Fort Gibbon	10.26	1905	3.30	1904	5.76	1903–1908
Kechumstuk	9.06	1906	3.66	1905	6.73	1904–1908

The table above shows that a total precipitation as high as 10.26 inches and as low as 2.44 inches has occurred during the mining season.

A comparison of the records of rainfall in 1907 throughout Alaska with records previously obtained shows that the season was nearly normal, especially in the interior; but the records of 1908 indicate that in the Fairbanks, Circle, and Rampart precincts, except in a small area at the head of Chatanika, Twelvemile, and Preacher creeks the precipitation was below the normal, while in Kechumstuk and Fort Egbert it was somewhat above the usual amount.

May, June, and July are invariably months of slight rainfall in the interior, and the streams soon reach a very low stage. Yet this is the most important period for the miner. The long hours of daylight and the warm weather afford favorable opportunities for mining and sluicing, but the abundant supply of water needed for this purpose is often lacking.

THE FAIRBANKS DISTRICT.

DESCRIPTION OF AREA.

The area known as the Fairbanks district extends about 60 miles to the north of Fairbanks and is from 40 to 50 miles wide. The greater part of the region 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 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, where it diverts a portion of the Tanana waters. Its course is along the foothills of the pleateau to the north, and it receives Chena River about 7 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, most of which extend 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 2,000 to 3,000 feet above the stream beds. That portion of the plateau which comes under discussion 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 drainage.

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 to 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, known as tundra, which is wet, spongy, and mossy, and ranges in thickness from 6 inches to 2 feet. In some localities this is meadow-like, producing a rank growth of grass and a variety of beautiful wild flowers. Ground ice is found beneath this tundra 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, gravelly clay, underlain by a mica schist which 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.

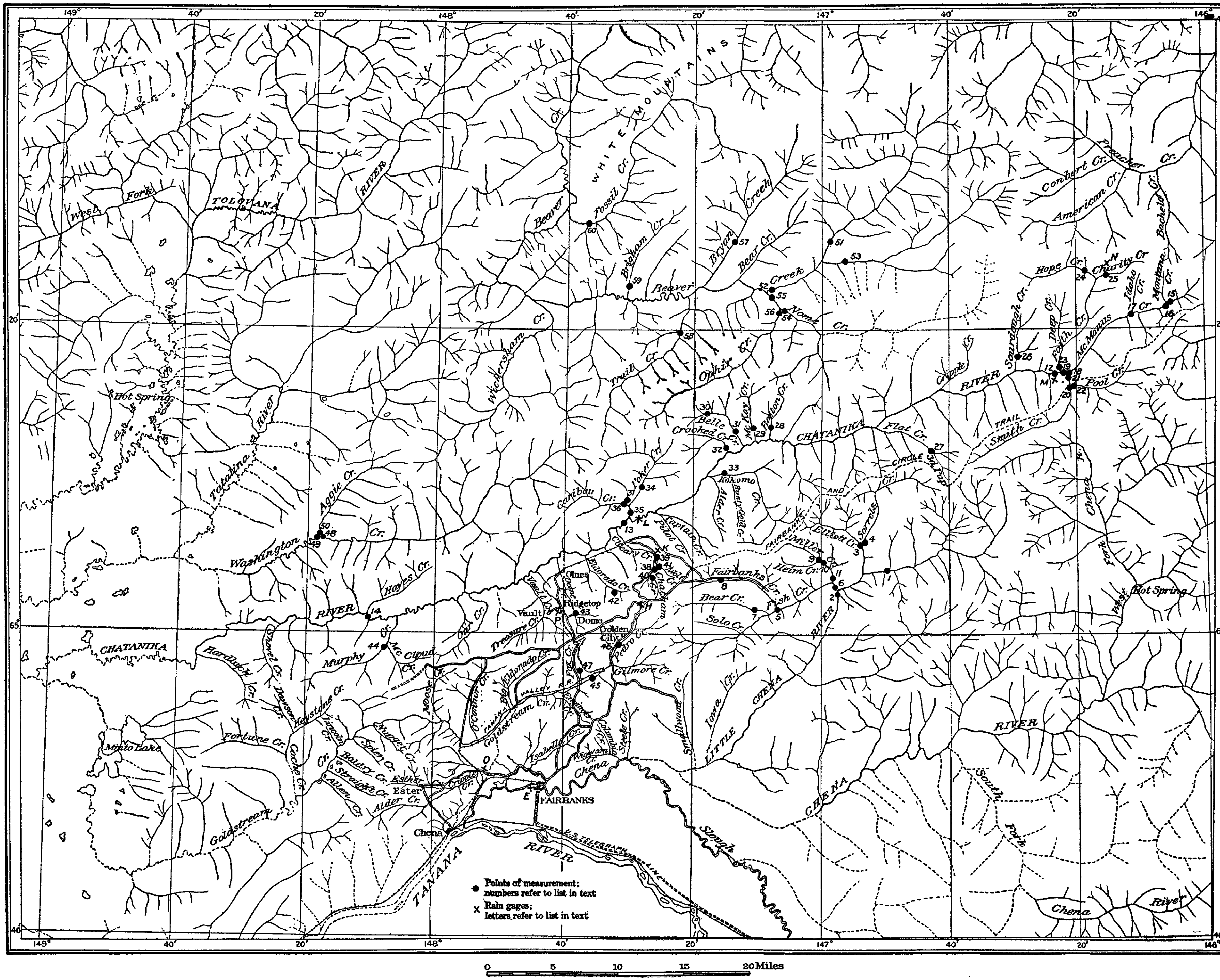
The Fairbanks mining district lies between Little Chena and Chatanika rivers. It embraces an area of about 500 square miles and extends 30 miles north of Fairbanks, which is situated on Chena Slough nearly 12 miles above its confluence with the Tanana. Most of the producing creeks rise in a high rocky 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.

GAGING STATIONS.

The following list gives the points in the Fairbanks district at which gages were established or discharge measurements made in 1907 or 1908. The numbers refer to Plate II:

Gaging stations in Fairbanks district, 1907–1908.

1. Little Chena River above Elliott Creek.
2. Little Chena River below Fish Creek.
3. Elliott Creek above Sorrels Creek.
4. Sorrels Creek near mouth.
5. Fish Creek above Fairbanks Creek.
6. Fish Creek at mouth.



MAP SHOWING LOCATION OF GAGING STATIONS IN FAIRBANKS DISTRICT.

7. Bear Creek below Tecumseh Creek.
8. Fairbanks Creek.
9. Miller Creek above Heim Creek.
10. Miller Creek below Heim Creek.
11. Miller Creek near mouth.
12. Chatanika River near Faith Creek.
13. Chatanika River below Poker Creek.
14. Chatanika River below Murphy Creek.
15. McManus Creek above Montana Creek.
16. McManus Creek below Montana Creek.
17. McManus Creek below Idaho Creek.
18. McManus Creek above Smith Creek.
19. McManus Creek near mouth.
20. Smith Creek above Pool Creek.
21. Smith Creek near mouth.
22. Pool Creek near mouth.
23. Faith Creek near mouth.
24. Hope Creek near Zephyr Creek.
25. Charity Creek near mouth.
26. Sourdough Creek near mouth.
27. Flat Creek below 3d Pup.
28. Boston Creek at elevation 800 feet.
29. McKay Creek at elevation 800 feet.
30. Belle Creek at elevation 1,200 feet.
31. Belle Creek at elevation 800 feet.
32. Crooked Creek near mouth.
33. Kokomo Creek near mouth.
34. Poker Creek at elevation 800 feet.
35. Poker Creek near mouth.
36. Caribou Creek above Little Poker Creek.
37. Little Poker Creek near mouth.
38. Cleary Creek above Wolf Creek.
39. Cleary Creek near Cleary.
40. Chatham Creek at mouth.
41. Wolf Creek at mouth.
42. Eldorado Creek above trail.
43. Dome Creek near Dome.
44. Murphy Creek above McCloud Creek.
45. Goldstream Creek near claim 6 below.
46. Pedro Creek at claim 1 above.
47. Fox Creek at elevation 900 feet.
48. Washington Creek above Aggie Creek.
49. Washington Creek below Aggie Creek.
50. Aggie Creek at mouth.
51. Beaver Creek above East Branch.
52. Beaver Creek above Nome Creek.
53. East Branch of Beaver Creek near mouth.
54. Nome Creek above Ophir Creek.
55. Nome Creek near mouth.
56. Ophir Creek at mouth.
57. Bryan Creek at elevation 1,800 feet.
58. Trail Creek 4 miles above mouth.
59. Brigham Creek near mouth.
60. Fossil Creek near mouth.

LITTLE CHENA RIVER DRAINAGE BASIN.

GENERAL DESCRIPTION.

The southern slope of the divide between the Chatanika and Chena drainage basins, from the headwaters of Smith and Flat creeks to Pedro Dome, a distance of about 25 miles, is drained by Little Chena River and its tributaries, Elliott and Fish creeks. The drainage basin is irregular in shape and 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 8 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 6 or 8 miles above the confluence of Chena Slough. Through this slough the Chena discharges its waters into the Tanana near the town of Chena. The slough affords a passageway for the Tanana steamers from its mouth to Fairbanks, 12 miles above, except in times of low water, when the cargoes are transferred at Chena to the Tanana Valley Railroad.

In the low-water period the stream occupies a channel 30 to 75 feet wide, crossing from side to side of a broad, gravelly bed ranging in width from 100 to 300 feet. The channel is defined by steep, alluvial banks that form the approach to the heavily timbered bottom lands which prevail in the river valley above the confluence of Fish Creek. In the high-water stages the river completely fills its broad bed, overflowing the banks and seeking numerous smaller channels that surround heavily wooded islands.

The greater part of the drainage basin is well covered with timber, that in the uplands, on the slopes and smaller divides, consisting of spruce, birch, and poplar, suitable only for fuel and cabin purposes. In the lower valleys and creek bottom lands the prevailing growth is spruce, much of which is suitable for milling purposes.

The area is everywhere covered with the common moss, but here and there limestones, mica schist, and gravel outcrop on the slopes. In the creek valleys the mossy covering is usually underlain with frozen muck and glacial ice. The numerous swamp areas near the river banks and the heavy growth of timber make travel very difficult.

In 1907 gaging stations were established on Elliott Creek above Sorrels Creek, on Sorrels Creek above its mouth, on Fish Creek above Fairbanks Creek, and on the Little Chena about 2 miles above Elliott

Creek, and in 1908 additional stations were established on Little Chena below Fish Creek, on Fish Creek at its mouth, and on Miller Creek at mouth. Much credit is due Sherman White, the observer, for his faithful work in making approximately daily observations at each of these stations.

Drainage areas of Little Chena River basin.[a]

Stream and location.	Area.	Total area.
	Sq. miles.	*Sq. miles.*
Little Chena River above gaging station	79.0	79.0
Little Chena River from gaging station to mouth of Elliott Creek	3.6	82.6
Elliott Creek above gaging station	13.8	
Sorrels Creek above gaging station	21.0	
Elliott Creek from gaging station to mouth	3.8	
Total Elliott Creek	38.6	121.2
Little Chena River from mouth of Elliott to Fish Creek	6.0	127.2
Fish Creek above Bear Creek	23.6	
Bear Creek above mouth	12.0	
Fish Creek from Bear Creek to gaging station	3.6	
Fish Creek above gaging station	39.2	
Fairbanks Creek above mouth	20.5	
Fish Creek, Fairbanks Creek to Miller Creek	13.0	
Miller Creek above mouth	16.7	
Fish Creek from Miller Creek to mouth	.8	
Total Fish Creek	90.2	217.4
Little Chena from mouth of Fish Creek to Anaconda Creek	30.7	248.1
Anaconda Creek above mouth	43.3	291.4
Little Chena from Anaconda Creek to mouth	113.2	404.6

[a] From reconnaissance map Yukon-Tanana region, Fairbanks quadrangle.

LITTLE CHENA RIVER ABOVE ELLIOTT CREEK.

A gaging station was established on Little Chena River about 2 miles above Elliott Creek, July 22, 1907. At this point the channel is from 30 to 50 feet wide during low and medium stages. It has a gravelly bed and is fairly straight for about 100 feet. A stake graduated to feet and tenths was driven near the left side and daily readings were taken.

Discharge measurements of Little Chena River above Elliott Creek, 1907–1908.

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
1907.	*Feet.*	*Sec.-ft.*	1908.	*Feet.*	*Sec.-ft.*
July 22	0.60	44.2	May 29	1.65	249
July 24	.56	39.7	July 21	.46	32.3
August 4	1.10	113	July 31	.46	33.6
August 5	1.05	103			
August 20	.73	56.7			

Daily gage height and estimated discharge of Little Chena River above Elliott Creek, 1907-1908.

[Elevation, 800 feet; drainage area, 79 square miles.]

Day.	1907.						1908.							
	July.		August.		September.		May.		June.		July.		August.	
	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1			0.7	53	1.0	95				210		65		32
2			1.3	157	.9	80				197		58		32
3			1.1	113	.9	80			1.40	185		58		32
4			1.1	113	.8	66				160		58		29
5			1.1	113	.9	80				185		58		29
6			1.0	95	.95	88			1.55	223		58		29
7			1.05	104	.95	88				185		58	0.41	29
8			1.1	113	1.0	95				172		58	.50	35
9			1.2	134		95				160		46		35
10			1.1	113	1.0	95			1.25	148		46		32
11			1.0	95						160		46	.40	28
12			.9	80						172		46		30
13			1.0	95						172		46		30
14			.8	66						197		46	.45	32
15			.9	80					1.45	197		42		35
16			.8	66						160		42		38
17				66					1.20	136		38		42
18				60						148		38		46
19				60					1.10	113		35	.70	52
20			.7	53			2.20	405		113		35		58
21			.7	53				374		125	0.46	33		65
22	0.60	42	.7	53				374		94		33	.90	79
23		42	.7	53				346		94		33	.80	65
24	.60	42	.7	53				318		86		33		58
25	.60	42		73				290		86		33		52
26	.90	80	1.0	95				263		79		33	.65	46
27	.80	66	.9	80				236		79		33		
28	.70	53	.9	80				210		72		33		
29	.60	42		88			1.60	236		72		33		
30	.60	42	1.0	95				250		65		33		
31	.60	42	1.0	95				250			.46	33		
Mean		49.3		85.4		86.2		296		142		43.2		41.1
Mean per sq. mile		.625		1.08		1.09		3.75		1.80		.547		.520
Run-off, depth in inches		.23		1.24		.40		1.67		2.01		.63		.49

LITTLE CHENA RIVER BELOW FISH CREEK.

A gaging station was established on Little Chena River below the mouth of Fish Creek May 1, 1908. Measurements were made from a car and cable during high water and by wading in low water.

Discharge measurements of Little Chena River below Fish Creek, 1908.

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
April 28	(a)	126	July 20	1.60	83
May 2	3.75	916	July 21	1.50	74.2
May 3	4.00	887	July 30	1.50	74.7
May 4	4.00	960	August 3	1.58	87.7
May 5	4.08	1,030	August 23	1.80	110

a Measurement made before gage was installed, river partly filled with ice.

Daily mean gage height and estimated discharge of Little Chena River below Fish Creek, 1908.

[Elevation, 700 feet; drainage area, 228 square miles.]

Day.	May.		June.		July.		August.	
	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1	3.65	714	3.35	537		161	1.48	68
2	3.70	746	2.95	367		153	1.56	78
3	4.00	960	2.65	274		145	1.58	80
4	4.00	960	2.48	231		145	1.54	74
5	4.05	998	3.48	608		137	1.49	68
6	4.15	1,075	3.55	651		129	1.44	62
7	3.90	885	3.00	384		122	1.45	64
8	3.71	753	2.80	318		115	1.50	70
9	3.68	732	2.48	230		108	1.50	70
10	3.70	746	2.31	192		108	1.49	68
11		732	2.40	212		108	1.45	64
12	3.65	714	2.60	260		101	1.40	59
13	3.68	732	2.55	248		95	1.40	59
14	3.70	746	2.68	282		88	1.46	65
15	3.98	940	2.98	378		82	1.49	68
16	4.85	1,668	2.58	256		76	1.52	72
17	4.68	1,510	2.50	235		70	1.62	84
18	4.38	1,265	2.70	288		70	1.60	82
19	4.38	1,265	2.45	224		82	1.65	88
20	4.44	1,320	2.40	212	1.60	82	1.70	95
21	4.38	1,265		235	1.50	70	1.82	111
22	3.88	870		303		70	1.90	122
23	3.50	620		260		70	1.75	101
24	3.52	632		212		70	1.72	98
25	3.20	465		212		70	1.70	95
26	2.82	324		201		70	1.64	83
27	2.62	265		190		70	1.65	88
28	3.25	489		180		70		
29	3.15	443		170	1.50	70		
30	3.15	443		161	1.50	70		
31	3.30	512			1.45	64		
Mean		832		284		94.9		79.2
Mean per square mile		3.65		1.25		.416		.347
Run-off, depth in inches		4.21		1.40		.48		.35

ELLIOTT CREEK ABOVE SORRELS CREEK.

Elliott Creek takes the drainage from the southern slope of Twin Butte Hills, in the Chatanika divide, and flows southward, discharging its waters and those of Sorrels Creek, its tributary, into the Little Chena about 4 miles above Fish Creek.

The drainage area is steep in its upper reaches and well timbered in the creek bottom. The stream flows in a narrow channel, rather deeply cut, and the banks are lined with willow and small spruce.

A gaging station was established about half a mile above the mouth of Sorrels Creek July 22, 1907, and regular readings were taken.

Discharge measurements of Elliott Creek above Sorrels Creek, 1907–1908.

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
1907.	*Feet.*	*Sec.-ft.*	1908.	*Feet.*	*Sec.-ft.*
July 23	1.6	5.1	May 29	2.15	32.5
August 5	1.85	13.8	July 21	1.35	4.4
August 20	1.615	7.1	July 31	1.35	4.5

Daily gage height and estimated discharge of Elliott Creek above Sorrels Creek, 1907–1908.

[Elevation, 800 feet; drainage area, 13.8 square miles.]

Day.	1907.						1908.							
	July.		August.		September.		May.		June.		July.		August.	
	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1			1.7	9.0	1.8	12.3				26.0		7.5		4.5
2			2.1	23	1.8	12.3				17		7.5		4.5
3			2.1	23	1.7	9.0			1.85	13		7.5		4.5
4				17.2	1.7	9.0				13		6.6		4.4
5			1.8	12.3	1.7	9.0				11		6.6		4.4
6			1.8	12.3		9.0			1.80	11		6.0		4.4
7				12.3		9.0				15		6.0	1.30	4.4
8			1.8	12.3	1.7	9.0				17		6.0	1.33	4.5
9			1.9	15.6		10.0				22		5.4		4.4
10			1.8	12.3		12.0			2.15	32		5.4		4.4
11			1.8	12.3						32		5.0	1.29	4.4
12			1.7	9.0						26		5.0		4.4
13			1.8	12.3						26		5.0		4.4
14			1.8	12.3						22		5.0	1.34	4.5
15			1.7	9.0					2.00	20		5.0		4.5
16			1.7	9.0						15		4.6		4.5
17				9.0					1.75	9.5		4.6		4.5
18				7.4						9.3		4.6		4.5
19			1.65	7.4					1.73	9.1		4.6	1.35	4.5
20			1.6	5.8			3.30	216		8.9		4.6		4.5
21			1.6	5.8				184		9.5		4.5		4.6
22	1.6	5.8	1.6	5.8				120		9.5		4.5	1.40	4.6
23	1.6	5.8	1.6	5.8				56		9.5		4.5		4.6
24	1.6	5.8	1.6	5.8				40		9.5		4.5		4.6
25	1.6	5.8		7.4				22		9.5		4.5		4.5
26	1.7	9.0	1.7	9.0				11		8.6		4.5	1.34	4.5
27	1.7	9.0	1.7	9.0				15		8.6		4.5		
28	1.6	5.8	1.8	12.3				22		8.6		4.5		
29	1.6	5.8		12.3			2.15	32		8.6		4.5		
30		4.1		12.3				48		8.6		4.5		
31	1.5	2.5	1.8	12.3				48				4.5		
Mean		5.94		11.0		10.0		67.8		14.8		5.22		4.48
Mean per square mile		.430		.797		.724		4.91		1.07		.378		.324
Run-off, depth in inches		.16		.92		.27		2.19		1.19		.44		.31

SORRELS CREEK.

Sorrels Creek rises in the Chatanika divide west of Flat Creek, and flows westward along this divide for about 5 miles, then, by an abrupt bend to the left, it takes a southerly course for about 6 miles to Elliott Creek, uniting with the latter about 3 miles above its mouth. The stream flows in a narrow irregular channel, rather deeply cut in the mucklike bottom lands, and is well hidden from view by the masses of spruce and willow along its banks.

A gaging station was established on this stream about one-half mile above its mouth July 23, 1907, and regular readings were taken.

Discharge measurements of Sorrels Creek near mouth, 1907–1908.

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
1907.	*Feet.*	*Sec.-ft.*	1908.	*Feet.*	*Sec.-ft.*
July 23	1.00	10.3	May 29	1.75	54.3
August 5	1.40	28.2	July 21	1.09	11.3
August 20	1.02	12.0	July 31	1.03	10.5

Daily gage height and estimated discharge of Sorrels Creek near mouth, 1907–1908.

[Elevation, 800 feet; drainage area, 21 square miles.]

Day.	1907.						1908.							
	July.		August.		September.		May.		June.		July.		August.	
	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1			1.1	14.7	1.2	19.0				66		38		11
2			1.4	27.8	1.2	19.0				50		36		11
3			1.4	27.8	1.1	14.7			1.55	36		35		10
4			1.5	32.1	1.1	14.7				34		34		10
5			1.35	25.6	1.1	14.7				28		32		10
6			1.3	23.4		14.7			1.45	30		30		10
7				23.4		14.7				30		29	1.00	10
8			1.3	23.4	1.1	14.7				29		28	1.02	10
9			1.4	27.8		14.7				28		27		10
10			1.3	23.4		19.0			1.40	27		25		10
11			1.3	23.4						29		23	.99	10
12			1.2	19.0						31		22		10
13			1.2	19.0						39		21		10
14			1.2	19.0						37		20	1.01	10
15			1.1	14.7					1.60	40		19		11
16			1.1	14.7						42		17		13
17				14.7					1.65	45		16		15
18				12.5						50		15		15
19				10.3					1.65	45		14	1.15	15
20			1.0	10.3			2.30	131		45		13		16
21			1.0	10.3				113		60	1.08	12		17
22	1.0	10.3	1.0	10.3				98		72		12	1.22	18
23	1.0	10.3	1.0	10.3				84		60		11		17
24	1.0	10.3	1.0	10.3				72		57		11		17
25	1.0	10.3		12.5				60		54		11		15
26	1.1	14.7	1.1	14.7				50		50		11	1.10	13
27	1.1	14.7	1.1	14.7				36		48		11		
28	1.0	10.3	1.2	19.0				45		45		11		
29	1.0	10.3		19.0			1.75	55		42		11		
30		8.2		19.0				66		40		11		
31	.9	6.0	1.2	19.0				66			1.03	11		
Mean		10.5		18.2		16.0		73.0		42.8		19.9		12.5
Mean per square mile		.500		.867		.762		3.48		2.04		.948		.595
Run-off, depth in inches		.19		1.00		.28		1.55		2.28		1.09		.58

FISH CREEK ABOVE FAIRBANKS CREEK.

Fish Creek rises in the high ridge at the head of Goldstream Creek and flows northwestward through an irregularly formed valley. About 14 miles below its source it makes an abrupt bend to the right, rounding the point of a rather steep divide that separates its drainage from that of the Little Chena, into which it discharges about 2 miles below this bend. Its course is tortuous and closely follows the right side of the valley, the left side of which is a broad, marshy bottom land. Its principal tributaries are Solo, Bear, Fairbanks, and Miller creeks, all from the left. The upper slopes of these streams are rather steep, but they become rapidly less as Fish Creek Valley is approached.

A gaging station was established a short distance above Fairbanks Creek July 22, 1907, and regular readings were taken.

Discharge measurements of Fish Creek above Fairbanks Creek, 1907–1908.

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
1907.	*Feet.*	*Sec.-ft.*	1908.	*Feet.*	*Sec.-ft.*
July 21	1.00	23.7	May 31	2.40	107.0
July 25	1.00	24.3	July 18	.85	16.0
August 3	1.55	47.8	July 19	.85	16.8
August 4	1.35	37.6	July 22	.75	12.8
August 19	1.00	20.8	July 29	.75	15.4
			August 5	.75	15.0

Daily gage height and estimated discharge of Fish Creek above Fairbanks Creek, 1907–1908.

[Elevation, 925 feet; drainage area, 39 square miles.]

Day.	1907.						1908.							
	July.		August.		September.		May.		June.		July.		August.	
	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1			3.2	155	1.0	24			2.35	102		33		13.5
2			2.4	100	1.0	24				86		31		13.5
3			1.4	39	1.0	24				79		31		13.5
4			1.3	35	1.0	24				71		29		13.5
5				37	1.1	27			1.95	71		29	0.75	13.5
6			1.4	39		27			2.70	137		29		13.5
7			1.55	47		27				98		26		13.5
8			1.3	35	1.1	27				68		26		13.5
9			1.6	50	1.1	27			1.40	38		24		13.5
10			1.6	50	1.3	35				43		24	.75	13.5
11				39						55		22		13.5
12			1.2	31					1.80	61		22		12.0
13			1.1	27						55		22	.70	12.0
14			1.1	27	2.6	*a* 115				52		20		13.5
15			1.1	27					1.50	43		18		15.0
16			1.0	24					1.50	43		18		15.0
17			1.0	24						41		16.5	.82	15.6
18				24						41	0.85	16.5		16.2
19			1.0	24						38	.85	16.5		16.5
20				24					1.40	38		15.0		16.8
21			1.0	24						43		12.0	.89	17.7
22	1.0	24	1.0	24			3.60	227		55	.75	13.5		17.4
23		24		24				197		52		13.5		17.1
24		24	1.0	24				167		49		13.5		16.8
25	1.0	24	1.1	27				127		46		13.5		16.5
26	1.1	27	1.1	27				90		43		13.5		16.1
27	1.0	24	1.0	24				94		41		13.5	.82	15.6
28	.9	21	1.0	24				98		38		13.5		
29	.9	21		27				102		38	.75	13.5		
30	.8	18	1.2	31				107		36		13.5		
31	.8	18	1.1	27			2.40	107				13.5		
Mean		22.5		36.8		26.6		132		56.7		19.9		14.8
Mean per square mile		.577		.944		.682		3.38		1.45		.510		.380
Run-off, depth in inches		.21		1.09		.25		1.26		1.61		.59		.38

a Not included in mean.

FISH CREEK AT MOUTH.

A gaging station was established at the mouth of Fish Creek May 1, 1908. Measurements were made from a car and cable during high water and by wading in low water.

Discharge measurements of Fish Creek at mouth, 1908.

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
May 5	4.22	618	May 28	2.30	148
May 6	3.98	530	May 30	2.75	208
Do	4.20	646	July 20	.90	26.0
May 7	3.90	558	July 21	.88	26.1
Do	4.02	571	July 30	.82	24.6
May 8	3.64	385	August 2	1.00	29.2
May 9	3.70	525	August 23	1.10	32.4

Daily mean gage height and estimated discharge of Fish Creek at mouth, 1908.

[Elevation, 700 feet; drainage area, 90.2 square miles.]

Day.	May.		June.		July.		August.	
	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1	3.98	564	2.60	206		65	0.82	23
2	4.00	570	2.28	147		61	.99	28
3	4.25	650	1.98	105		57	.98	28
4	4.35	682	1.80	83		53	.92	25
5	4.28	660	2.25	142		49	.87	24
6	4.05	586	3.12	327		45	.82	22
7	3.95	554	2.42	170		42	.85	24
8	3.65	464	2.22	138		38	.89	25
9	3.65	464	1.90	95		35	.90	25
10	3.65	464	1.65	69		33	.88	25
11		445	1.75	78		31	.84	24
12	3.50	422	2.28	146		30	.80	22
13	3.45	400	2.15	128		28	.80	22
14	3.50	422	2.18	132		27	.87	24
15	3.48	417	2.58	202		25	.88	25
16	4.40	396	2.10	121		24	.90	25
17	4.35	383	2.10	121		22	.99	28
18	3.90	538	2.62	210		22	.95	27
19	3.78	500	2.05	114		24	.94	27
20	3.75	493	1.90	95		25	.94	27
21	3.52	429		114		25	1.08	31
22	3.15	334		142		25	1.10	31
23	2.78	246		114		25	1.00	28
24	2.55	196		95		24	.98	28
25	2.50	186		89		24	.96	27
26	2.25	142		83		24	.95	27
27	1.98	105		78		24	1.00	28
28	2.25	142		73		24		
29	2.40	166		73	0.85	24		
30	2.80	250		69	.82	23		
31	2.80	250			.79	22		
Mean		404		125		32.2		25.9
Mean per square mile		4.48		1.39		.356		.287
Run-off, depth in inches		5.16		1.55		.41		.28

BEAR CREEK.

Bear Creek rises in the high divide at the head of Goldstream Creek, flows eastward through a deep, narrow valley, and unites with Fish Creek about one-half mile above the gaging station. The following measurements were made below Tecumseh Creek: July 20, 1907, 8.4 second-feet; August 22, 1907, 7 second-feet; July 19, 1908, 5.4 second-feet; drainage area, 12 square miles; discharge per square mile, 0.70, 0.584, and 0.450 second-feet, respectively.

FAIRBANKS CREEK.

Fairbanks Creek rises on the eastern side of Pedro Dome, opposite the headwaters of Cleary Creek, and flows eastward about 10 miles to Fish Creek. It is separated from Bear Creek on the right by a steep, high ridge, rising 800 to 1,000 feet above the stream bed. The valley to the left is more gradual in slope, and is drained by several small tributaries—Moose, Crane, Alder, Walnut, and Deep creeks. The stream flows close to the dividing ridge on the east until it approaches the broad lowland near Fish Creek. Its lower course lies through a narrow, deep-cut channel, thickly lined with willow and spruce. The stream has rather steep slopes in its upper course. Below Moose Creek the average fall is about 75 feet to the mile.

Discovery claim is located near Alder Creek, and mining operations are carried on from claim 9 above to claim 13 below. The pay streak follows the stream channel closely down to claim 9 below, where it swings to the left limit. Above claim 2 below, most of the work is by the open-cut method. Below this point it is underground by drifting. The following measurements were made in 1907, but owing to the unfavorable conditions they are approximate only.

Discharge measurements of Fairbanks Creek, 1907.

Date.	Elevation.	Discharge.	Date.	Elevation.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
June 24	1,300	1.4	July 5	1,375	.72
Do	1,250	2.2	July 20	1,400	1.3

MILLER CREEK.

Miller Creek rises in the southeastern slope of Coffee Dome and flows southward, joining Fish Creek about 1 mile above its confluence with Little Chena River. It is about 6 miles long and flows through a narrow valley, draining an area of 16.7 square miles. A regular station was established at the mouth of the creek May 13, 1908, and several miscellaneous measurements were made in 1907 and 1908.

Discharge measurements of Miller Creek at mouth, 1908.

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
May 28	1.20	27.9	July 21	.60	4.9
Do	1.20	26.2	July 30	.58	4.86
May 30	1.32	29.4	August 3	.62	5.78
July 20	.60	4.2			

Daily mean gage height and estimated discharge of Miller Creek at mouth, 1908.

[Elevation, 750 feet; drainage area, 16.7 square miles.]

Day.	May.		June.		July.		August.	
	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1			1.40	39.2		11.1	0.58	4.6
2			1.10	19.6		10.8	.62	5.3
3			.98	14.8		10.6	.62	5.3
4			.90	12		10.3	.60	4.9
5			1.14	22		10.0	.58	4.6
6			1.60	55.2		9.7	.58	4.6
7			1.10	19.6		9.4	.58	4.6
8			1.02	16.1		9.2	.60	4.9
9			.88	11.4		8.9	.60	4.9
10			.85	10.6		8.6	.58	4.6
11			.90	12.0		8.4	.56	4.3
12			1.18	23.6		8.2	.54	4
13	2.05	91.2	1.28	29.8		8.0	.54	4
14	2.08	94.2	1.32	32.8		7.8	.60	4.9
15	2.18	101	1.24	26.2		7.6	.60	4.9
16	2.45	122	1.02	16.1		7.4	.62	5.3
17	2.42	120	.95	13.8		7.2	.60	4.9
18	2.20	103	1.10	19.6		7.0	.60	4.9
19	2.18	101	.89	11.7		6.8	.60	4.9
20	2.15	99.2	.88	11.4		6.6	.61	5.1
21	1.90	79.2		13.8		6.4	.67	6.4
22	1.60	55.2		15.4		6.2	.67	6.4
23	1.22	26		13.8		5.9	.65	5.9
24	1.22	26		13.4		5.7	.62	5.3
25	1.15	22		13		5.5	.61	5.1
26	.95	13.8		12.6		5.3	.60	4.9
27	.98	14.8		12.3		5.1	.61	5.1
28	1.18	23.6		12.0		4.9		
29	1.28	29.8		11.7	0.60	4.9		
30	1.35	35.2		11.4	.58	4.6		
31	1.35	35.2			.56	4.3		
Mean		62.7		18.2		7.50		4.98
Mean per square mile		3.77		1.08		.449		.298
Run-off, depth in inches		2.65		1.20		.52		.30

Miscellaneous measurements of Miller Creek, 1907–1908.

Date.	Point of measurement.	Elevation.	Drainage area.	Discharge.	Discharge per square mile.
1907.		*Feet.*	*Sq. miles.*	*Sec.-ft.*	*Sec.-ft.*
July 6	Near mouth	750	15	7.0	0.466
July 24	.....do	750	15	7.6	.506
August 20	.....do	750	15	8.0	.533
August 6	Below mouth of Heim Creek	790	10	8.0	.800
August 7	.....do	790	10	8.0	.800
Do	Above mouth of Heim Creek	800	6	4.9	.816
1908.					
July 21	.....do	800	6	2.5	.416
August 1	.....do	800	6	2.2	.366
July 21	Below mouth of Heim Creek	790	10	3.1	.310
August 1	.....do	790	10	2.4	.240

CHATANIKA RIVER DRAINAGE BASIN.

GENERAL DESCRIPTION.

Chatanika River is formed by the junction of Faith and McManus creeks, which drain the high ridge constituting the 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 western side of the valley, which is from one-half mile to 7 miles wide and about 80 miles long. The drainage area of the river above its mouth is approximately 1,300 square miles.

From 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, the valley widens and the bottom lands become marshy and swampy. From the left, the Chatanika receives drainage from 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, after which the dividing ridges disappear and the stream meanders through the low swampy grounds to the north of Tanana River. About 10 miles from its mouth Goldstream Creek, its largest tributary, joins it from the left.

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 right are short and precipitous, flowing through V-shaped valleys; those from the left have less precipitous courses and broader valleys and gradually lose themselves in the rather broad expanse of swamplike bottom lands.

The altitude and drainage area of the upper Chatanika has attracted the attention of "outside" capital for some time. The general topography has seemed suitable for a possible water supply by ditch line to the mining district proper, and the favorable slope of portions of Faith and McManus creeks has made them attractive to the promotor for hydraulicking.

Several gaging stations were established in this drainage basin during 1907. In June A. D. Gassaway, general manager of the Chatanika Ditch Company, began the first records of actual stream flow in this section by establishing gaging weirs at the mouth of Faith and McManus creeks.

Through the courtesy of this company the records are published in this report.

CHATANIKA RIVER NEAR FAITH CREEK.

A gaging station was established July 10, 1907, on the Chatanika, about 2,000 feet below the confluence of Faith and McManus creeks, and readings were taken twice each day by M. T. Kerrick, an employee of the Chatanika Ditch Company. The 1908 readings were made by Herman Salchow, proprietor of Faith Creek Road House.

Discharge measurements of Chatanika River near Faith Creek, 1907–1908.

Date.	Hydrographer.	Gage height.	Discharge.	Date.	Hydrographer.	Gage height.	Discharge.
1907.		*Feet.*	*Sec.-ft.*	1908.		*Feet.*	*Sec.-ft.*
July 16	C. C. Covert	1.58	51.9	May 13	C. W. McConaughy	[a]3.48	396
July 26	E. B. Brigham	1.80	80.5	May 14	do	[a]3.37	300
August 3	do	1.89	96.5	Do	do	[a]3.54	367
August 7	do	2.26	188	May 21	do	4.15	1,340
				June 26	do	1.95	130
1908.				July 12	C. C. Covert	2.05	144
May 11	C. W. McConaughy	[a]3.90	311	July 13	C. E. Ellsworth	2.15	178
May 13	do	[a]3.40	297	Do	do	2.03	119
Do	do	[a]3.40	334	August 31	C. C. Covert	2.05	142

[a] Backwater from ice jam below station.

Daily gage height and estimated discharge of Chatanika River near Faith Creek, 1907–1908.

[Elevation, 1,350 feet; drainage area, 132 square miles.]

Day.	1907.[a]						1908.							
	July.		August.		September.		May.		July.		August.		September.	
	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1			1.80	82	2.08	145						140	2.4	270
2			2.02	131	2.03	133						140	2.5	320
3			1.86	96	2.00	126						125	2.9	530
4			1.93	109	2.01	128						125	2.7	420
5			1.95	114	2.06	140						102		370
6			1.95	114	2.01	128						102	2.5	320
7			2.25	205	1.98	121						100	2.4	270
8			2.12	157	2.02	131						100	2.3	225
9			2.05	138	1.99	124						102	2.3	225
10			2.02	131	1.97	119						102	2.3	225
11			1.92	107	2.34	243	4.17	430				100	2.2	185
12			1.85	95	5.00	1,990	3.76	470				95	2.1	150
13			1.85	95	3.20	710	3.45	340	2.1	150		95	2.1	150
14			1.80	82	2.86	503	3.45	340	2.1	150		102	2.1	150
15			1.80	82	2.77	453	3.47	350	1.9	102		102	2.1	150
16			1.80	82	3.24	734	3.54	380	2.1	150		114	2.2	185
17	1.65	60	1.80	82	3.05	620	3.51	370	1.9	102	2.0	126	2.2	185
18	1.86	96	1.78	78	2.78	463	3.42	320	2.0	126	2.1	150	2.1	150
19	1.80	82	1.75	72	2.63	385	3.56	940	1.9	102	2.1	150	2.1	150
20	1.75	72	1.75	72	2.56	350	4.11	1,300	1.9	102	2.2	185	2.1	150
21	1.70	66	1.75	72	2.50	320	4.15	1,340	1.8	82	2.4	270	2.0	126
22	1.62	57	1.98	121	2.43	285			1.8	82	2.4	270	2.0	126
23	1.60	55	1.92	107	2.35	248			1.9	102	2.3	225	2.0	126
24	1.64	59	2.04	136	2.31	230			2.0	126	2.2	185	2.1	150
25	1.75	72	2.22	193	2.29	221			2.0	126	2.0	126	2.3	225
26	1.85	95	2.25	205	2.29	221			2.0	126	2.0	126	2.2	185
27	1.75	72	2.15	168	2.30	225				150	2.0	126	2.1	150
28	1.67	62	2.13	161	2.34	243				175	2.1	150	2.1	150
29	1.65	60	2.25	205	2.42	280				200	2.1	150	2.0	126
30	1.60	55	2.25	205	2.36	252				180	2.1	150	(b)	102
31	1.60	55		171						150	2.0	126		
Mean		67.8		125		342		598		131		137		208
Mean per square mile		.514		.947		2.59		4.53		.992		1.04		1.58
Run-off, depth in inches		.28		1.09		2.89		1.85		.70		1.20		1.76

[a] Revised from 1908 curve.

[b] The river was frozen after September 30, 1908.

CHATANIKA RIVER BELOW POKER CREEK.

A gaging station was established on Chatanika River below Poker Creek June 20, 1907. A post gage driven firmly in the ground near the log chute of the Cleary Creek Lumber Company's mill was read twice each day by J. Fitzsimmons.

Discharge measurements of Chatanika River below Poker Creek, 1907–1908.

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
1907.	*Feet.*	*Sec.-ft.*	1908.	*Feet.*	*Sec.-ft.*
June 22	1.08	246	August 8	0.95	207
July 4	.83	178	August 14	.90	192
August 9	1.98	669	August 22	1.85	420

Daily mean gage height and estimated discharge of Chatanika River below Poker Creek, 1907.

[Elevation 700 feet; drainage area, 456 square miles. Discharges over 1,000 second-feet are approximate.]

Day.	June.		July.		August.		September.		October.	
	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1			0.9	192	2.1	752	1.45	384	2.25	860
2			.9	192	2.6	1,160	1.4	363	2.0	680
3			.9	192	2.0	680	1.3	321	1.85	590
4			.8	167	1.75	530	1.3	321	1.75	530
5			.8	167	1.75	530	1.25	300	1.70	505
6			.8	167	1.65	480	1.3	321	1.65	480
7			.8	167	1.5	405	1.3	321	1.6	455
8			.95	204	1.75	530	1.3	321	1.45	384
9			.85	180	1.9	620	1.45	384	1.25	300
10			.8	167	1.85	590	1.3	321	1.05	232
11			.9	192	1.6	455	1.35	342	1.45	384
12			.9	192	1.5	405	3.6	2,160	1.85	590
13			.95	204	1.35	342	4.45	3,160	1.8	560
14			.9	192	1.4	363	3.25	1,780	1.75	530
15			1.0	216	1.25	300	2.85	1,390	(a)	
16			1.05	232	1.2	283	4.0	2,620		
17			1.1	250	1.1	250	4.3	2,980		
18			1.1	250	1.1	250	2.35	942		
19			1.2	283	1.0	216	2.5	1,060		
20	1.1	250	1.15	266	1.1	250	2.3	901		
21	1.1	250	1.1	250	1.1	250	2.35	942		
22	1.1	250	1.1	250	1.0	216	2.3	901		
23	1.1	250	.95	204	1.15	266	2.25	860		
24	1.05	232	.9	192	1.2	283	2.15	788		
25	1.0	216	.9	192	1.35	342	2.0	680		
26	.9	192	1.05	232	1.55	430	2.0	680		
27	.9	192	1.1	250	1.3	321	2.0	680		
28	1.0	216	1.1	250	1.4	363	2.0	680		
29	1.1	250	1.1	250	1.55	430	2.15	788		
30	1.0	216	1.0	216	1.7	505	2.35	942		
31			.9	192	1.6	455				
Mean		228		211		428		954		506
Mean per square mile		.500		.463		.939		2.09		1.11
Run-off, depth in inches		.20		.53		1.08		2.33		.68

[a] The river was frozen over after October 14.

Daily mean gage height and estimated discharge of Chatanika River below Poker Creek, 1908.

[Elevation, 700 feet; drainage area, 456 square miles. Discharges over 1,000 second-feet are approximate.]

Day.	May.		June.		July.		August.		September.		October.	
	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1			3.7	2,280	1.4	363	1.15	266	1.3	321	1.15	266
2			3.3	1,830	1.35	342	1.15	266	1.45	384	1.25	300
3			3.05	1,580	1.15	266	1.15	266	2.1	752	1.35	342
4			2.6	1,160	1.85	590	1.05	232	2.6	1,160	1.2	283
5			2.9	1,430	1.55	430	1.05	232	2.35	942	1.15	266
6			3.65	2,220	1.45	384	.95	204	2.1	752	1.05	232
7			2.6	1,160	1.45	384	.95	204	1.95	650	1.05	232
8			2.6	1,160	1.5	405	.95	204	1.8	560	1.15	266
9			2.2	824	2.35	942	1.0	216	1.75	530	1.0	216
10			1.95	650	1.8	560	1.0	216	1.6	455	.95	204
11			2.15	788	1.45	384	.95	204	1.55	430	1.05	232
12			2.35	942	1.35	342	.95	204	1.5	405	1.05	232
13			2.95	1,480	1.35	342	.9	192	1.45	384	1.0	216
14			2.9	1,430	1.25	300	.9	192	1.35	342	.95	204
15			3.25	1,780	1.2	283	.95	204	1.25	300	.85	179
16	4.35	3,040	2.5	1,060	1.2	283	1.05	232	1.35	342	.85	179
17	4.55	3,280	2.65	1,200	1.35	342	1.2	283	1.4	363	1.0	216
18	4.5	3,220	2.45	1,020	1.25	300	1.35	342	1.5	405	1.05	232
19	4.6	3,340	2.2	824	1.2	283	1.4	363	1.8	560	1.05	232
20	4.6	3,340	2.05	716	1.1	250	1.5	405	1.7	505	1.0	216
21	5.25	4,120	1.95	650	.95	204	1.6	455	1.5	405	.85	179
22	4.75	3,520	1.8	560	.95	204	1.6	455	1.45	384	(a)	
23	3.55	2,110	1.6	455	.95	204	1.55	430	1.45	384		
24	4.2	2,860	1.5	405	1.0	216	1.4	363	1.3	321		
25	4.3	2,980	1.35	342	.95	204	1.35	342	1.25	300		
26	3.65	2,220	1.3	321	.95	204	1.3	321	1.25	300		
27	3.45	2,000	1.2	283	.95	204	1.25	300	1.3	321		
28	3.2	1,730	1.3	321	1.0	216	1.25	300	1.25	300		
29	3.45	2,000	1.4	363	1.2	283	1.25	300	1.15	266		
30	3.55	2,110	1.2	283	1.25	300	1.25	300	1.25	300		
31	3.35	1,890			1.2	283	1.25	300				
Mean		2,730		984		332		284		461		234
Mean per square mile		5.99		2.16		.728		.623		1.01		.513
Run-off, depth in inches		3.56		2.41		.84		.72		1.12		.40

[a] The river was frozen over after October 21.

M'MANUS CREEK.

McManus Creek, the left fork of Chatanika River, rises between the headwaters of Birch Creek, a tributary of the Yukon, and the west fork of the Chena, a tributary of the Tanana. The ridges that surround it have a general elevation of about 3,000 feet. Its principal tributaries are Montana and Idaho creeks from the north, and Smith Creek which enters from the south near its mouth. Pool Creek is tributary to Smith Creek. One or two possible reservoir sites are found in this basin, but they are not as favorable as those on Faith Creek.

A gaging weir was established on McManus Creek near its mouth June 20, 1907, by the Chatanika Ditch Company, and records were kept until the weir was washed out on September 5. A number of miscellaneous measurements were also made.

Daily estimated discharge, in second-feet, of McManus Creek near mouth, 1907.

[Elevation, 1,375 feet; drainage area, 80 square miles.]

Day.	June.	July.	Aug.	Sept.	Day.	June.	July.	Aug.	Sept.
1		21.6	81.2	71.5	20	34.8	31.6	33.6	
2		20.1	80.8	62.8	21	34.8	26.0	32.2	
3		19.0	56.1	57.8	22	31.2	21.2	68.7	
4		18.5	51.2	57.2	23	34.8	17.8	50.3	
5		17.8	63.4		24	25.0	21.4	67.1	
6		16.1	60.6		25	21.7	19.1	81.2	
7		17.5	98.6		26	25.0	38.6	102.0	
8		17.8	84.3		27	24.3	29.1	92.6	
9		15.8	75.6		28	31.1	23.9	91.2	
10		15.0	77.8		29	26.0	21.8	114.0	
11		16.1	62.2		30	23.2	18.8	112.0	
12		15.0	49.8		31		16.7	94.1	
13		15.4	45.5						
14		17.8	40.0		Mean	28.5	21.4	66.4	
15		18.5	37.2		Mean per square				
16		19.0	42.4		mile	.356	.268	.830	
17		21.6	39.0		Run-off, depth				
18		34.7	37.4		in inches	.15	.31	.96	
19		40.0	34.7						

NOTE.—These discharges were measured by weir, and were furnished by the Chatanika Ditch Company.

Miscellaneous measurements in McManus Creek drainage basin, 1907–1908.

Date.	Point of measurement.	Elevation.[a]	Drainage area.	Discharge.	Discharge per square mile.
1907.		*Feet.*	*Sq. miles.*	*Sec.-ft.*	*Sec.-ft.*
July 10	McManus Creek at mouth	1,375	80	15.6	0.195
Do	do	1,375	80	16.4	.205
July 12	McManus Creek above Smith Creek	1,400	42.8	10.2	.243
Do	Smith Creek near mouth	1,400	34	7.8	.229
Do	McManus Creek at mouth	1,375	80	15.6	.192
July 13	McManus Creek ¾ mile above Montana Creek.	2,000	8	1.8	.162
Do	McManus Creek below Montana Creek.	1,975	10	3.8	.380
Do	McManus Creek 1½ miles below Idaho Creek.	1,800	26	6.5	.250
Do	McManus Creek ½ mile above mouth	1,390		[b]21.4	
July 14	McManus Creek 500 feet above Smith Creek.	1,400	42	12.4	.296
Do	Smith Creek near mouth	1,400	34	8.7	.256
Do	Smith Creek above Pool Creek	1,450	17	5.4	.323
Do	Pool Creek above mouth	1,450	14	2.4	.172
Do	McManus Creek above mouth	1,380		[b]19.4	
1908.					
July 14	McManus Creek at mouth	1,375	80	59.0	.738
Do	McManus Creek 500 feet above Smith Creek.	1,400	42	36.0	.858
July 12	Smith Creek below Pool Creek	1,400	34	33.8	.994
July 13	do	1,400	34	27.4	.806
July 14	do	1,400	34	22.7	.668
July 13	Smith Creek above Pool Creek	1,450	17	11.0	.647
July 14	do	1,450	17	9.3	.547
August 30	do	1,450	17	14.2	.835
September 1	do	1,450	17	20.5	1.21
July 12	Pool Creek at mouth	1,450	14	15.4	1.10
July 13	do	1,450	14	11.0	.786
July 14	do	1,450	14	12.3	.878

[a] Taken from topographic map of Fairbanks quadrangle; approximate only.
[b] Measurement approximate.

FAITH CREEK.

Faith Creek, the right fork of Chatanika River, has its source in the southeasterly slope of the high ridges separating the Beaver and Birch Creek drainage basin from that of the Chatanika. It occupies a rather narrow, irregular valley, very steep in its upper course, and drains an area of 51 square miles.

In the upper portion of the valley considerable ice remains as late as the middle of July, especially in Charity Creek. Below the mouth of Deep Creek, a tributary from the right in the lower valley, there is a favorable reservoir site and with a dam of moderate size a considerable amount of the flood waters could be stored.

The Chatanika Ditch Company established a gaging weir at the mouth of Faith Creek in 1907, and daily records were kept subsequent to June 21.

Daily estimated discharge, in second-feet, of Faith Creek near mouth, 1907.

[Elevation, 1,375 feet; drainage area, 51 square miles.]

Day.	June.	July.	Aug.	Sept.	Day.	June.	July.	Aug.	Sept.
1		32.6	36.4	59.0	20	44.7	43.9	27.8	
2		28.5	41.1	52.5	21	44.7	38.6	26.9	
3		26.4	35.9	50.2	22	42.8	31.4	44.2	
4		24.8	34.7	66.4	23	39.3	25.5	39.4	
5		22.1	42.5		24	38.8	28.8	49.8	
6		21.6	40.6		25	35.3	26.4	62.8	
7		22.0	87.4		26	36.5	61.0	82.6	
8		20.8	62.7		27	34.4	42.0	69.3	
9		20.1	52.4		28	45.9	28.4	62.6	
10		19.2	44.2		29	43.6	30.6	70.5	
11		21.0	39.0		30	36.8	26.7	72.5	
12		20.5	35.0		31		25.0	67.8	
13		20.1	42.8						
14		21.0	35.6		Mean	40.5	29.2	47.5	
15		20.9	33.6		Mean per square mile	.795	.572	.932	
16		21.7	34.4						
17		35.3	30.8		Run-off, depth in inches	.32	.66	1.07	
18		35.0	30.6						
19		62.5	28.5						

NOTE.—These discharges were measured by weir, and were furnished by the Chatanika Ditch Company.

Miscellaneous measurements in Faith Creek drainage basin, 1907-1908.

Date.	Point of measurement.	Elevation.	Drainage area.	Discharge.	Discharge per square mile.
		Feet.	*Sq. miles.*	*Sec.-ft.*	*Sec.-ft.*
1907.					
July 11	Hope Creek near Zephyr Creek			7.7	0.42
Do	Charity Creek near mouth			5.7	.76
1908.					
July 12	Faith Creek near mouth	1,375	51	66.9	1.31
July 13	do	1,375	51	77.7	1.52
July 14	do	1,375	51	67.7	1.33

KOKOMO CREEK.

Kokomo Creek, a tributary to Chatanika River from the left, about 28 miles below Faith Creek, rises in the high ridge at the head of Miller and Elliot creeks and flows northward, draining an area of 33 square miles. Daily readings were taken from a reference point in a large stump on the river bank above Alder Creek and about 1 mile above the mouth of the stream.

Discharge measurements of Kokomo Creek near mouth, 1907.

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
July 9	−3.00	13.9
August 14	−2.70	22.7

Daily gage height and estimated discharge of Kokomo Creek near mouth, 1907.

[Elevation, 750 feet; drainage, area 26 square miles.]

Day.	July. Gage height.	July. Discharge.	August. Gage height.	August. Discharge.	Day.	July. Gage height.	July. Discharge.	August. Gage height.	August. Discharge.
	Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*		*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1			+0.9	112	19	−3.0	13.9		
2			−1.2	68	20	−3.0	13.9		
3			−2.0	43.8	21	−3.0	13.9		
4			−2.2	37.9	22	−3.1	10.9		
5			−2.4	31.8	23	−3.2	7.9		
6			−2.4	31.8	24	−3.0	13.9		
7			−2.3	34.8	25	−3.1	1.09		
8			−2.4	31.8	26	−3.0	13.9		
9	−3.0	13.9	−2.0	43.8	27	−3.0	13.9		
10	−3.1	10.9	−2.2	37.9	28	−3.0	13.9		
11	−2.6	25.8	−2.4	31.8	29	−3.1	10.9		
12	−2.8	19.8	−2.5	28.9	30	−3.2	7.9		
13	−2.8	19.8	−2.6	25.8	31	−3.2	7.9		
14	−2.9	16.8	−2.7	22.7					
15	−2.9	16.8			Mean		14.2		41.6
16	−2.9	16.8			Mean per square mile		.546		1.60
17	−3.0	13.9			Run-off, depth in inches		.47		.83
18	−2.8	19.8							

POKER CREEK.

Poker Creek, with its tributary, Caribou Creek, rises in the high, barren ridges about Poker Dome and opposite the headwaters of Ophir, Trail, and Washington creeks. It drains an oval-shaped area of 40.5 square miles, well covered with timber, and has steep precipitous slopes in its upper course.

The Tanana Electric Company has constructed a ditch line along the left bank of Poker Creek, following approximately the 800-foot contour. This ditch diverts water from Poker, Little Poker, and Caribou creeks to a point on the Chatanika, where about 80 feet head is obtained. A power plant was installed at this point, in 1908, and is run by water when available, and by steam at other times.

Discharge measurements in Poker Creek drainage basin, 1907–1908.

Date.	Point of measurement.	Drainage area.	Gage height.	Discharge.	Discharge per square mile.
		Sq. miles.	*Feet.*	*Sec.-ft.*	*Sec.-ft.*
1907.					
July 27	Poker Creek near mouth	40	1.09	22.3	0.558
July 30	do	40	1.10	22.6	.565
August 9	do	40	1.32	36.6	.915
August 10	do	40	1.33	37.8	.944
Do	Caribou Creek above Little Poker Creek			10.4	
Do	Little Poker Creek near mouth			3.9	
Do	Poker Creek at elevation 800 feet	18.1		21.1	1.17
1908.					
August 14	do	18.1		9.3	.514
Do	Little Poker and Caribou Creek ditch			6.2	

CLEARY CREEK.

Cleary Creek heads to the north of Pedro Dome in a rather low saddle which separates its waters from those of Eldorado Creek and which has an elevation of about 1,800 feet. The creek flows in a northerly direction for about 3 miles, then, by a gradual curve to the left, takes a northwesterly course to Chatanika River, to which it is tributary from the left about 2 miles below Poker Creek.

The creek has an average slope of about 90 feet to the mile through the mining section. It is considered the best producer in the camp. (See Pl. III.) The pay streak follows the creek channel closely about to claim 15 below. At that point it swings to the left bank, which it follows to the Chatanika flats.

Cleary Creek has a drainage area of 10.5 square miles above its mouth.

Discharge measurements in Cleary Creek drainage basin, 1907–1908.

Date.	Point of measurement.	Drainage area.	Discharge.	Discharge per square mile.
		Sq. miles.	*Sec.-ft.*	*Sec.-ft.*
1907.				
July 4	Cleary Creek near Cleary		2.9	
1908.				
July 23	Cleary Creek above Wolf Creek	3.4	1.6	0.471
Do	Chatham Creek at mouth	3.0	1.3	.433
Do	Wolf Creek at mouth	3.8	.91	.240

ELDORADO CREEK.

Eldorado Creek rises on the western slope of Pedro Dome and drains a rather narrow valley between Cleary and Dome creeks. It has a steep slope in its upper portion. The average fall of the creek through the mining section is 115 feet per mile. It is about 5 miles long and drains an area of 13.7 square miles. The creek flows in a narrow, rather deep-cut channel, well lined with willows.

The pay streak is on the right bank and is located from claim 7 above to claim 4 below. Bed rock ranges from 90 to 122 feet below

MINING OPERATIONS ON CLEARY CREEK.

the surface, with 10 to 80 feet of gravel. The following measurement was made June 26, 1907: Discharge, 0.45 second-foot; elevation, 930 feet; drainage area, 4 square miles; discharge, 0.112 second-foot per square mile.

DOME CREEK.

Dome Creek rises in the Chatanika divide, opposite Steamboat and Flume creeks, and flows northward into Chatanika River. It is about 5 miles long and drains an area of 13.9 square miles. The creek has an average grade through the mining section of about 70 feet to the mile and good values are found in its upper and lower courses. Discovery claim is located on the right bank near the town of Dome. The creek is being worked on several claims from 7 above to 20 below. The pay streak is on the right bank for practically its entire length. Bed rock ranges from 40 feet below the surface in the upper portion of the drainage area to more than 200 feet below in the Chatanika flats, near the mouth of the stream. Very little water flows in the main channel during the low-water period, a large part of the flow being diverted by numerous small ditches. A measurement, made June 27, 1907, in a ditch near claim 2 below, gave an approximate discharge of 0.84 second-foot.

MISCELLANEOUS MEASUREMENTS.

Measurements were made of a number of small streams tributary to Chatanika River. Sourdough enters the river from the north about 3 miles below Faith Creek. Flat Creek is a small tributary from the south. Boston, Mackay, Belle, and Crooked creeks rise in the high ridge that separates their basins from the basin of Ophir Creek, a tributary of Beaver Creek, and enter the Chatanika from the north, about 25 miles below Faith Creek. They are 4 to 6 miles long and very steep, with deep, narrow valleys. Murphy Creek enters the river from the south near the lower end of the Chatanika flats.

Miscellaneous measurements in Chatanika River drainage basin, 1907–1908.

Date.	Point of measurement.	Elevation.	Drainage area.	Discharge.	Discharge per square mile.
1907.		*Feet.*	*Sq. miles.*	*Sec-ft.*	*Sec.-ft.*
August 15	Boston Creek	800	6.5	3.9	0.600
Do	Mackay Creek	800	6.2	3.7	.596
Do	Crooked Creek	800	7.2	6.3	.875
Do	Belle Creek	800	11.2	10.	.909
1908.					
August 9	.....do	1,200	3.0	1.4	.467
July 13	Sourdough Creek near mouth		15.9	22.5	1.42
July 15	Flat Creek below 3d Pup		7.0	2.8	.400
August 29	.....do		7.0	3.7	.529
July 26	Murphy Creek above McCloud Creek		17.0	1.7	.100
August 20	.....do		17.0	1.3	.076
August 26	Chatanika River below Murphy Creek		814	263	.323

GOLDSTREAM CREEK DRAINAGE BASIN.

GENERAL DESCRIPTION.

Goldstream Creek flows southwestward, in a narrow, winding course, between the drainage basin of Chatanika River on the right and the Little Chena and Tanana basins on the left, paralleling Chatanika River, which it enters from the east, and draining the central portion of the Fairbanks mining district. It is about 70 miles long and it drains an area of about 500 square miles. About 40 miles below its source it leaves the dividing ridges and for the remainder of its course to the Chatanika flows in a zigzag channel across the soft, mucky flats northwest of Tanana River. The stream bed is sandy and shifting, and the channel is deeply cut in the alluvial soil that forms the bottom lands.

The dividing ridges rise about 1,000 feet above the stream bed and are well timbered with spruce and birch. On each side of the stream is a narrow lowland, with a gradual slope upward toward the ridges. This lowland is everywhere covered with the common moss, and where the valley widens, in its lower portion, lakes and swamps are numerous. The bottom land was once well covered with timber, but this has been removed to make way for the railroad and mining enterprises. About 12 miles below the source of the river the southern ridge is broken by a low saddle, over which the Tanana Valley Railroad from Fairbanks enters the mining district.

The upper portion of the valley is drained by Pedro and Gilmore creeks, which unite to form Goldstream Creek near Gilmore, about 12 miles north of Fairbanks.

Along Pedro Creek the pay streak follows the stream channel closely and bed rock is from 10 to 30 feet below the surface. On Goldstream Creek the pay streak is along the right bank to about claim 10 below and then swings to the left bank, which it follows to about claim 22 below. Farther than this it has not been definitely located. The depth to bed rock ranges from 20 to 60 feet.

Gilmore Creek, the left fork of Goldstream Creek, has shown small values and very little work is in progress. The creek has a fairly good grade and drains an area of 11.8 square miles.

Goldstream Creek receives numerous small tributaries from both sides. From the right come Fox, Gold Run, Big Eldorado, O'Connor, and Cache creeks; from the left, Engineer, Butter, Spear, Nugget, Straight, and Allen creeks. Prospecting and more or less mining is done on nearly all these creeks. They are from 4 to 12 miles long and drain small areas.

On the upper portion of Goldstream Creek and along Pedro Creek several small ditches have been built to divert water for sluicing. The largest ditch is owned by the Goldstream Ditch Company and its construction cost about $6,500. It is about 2 miles long and has a fall of about 7 feet to the mile. It diverts water from claim 6 below, along the left bank of Goldstream Creek, and supplies several mines at the rate of $2 per hour per sluice head, which ranges from 60 to 80 miner's inches of water. A measurement made June 28, 1907, in the lower end of a flume near the intake to this ditch gave a discharge of 10.8 second-feet. A short extension was made to this ditch in 1908 and it now supplies water to mines as far as claim 16 below.

GOLDSTREAM CREEK AT CLAIM 6 BELOW.

A good location for a gaging station could not be found on Goldstream Creek because of the unfavorable condition of the channel and the numerous small ditches that divert the flow. A gage was established, however, near the lower line of claim 6 below, a short distance above the intake to the Goldstream ditch, June 20, 1907, and was read twice each day by John L. Meder. The water diverted by a small ditch a short distance above the gaging station is not considered in the table of estimates. Several measurements made in this ditch gave an average discharge of 1.5 second-feet.

Discharge measurements of Goldstream Creek at claim 6 below, 1907.

Date.	Width.	Area of section.	Gage height.	Discharge.
	Feet.	*Sq. ft.*	*Feet.*	*Sec.-feet.*
June 21	11.3	8.1	1.00	10.8
June 28	12.4	10.3	1.31	21.1

Daily mean gage height and estimated discharge of Goldstream Creek at claim 6 below, 1907.

[Elevation, 870 feet; drainage area, 28.6 square miles.]

Day.	June.		July.		August.		September.		October.	
	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1			1.3	20.7	1.55	30.2	1.25	18.9	1.3	20.7
2			1.05	12.3	1.6	32.2	1.20	17.1	1.3	20.7
3			1.0	10.8	1.3	20.7	1.20	17.1	1.4	24.4
4			.95	9.3	1.15	15.4	1.25	18.9	1.3	20.7
5			.8	4.9	1.1	13.8	1.30	20.7	1.3	20.7
6			.75	3.6	1.15	15.4	1.2	17.1	1.3	20.7
7			1.15	15.4	1.4	24.4	1.2	17.1	1.2	17.1
8			1.05	12.3	1.45	26.3	1.15	15.4		
9			1.0	10.8	1.35	22.5	1.2	17.1		
10			.85	6.4	1.6	32.2	1.15	15.4		
11			1.6	32.2	1.45	26.3	1.35	22.5		
12			1.55	30.2	1.15	15.4	1.7	36.6		
13			1.2	17.1	1.1	13.8	1.7	36.6		
14			1.1	13.8	1.05	12.3	1.5	28.2		
15			1.65	34.4	1.05	12.3	1.5	28.2		

Daily mean gage height and estimated discharge of Goldstream Creek at claim 6 below, 1907—Continued.

Day.	June.		July.		August.		September.		October.	
	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
16			1.5	28.2	1.1	13.8	1.8	41		
17			1.25	18.9	1.0	10.8	1.55	30.2		
18			1.15	15.4	1.0	10.8	1.45	26.3		
19			1.05	12.3	1.0	10.8	1.3	20.7		
20	1.0	10.8	1.05	12.3	1.1	13.8	1.6	32.2		
21	1.0	10.8	1.0	10.8	1.25	18.9	1.45	26.3		
22	.95	9.3	.95	9.3	1.3	20.7	1.4	24.4		
23	.8	4.9	.9	7.8	1.3	20.7	1.55	30.2		
24	.9	7.8	1.05	12.3	1.3	20.7	1.45	26.3		
25	.9	7.8	.95	9.3	1.25	18.9	1.4	24.4		
26	1.05	12.3	.95	9.3	1.35	22.5	1.4	24.4		
27	.85	6.4	.85	6.4	1.3	20.7	1.3	20.7		
28	1.3	20.7	.85	6.4	1.35	22.5	1.25	18.9		
29	1.55	30.2	.8	4.9	1.45	26.3	1.35	22.5		
30	1.45	26.3	.8	4.9	1.5	28.2	1.4	24.4		
31			.7	2.2	1.5	28.2				
Mean		13.4		13.1		20.0		24.0		20.7
Mean square mile		.469		.458		.699		.839		.724
Run-off, depth in inches		.192		.53		.81		.94		.19

NOTE.—These discharges do not include the amount diverted at claim 3 below by a small ditch, carrying from 1 to 1.5 second-feet. The creek was frozen after October 7.

PEDRO CREEK.

Pedro Creek, the right fork of Goldstream Creek, is about 6 miles long and has a fall of 100 to 200 feet to the mile in its upper course. About 3 miles from its source Twin Creek, a tributary from the right, enters. Here in 1902 gold was first found in the Fairbanks district by Felix Pedro. Below this point the creek has a grade of about 80 feet to the mile, which gradually lessens as it approaches Goldstream Creek. The following measurement was made at claim 1 above July 22, 1908: Discharge, 3.2 second-feet; drainage area, 6.3 square miles; discharge per square mile, 0.508 second-foot.

FOX CREEK.

Fox Creek rises in the Chatanika divide opposite Vault Creek. It is about 3½ miles long and flows southward through a V-shaped valley into Goldstream Creek. Considerable mining activity was under way in 1908. The following measurements were made at elevation 900 feet: July 6, 1907, 2.0 second-feet; August 24, 1908, 0.43 second-foot.

WASHINGTON CREEK DRAINAGE BASIN.

GENERAL DESCRIPTION.

Washington Creek rises in the southern slope of the dividing ridge south of Beaver Creek drainage, and flows southwestward into Tatalina River about 12 miles above the confluence of that stream with the Tolovana. It parallels the Chatanika, from which it is separated at a distance of about 6 miles, by a high dividing ridge. The creek is about 35 miles long and drains an area of 198 square miles. It is shown on the reconnaissance map of the Fairbanks quadrangle.

The valley is long and narrow, is well timbered, and is bordered on each side by high ridges, portions of which are from 1,200 to 1,800 feet above the stream bed.

Late in the fall of 1907 rumors of a strike on Washington Creek attracted some attention and during the winter of 1907–8 considerable work was done on this creek, not only in prospecting, but in staking new ground. The summer of 1908 found the creek staked from its headwaters to within a few miles of its mouth.

Aggie Creek, which enters Washington Creek about 12 miles above its mouth, is its only important tributary. This stream is about 12 miles long and drains an area of 35.8 square miles.

A fall of about 200 feet in 8 miles on Washington Creek below Aggie Creek affords opportunity for power development. In 1908 the break-up on Washington Creek occurred about May 5, but there was considerable ice in the stream until after May 9, and the water could not have been used in a diverting ditch until about May 20.

WASHINGTON CREEK ABOVE AGGIE CREEK.

This station was established May 23, 1908, about 500 feet above the mouth of Aggie Creek, on the left-hand side of the stream. The gage, known as gage No. 2, was fastened to a wooden trestle under the footbridge constructed for high-water measurements. The bench mark is the top of a stake about 6 inches above ground, 10 feet from low-water mark on the left-hand side of the stream, and 4 feet above gage datum.

Discharge measurements of Washington Creek above Aggie Creek, 1908.

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-feet.*		*Feet.*	*Sec.-feet.*
May 23	3.65	311.0	July 28	2.10	19.3
May 24	3.60	304.0	August 19	2.10	17.3
July 27	2.08	18.2			

Daily mean gage height and estimated discharge of Washington Creek above Aggie Creek, 1908.

[Elevation, 600 feet; drainage area, 117 square miles.]

Day.	May.		June.		July.		August.		September.	
	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1			3.45	266		45	2.15	22	2.25	30
2			3.22	203		45	2.18	24	2.32	38
3			3.00	146		45	2.25	30	2.58	67
4			2.95	135	2.40	45	2.20	26	2.80	104
5			2.82	109	2.40	45	2.20	26		
6			3.38	245	2.35	40	2.18	24		
7			3.38	245	2.40	45	2.15	22		
8			3.08	163	2.50	57	2.15	22		
9			2.90	124	2.55	63	2.15	22		
10			2.68	82	2.45	51	2.15	22		
11			2.55	63	2.38	43	2.15	22		
12			2.48	54	2.32	37	2.15	22		
13			2.62	74	2.20	26	2.15	22		
14			2.62	74	2.20	26	2.15	22		
15			4.50	557	2.25	30	2.15	22		
16			3.75	342	2.20	26	2.15	22		
17			3.32	231	2.20	26	2.15	22		
18			3.00	146	2.22	28	2.20	26		
19			3.20	196	2.22	28	2.15	22		
20			3.22	203	2.20	26	2.22	28		
21			3.10	170	2.20	26	2.20	26		
22			3.78	359	2.18	24	2.22	28		
23	3.65	316	3.12	176	2.10	18	2.22	28		
24	3.65	316	2.82	109	2.15	22	2.20	26		
25	3.45	266	2.60	70	2.15	22	2.15	22		
26	3.20	196	2.40	45	2.15	22	2.20	26		
27	3.15	183	2.42	48	2.15	22	2.20	26		
28	3.35	236		48	2.20	26	2.20	26		
29	3.50	278		48	2.22	28	2.25	30		
30	4.00	408		48	2.15	22	2.25	30		
31	3.75	342			2.15	22	2.20	26		
Mean		282		159		33.2		24.6		59.8
Mean per square mile		2.41		1.36		.284		.210		.512
Run-off, depth in inches		.81		1.52		.33		.24		.08

WASHINGTON CREEK BELOW AGGIE CREEK.

This station was established May 5, 1908, by E. J. Burger for Martin Harrais, manager of the Chena Lumber and Light Company, of Chena, to determine the possibility of using the stream for the development of power. Gage No. 1, first installed, was replaced May 24 by gage No. 4, which is located about 500 feet below the mouth of Aggie Creek, on the left bank, and is referred to a spike driven in a notch cut at the base of the stream side of a cottonwood tree about 10 inches in diameter and 10 feet back from the edge of the bank; the top of the spike is 9.9 feet above the gage datum.

Theoretically the discharge at gage No. 4 should represent the totals at Nos. 2 and 3, but this is not always the case, for during high water a small stream from the left bank discharges between the gages, and in the low-water period there is more or less seepage through the gravel. The records check very closely, however, and probably give very nearly the actual discharge of the creek during the season.

Discharge measurements of Washington Creek below Aggie Creek, 1908.

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-feet.*		*Feet.*	*Sec.-feet.*
May 23	3.30	419	July 28	1.85	27.0
May 24	3.35	440	August 18	1.80	25.9
July 27	1.80	25.8	August 19	1.80	25.6

Daily mean gage height and estimated discharge of Washington Creek below Aggie Creek, 1908.

[Elevation, 600 feet; drainage area, 147 square miles.]

Day.	May.[a]		June.		July.		August.		September.	
	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1			3.12	332		53	1.80	28	1.95	38
2			3.00	284		53	1.84	31	2.06	49
3			2.75	185		53	1.92	37	2.32	82
4			2.70	166	2.10	52	1.86	33	2.55	124
5		840	2.62	141	2.10	52	1.85	32		
6		720	2.98	279	2.05	48	1.80	28		
7		760	2.96	274	2.11	53	1.80	28		
8		880	2.78	194	2.24	69	1.80	28		
9		920	2.64	149	2.30	88	1.80	28		
10		1,200	2.45	104	2.18	61	1.80	28		
11		760	2.32	80	2.18	61	1.80	28		
12		688	2.25	70	2.05	48	1.80	28		
13		1,120	2.38	89	1.86	33	1.80	28		
14		1,160	2.42	98	1.85	32	1.80	28		
15		1,400	3.66	600	1.92	37	1.80	28		
16		1,280	3.18	360	1.87	34	1.80	28		
17		1,240	2.91	246	1.87	34	1.80	28		
18		1,160	2.68	160	1.91	36	1.85	32		
19		1,040	2.82	210	1.91	36	1.80	28		
20		1,120	2.84	218	1.88	34	1.88	34		
21		840	2.75	185	1.85	32	1.85	32		
22		490	3.22	375	1.83	30	1.88	34		
23	3.10	328	2.76	188	1.75	24	1.88	34		
24	3.35	440	2.52	118	1.82	30	1.85	32		
25	3.18	352	2.30	77	1.81	29	1.80	28		
26	2.92	250	2.10	52	1.80	28	1.86	33		
27	2.88	234	2.15	58	1.80	28	1.86	33		
28	3.06	310		56	1.90	35	1.86	33		
29	3.20	370		56	1.90	35	1.92	37		
30	3.52	525		56	1.79	27	1.92	37		
31	3.40	465			1.78	26	1.86	33		
Mean		774		182		41.3		30.8		73.1
Mean per square mile		5.26		1.23		.281		.210		.498
Run-off, depth in inches		5.28		1.37		.324		.24		.07

[a] Discharges from May 5 to 22, inclusive, are based on readings from gage No. 1, and on account of unfavorable channel conditions are approximate.

AGGIE CREEK AT MOUTH.

This station was established May 23, 1908. The gage, known as "gage No. 3," is located on the right bank about 1,000 feet above the mouth of the stream. It is referred to a spike driven in the top of a stump about 5 feet farther downstream on the same side; the top of the spike is 6.10 feet above the datum of the gage.

Discharge measurements of Aggie Creek at mouth, 1908.

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-feet.*		*Feet.*	*Sec.-feet.*
May 23	2.92	108.0	July 28	1.09	8.8
May 24	3.29	136.0	August 19	.90	7.0
July 27	.95	6.3			

Daily mean gage height and estimated discharge of Aggie Creek at mouth, 1908.

[Elevation, 600 feet; drainage area, 35.8 square miles.]

Day.	May.		June.		July.		August.		September.	
	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1			2.30	65		7.5	.92	6.2	1.08	8.5
2			2.50	79		7.5	1.00	7.5	1.18	10.6
3			1.80	36		7.5	1.00	7.5	1.30	14.0
4			1.72	31	1.00	7.5	.98	7.0	1.35	16.0
5			1.80	36	1.00	7.5	.95	6.5		
6			1.78	34	1.02	7.8	.92	6.2		
7			1.65	28	1.05	8.0	.90	6.0		
8			1.75	34	1.17	11.0	.90	6.0		
9			1.58	24	1.30	14.0	.90	6.0		
10			1.47	20	1.07	9.5	.90	6.0		
11			1.40	17	1.10	9.0	.90	6.0		
12			1.38	16	1.02	7.8	.90	6.0		
13			1.32	14	.98	7.0	.90	6.0		
14			1.55	23	.98	7.0	.90	6.0		
15			1.90	41	.98	7.0	.90	6.0		
16			1.50	21	1.02	7.8	.90	6.0		
17			1.35	16	1.02	7.8	.90	6.0		
18			1.30	14	1.00	7.5	.90	6.0		
19			1.30	14	1.00	7.5	.90	6.0		
20			1.30	14	1.00	7.5	.90	6.0		
21			1.30	14	1.00	7.5	.90	6.0		
22			1.35	16	.95	6.5	.90	6.0		
23	2.90	107	1.17	11	.95	6.5	.90	6.0		
24	3.15	125	1.15	10	1.00	7.5	.90	6.0		
25	2.60	86	1.05	8.0	.98	7.0	.90	6.0		
26	2.06	50	1.07	8.5	.95	6.5	.95	6.5		
27	2.05	50	1.02	7.8	.95	6.5	.95	6.5		
28	2.40	72		7.8	1.05	8.0	.95	6.5		
29	2.67	91		7.8	.98	7.0	.95	6.5		
30	3.02	116		7.8	.88	5.0	.95	6.5		
31	3.12	123			.85	4.5	.95	6.5		
Mean		91.2		22.5		7.58		6.26		12.2
Mean per square mile		2.55		.629		.211		.174		.341
Run-off, depth in inches		.85		.70		.24		.20		.05

BEAVER CREEK DRAINAGE BASIN.

GENERAL DESCRIPTION.

A high limestone ridge—the White Mountains—50 miles north of Fairbanks, is perhaps the highest portion of the divide between the Yukon and Tanana drainage basins. Beaver Creek, which drains the largest part of this particular portion of the divide, has its source far back in the deep canyons of the southern slope. There are two branches of Beaver Creek in its upper drainage basin that join at about latitude 65° 25′ north, and longitude 147° west. These two branches drain the highest portion of the mountains. The southern branch rises in a high ridge opposite the tributaries of Preacher Creek. It has a steep and tortuous course, flowing over a rocky bed and through a deep valley. The northern or main branch of Beaver Creek drains to the south the central portion of the mountain ridge. The gorgelike valley of the upper portion of this branch runs in an east-west direction and forms with the main valley a letter T. The course of the northern branch is tortuous and the bed is rough and gravelly. In the valley at the junction of these two branches some timber is found, and there are also small patches of meadow land. From the junction the main stream flows westward for about 25 miles, then makes an abrupt bend to the right and flows in a northeasterly direction, draining the northern slope of the White Mountains. Its course above the "big bend" is through a rather broad, parklike valley, over a wide gravelly bed, in a series of riffles and pools. This portion of the stream, with its tributaries, drains the southern slope of the White Mountains. In many places the stream has several channels, forming numerous islands which are usually covered with a heavy growth of timber.

Bear and Bryan creeks are the important tributaries from the right. High, barren limestone ridges separate these creeks and form deep, narrow, gorgelike valleys, through which the streams flow over precipitous, narrow beds.

There is but little timber on the slopes of the mountains except in the lower course of the stream, and here the average size is smaller than that of the timber in the Chatanika and Little Chena basins.

The southern tributaries of Beaver Creek above the big bend are Nome, Ophir, Trail, and Wickersham creeks, whose upper portions drain the dividing ridge to the north of Chatanika River. These streams have more gradual slopes than the northern tributaries, and flow through rather narrow channels cut deep into the soft, alluvial soil of which their bottom lands consist. The ridges separating these creeks are at a much lower elevation than those on the northern slope.

They are covered with timber and the many small streams which drain their slopes are fed by numerous springs. The general direction of these streams, with the exception of Nome Creek, is to the northwest—a course almost opposite that of the main creek which receives their black, tranquil waters.

The upper portion of the Beaver Creek drainage basin is oval in shape and rises to an elevation of 1,800 to 4,000 feet. A portion of the easterly divide has an altitude of 5,000 feet. About 8 miles below the "big bend" Fossil Creek enters Beaver Creek from the right through a deep, narrow canyon. It drains a long, narrow, rather high valley and rises on the northern slope of Cache Mountain, which has an elevation of over 4,000 feet and separates the Fossil Creek drainage basin from that of Bryan Creek. Fossil Creek flows northward for 5 or 6 miles, makes a long, easy curve to the left, flows around the northern foothills, and finally takes a southwesterly course close to the high limestone ridge that separates it from Beaver Creek.

In the upper portion of the Fossil Creek basin, on the right-hand side, there is a marked case of stream piracy. A small stream reaches into the right-hand part of the basin and takes a portion of the drainage through a gorge of high elevation into Beaver Creek, about 12 miles below the mouth of Fossil Creek.

Victoria Creek, a tributary from the left about 20 miles below Fossil Creek, has its source nearly opposite Cache Mountain and is separated from Beaver Creek, which it parallels for about 50 miles, by a limestone ridge ranging from 1,000 to nearly 3,000 feet above the bed of the stream.

Some distance below the mouth of Victoria Creek, Beaver Creek changes its course to the left and flows in a northwesterly direction through a less mountainous country to the Yukon.

Beaver Creek has every indication of furnishing a good water supply. Its high drainage basin makes its waters desirable for either hydraulicking or power development. Although the present location of the mining camps is at a prohibitive distance for ditch lines, future developments may make valuable any information concerning the daily flow and run-off in this drainage basin.

MEASUREMENTS.

The following miscellaneous measurements were made in Beaver Creek drainage basin:

Miscellaneous measurements in Beaver Creek drainage basin, 1907–1908.

Date.	Stream and locality.	Approximate elevation.	Drainage area.	Discharge.	Discharge per square mile.
1907.		*Feet.*	*Sq. miles.*	*Sec.-ft.*	*Sec.-ft.*
August 27	Trail Creek	1,700	27	39.9	1.48
Do	Brigham Creek	1,500	15	16.0	1.06
August 28	Fossil Creek	1,300	....	19.2	....
August 29	Bryan Creek	1,800	48	75.3	1.57
August 30	Beaver Creek above East Branch	1,800	122	267	2.19
Do	East Branch Beaver Creek above mouth	1,800	67	124	1.85
Do	Nome Creek near mouth	1,700	120	135	1.12
1908.					
August 11	Beaver Creek above East Branch	1,800	122	80.3	.658
August 12	Beaver Creek above Nome Creek	1,675	226	108	.478
August 11	East Branch of Beaver Creek at mouth	1,800	67	44.3	.661
August 12	Nome Creek near mouth	1,700	120	33.6	.280
Do	Nome Creek above Ophir Creek	1,725	87	26.0	.299
Do	Ophir Creek near mouth	1,725	33	2.0	.066

THE CIRCLE DISTRICT.

DESCRIPTION OF AREA.

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

The northwest portion of the low broad plain forms the bottom lands of the Yukon Flats north of Crazy Mountains; the southeast portion occupies 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 longest diameter is east and west, occupies a position 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 Birch Creek drainage from the lower, and it 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, while below this altitude, especially in the flats where Birch and Crooked creeks join, considerable timber is found. These flats afford conditions particularly favorable to agriculture as well as to mining. At Central House, on the lower end of Deadwood Creek, and at the Hot Sulphur Springs all kinds of vegetables grow in abundance; and prospecting at the lower end of Deadwood Creek shows an extensive area of ground which seems suitable for dredging.

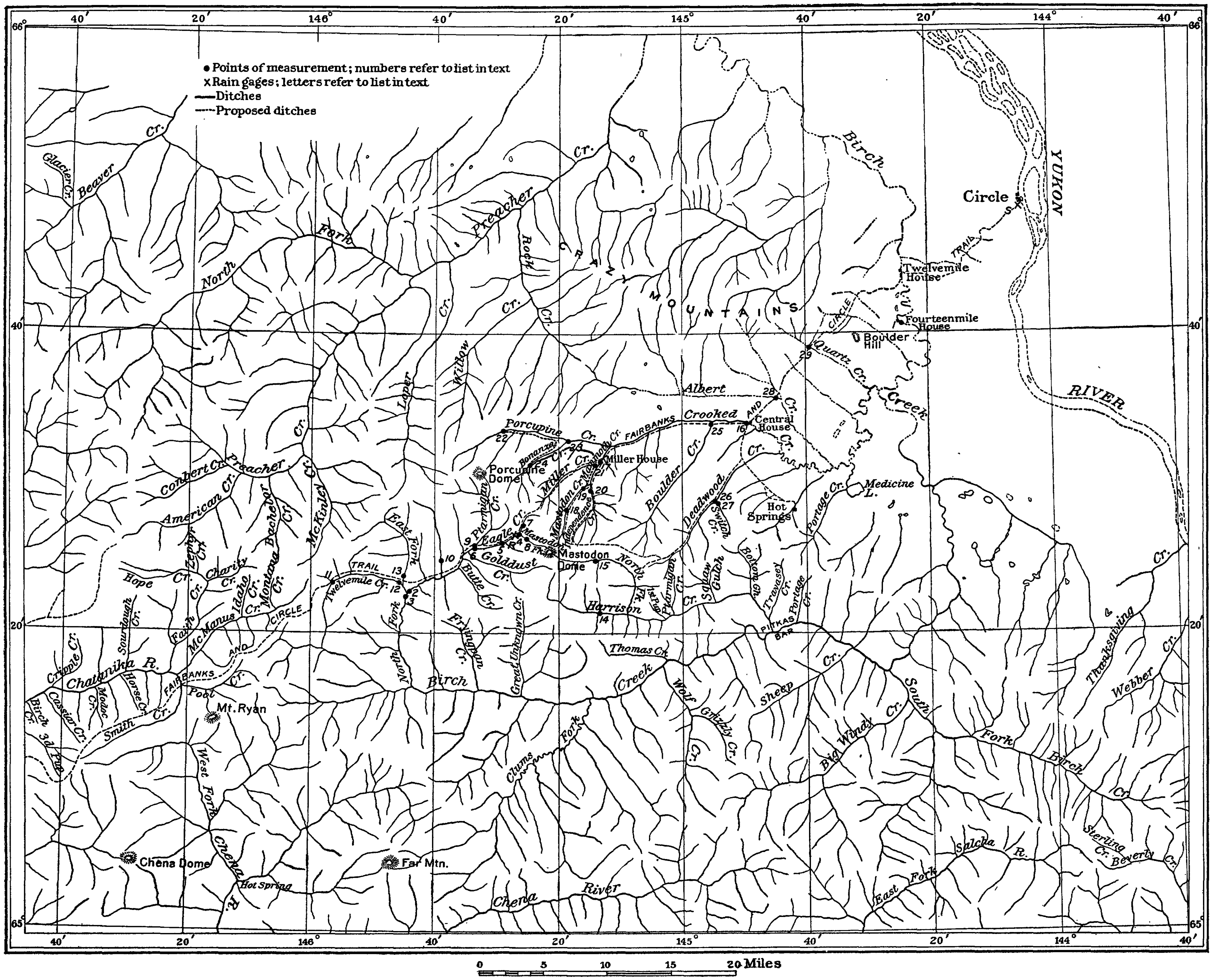
Circle, about 140 miles below Eagle, on the left bank of the Yukon, is the supply point for mines in this region, which are reached by sleds in winter and by pack train in summer. It is at Circle that the overland trail to the Fairbanks district, south of the divide, starts. In 1908 the Alaska Road Commission constructed about 20 miles of good wagon road along this trail, and expects to continue it to Miller House during the coming season.

GAGING STATIONS.

The following is a list of the points in the Circle district at which gages were established or measurements made in 1908. The numbers refer to Plate IV.

Gaging stations in Circle district, 1908.

1. Birch Creek at Fourteenmile House.
2. North Fork of Birch Creek above Twelvemile Creek and Twelvemile Creek at mouth.
3. North Fork of Birch Creek below Twelvemile Creek.
4. Eagle Creek below Mastodon Fork.
5. Eagle Creek below Cripple Creek.
6. Eagle Creek at mouth.
7. Miller Fork above ditch intake and Miller Fork ditch at intake.
8. Mastodon Fork above storage dam and Miller Fork ditch at outlet.
9. Ptarmigan Creek at mouth.
10. Tributary of North Fork of Birch Creek.
11. Twelvemile Creek at elevation of 2,500 feet.
12. Twelvemile Creek above East Fork.
13. East Fork of Twelvemile Creek near mouth.
14. Harrison Creek at elevation 2,200 feet.
15. North Fork of Harrison Creek at elevation 2,200 feet.
16. Crooked Creek at Central House.
17. Mammoth Creek at Miller House.
18. Mastodon Creek at claim 21 above.
19. Mastodon Creek at claim 1 above.
20. Independence Creek near mouth.
21. Miller Creek near mouth.
22. Porcupine Creek near proposed ditch intake.
23. Porcupine Creek below Bonanza Creek.
24. Bonanza Creek at ditch intake.
25. Boulder Creek near mouth.
26. Deadwood Creek above Switch Creek.
27. Switch Creek at mouth.
28. Albert Creek at trail crossing.
29. Quartz Creek at trail crossing.



MAP SHOWING LOCATION OF GAGING STATIONS IN CIRCLE DISTRICT.

BIRCH CREEK DRAINAGE BASIN.

GENERAL DESCRIPTION.

Birch Creek, with its tributaries, North and South forks, and their many ramifying branches, drains the southern part of the plateau country of the Circle district.

Crooked and Preacher creeks, which join Birch Creek in its lower course, drain the north slope of the ridge which separates the upper from the lower Birch Creek drainage, the Crazy Mountains, and a large portion of the broad alluvial plain. The main stream rises east of the headwaters of Chatanika River, and flows eastward to within less than 20 miles of the Yukon; it then turns to the north and flows roughly parallel to the main river to its mouth below Fort Yukon.

BIRCH CREEK AT FOURTEENMILE HOUSE.

A gaging station was established on Birch Creek at Fourteenmile House June 27, 1908. A post gage, graduated to feet and tenths and driven firmly in the ground on the left bank, was read twice each day during the remainder of the season by William Reger, road-house keeper and ferryman. Measurements are made from a ferry established by the Alaska Road Commission. Birch Creek at this point has a straight course for nearly 1,000 feet above and below the gage. The bed is gravelly and permanent. The left bank is steep and is seldom flooded except in extreme high water. The right bank is lower, somewhat timbered, and is more frequently overflowed.

Discharge measurements of Birch Creek at Fourteenmile House, 1908.

Date.	Area of section.	Mean velocity.	Gage heighth.	Discharge.
	Sq. feet.	*Ft. per sec.*	*Feet.*	*Sec.-feet.*
June 27	655	1.62	3.17	1,060
June 28	653	1.60	3.07	1,040
September 11	960	2.15	4.00	2,060
September 12	870	1.97	3.82	1,710

Daily mean gage height and estimated discharge of Birch Creek at Fourteenmile House, 1908.

[Elevation, 700 feet; drainage area, 2,150 square miles.]

Day.	June.		July.		August.		September.	
	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1			3.38	1,210	2.62	875	3.58	1,400
2			3.10	1,040	2.55	859	3.70	1,550
3			3.00	990	2.50	847	4.08	2,210
4			3.32	1,170	2.50	847	5.55	5,130
5			3.05	1,010	2.50	847	6.02	6,070
6			2.98	984	2.48	842	5.75	5,530
7			3.15	1,060	2.45	835	5.25	4,530
8			3.92	1,900	2.40	825	5.02	4,070
9			4.30	2,630	2.42	829	4.85	3,730
10			4.22	2,470	3.52	1,320	4.32	2,670

Daily mean gage height and estimated discharge of Birch Creek at Fourteenmile House, 1908—Continued.

Day.	June.		July.		August.		September.	
	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
11	....	....	3.75	1,620	3.45	1,270	4.00	2,060
12	....	....	3.45	1,270	3.25	1,120	3.88	1,830
13	....	....	3.28	1,140	3.12	1,040	3.72	1,580
14	....	....	3.12	1,040	3.00	990	3.68	1,520
15	....	....	3.02	1,000	2.92	966	3.65	1,480
16	....	....	3.02	1,000	2.90	960	3.60	1,420
17	....	....	3.10	1,040	2.85	945	3.55	1,360
18	....	....	3.05	1,010	2.88	954	3.55	1,360
19	....	....	3.00	990	2.90	960	3.62	1,440
20	....	....	2.92	966	2.95	975	3.72	1,580
21	....	....	2.82	936	3.00	990	3.62	1,440
22	....	....	2.72	906	3.18	1,080	3.52	1,320
23	....	....	2.62	875	3.70	1,550	3.35	1,190
24	....	....	2.58	867	3.55	1,360	3.18	1,080
25	....	....	2.52	852	3.45	1,270	3.08	1,030
26	3.35	1,190	2.50	847	3.45	1,270	3.00	990
27	3.20	1,090	2.62	875	3.42	1,250	2.88	954
28	3.10	1,040	2.65	885	3.35	1,190	2.78	924
29	3.08	1,020	2.62	875	3.52	1,330	2.70	900
30	3.20	1,090	2.60	872	3.82	1,620	....	....
31	....	....	2.65	885	3.68	1,520	....	....
Mean	....	1,090	....	1,140	....	1,080	....	2,150
Mean per square mile	....	.507	....	.530	....	.502	....	1.00
Run-off, depth in inches	....	.09	....	.61	....	.58	....	1.08

NOTE.—The creek was frozen after September 29.

NORTH FORK OF BIRCH CREEK.

North Fork of Birch Creek is formed by the confluence of Eagle and Ptarmigan creeks and flows southwestward through an unsymmetrical valley, flanked on both sides by high precipitous ridges, those to the north rising to an elevation of 2,000 feet to 2,500 feet above the stream bed in a distance of 5 to 6 miles.

Considerable timber, a large portion of which has reached a size suitable for milling, grows along the creek bottom. About 8 miles below Eagle Creek, North Fork turns abruptly to the left, and Twelvemile Creek, a tributary from the right, enters. The grade of these two streams above this point ranges from 75 feet to over 100 feet to the mile.

Much prospecting has been done, especially on Twelvemile Creek, where bed rock lies from 12 to 20 feet below surface, but on account of underground water very little is known of the bed rock conditions. North Fork enters Birch Creek about 8 miles below Twelvemile.

Eagle Creek is formed by the confluence of Miller and Mastodon forks, which drain the western slope of the high ridge connecting Mastodon and Porcupine domes, whose eastern drainage is carried into Miller and Mastodon creeks. The creek is about 4 miles long and, with Ptarmigan, forms the North Fork of Birch Creek. Gold was discovered on Eagle Creek in 1895, and much work has been done at its upper end and on Mastodon Fork. In 1908 Berry and Lamb completed the installation of a hydraulic plant. (See Pl. V, *A*.)

The following measurements were made of North Fork and its tributaries:

Miscellaneous measurements of North Fork of Birch Creek and tributaries, 1908.

Date.	Stream and locality.	Drainage area.	Discharge.	Discharge per square mile.
		Sq. miles.	*Sec.-ft.*	*Sec.-ft.*
July 10	North Fork of Birch Creek above Twelvemile Creek	87	87	1.00
September 4	.....do	87	191	2.20
July 9	North Fork of Birch Creek below Twelvemile Creek	132	125	.947
July 10	.....do	132	129	.977
September 6	Eagle Creek below Mastodon Fork	8.4	[a] 4.2	
July 7	Eagle Creek below Cripple Creek	12.4	10.5	.847
July 9	Eagle Creek at mouth	15.5	15.4	.994
September 5	.....do	15.5	24.7	1.59
September 6	Miller Fork of Eagle Creek above ditch intake	2.6	2.1	.808
Do	Miller Fork ditch at intake		2.8	
Do	Miller Fork ditch at outlet		1.4	
July 7	Mastodon Fork of Eagle Creek above storage dam	4.1	1.1	.268
September 6	.....do	4.1	1.3	.317
July 9	Ptarmigan Creek at mouth	19	26.2	1.38
September 5	.....do	19	24.7	1.30
July 9	Tributary of North Fork of Birch Creek from north near mouth.	11.6	20.3	1.75
July 10	Twelvemile Creek at elevation 2,500 feet	1.6	6.3	3.94
July 11	.....do	1.6	6.0	3.75
Do	Twelvemile Creek above East Fork	18.9	15.6	.825
Do	Twelvemile Creek at mouth	44.5	38	.855
September 4	.....do	44.5	73.3	1.64
July 10	East Fork Twelvemile Creek near mouth	22.9	24.4	1.07
September 4	.....do	22.9	23.9	1.04

[a] Some water was diverted past section in the ditch from Miller and Mastodon forks; this measurement shows the seepage from the diversion dams and ditch.

HARRISON CREEK.

Harrison Creek, tributary to Birch Creek from the north near the junction of the South Fork, drains a narrow, irregular, V-shaped valley south of the divide at the head of Independence, Boulder, and Deadwood creeks. The North Fork of this stream, which heads against Mastodon Dome, was the scene of the first hydraulicking in the Birch Creek region, though on account of miscalculations the venture proved a failure.

The following measurements were made on this stream in 1908: July 8, Harrison Creek, elevation, 2,200 feet; discharge, 4.9 second-feet; drainage area, 17.9 square miles; discharge, 0.274 second-foot per square mile. July 8, North Fork, elevation, 2,600 feet; discharge, 7.1 second-feet; drainage area, 6.2 square miles; discharge, 1.15 second-feet per square mile.

CROOKED CREEK.

Over the divide to the north, Crooked Creek, with its fan-shaped drainage basin, gathers the waters of Porcupine and Mastodon domes. Porcupine and Mammoth creeks form this stream which, after leaving the hills, meanders through a rather broad valley for about 30 miles, discharging its waters into Birch Creek about 10 miles above Fourteenmile House. Boulder and Deadwood creeks are tributaries from the south.

The following miscellaneous measurements were made in Crooked Creek drainage basin in 1908:

Measurements in Crooked Creek drainage basin, 1908.

Date.	Stream and locality.	Drainage area.	Discharge.	Discharge per square mile.
		Sq. miles.	*Sec.-feet.*	*Sec.-feet.*
June 30	Crooked Creek at Central House	161	57.7	0.358
July 1	do	161	52.0	.323
September 9	do	161	86.4	.536
July 1	Albert Creek at trail crossing		9.1	
Do	Quartz Creek at trail crossing	8.4	2.7	.322

MAMMOTH CREEK.

Mammoth Creek, which with Porcupine Creek forms Crooked Creek, is itself formed by the confluence of Mastodon and Independence creeks. These creeks, with Miller Creek, drain the area between Bonanza and Boulder creeks. Mastodon and Independence creeks head on the northern slope of Mastodon Dome, flow northwestward about 6 miles, and unite to form Mammoth Creek. Mastodon Creek Valley is V-shaped and is flanked on either side by even-topped ridges having a gentle slope parallel to that of the stream and about 1,300 feet above its bed. Independence Creek has an unsymmetrical valley with the steep slope on the left, the right side being cut by numerous small tributaries. Both streams flow in rather loose gravelly beds, and their valleys are sparsely timbered and very steep in their upper courses. Considerable mining has been done on these creeks, especially on Independence, where operations were active in 1908. Miller Creek rises in the ridge between Porcupine and Mastodon domes and flows northeastward to Mammoth Creek. Some mining has been done on this creek.

A gaging station was established on Mammoth Creek at Miller House, July 2, 1908. The gage is nailed to a log retaining wall on the left bank of the stream just below the bridge, and is referred to a spike driven in a log at the upstream end of the road house, marked B. M.; the spike is 10.17 feet above zero of gage. Readings were taken by J. F. Kelly, merchant, at Miller House.

Discharge measurements of Mammoth Creek at Miller House, 1908.

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-feet.*		*Feet.*	*Sec.-feet.*
July 2	0.85	33.7	September 6	0.90	34.9
July 6	.70	20.7	September 7	.85	31.0
July 7	1.00	48.0			

Daily mean gage height and estimated discharge of Mammoth Creek at Miller House, 1908.

[Elevation, 1,700 feet; drainage area, 37.1 square miles.]

Day.	September.		October.		Day.	September.		October.	
	Gage height.	Discharge.	Gage height.	Discharge.		Gage height.	Discharge.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*		*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1			0.50	14.4	18	.70	20.7		
2			.50	14.4	19	.90	36.0		
3			.50	14.4	20	.85	31.0		
4			.50	14.4	21	.80	26.8		
5			.50	14.4	22	.70	20.7		
6			.50	14.4	23	.60	16.7		
7			.50	14.4	24	.60	16.7		
8	0.90	36.0	.50	14.4	25	.55	15.4		
9	.80	26.8	.50	14.4	26	.50	14.4		
10	.90	36.0	.40	13.0	27	.50	14.4		
11	.85	31.0	.40	13.0	28		14.9		
12	.70	20.7	.40	13.0	29	.55	15.4		
13	.75	23.4	.40	13.0	30	.50	14.4		
14	.70	20.7							
15	.75	23.4			Mean		22.6		14.0
16	.70	20.7			Mean per sq. mile		.609		.376
17	.75	23.4			Run-off, depth in inches		.52		.18

NOTE.—Creek frozen over after October 13.

Miscellaneous measurements in Mammoth Creek drainage basin, 1908.

Date.	Stream and locality.	Drainage area.	Discharge.	Discharge per square mile.
		Sq. miles.	*Sec.-ft.*	*Sec.-ft.*
September 6	Mastodon Creek at claim 21 above	6.9	3.9	0.565
September 7	do	6.9	9.1	1.32
July 5	Mastodon Creek at claim 1 above	10.4	7.7	.742
September 7	do	10.4	11.5	1.11
July 5	Independence Creek near mouth	13.2	4.6	.348
September 7	do	13.2	11.9	.902
July 6	Miller Creek near mouth	10.5	5.9	.562
September 7	do	10.5	11.2	1.07

PORCUPINE CREEK.

Porcupine Creek, the left branch of Crooked Creek, rises in the high ridges around Porcupine Dome and flows southeastward through a deep, unsymmetrical valley for about 14 miles to Crooked Creek. Bonanza Creek, a tributary from the right, enters about 4 miles above the mouth.

The following miscellaneous measurements were made in its upper drainage basin in 1908: Porcupine Creek near proposed ditch intake, elevation, about 2,200 feet; discharge, 12.6 second-feet; drainage area, 17.8 square miles; discharge, 0.708 second-foot per square mile. Bonanza Creek at ditch intake, elevation, 2,200 feet; July 4, discharge, 12.4 second-feet; July 6, discharge, 13 second-feet; September 7, discharge, 12.3 second-feet; drainage area, 7.9 square miles; discharge, 1.56, 1.64, and 1.56 second-feet per square mile, respectively.

In 1908 Berry & Lamb constructed along the right side of these creeks a ditch for hydraulicking on Mammoth Creek. This ditch is described in detail on pages 95–96 of this report.

A gaging station was established on Porcupine Creek below Bonanza Creek July 4, 1908. Readings were taken by Mr. Miller, in the employ of Berry & Lamb.

Discharge measurements of Porcupine Creek below Bonanza Creek, 1908.

Date.	Gage height.	Discharge.
	Feet.	*Sec.-feet.*
July 4	1.55	25.0
July 6	1.58	26.0
September 7	1.70	38.8

Daily gage height and estimated discharge of Porcupine Creek below Bonanza Creek, 1908.

[Drainage area, 39.9 square miles.]

Day.	July.		August.		Day.	July.		August.	
	Gage height.	Discharge.	Gage height.	Discharge.		Gage height.	Discharge.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*		*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1			1.37	16.8	20	1.49	21.3		
2			1.37	16.8	21	1.44	19.2		
3			1.32	16.1	22	1.40	17.8		
4	1.55	24.5	1.30	15.7	23	1.42	18.5		
5	1.53	23.4	1.29	15.6	24	1.50	21.7		
6	1.79	53.5	1.30	15.7	25	1.51	22.3		
7	2.26	147	1.28	15.5	26	1.48	20.8		
8	2.10	115	1.32	16.1	27	1.46	19.9		
9	1.95	85.5	1.48	20.8	28	1.44	19.2		
10	1.85	65.5	1.50	21.7	29	1.44	19.2		
11	1.90	75.5			30	1.42	18.5		
12	1.72	41.8			31	1.40	17.8		
13	1.64	31.5							
14	1.72	41.8			Mean		40.0		17.1
15	1.76	48.1							
16	1.72	41.8			Mean per square mile		1.00		.429
17	1.68	36.3							
18	1.61	29.0			Run-off, depth in inches		1.04		.16
19	1.52	22.8							

BOULDER CREEK.

Boulder Creek rises in the dividing ridge north of the North Fork of Harrison Creek and drains a rather narrow valley between Mammoth and Deadwood creeks. It is about 12 miles long, flows in a northeasterly direction, and empties into Crooked Creek about 4 miles above Central House.

The following discharge measurements were made at the mouth of this stream in 1908: July 1, discharge, 8 second-feet; July 2, 5.8 second-feet; drainage area, 38.8 square miles; discharge per square mile, 0.206 and 0.150 second-foot, respectively.

DEADWOOD CREEK.

Deadwood Creek rises in the ridge to the north of Harrison Creek, drains a precipitous V-shaped area between that stream and Boulder Creek, and unites with Crooked Creek about 4 miles below Central House. It is about 20 miles long. For about 8 miles the stream flows through the narrow part of the area and is very steep. Below Switch Creek, a tributary from the right, the grade lessens and the valley gradually widens until it merges into that of Crooked Creek.

About 35 claims are being worked on this creek, all by the "open-cut" method. The stretch including the lower 3 or 4 miles is being prospected for dredging purposes. A churn drill will probably be put on this part of the ground during the coming season.

The following discharge measurements were made July 1, 1909: Deadwood Creek above Switch Creek, 9.1 second-feet; drainage area, 21.3 square miles; discharge per square mile, 0.427 second-foot. Switch Creek at mouth, 0.72 second-foot; drainage area, 5.8 square miles; discharge per square mile, 0.124 second-foot.

THE RAMPART DISTRICT.

DESCRIPTION OF AREA.

The area originally known as the Rampart district embraces three main drainage areas, as follows: Minook and Troublesome creeks, tributary to Yukon River, and Baker Creek, tributary to the Tanana.

Mining was actively begun in this region in 1896 on Little Minook Creek, which is tributary to Minook Creek from the right about 5 miles from its mouth, and its total gold output since that time exceeds $2,000,000.

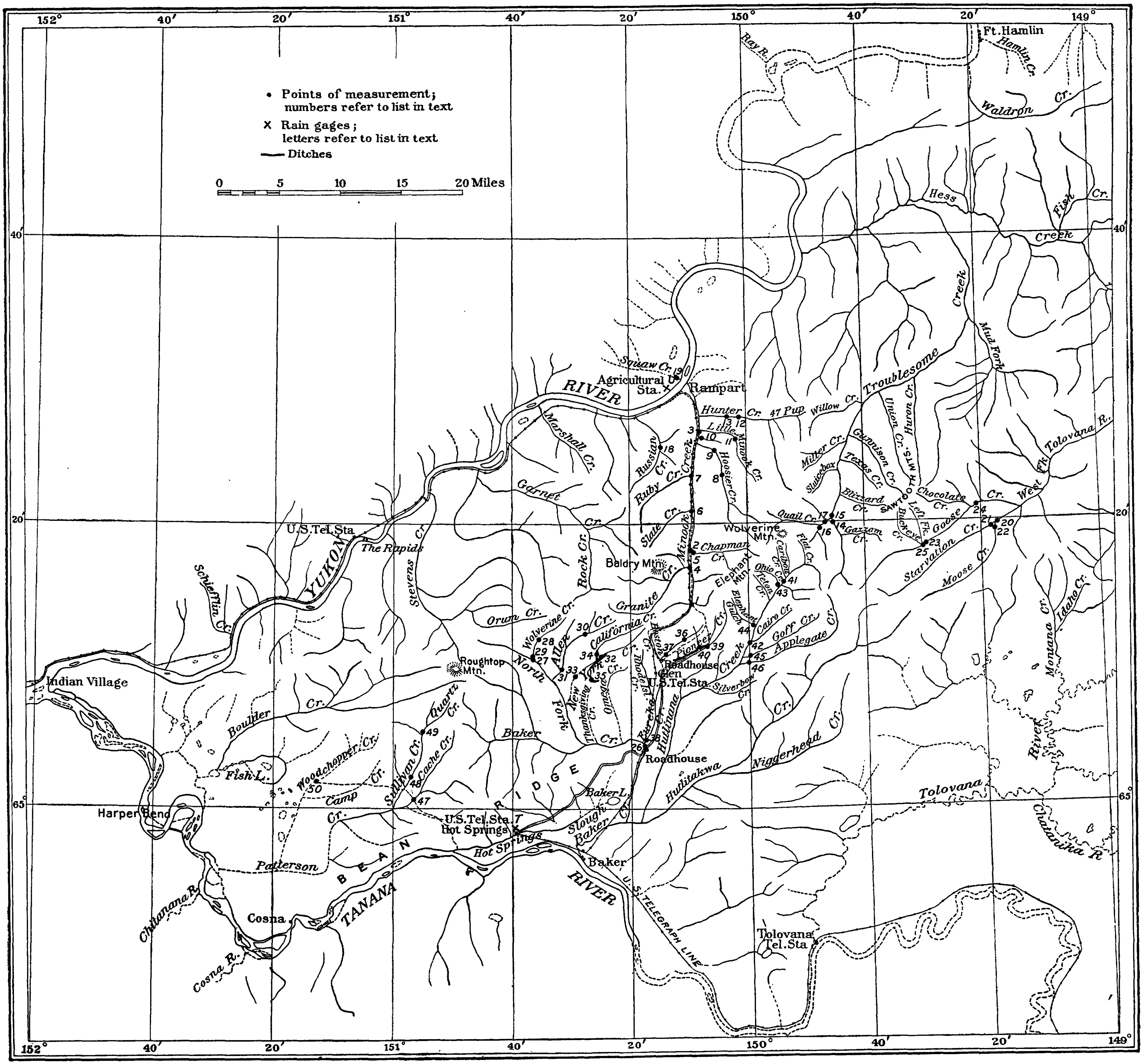
The town of Rampart, situated on the left bank of the Yukon River just below the mouth of Minook Creek, was long the main supply point for the entire region, and from it all the mining outfits and provisions were hauled on sleds in winter and packed on horses in summer. Now, however, the Baker Creek area is by far the largest producer, and since several stores have been opened at Hot Springs, about 6 miles from the Tanana River on the Baker Slough, Rampart has ceased to be the main trading point, and the term "Rampart district" is now understood by some to include only Minook and Troublesome creeks. In this report, however, the original meaning is retained.

The divide between Minook Creek and Baker Creek drainage basins has a general but very irregular east and west direction, with a notable break to the north at the head of Hutlinana Creek. It varies in elevation from 1,000 to 4,000 feet, Wolverine Mountain being the highest point. The northern area is rugged and mountainous, with narrow valleys and precipitous slopes, even down to the mouth of the streams, while the southern area, although rough at the headwaters, broadens out below into alluvial flats in which the streams are sluggish.

Timber sufficient for fuel is found in most of the valleys and lower slopes of the Rampart region. Spruce, birch, and poplar are abundant on the hillsides near Hot Springs and along the Tanana. Minook Creek Valley originally contained timber suitable for mine supports, but of such timber little is left. Timber near the mines, scanty at best, is being destroyed by forest fires which are depleting the supply much more rapidly than the many legitimate uses to which it is being put.

Hot Springs, situated in a country which, except in the immediate vicinity of the mining claims, is practically a wilderness, affords all the luxuries and conveniences which are associated with a modern summer hotel in the States, including shower baths, swimming pools, comfortable rooms with hot and cold water, fresh milk, eggs, and vegetables. The farm of several acres is cultivated by modern methods. An extensive system of hothouses furnishes means of maturing many varieties of fruit and vegetables that could not otherwise be raised, even in the warm ground in the vicinity of the springs.

Transportation facilities in this region are reasonably good. Minook and Troublesome creeks receive their supplies via the Yukon River from Rampart as the distributing point. The Alaska Road Commission has built, up Minook Valley, about 6 miles of road which is very good during the dry season and which, as comparatively little mining is carried on above that point, meets as well as could be expected the needs of this country, where road construction and particularly road maintenance are so expensive. The Baker Creek workings are reached via the Tanana River, with Hot Springs as distributing point. Mr. Frank Manley, who has done so much toward developing that country, constructed during 1906 and 1907 about 30 miles of road between Hot Springs and Thanksgiving and Pioneer creeks. This road was improved during 1908 by the road commission and now affords direct and comfortable access to practically all the Baker Creek mines. A road between Hot Springs and the Patterson Creek mines was also under construction by the road commission during the latter part of the season of 1908. This road will follow the right bank of the Baker Slough to within about one-



MAP SHOWING LOCATION OF GAGING STATIONS IN RAMPART DISTRICT.

half mile of its mouth, where the course turns abruptly to the right and passes over the divide into the Patterson Creek basin. When completed it will afford wagon communication with the Tanana River boats, will make possible the transportation of heavy mining machinery, and will also do away with the present necessity of packing all the supplies to Patterson Creek—a very expensive and tedious method, even under the most favorable conditions.

As in the Fairbanks and Circle districts, much valuable ground is lying idle or being worked at excessive cost because of the lack of water, and some practical means of securing an adequate supply becomes more vitally important each year and presents a problem which should receive the careful consideration of every mine owner.

GAGING STATIONS.

The following list gives the points in the Rampart district at which gages were established or measurements made in 1908. The numbers refer to Plate V.

Gaging stations in Rampart district, 1908.

1. Minook Creek 4½ miles above Chapman Creek.
2. Minook Creek below Chapman Creek.
3. Minook Creek above Little Minook Creek.
4. Granite Creek at road crossing.
5. Chapman Creek at mouth.
6. Slate Creek at mouth.
7. Ruby Creek at mouth.
8. Hoosier Creek above and below pipe intake.
9. Hoosier Creek at claim 11 above.
10. Little Minook Junior Creek at mouth.
11. Little Minook Creek at claim 9 above.
12. Hunter Creek at claim 17 above.
13. Hunter Creek at claim 14 above.
14. Troublesome Creek above Quail Creek.
15. Troublesome Creek below Quail Creek.
16. Quail Creek above South Fork and South Fork at mouth.
17. Quail Creek above Nugget Gulch.
18. Russian Creek 3 miles above mouth.
19. Squaw Creek at mouth.
20. West Fork of Tolovana River near Moose Creek.
21. Starvation Creek at mouth.
22. Moose Creek at mouth.
23. Goose Creek below Buckeye Creek.
24. Goose Creek 4 miles above mouth.
25. Buckeye Creek at mouth.
26. Baker Creek at road crossing.
27. North Fork of Baker Creek below Wolverine Creek.
28. Wolverine Creek 2 miles above mouth.
29. Wolverine Creek at mouth.
30. Allen Creek 5 miles above mouth.
31. Allen Creek at trail crossing.

32. New York Creek at Thanksgiving ditch intake.
33. New York Creek at trail crossing.
34. California Creek at Thanksgiving ditch intake and California Creek branch of Thanksgiving ditch near intake.
35. Thanksgiving ditch near outlet.
36. Eureka Creek at claim 14 above.
37. Eureka Creek at claim 5 above.
38. Eureka Creek at mouth.
39. Pioneer Creek at What Cheer Bar ditch intake.
40. What Cheer Bar ditch near Seattle Creek.
41. Hutlinana Creek below Caribou Creek.
42. Hutlinana Creek below Cairo Creek.
43. Ohio Creek at trail crossing.
44. Elephant Gulch at mouth.
45. Goff Creek near mouth.
46. Applegate Creek 1 mile above mouth.
47. Cache Creek at trail crossing.
48. Sullivan Creek 3 miles above mouth.
49. Quartz Creek near mouth.
50. Woodchopper Creek at trail crossing.

MINOOK CREEK DRAINAGE BASIN.

GENERAL DESCRIPTION.

Minook Creek heads on the northern slope of Eureka Dome, flows northeastward for about 4 miles, and then takes a northerly course through a remarkably straight valley to the Yukon River, which it joins just above Rampart. It is about 25 miles long and drains an area of 198 square miles, the major portion being on the east of the stream. The basin is covered with a light growth of timber which furnishes an ample supply for fuel but very little suitable for milling.

The chief tributaries are Chapman, Hoosier, Little Minook, and Hunter creeks from the east and Granite, Ruby, and Slate creeks from the west. Above Granite Creek the valley is narrow and V-shaped; below that point it broadens out and has perhaps a maximum width of one-half mile. The western slope is precipitous throughout the entire length, while the eastern slope below Chapman Creek is more gradual, with prominent benches. In the upper course the stream is crooked, meandering from one side of the valley to the other; the lower part is comparatively straight.

The summer and winter trails from Rampart to Eureka coincide through the greater part of the distance—to a point about 2 miles above Granite Creek, where the summer trail crosses the creek and passes on to the divide between Eureka and Pioneer creeks. The winter trail keeps to the left of Minook Creek, crosses the divide to the west of Eureka Dome, and passes down the right limit of Boston Creek. The trail is very difficult to travel, owing to the large quantity of ground ice along its left bank, which keeps it saturated even during the driest part of the summer season.

"Just below the mouth of Slate Creek the Minook spreads into a number of branches in a wide gravel flat. This flat, which is typical of many Alaskan streams, is probably due to a change in the grade of the creek. The stream here is unable to carry the gravels of the swifter water above, and so spreads them upon the flat. Here are found the so-called 'winter glaciers,' some of which last through the short summers. In 1904 a quarter or half acre of 'winter glacier' still remained when the September frosts occurred. This ice owes its origin to the fact that, as the water freezes in the fall, the channel is greatly narrowed. The resulting hydrostatic pressure cracks the ice and the water overflows and freezes. This process is repeated until considerable thickness of ice is accumulated."[a]

MINOOK CREEK ABOVE LITTLE MINOOK CREEK.

A board gage was erected May 25, 1908, by M. E. Koonce on Minook Creek just above Little Minook Creek. This gage was read by the miners of Hoosier and Little Minook creeks on their way to and from Rampart.

Discharge measurements of Minook Creek above Little Minook Creek, 1908.

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-feet.*		*Feet.*	*Sec.-feet.*
August 9	1.58	31.3	September 12	1.91	56.9
August 16	1.50	30.4	September 14	1.86	49.9
September 5	2.50	110.0	September 15	1.85	50.1
September 7	2.25	82.5	September 19	2.25	81.9
September 10	2.15	70.9			

Daily gage height and estimated discharge of Minook Creek above Little Minook Creek, 1908.

[Elevation, 425 feet; drainage area, 130 square miles.]

Day.	May.	June.		July.		August.		September.	
	Gage height.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
	Feet.	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1		3.6		2.2	77	1.60	33	1.70	38
2		3.6			73		34		68
3					69		36		98
4					65	1.70	38	2.65	128
5					58	1.70	38	2.50	110
6				1.9	51		37	2.35	92
7		2.9	160		77		35	2.25	82
8			159	2.4	98		34	2.29	86
9		2.8	147	2.5	110	1.60	33	2.20	77
10		2.5	110	2.2	77	1.57	32	2.15	72
11			119		74	1.55	31		61
12			128		70		31	1.90	51
13			137		67		31		50
14			146		63	1.55	31	1.85	48
15			155		60	1.50	30	1.85	48

[a] Hess, F. L., The Rampart placers: Bull. U. S. Geol. Survey No. 337, 1908, pp. 67-68.

Daily gage height and estimated discharge of Minook Creek above Little Minook Creek, 1908—Continued.

Date.	May.	June.		July.		August.		September.	
	Gage height.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
	Feet.	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
16			164		56	1.50	31		59
17			173		53		32		70
18			182		49		33	2.25	82
19			191		46		34		72
20		3.20	200		42		35		62
21		2.92	163	1.70	38	1.65	35		51
22			147		38		35	1.80	44
23			131		37		34		
24		2.55	116		36	1.60	33		
25	4.70		103		36	1.65	35		
26	4.10		90		35	1.60	33		
27	4.91	2.20	77	1.65	35		34		
28			77		35		35		
29			77		35		36		
30	4.15	2.20	77		34		37		
31	4.25				34		38		
Mean			134		56.0		34.0		70.4
Mean per square mile			1.03		.431		.262		.542
Run-off, depth in inches			.92		.50		.30		.44

GRANITE CREEK.

Granite Creek rises opposite Allen Creek in the Baker-Minook divide and flows in a northeast direction, entering Minook Creek about 16 miles from the Yukon. It is about 8 miles long and is the third largest tributary of Minook Creek. The lower valley is V-shaped, with steep rocky slopes, and the bed is of heavy bowlders intermixed with gravel. The upper valley was not visited.

The following measurement was made near the mouth August 8, 1908: Discharge, 5.7 second-feet; drainage area, 26.9 square miles; discharge, 0.212 second-foot per square mile.

CHAPMAN CREEK.

Chapman Creek enters Minook Creek from the east about 1 mile below Granite Creek. It heads on the north slope of Elephant Mountain and is about 5 miles long. Considerable work has been done on the creek and favorable prospects have been found, but no actual mining has been carried on.

The following measurement was made August 8, 1908, near the mouth: Discharge, 2.9 second-feet; drainage area, 14.8 square miles; discharge, 0.196 second-foot per square mile.

SLATE CREEK.

Slate Creek is tributary to Minook Creek about 12 miles from the Yukon. It heads on the north slope of Baldy Mountain and has a length of 5 miles, with an average grade of nearly 350 feet per mile. The valley is V-shaped near the mouth and unsymmetrical toward the headwaters of the stream, with rugged slopes well covered with timber. This creek has been worked since 1902, and good values are said to have been found.

The following measurement was made near the mouth August 8, 1908: Discharge, 2.2 second-feet; drainage area, 7.9 square miles; discharge, 0.278 second-foot per square mile.

RUBY CREEK.

Ruby Creek, the first western tributary of importance, enters Minook Creek about 8 miles from the Yukon and 3 miles above the mouth of Hoosier Creek. Its course is northeastward, parallel to that of Slate Creek. It is about 8 miles long.

The valley is sharp cut and unsymmetrical. The right side has several small tributaries, while the left is broken only by mere rills.

The producing claims are all within 1½ miles of the mouth. Prospecting above that point has been hampered by live water in the gravels.

On August 8, 1908, a measurement was made as follows: Discharge, 1.7 second-feet; drainage area, 10.6 square miles; discharge, 0.160 second-foot per square mile.

HOOSIER CREEK.

Hoosier Creek rises in the high divide at the head of Chapman Creek and flows northwestward, emptying into Minook Creek from the right about 5 miles above its mouth. Practically the only mining on this creek in 1908 was at claim 14 above where a hydraulic elevator was in operation during a portion of the season. A gaging station was established on claim 11 above, August 16, and readings taken by M. E. Koonce.

Discharge measurements of Hoosier Creek at claim 11 above, 1908.

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
August 16	0.35	4.7	September 9	0.57	14.5
September 5	.65	20.6	September 14	.43	7.2

Daily gage height and estimated discharge of Hoosier Creek at claim 11 above, 1908.

[Elevation, 600 feet; drainage area, 25.7 square miles.]

Day.	August.		September.		Day.	August.		September.	
	Gage height.	Discharge.	Gage height.	Discharge.		Gage height.	Discharge.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*		*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1			0.40	8.0	20	0.35	4.7	0.45	8.0
2				25.0	21		4.7	.35	4.7
3			.85	42.0	22		4.7		
4			.70	25.4	23		4.7		
5			.70	25.4	24		4.7		
6			.55	13.0	25		4.7		
7			.65	20.6	26		4.7		
8			.55	13.0	27		4.7		
9				11.6	28		4.7		
10			.50	10.2	29		4.7		
11				9.5	30		4.7		
12				9.0	31	.35	4.7		
13				8.5					
14			.45	8.0	Mean		4.70		13.6
15			.45	8.0					
16	0.35	4.7	.45	8.0	Mean per square mile		.183		.529
17	.35	4.7	.43	7.7					
18	.35	4.7	.50	10.2	Run-off, depth in inches		.10		.41
19		4.7		9.1					

LITTLE MINOOK JUNIOR CREEK.

Little Minook Junior Creek is a small tributary of Minook Creek and drains a small area between the mouths of Little Minook and Hoosier creeks.

It is about 2½ miles long. The lower valley has a heavy grade and is sharply V-shaped. The upper valley has more gentle slopes and a lower stream gradient.

But little mining work was accomplished during the summer of 1908, owing to the lack of water, although some very rich ground was said to have been found. The stream probably seldom furnishes a sluice head of water except during the spring run-off.

A measurement was made near the mouth on September 5, 1908: Discharge, 0.32 second-foot; drainage area, 1.3 square miles; discharge, 0.246 second-foot per square mile.

LITTLE MINOOK CREEK.

Little Minook Creek is tributary to Minook Creek about 5 miles from the Yukon. Its drainage basin lies between Hunter and Hoosier creeks and is entirely surrounded by them. The course of the stream is parallel to that of Hunter Creek, with the same pronounced bend to the left about 3 miles from its mouth. The valley is sharply V-shaped with precipitous slopes, sparsely covered with small timber. This stream has been the largest producer of the Minook basin, but it has been worked in a rather unsystematic manner on account of the many different owners. Underground water also has caused considerable trouble, making it necessary to abandon some ground shown to be rich. No pay has been found above claim 9 above. A favorite method of removing the overburden of muck and gravel during the open season is by means of automatic dams (Pl. VII, *B*). A gaging station was established on this stream at claim 9 above on June 21, 1908, and readings were taken by Messers. Nelson, Cummings, and Larson.

Discharge measurements of Little Minook Creek at claim 9 above, 1908.

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-feet.*		*Feet.*	*Sec.-feet.*
August 10	0.79	0.75	September 7	0.98	2.5
August 15	.79	.67	September 15	.91	1.3
September 4	1.17	6.8			

Daily gage height and estimated discharge of Little Minook Creek at claim 9 above, 1908.

[Elevation, 900 feet; drainage area, 5.9 square miles.]

Day.	June.		July.		August.		September.	
	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1			0.92	1.60	0.75	0.62	1.08	4.2
2			.92	1.60	.83	.87	1.17	6.8
3			.92	1.60		.84	1.21	10.1
4			.83	.87		.82	1.17	6.8
5			.83	.87		.80		5.3
6			.92	1.60		.78		3.8
7			1.08	4.20		.76	.98	2.3
8			1.50	26.40		.74		2.2
9			1.42	20.50		.72		2.1
10			1.33	14.60	.79	.70		2.0
11			1.33	14.60		.70		1.9
12				10.30		.70		1.8
13				6.00		.70		1.7
14			.92	1.60		.70		1.6
15			.83	.87	.79	.70	.91	1.4
16			.83	.87		.76		
17			.75	.62		.82		
18			.75	.62	.83	.87		
19				.62		.87		
20				.62		.87		
21	1.17	6.8		.62		.87		
22	1.08	4.2		.62		.87		
23	1.00	2.6		.62		.87		
24	.92	1.6		.62		.87		
25	.92	1.6		.62		.87		
26	.92	1.6		.62		.87		
27	.92	1.6		.62		.87		
28	.92	1.6		.62		.87		
29	.92	1.6		.62		.87		
30	.92	1.6		.62		.87		
31			.75	.62	.83	.87		
Mean		2.48		3.78		.800		3.60
Mean per square mile		.420		.641		.136		.610
Run-off, depth in inches		.16		.79		.16		.34

HUNTER CREEK.

Hunter Creek, the largest tributary of Minook Creek, enters it from the right about 3 miles from its mouth. It flows northward to its junction with 47 Pup, where it makes a right-angle turn to the west, entering Minook Creek about 6 miles farther on. It is a crooked stream about 12 miles long, and has a narrow V-shaped valley and rough precipitous slopes. The lower part of the valley on the right side is marked by a very pronounced bench which so far has furnished the chief gold-bearing gravels. Hunter Creek has a particularly heavy growth of timber, much of which would be suitable for saw logs.

Two hydraulic plants were in operation on this creek during 1908—one on Discovery claim and one on claim 17 above. A gaging station was established on this stream at claim 17 above, August 11, 1908, and regular readings were taken by S. M. Wheeler.

Discharge measurements of Hunter Creek at claim 17 above, 1908.

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
August 11	0.50	4.5	September 10	0.79	12.7
September 6	.90	17.9	September 16	.65	8.4

Daily gage height and estimated discharge of Hunter Creek at claim 17 above, 1908.

[Elevation 600 feet; drainage area, 33.4 square miles.]

Day.	August.		September.		Date.	August.		September.	
	Gage height.	Dis-charge.	Gage height.	Dis-charge.		Gage height.	Dis-charge.	Gage height.	Dis-charge.
	Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*		*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1			0.60	6.6	21	0.55	5.5		
2			.75	11.4	22	.50	4.5		
3			1.05	25.1	23	.45	3.7		
4			1.10	27.7	24	.50	4.5		
5			1.00	22.6	25	.50	4.5		
6			.90	17.9	26	.50	4.5		
7			.85	15.6	27	.50	4.5		
8			.85	15.6	28	.50	4.5		
9				14.1	29	.50	4.5		
10			.79	12.6	30	.50	4.5		
					31	.55	5.5		
11	0.50	4.5		11.1					
12	.55	5.5	.70	9.6	Mean		4.60		15.8
13	.50	4.5			Mean per square mile		.138		.473
14	.50	4.5							
15	.50	4.5			Run-off, depth in inches		.11		.14
16	.50	4.5							
17	.50	4.5							
18	.50	4.5							
19	.50	4.5							
20	.50	4.5							

MISCELLANEOUS MEASUREMENTS.

The following measurements, not previously listed, were made in the Minook Creek drainage basin in 1908.

Miscellaneous measurements in Minook Creek drainage basin, 1908.

Date.	Stream and locality.	Drainage area.	Discharge.	Discharge per square mile.
		Sq. miles.	*Sec.-ft.*	*Sec.-ft.*
August 8	Minook Creek 4½ miles above Chapman Creek	9.2	2.9	0.315
Do	Minook Creek below Chapman Creek	58.3	7.1	.122
August 10	Hoosier Creek above pipe intake	21.2	4.8	.226
September 9	do	21.2	11.1	.523
Do	Hoosier Creek below pipe intake		1.2	
August 10	Hunter Creek at 14 above	33.4	2.3	.069
September 5	Little Minook Junior Creek at mouth	1.3	.32	.246

TROUBLESOME CREEK DRAINAGE BASIN.

GENERAL DESCRIPTION.

Troublesome Creek rises southeast of Wolverine Mountain, between the headwaters of Hutlinana Creek and the West Fork of the Tolovana River, and flows northeastward for about 40 miles, entering Hess Creek 10 miles from the Yukon River.

No study of this creek was made below the mouth of Quail Creek, but it is said to follow a winding course, meandering from one side of the valley to the other through soft mucky soil, abounding with "niggerheads" and a thick growth of small trees which make travel slow and tedious. It also has steep, high slopes which make it very difficult of approach.

The main and tributary valleys at the head are almost canyon-like in appearance, being shut in by rocky, barren ridges which are high and precipitous.

Troublesome Creek seems to be the only one near enough to the Rampart mines with sufficient run-off and gradient to be worthy of consideration as a possible water supply for the development of hydro-electric power to be transmitted to that region. The approximate average grade of the stream below the mouth of Quail Creek is 45 feet per mile, ranging from 150 feet per mile at the upper limit to 18 feet per mile at the mouth.

About 7 miles from the head Troublesome Creek receives Quail Creek, its first important tributary. Quail Creek heads opposite Hoosier Creek and flows eastward, draining the north slope of Wolverine Mountain. It is about 5 miles long and drains an area of 20.6 square miles. The south slope of its basin is rocky and barren, rising precipitously to the summit of Wolverine Mountain. On the north the valley has a very gentle approach and is covered with a heavy growth of wild grass which furnishes excellent forage for pack animals. The stream is lined with a dense growth of willows in the upper portion, and near the mouth is a growth of spruce suitable for cabin and fuel purposes. A trail from Rampart to the mouth of Quail Creek, a distance of about 20 miles, follows up the right side of Little Minook Creek, crosses the divide, and passes diagonally down the long, gentle slope on the left side of Quail Creek.

Considerable work was being done on the creek during the summer of 1908, and gold values were said to have been found in the gravels. The work thus far carried on has been prospecting rather than actual mining.

The South Fork joins Quail Creek about a mile above Troublesome Creek and is its largest tributary.

TROUBLESOME CREEK BELOW QUAIL CREEK.

A gaging station was established on Troublesome Creek below the mouth of Quail Creek, August 12, 1908, and regular readings were taken by C. F. W. Cassidy.

Discharge measurements of Troublesome Creek below Quail Creek, 1908.

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
August 12	0.75	7.2	September 3	1.20	35.7
August 14	.73	6.2	September 4	1.30	50.4
September 2	1.07	25.4			

Daily gage height and estimated discharge of Troublesome Creek below Quail Creek, 1908.

[Elevation 1,750 feet; drainage area 43.2 square miles.]

Day.	August.		September.		Day.	August.		September.	
	Gage height.	Discharge.	Gage height.	Discharge.		Gage height.	Discharge.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*		*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1			0.86	11.2	20	0.79	8.3		10.3
2			1.04	23.2	21	.78	8.0		10.0
3			1.2	38.0	22	.78	8.0		9.8
4			1.3	48.0	23	.75	7.0	0.82	9.6
5				46.0	24	.73	6.4	.68	5.2
6				43.0	25	.75	7.0	.60	4.0
7				41.0	26	.78	8.0		
8				37.5	27	.75	7.0		
9				34.6	28		8.0		
10				32.0	29	.82	9.4		
11			1.11	29.2	30	.80	8.6		
12	0.75	7.0	1.1	28.3	31	.78	8.0		
13		6.7	1.03	22.4					
14	.73	6.4	.90	13.4	Mean		7.48		22.2
15		6.3		13.0					
16	.72	6.2		12.6	Mean per square mile		.173		.518
17	.75	7.0		12.2					
18	.78	8.0		10.9	Run-off, depth in inches		.13		.48
19	.79	8.3		10.6					

MISCELLANEOUS MEASUREMENTS.

The following measurements were made to determine the proportional discharge of Troublesome Creek and its tributaries:

Miscellaneous measurements in Troublesome Creek drainage basin, 1908.

Date.	Stream and locality.	Drainage area.	Discharge.	Discharge per square mile.
		Sq. miles.	*Sec.-ft.*	*Sec.-ft.*
August 12	Troublesome Creek above Quail Creek	21.4	2.5	0.117
Do	Quail Creek above South Fork	13.3	2.8	.210
Do	Quail Creek above Nugget Gulch	17.6	4.3	.244
Do	South Fork of Quail Creek at mouth	3.7	1.4	.378

MINOR YUKON RIVER DRAINAGE.

RUSSIAN CREEK.

Russian Creek enters Yukon River from the south about 4 miles below Rampart. It has an unsymmetrical valley with steep slopes and a rather broad bottom land, thickly covered with small trees. It is about 8 miles long and flows in a general northerly direction.

A measurement was made about 3 miles above the mouth on September 19, 1908, as follows: Discharge, 1.9 second-feet; drainage area, 9.9 square miles; discharge, 0.192 second-foot per square mile.

SQUAW CREEK.

Squaw Creek enters Yukon River just above Rampart, directly opposite Minook Creek. The creek was not seen above the mouth, but the upper valley is said to have a valuable growth of timber, and plans were being made to install a portable sawmill on the creek during the winter of 1908–9. Considerable winter prospecting has been done, but no values are reported. A measurement was made September 11, 1908, at the mouth, which gave a discharge of 27.7 second-feet.

WEST FORK OF TOLOVANA RIVER DRAINAGE BASIN.

DESCRIPTION.

The West Fork of Tolovana River is formed by three main arteries—Goose, Starvation, and Moose creeks—which flow northeastward in generally parallel courses the greater portion of their length. They are separated by bench-like divides which rise 600 to 800 feet above the valley bottoms.

Goose Creek is the largest of the three and drains the highest ground. Sawtooth Mountain, rising high above it on the north, contributes the greater part of the run-off. The valley has an average width of perhaps one-fourth mile and is rather difficult to travel, having an extra thickness of the prevalent moss and containing many "niggerheads" in a bed of muck and water. The bottom land is dotted with clumps of spruce and birch, but the timber generally is small. The creek crosses from side to side of the valley, and its gravelly bed contains large bowlders. The right slope is steep and makes a sharp angle with the bottom land and is unbroken by any noticeable water courses below Buckeye Creek. The left bank is marked by numerous feeders with deep-cut valleys extending back for several miles.

Buckeye Creek is tributary to Goose Creek from the left about 10 miles from the mouth. It has shown sufficient gold to warrant careful prospecting. The creek, however, probably never furnishes sufficient water for anything more than the washing of spring dumps.

Starvation and Moose creeks were visited only at the mouth, but as seen from a distance the lower valleys appeared to have the same general characteristics as those of Goose Creek.

MEASUREMENTS.

Miscellaneous measurements in West Fork of Tolovana River drainage basin, 1908.

Date.	Stream and locality.	Drainage area.	Discharge.	Discharge per square mile.
		Sq. miles.	*Sec.-ft.*	*Sec.-ft.*
August 13	West Fork of Tolovana River near Moose Creek	43.8	4.0	0.091
Do	Starvation Creek at mouth	23.8	2.2	.092
Do	Moose Creek at mouth	19.8	1.9	.096
Do	Goose Creek 4 miles above mouth	41.0	3.2	.078
August 14	Goose Creek below Buckeye Creek	20.8	1.6	.077
Do	Buckeye Creek at mouth	10.6	.20	.019

BAKER CREEK DRAINAGE BASIN.

GENERAL DESCRIPTION.

Baker Creek and its tributaries drain a roughly fan-shaped area 542 square miles in extent. The greatest width of this basin from east to west is 37 miles, and its greatest width from north to south, 21 miles.

The name Baker Creek is applied to the extreme western fork. It heads near Sullivan Creek on the south slope of Roughtop Mountain and flows eastward for about 17 miles; it then makes a right-angle turn to the south around the north end of Bean Ridge which it follows closely for about 4 miles below the turn, where it crosses the flat and receives its two largest tributaries, Hutlinana and Hutlitakwa creeks, which drain over half the entire area. It is about 28 miles long and enters the Tanana 70 miles from the Yukon.

The system of main and tributary streams is very unsymmetrical, about 88 per cent of the area lying on the left side. South of the creek the country rises abruptly to the summit of Bean Ridge and furnishes no tributaries of importance. On the north the valley spreads out into a broad, alluvial flat with a very gradual slope until near the head of the tributaries, where it rises abruptly to the summit of the divide.

No values have yet been found on the main creek, the chief producing creeks being Thanksgiving, Glenn, Eureka, and Pioneer.

The basin as a whole is favored with an abundant and diversified growth of timber. In the upper drainage this growth is small, but has furnished sufficient supply for fuel and cabins; on the flats, particularly in the lower valley of the Hutlinana, there is considerable spruce suitable for milling. Several sawmills have been in operation during the past two or three winters, but their output has been mainly flume lumber. On the slope near Hot Springs there is a heavy growth of birch and poplar.

Baker Creek has such a low gradient that its water can never be conveyed to any of the present mines by a gravity system, but as a supply for pumping it is ample, and it is so situated that it is worth consideration for that purpose.

BAKER CREEK AT ROAD CROSSING.

A gaging station was established on Baker Creek just above the road crossing, and below Eureka Creek. The gage is referred to a stake driven in the left bank about 15 feet from the gage, the top of which is 6.33 feet above the gage datum. Readings were taken twice a day by Charles H. Dickson, but as no measurements were made during the higher stages in September, no daily discharges can be computed.

Discharge measurements of Baker Creek at road crossing, 1908.

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
August 6	1.00	41.2
August 2	1.03	44.5
August 27	.98	42.8

ALLEN CREEK.

Allen Creek, which enters the North Fork of Baker Creek about 2½ miles above the mouth of New York Creek, is about 8 miles long. It flows southwestward in a winding course between deep-cut, mucky banks, splitting at many places into several channels, causing numerous island-like formations. The banks are lined with an almost impenetrable growth of willows. The left slope is rocky and barren and in some places rises almost vertically from 600 to 800 feet above the stream. The right side of the valley, which furnishes the greater part of the run-off, slopes gradually to the summit, which is capped by rocky cliffs. Allen Creek has been considered as a possible auxiliary water supply for the Thanksgiving Creek mines.

The following measurements were made August 22, 1908, at trail crossing: One mile above mouth, discharge, 4.9 second-feet; drainage area, 15.3 square miles; discharge, 0.320 second-foot per square mile. Five miles above mouth, discharge, 2.7 second-feet; drainage area, 5.9 square miles; discharge, 0.457 second-foot per square mile.

NEW YORK CREEK AT THANKSGIVING DITCH INTAKE.

New York Creek rises in a rather low saddle opposite the headwaters of Minook Creek and flows southwestward about 10 miles to North Fork of Baker Creek. The upper valley of this creek is narrow, V-shaped, and precipitous.

June 6, 1908, a gage was installed on New York Creek above the intake to Thanksgiving ditch, and daily readings were taken by employees of Frank G. Manley.

Discharge measurements of New York Creek at Thanksgiving ditch intake, 1908.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
June 6	C. C. Covert	0.40	5.3
June 8	do	.34	4.5
July 7	A. V. Thorns	.05	.71
August 7	C. E. Ellsworth	.09	1.1
August 18	do	.12	1.4

Daily gage height and estimated discharge of New York Creek at Thanksgiving ditch intake, 1908.

[Elevation, 800 feet; drainage area, 4.7 square miles.]

Day.	June.		July.		August.		September.	
	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1			0.05	0.7			0.40	5.4
2			.05	.7			.35	4.5
3			.10	1.2			.50	7.2
4			.05	.7			.35	4.5
5			.05	.7			.30	3.7
6	0.40	5.4	.05	.7				3.4
7	.35	4.5	.05	.7			.25	3.0
8	.55	8.2	.05	.7	0.10	1.2	.35	4.5
9	.30	3.7	.05	.7	.05	.7	.30	3.7
10	.25	3.0	.15	1.7	.05	.7	.25	3.0
11	.25	3.0	.10	1.2		.7	.20	2.3
12	.25	3.0	.05	.7	.05	.7	.20	2.3
13	.20	2.3	.05	.7		.7	.20	2.3
14	.30	3.7	.05	.7	.05	.7	.20	2.3
15	.40	5.4			.05	.7	.25	3.0
16	.30	3.7			.05	.7	.20	2.3
17	.25	3.0			.05	.7	.25	3.0
18	.25	3.0				1.4	.55	8.2
19	.25	3.0			.25	3.0	.50	7.2
20	.40	5.4			.20	2.3	.45	6.3
21	.30	3.7			.15	1.7		
22	.25	3.0			.15	1.7		
23	.20	2.3			.10	1.2		
24	.20	2.3			.10	1.2		
25	.15	1.7				1.4		

Daily gage height and estimated discharge of New York Creek at Thanksgiving ditch intake, 1908—Continued.

Day	June.		July.		August.		September.	
	Gage. height.	Dis-charge.	Gage. height.	Dis-charge.	Gage. height.	Dis-charge.	Gage. height.	Dis-charge.
	Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
26	.10	1.2			.15	1.7		
27	.10	1.2			.10	1.2		
28	.10	1.2			.10	1.2		
29	.10	1.2			.10	1.2		
30	.05	.7			.10	1.2		
31						3.0		
Mean		3.15		.843		1.29		4.10
Mean per square mile		.670		.179		.275		.873
Run-off, depth in inches		.62		.09		.25		.65

CALIFORNIA CREEK AT THANKSGIVING DITCH INTAKE.

California Creek enters New York Creek from the right about 5 miles from its source.

August 7, 1908, a gage was installed on California Creek above the intake to Thanksgiving ditch and daily readings were taken by employees of Frank G. Manley.

Discharge measurements of California Creek at Thanksgiving ditch intake, 1908.

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
August 1	1.00	2.4
August 18	1.03	2.9

Daily gage height and estimated discharge of California Creek at Thanksgiving ditch intake, 1908.

[Elevation, 825 feet; drainage area, 6.7 square miles.]

Day.	August.		September.		Day.	August.		September.	
	Gage height.	Dis-charge.	Gage height.	Dis-charge.		Gage height.	Dis-charge.	Gage height.	Dis-charge.
	Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*		*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1			1.10	4.2	21	1.00	2.4		
2			1.15	5.2	22	1.00	2.4		
3			1.25	7.5	23	1.00	2.4		
4			1.20	6.3	24	1.00	2.4		
5			1.15	5.2	25		2.4		
6				4.7	26	1.00	2.4		
7			1.10	4.2	27	1.00	2.4		
8	1.00	2.4	1.15	5.2	28	1.00	2.4		
9	1.00	2.4	1.10	4.2	29	1.00	2.4		
10	1.00	2.4	1.05	3.2	30	1.00	2.4		
11		2.4	1.10	4.2	31				
12	1.00	2.4	1.05	3.2					
13		2.4	1.05	3.2	Mean		2.45		5.07
14	1.00	2.4	1.10	4.2	Mean per square mile		.366		.757
15	1.00	2.4	1.10	4.2					
16	1.00	2.4	1.05	3.2	Run-off, depth in inches		.31		.56
17	1.00	2.4	1.11	4.4					
18	1.03	2.9	1.30	8.7					
19	1.05	3.2	1.30	8.7					
20	1.00	2.4	1.25	7.5					

THANKSGIVING DITCH NEAR OUTLET.

Thanksgiving ditch taps New York and California creeks a short distance above their confluence. It is about 4 miles long and supplies water for use on Thanksgiving Creek, a small tributary of Baker Creek and one of the richest in the Rampart region. The chief workings so far have been near the head of the creek. Prospecting with a churn drill has been carried on below the present workings and also between Thanksgiving and Omega creeks.

During the early part of the season of 1908 much money was spent in constructing bed-rock flumes, installing machinery, and breaking the ground preparatory to stripping, but owing to the exceptionally low water the work was much curtailed.

A steam scraper for use in removing tailings from the sluice boxes was in operation on this creek during part of the season. It was of the bottomless type, with a capacity of 2 cubic yards. A 35-horsepower boiler and a 3-drum hoist, operated by one man, moved 150 cubic yards of dirt an average distance of 150 feet on 1 cord of wood.

A gage was established on this ditch June 6, 1908, about one-fourth mile above the outlet.

Discharge measurements of Thanksgiving ditch near outlet, 1908.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
June 6	C. C. Covert	1.20	11.2
June 8	do	1.20	10.7
July 7	A. V. Thorns	.60	2.9
August 7	C. E. Ellsworth	.60	2.1
August 18	do	.68	2.7
August 29	do	.60	1.8

Daily gage height and estimated discharge of Thanksgiving ditch near outlet, 1908.

Day.	June.		July.		August.		September.	
	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1			0.65	2.4			0.90	5.3
2			.60	2.1			.95	6.1
3			.75	3.3			1.20	10.9
4			.70	2.8			1.10	8.9
5			.60	2.1			1.00	7.0
6	1.20	10.9	.60	2.1				6.2
7	1.05	7.9	.60	2.1			.90	5.3
8	1.20	10.9	.65	2.4	0.60	2.1	1.05	7.9
9	1.10	8.9	.60	2.1	.55	1.8	.95	6.1
10	1.05	7.9	.70	2.8	.55	1.8	.90	5.3
11	.95	6.1	.65	2.4		1.7	.80	3.9
12	.95	6.1	.65	2.4	.50	1.6	.75	3.3
13	.90	5.3	.60	2.1		1.6	.75	3.3
14	1.10	8.9	.60	2.1	.50	1.6	.80	3.9
15	1.25	12.0			.50	1.6	.85	4.5

Daily gage height and estimated discharge of Thanksgiving ditch near outlet, 1908—Cont'd.

Day.	June.		July.		August.		September.	
	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
16	1.10	8.9			0.50	1.6	0.80	3.9
17	1.05	7.9			.55	1.8	.85	4.5
18	1.10	8.9				2.8	1.25	12.0
19	1.00	7.0			.80	3.9	1.20	10.9
20	1.10	8.9			.70	2.8	1.15	9.9
21	1.25	12.0			.70	2.8		
22	1.00	7.0			.70	2.8		
23	.90	5.3			.65	2.4		
24	.80	3.9			.65	2.4		
25	.70	2.8				2.4		
26	.70	2.8			.65	2.4		
27	.70	2.8			.60	2.1		
28	.70	2.8			.60	2.1		
29	.70	2.8			.60	2.1		
30	.65	2.4			.60	2.1		
31						3.7		
Mean		6.84		2.37		2.25		6.46

CALIFORNIA CREEK BRANCH OF THANKSGIVING DITCH NEAR INTAKE.

June 6, 1908, a gage was placed in the California Creek branch a short distance below the intake, and was read by employees of Frank G. Manley.

Discharge measurements of California branch of Thanksgiving ditch near intake, 1908.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
June 6	C. C. Covert	0.85	6.0
June 8	do	1.02	7.9
July 7	A. V. Thorns	.65	2.1
August 7	C. E. Ellsworth	.64	2.0
August 18	do	.72	2.5

Daily gage height and estimated discharge of California branch of Thanksgiving ditch near intake, 1908.

Day.	June.		July.		August.		September.	
	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1			0.65	2.1			0.80	3.6
2			.60	1.8			.90	5.3
3			.70	2.5			.85	4.4
4			.65	2.1			1.00	7.9
5			.65	2.1			.90	5.3
6	0.85	4.4	.65	2.1			.85	4.4
7	.80	3.6	.65	2.1				4.4
8	1.00	7.9	.60	1.8	0.65	2.1	.85	4.4
9	.75	3.0	.65	2.1	.65	2.1	.85	4.4
10	.90	5.3	.70	2.5	.65	2.1	.80	3.6

Daily gage height and estimated discharge of California branch of Thanksgiving ditch near intake, 1908—Continued.

Day.	June.		July.		August.		September.	
	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
11	0.80	3.6	0.65	2.1	....	2.1	0.80	3.6
12	.85	4.4	.65	2.1	0.65	2.1	.75	3.0
13	.80	3.6	.65	2.1	....	2.1	.80	3.6
14	.90	5.3	.65	2.1	.65	2.1	.80	3.6
15	.95	6.5	....	....	.65	2.1	.75	3.0
16	.85	4.4	....	....	.65	2.1	.80	3.6
17	.85	4.4	....	....	.65	2.1	1.00	7.9
18	.85	4.4	....	....	.72	2.7	1.00	7.9
19	.80	3.6	....	....	.75	3.0	.75	3.0
20	1.30	17.0	....	....	.70	2.5	.95	6.5
21	1.00	7.9	....	....	.70	2.5	....	....
22	.90	5.3	....	....	.70	2.5	....	....
23	.80	3.6	....	....	.65	2.1	....	....
24	.80	3.6	....	....	.65	2.1	....	....
25	.75	3.0	....	....	....	2.1	....	....
26	.70	2.5	....	....	.65	2.1	....	....
27	.70	2.5	....	....	.65	2.1	....	....
28	.70	2.5	....	....	.65	2.1	....	....
29	.70	2.5	....	....	.65	2.1	....	....
30	.65	2.1	....	....	.65	2.1	....	....
31	....	....	....	....	....	2.1	....	....
Mean	....	4.68	....	2.08	....	2.20	....	4.67

EUREKA CREEK.

Eureka Creek rises in the Minook-Baker divide just east of Eureka Dome, flows southwestward for about 5 miles, then takes a more southerly course and unites with Baker Creek at the point where that creek makes its decided turn to the south. The total length of Eureka Creek is about 12 miles. It receives Boston Creek about 5 miles below its head.

Above Boston Creek the valley resembles that of Pioneer Creek. The south side rises abruptly about 600 feet above the stream and furnishes no tributaries, while the north slope is gentle and is cut by several small streams. Below Boston Creek the valley rapidly broadens into Baker Flats, which are covered with a dense growth of willows intermixed with some good-sized spruce and which the stream crosses in a meandering and sluggish manner through a deep-cut, mucky channel.

The main diggings are near the junction of Boston Creek, although placer-gold values have been found at several points above.

Miscellaneous measurements of Eureka Creek, 1908.

Date.	Locality.	Drainage area.	Discharge.	Discharge per square mile.
		Sq. miles.	*Sec.-ft.*	*Sec.-ft.*
August 21	Claim 14 above	2.8	0.77	0.275
Do	Claim 5 above	5.8	1.3	.224
August 6	Mouth	37.7	4.8	.127

PIONEER CREEK.

Pioneer Creek heads in the south slope of Elephant Mountain and flows southwestward. It is about 11 miles long and, for about 5 miles of its course, parallels Eureka Creek, to which it is a tributary, some 7 miles from the head.

On the south side, which the creek closely follows, the valley rises almost precipitously about 800 feet above the bed of the stream and is broken only by small gulches. The north side, in contrast, exhibits a very gentle slope marked by a prominent bench which is cut at right angles to Pioneer Creek by several small tributaries of similar appearance. There is very little timber in the valley, the supply being barely sufficient for fuel. Most of the diggings are on the north slope. What Cheer Bar, Seattle Bar, Doric Creek, Boothby Creek, and Joe Bush Creek cover the principal claims.

A ditch 4 miles long diverts water from Pioneer Creek just above Joe Bush Creek and carries it to the What Cheer Bar workings. A measurement was made on this ditch near Seattle Creek June 7, 1908, as follows: Gage height, 1.95 feet; discharge, 10.6 second-feet.

A gaging station was established on this stream at the intake of What Cheer Bar ditch June 7, 1908. Daily readings were taken by employees of Frank G. Manley.

Discharge measurements of Pioneer Creek at What Cheer Bar ditch intake, 1908.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
June 7	C. C. Covert	0.95	10.8
June 21	A. V. Thorns	.65	4.0
August 8	C. E. Ellsworth	.50	2.6
August 19	do	.52	2.6
September 1	do	.70	7.2

Daily gage height and estimated discharge of Pioneer Creek at What Cheer Bar ditch intake, 1908.

[Elevation, 900 feet; drainage area, 8.1 square miles.]

Day.	June.		August.		September.	
	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1			0.55	2.9	0.70	4.7
2				2.9	.67	3.7
3				2.9	.78	6.2
4				2.9	.72	4.8
5			.55	2.9		4.4
6				2.8		4.0
7	0.95	10.8		2.7	.63	3.7
8	.85	7.9	.50	2.6		3.6
9	.80	6.6		2.6		3.4
10	.80	6.6		2.6		3.2

Daily gage height and estimated discharge of Pioneer Creek at What Cheer Bar ditch intake, 1908—Continued.

Day.	June.		August.		September.	
	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
11	.75	5.6		2.6		3.0
12	.75	5.6		2.6		2.8
13	.70	4.7	0.50	2.6	0.51	2.6
14	.85	7.9		2.7		3.0
15	.95	10.8		2.8	.60	3.4
16	.85	7.9		2.9		4.2
17	.80	6.6	.55	2.9		5.0
18	.75	5.6		2.9		5.8
19	.75	5.6		2.9	.80	6.6
20	.70	4.7		2.9	.75	5.6
21	.65	4.0		2.9		
22	.65	4.0		2.9		
23	.60	3.4		2.8		
24	.60	3.4		2.7		
25	.60	3.4		2.6		
26		3.4		2.6		
27		3.4		2.6		
28		2.9	.50	2.6		
29		2.9		3.1		
30	.55	2.9		3.6		
31				4.1		
Mean		5.44		2.52		4.18
Mean per square mile		.672		.311		.516
Run-off, depth in inches		.60		.36		.39

NOTE.—As there was practically no rain in this section during July it is presumable that the discharge for the month averaged not to exceed 2.9 second-feet.

HUTLINANA CREEK.

Hutlinana Creek is tributary to Baker Creek about 7 miles above its mouth, near the southern border of the Baker Flats. Its course is in general parallel to that of Eureka Creek. For the first mile or two the stream flows nearly due north; it then turns gradually toward the west, passing the south slope of Wolverine Mountain, and finally takes a general southwesterly course to the mouth. It has a broad, gravelly bed with sharp banks and follows a winding course, making many abrupt turns in passing from one side of the valley to the other. In general, however, it keeps near the left side. The topography of Hutlinana Valley presents strong contrasts—from Wolverine Mountain, with an elevation of 4,600 feet, to the marshy, alluvial Baker Flats.

Above Elephant Creek the east side of Hutlinana Valley rises precipitously and is broken by fewer tributaries than the west side, which is cut by many small streams, and exhibits a gradual, bench-like slope for a considerable distance back from the stream, beyond which it rises rapidly to the summit of Elephant and Wolverine mountains. The gravelly valley bottom forms a water course of such nature that during a period of protracted drought 50 per cent or even more of the run-off may pass beneath the surface. Many other streams in the Rampart region have the same characteristic feature.

The valley contains a heavy growth of timber, much of which is suitable for milling. A sawmill has been in operation on the creek, and, considering the value of sawed lumber, it is surprising that such work is not carried on more extensively.

About 1 mile below Elephant Gulch a hot spring rises in the bed of the creek of a temperature and size sufficient to prevent the creek from freezing for a considerable distance below, even during the intense cold of the winter months. In the vicinity of the spring there are several acres of warm ground, now covered with a luxuriant growth of large spruce, poplar, and birch, which on clearing would be suitable for agriculture. Mr. F. E. Diver has taken up a homestead about the spring, and during the summer of 1908 he constructed a large cabin that could be used as a road house, put under cultivation some small patches of ground, and successfully raised several varieties of vegetables. If paying mines should be developed along the creek, Mr. Diver would find a ready and profitable market for his produce.

Considerable exploring has been done near the headwaters of the creek, but the presence of ground water and the lack of suitable machinery have prevented systematic prospecting and the working of ground that, under more favorable conditions, might yield gold in paying quantities.

Prospecting with a churn drill was probably done on Hutlinana Creek during the winter of 1908–9.

A gage was installed June 9, 1908, on the left bank a short distance below Cairo Creek, from which readings were taken during the summer by F. E. Diver. On September 1, 1908, a gage was installed above Cairo Creek on the left bank, about 500 feet below the hot springs, from which all subsequent readings will be made.

Discharge measurements of Hutlinana Creek below Cairo Creek, 1908.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
June 9	C. C. Covert	1.32	76.3
June 25	A. V. Thorns	1.00	41.2
August 19	C. E. Ellsworth	.50	10.5
September 1	do	.65	14.9

Daily gage height and estimated discharge of Hutlinana Creek below Cairo Creek, 1908.

[Elevation, 1,050 feet; drainage area, 44.2 square miles.]

Day.	June.		July.		August.	
	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1			0.90	32.0	0.60	12.8
2			.90	32.0		12.7
3				31.0		12.6
4				30.0		12.5
5				29.0		12.4
6				28.0		12.3
7				27.0		12.2
8				26 0		12.1
9	1.30	74.0		25.0		12.0
10	1.30	74.0	.80	24.0		12.0
11		85.6	.80	24.0		11.8
12	1.50	97.0	.80	24.0		11.7
13	1.60	109		24.0		11.6
14	1.70	122	.80	24.0		11.4
15	1.70	122	.80	24.0		11.3
16		109	.80	24 0		11.2
17	1.50	97		22 6		11.0
18	1.40	85.6		21.3		10.8
19	1.30	74.0		20 0	.50	10.5
20		66.0		18.7	.50	10.5
21		59.4	.70	17.4	.50	10 5
22	1.10	51.8		17.4		
23	1.10	51.8	.70	17.4		
24	1.10	51.8		17.4		
25	1.00	41.4		17.4		
26		37.6	.70	17 4		
27		34.7		15 8		
28	.90	32 0		14.3		
29	.90	32.0	.60	12 8		
30	.80	24.0		12 8		
31				12.8		
Mean		69 6		22 0		11.7
Mean per square mile		1 57		.498		.265
Run-off, depth in inches		1.28		.58		.20

MISCELLANEOUS MEASUREMENTS.

Most of the miscellaneous measurements made in the Baker Creek drainage basin are given in the following table.

Ohio Creek and Elephant Gulch are small tributaries of Hutlinana Creek from the right near the headwaters. Goff and Applegate creeks, the two largest tributaries of Hutlinana Creek, enter it from the east about 12 miles from the head. Applegate Creek is said to have several good-sized thermal springs in its upper drainage which furnish the greater portion of the run-off during the low-water season.

The measurements on Hutlinana Creek below the mouth of Caribou Creek were made about 500 feet below the proposed ditch intake, as determined by surveys made during the summer of 1908 in connection with the project to convey water from Hutlinana Creek to the Baker Creek mines.

Miscellaneous measurements in Baker Creek drainage basin, 1908.

Date.	Stream and locality.	Drainage area.	Discharge.	Discharge per square mile.
		Sq. miles.	*Sec.-ft.*	*Sec.-ft.*
August 30	North Fork of Baker Creek below Wolverine Creek	19.7	5.2	0.264
Do	Wolverine Creek 2 miles above mouth	6.2	2.1	.339
Do	Wolverine Creek at mouth	8.2	2.6	.317
August 22	New York Creek at trail crossing	17.3	[a] 1.4	
June 6	Thanksgiving ditch at outlet		11.1	
August 29	do		1.7	
June 7	What Cheer Bar ditch near Seattle Creek		4.0	
August 20	Hutlinana Creek below Caribou Creek	16.1	1.9	.118
September 2	do	16.1	3.1	.192
August 20	Ohio Creek at trail crossing	3.2	.93	.290
Do	Elephant Gulch at mouth	3.3	1.1	.333
Do	Goff Creek near mouth	11.4	2.4	.211
Do	Applegate Creek 1 mile above mouth	18.9	2.8	.148

[a] 1.7 second-feet diverted above point of measurement.

PATTERSON CREEK DRAINAGE BASIN.

Patterson Creek is formed by the junction of Sullivan and Cache creeks and is tributary to Tanana River about 40 miles below the mouth of Baker Creek. It drains an area of low relief, the most prominent feature of which is Bean Ridge on the south, which furnishes several small tributaries. Woodchopper Creek is tributary to Patterson Creek about 6 miles from the Tanana.

Sullivan Creek, the right fork of Patterson Creek, rises on the south slope of Roughtop Mount, and for about 10 miles flows a little west of south through a wide valley with gentle slopes and high, broad benches. Birch and spruce timber suitable for cabins and fuel is abundant in the lower valley.

Values were located on Sullivan Creek by Messrs. Snyder and Kemper January 1, 1907, just befow the mouth of Tufty Gulch, since which time work on Discovery and one or two other claims has been successfully carried on. The bench on the left side was prospected quite extensively during the summer of 1908, and values are said to have been found at several places. Lack of water is apt to seriously interfere with extensive operations along the present line of exploration. Some prospecting has been done on Cache Creek, but no values have been found.

A gage was established on Sullivan Creek August 4, 1908, 3 miles above the mouth, and readings taken by employees on the ditch, but as measurements were made only at low water no daily discharges can be computed.

Miscellaneous measurements in Patterson Creek drainage basin, 1908.

Date.	Stream and locality.	Drainage area.	Gage height.	Discharge.	Discharge per square mile.
		Sq. miles.	*Feet.*	*Sec.-ft.*	*Sec.-ft.*
August 4	Cache Creek at trail crossing	22.7		3.2	0.141
Do	Sullivan Creek 3 miles above mouth	20.7	0.80	5.7	.275
August 24	do	20.7	.70	4.5	.217
August 26	Quartz Creek near mouth	8.0		2.8	.350
August 25	Woodchopper Creek at trail crossing	19.7		4.4	.223

FIFTYMILE RIVER AT WHITE HORSE.

Since 1902 the White Pass and Yukon Railroad Company has kept daily records of the stage of Fiftymile River at White Horse, together with the dates of opening and closing of navigation. In 1908 members of the United States Geological Survey, on their way to the interior of Alaska, made the following measurements of the river at this point.

June 10, gage height, 9⅛ inches; discharge, 4,490 second-feet.

June 16, gage height, 16⅜ inches; discharge, 5,100 second-feet.

Drainage area, 7,630 square miles; discharge, 0.588 and 0.668 second-foot per square mile, respectively.

COMPARATIVE DISCHARGE OF DIFFERENT AREAS.

In order to afford a comparison of the discharge of different drainage areas in the Yukon-Tanana region during 1907-1908 the following tables have been prepared, showing the minimum daily flow and the mean weekly supply in second-feet and, for some streams, in second-feet per square mile. These tables can be used in estimating the discharge of streams in this region having similar drainage areas, but such estimates will only roughly approximate the true discharge because of the variation of the controlling conditions in the individual drainage basin. The diagram (fig. 3) is plotted from the table of discharge in second-feet per square mile on page 89. It illustrates graphically in weekly periods the discharge of various streams in second-feet per square mile, and it has been prepared for use in connection with the tables of comparative discharge.

A table of drainage areas of a few of the important streams in this region other than those studied is given on page 89. If this table is used in connection with the precipitation records and the tables of comparative discharge, it may prove useful in making rough estimates of minimum stream flow in areas for which no data have been obtained.

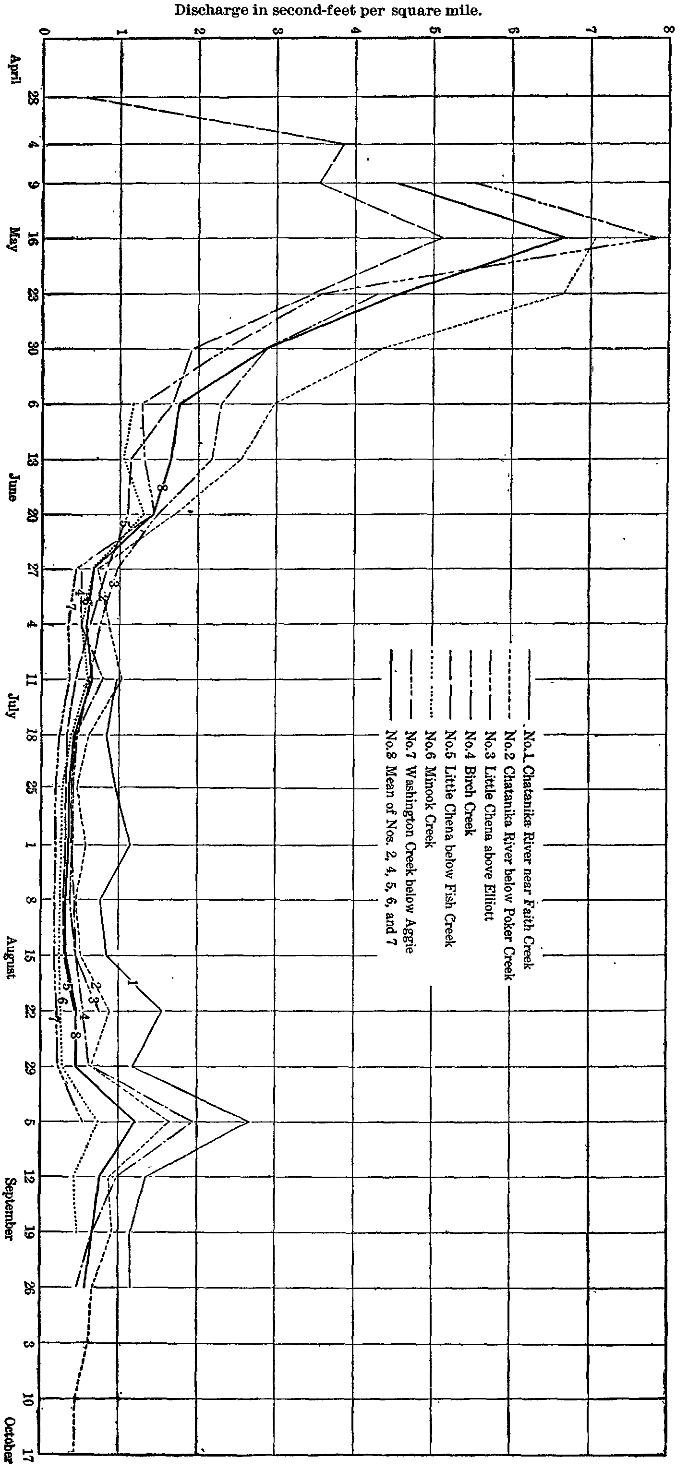


FIGURE 3.—Diagram showing mean weekly discharge in second-feet of streams in Yukon-Tanana region.

Estimated minimum daily flow of streams in Yukon-Tanana region, 1907–1908.

FAIRBANKS DISTRICT.

Stream and locality.	Elevation.	Date.	Minimum flow.	Drainage area.	Minimum discharge per square mile.	Duration of record.
	Feet.	1907.	*Sec.-feet.*	*Sq. miles.*	*Sec.-foot.*	
Little Chena River above Elliott Creek.	800	July 22–25, 29–31.	42	79	0.532	July 22–Sept. 10.
Elliott Creek above Sorrels Creek	800	July 31	2.5	13.8	.181	Do.
Sorrels Creek above mouth	800	....do	6	21	.286	Do.
Fish Creek above Fairbanks Creek.	925	July 30–31	18	39	.462	Do.
Faith Creek at mouth	1,400	July 10	19.2	51	.376	June 20.
McManus Creek at mouth	1,400	July 10–12	15	80	.188	Do.
Chatanika River below Faith Creek.	1,350	July 31	54	132	.409	July 17–Sept. 30.
Kokomo Creek near mouth	750	July 23, 30–31	7.9	26	.304	July 9–Aug. 14.
Chatanika River below Poker Creek.	700	July 4–7, 10	167	456	.366	June 20–Oct. 14.
		1908.				
Little Chena River above Elliott Creek.	800	Aug. 11	28	79	.354	May 20–Aug. 26.
Little Chena River below Fish Creek.	700	Aug. 12–13	59	228	.259	May 1–Aug. 27.
Elliott Creek above Sorrels Creek.	800	Aug. 4–7, 9–13.	4.4	13.8	.319	May 20–Aug. 26.
Sorrels Creek near mouth	800	Aug. 3–14	10	21	.476	Do.
Fish Creek above Fairbanks Creek.	925	Aug. 21–Sept. 12–13.	12	39	.308	May 22–Aug. 27.
Fish Creek at mouth	700	July 17–18, 31–Aug. 6, 12–13	22	90.2	.244	May 1–Aug. 27.
Miller Creek near mouth	750	Aug. 12–13	4.0	15	.267	May 13–Aug. 27.
Chatanika River near Faith Creek.	1,350	July 21–22	82	132	.621	July 13–Sept. 30.
Chatanika River below Poker Creek.	700	Oct. 15–16, 21	179	456	.386	May 16–Oct. 21.
Washington Creek above Aggie Creek.	600	July 23	18	117	.154	May 23–Sept. 4.
Washington Creek below Aggie Creek.	600	July 23	24	153	.157	May 5–Sept. 4.
Aggie Creek above mouth	600	July 31	4.5	35.8	.126	May 23–Sept. 4.

CIRCLE DISTRICT.

Stream and locality.	Elevation.	Date.	Minimum flow.	Drainage area.	Minimum discharge per square mile.	Duration of record.
		1908.				
Birch Creek at Fourteenmile House.	700	Aug. 8	825	2,150	0.384	June 20–Sept. 20.
Mammoth Creek at Miller House	1,700	Oct. 10–13	13.0	37.1	.350	Sept. 8–Oct. 13.
Porcupine Creek below Bonanza Creek.	1,900	Aug. 7	15.5	39.9	.388	July 4–Aug. 10.

RAMPART DISTRICT.

Stream and locality.	Elevation.	Date.	Minimum flow.	Drainage area.	Minimum discharge per square mile.	Duration of record.
		1908.				
Minook Creek above Little Minook Creek.	425	Aug. 15	30	130	0.231	June 7–Sept. 22.
Hoosier Creek at claim 11 above.	600	Aug. 16–31–Sept. 21.	4.7	25.7	.183	Aug. 16–Sept. 21.
Little Minook Creek at claim 9 above.	1,000	July 17–Aug. 1.	.62	5.9	.105	June 21–Sept. 15.
Hunter Creek at claim 17 above.	600	Aug. 23	3.7	33.4	.111	Aug. 11–Sept. 12.
Troublesome Creek below Quail Creek.	1,750	Sept. 25	4.0	43.2	.093	Aug. 12–Sept. 25.
New York Creek at Thanksgiving ditch intake.	800	June 30–July 14, Aug. 9–17.[a]	.7	4.7	.149	June 6–Sept. 20.
Thanksgiving ditch near outlet	800	Aug. 12–16	1.6	....	....	Do.
California Creek branch of Thanksgiving ditch near intake.	800	July 2, 8	1.8	....	....	Do.
Pioneer Creek at What Cheer Bar ditch intake.	900	Aug. 8–13, 25–28; Sept. 13.	2.6	8.1	.321	June 7–Sept. 20.
Hutlinana Creek below Cairo Creek.	1,050	Aug. 19–21	10.5	44.2	.238	June 9–Aug. 21.

[a] No records July 15 to August 7, inclusive; discharge may have been less than 0.7 second-foot.

Mean estimated weekly water supply, in second-feet, from Little Chena and Chatanika River basins, Fairbanks district, 1907.

Date.	Available for use by diversion at elevation 1,350 feet.	Available for use by pumping at elevation 700 feet.	Available for use by diversion at elevation 800 to 925 feet.				
	Chatanika River near Faith Creek.	Chatanika River below Poker Creek.	Little Chena River above Elliott Creek.	Elliott Creek above Sorrels Creek.	Sorrels Creek near mouth.	Fish Creek above Fairbanks Creek.	Total in Little Chena drainage basin.
June 17–23	86	....	....	....	....	....	....
June 24–30	64	216	....	....	....	....	....
July 1–7	44	178	....	....	....	....	....
July 8–14	36	190	....	....	....	....	....
July 15–21	64	250	....	....	....	....	....
July 22–28	67	224	52	7	12	24	95
July 29–August 4	84	540	80	12	18	55	165
August 5–11	138	516	110	12	24	42	188
August 12–18	85	313	73	10	16	26	125
August 19–25	110	260	56	6	10	24	96
August 26–September 1	180	413	90	11	18	26	145
September 2–8	130	324	82	9	15	26	132
September 9–15	592	1,360	....	....	....	....	....
September 16–22	451	1,480	....	....	....	....	....
September 23–29	238	737	....	....	....	....	....
September 30–October 6	....	655	....	....	....	....	....
October 7–13	....	415	....	....	....	....	....
Mean	158	504	78	10	16	32	136
Maximum	592	1,480	110	12	24	55	188
Minimum	36	190	52	6	10	24	95

Mean estimated weekly water supply, in second-feet, from Little Chena, Chatanika River, and Washington Creek basins, Fairbanks district, 1908.

Date.	Available for use by diversion at elevation 1,350 feet.	Available for use by pumping at elevation 700 feet.	Available for use by diversion at elevation 800 to 925 feet.					Available for use by diversion at elevation 600 feet.
	Chatanika River near Faith Creek.	Chatanika River below Poker Creek.	Little Chena River above Elliott Creek.	Elliott Creek above Sorrels Creek.	Sorrels Creek near mouth.	Fish Creek above Fairbanks Creek.	Total in Little Chena drainage basin.	Washington Creek below Aggie Creek.
May 16–19	....	3,220	....	....	....	....	....	[a] 1,200
May 20–26	....	3,020	339	93	87	[b] 162	681	546
May 27–June 2	....	1,980	227	30	55	98	410	360
June 3–9	....	1,360	181	15	31	79	306	198
June 10–16	....	1,160	172	25	34	50	281	200
June 17–23	....	775	118	9.3	54	44	225	226
June 24–30	....	331	77	8.9	48	42	176	68
July 1–7	....	394	59	6.8	33	30	129	52
July 8–14	[c] 150	468	48	5.3	24	23	100	56
July 15–21	110	278	38	4.6	15	16	74	35
July 22–28	127	207	33	4.5	11	13.5	62	29
July 29–August 4	151	271	32	4.5	11	13.5	61	31
August 5–11	101	211	31	4.4	10	13.5	59	29
August 12–18	112	236	36	45	12	14	66	29
August 19–25	202	402	[d] 59	[d] 46	[d] 16	17	97	32
August 26–September 1	157	306	....	....	....	....	....	35
September 2–8	351	743	....	....	....	....	....	[e] 85
September 9–15	176	407	....	....	....	....	....	....
September 16–22	153	423	....	....	....	....	....	....
September 23–29	[f] 152	313	....	....	....	....	....	....
September 30–October 6	....	284	....	....	....	....	....	....
October 7–13	....	228	....	....	....	....	....	....
October 14–21	....	205	....	....	....	....	....	....
Mean	162	749	104	15.7	31.5	44	195	225
Maximum	351	3,220	339	93	87	162	681	1,200
Minimum	101	205	31	4.4	10	13.5	59	29

[a] May 13–19. [b] May 22–26. [c] July 13–14. [d] August 19–26. [e] September 2–4. [f] September 23–30.

Mean estimated weekly water supply, in second-feet, of streams in the Circle district, 1908.

Date.	Birch Creek at ferry.	Porcupine Creek below mouth of Bonanza Creek.	Mammoth Creek at Miller House.
June 26–July 3	1,240	....	....
July 4–10	1,600	73.5	....
July 11–17	1,160	45.3	....
July 18–24	936	21.5	....
July 25–31	870	19.7	....
August 1–7	850	16.0	....
August 8–14	1,060	[a] 19.5	....
August 15–21	964	....	....
August 22–28	1,280	....	....
August 29–September 4	2,110	....	....
September 5–11	4,090	....	[b] 32.5
September 12–18	1,510	....	21.9
Septemebr 19–25	1,290	....	23.3
September 26–October 2	[c] 942	....	14.6
October 3–9	....	....	14.4
October 10–13	....	....	13.0
Mean	1,420	32.6	17.1
Maximum	4,090	73.5	32.5
Minimum	850	16.0	13.0

[a] August 8–10. [b] September 8–11. [c] September 26–29.

Mean weekly water supply, in second-feet, of streams in the Rampart district, 1908.

Date.	Minook Creek above Little Minook Creek.	Hoosier Creek at claim 11 above.	Little Minook Creek at claim 9 above.	Hunter Creek at claim 17 above.	Troublesome Creek below Quail Creek.	New York Creek at Thanksgiving ditch intake.	California Creek branch of Thanksgiving ditch near intake.	Thanksgiving ditch near outlet.	Pioneer Creek at What Cheer Bar ditch intake.	Hutlinana Creek below Cairo Creek.
June 6–12	[a] 136	....	....	....	....	4.4	4.6	8.4	[a] 7.2	[b] 82.
June 13–19	164	....	....	....	....	3.4	4.6	8.7	7.0	103
June 20–26	136	....	[c] 3.1	....	....	2.8	7.2	6.0	3.8	51.4
June 27–July 3	75	....	1.6	....	....	1.0	2.3	2.7	3.0	31.1
July 4–10	77	....	9.9	....	....	.8	2.1	2.3	....	27.0
July 11–17	63	....	5.0	....	....	[d] .8	[d] 2.1	[d] 2.2	....	23.8
July 18–24	41	....	.62	....	....	....	....	....	....	18.5
July 25–31	35	....	.62	....	....	....	....	....	....	14.8
August 1–7	36	....	.78	....	....	....	....	....	2.9	12.5
August 8–14	32	....	.71	[e] 4.8	[f] 6.7	.8	2.1	1.7	2.6	11.8
August 15–21	33	[g] 4.7	.82	4.6	6.6	1.5	2.4	2.5	2.9	10.8
August 22–28	34	4.7	.87	4.4	7.5	1.4	2.2	2.4	2.7	....
August 29–September 4	62	16.4	4.4	12.2	20.9	3.9	3.9	5.6	4.6	....
September 5–11	83	14.8	2.8	[h] 14.9	37.6	3.8	4.3	6.0	3.6	....
September 12–18	58	8.5	[i] 1.6	....	16.1	3.3	4.7	5.1	3.8	....
September 19–25	[j] 33	[k] 7.3	....	....	8.5	[l] 6.8	[l] 4.8	[l] 10.4	[l] 6.1	....
Mean	68.6	9.4	2.53	8.18	14.8	2.67	3.64	4.92	4.18	35.2
Maximum	164	16.4	9.9	14.9	37.6	6.8	7.2	10.4	7.2	103
Minimum	32	4.7	.62	4.4	6.6	.8	2.1	1.7	2.6	10.8

[a] June 7–12.
[b] June 9–12.
[c] June 21–26.
[d] July 11–14.
[e] August 11–14.
[f] August 12–14.
[g] August 16–21.
[h] September 5–12.
[i] September 12–15.
[j] September 18–22.
[k] September 18–21.
[l] September 19–20.

Mean estimated weekly discharge, in second-feet, per square mile of streams in Yukon-Tanana region, 1908.

Date.	Chatanika River below Poker Creek (drainage area 456 square miles).	Little Chena River below Fish Creek (drainage area 228 square miles).	Washington Creek below Aggie Creek (drainage area 147 square miles).	Hutlinana Creek below Cairo Creek (drainage area 130 square miles).	Minook Creek above Little Minook Creek (drainage area 130 square miles).	Birch Creek at Fourteenmile House (drainage area 2,150 square miles).	Mean.	Chatanika River near Faith Creek (drainage area 132 square miles).	Little Chena River above Elliott Creek (drainage area 79 square miles).	Mean.
May 1-5		3.84								
May 6-12		3.53	5.51				4.52			
May 13-19	7.03	5.10	7.84				6.66			
May 20-26	6.61	3.44	3.57				4.54		4.29	
May 27-June 2	4.34	1.92	2.35				2.87		2.87	
June 3-9	2.98	1.69	1.29	1.67	1.18		1.76		2.29	
June 10-16	2.52	1.14	1.31	2.32	1.05		1.67		2.18	
June 17-23	1.70	1.10	1.48	1.57	1.30		1.43		1.49	
June 24-30	.72	.83	.44	.82	.68	.51	.67		.98	
July 1-7	.86	.62	.34	.68	.51	.50	.58		.75	
July 8-14	1.02	.45	.37	.55	.61	.80	.63	.97	.61	.79
July 15-21	.61	.33	.23	.48	.38	.46	.42	.83	.48	.66
July 22-28	.45	.31	.19	.38	.28	.40	.35	.96	.42	.69
July 29-August 4	.59	.32	.20	.28	.27	.40	.36	1.15	.41	.78
August 5-11	.46	.29	.19	.27	.26	.45	.32	.76	.39	.58
August 12-18	.52	.31	.19	.25	.24	.46	.33	.85	.46	.66
August 19-25	.88	.43	.21	.24	.26	.54	.43	1.55	.75	1.15
August 26-September 1	.67		.23		.28	.64	.46	1.19		
September 2-8	1.63		.55		.73	1.93	1.21	2.66		
September 9-15	.89				.44	.99	.77	1.33		
September 16-22	.92				.48	.66	.69	1.16		
September 23-29	.68					.47	.58	1.15		
September 30-October 6	.62									
October 7-13	.45									
October 14-21	.45									

Drainage areas of streams in interior of Alaska.

	Square miles.
Fiftymile River at White Horse, Yukon Territory	7,630
Yukon River at Dawson, Yukon Territory	115,000
Yukon River at Fort Yukon	177,000
Yukon River at Rampart	206,000
Yukon River at mouth	322,000
Fortymile Creek 3 miles below Fortymile telegraph station [a]	1,620
Fortymile Creek at mouth	6,350
Charley River at elevation 2,200 feet [b]	449
Charley River at elevation 1,000 feet [c]	1,470
Charley River at mouth	1,760
Birch Creek at mouth	3,090
Preacher Creek at mouth	1,100
Beaver Creek at mouth	5,360
Tanana River at mouth	42,000
Salcha River at the Splits [d]	1,290
Salcha River at mouth	2,150

[a] 100 feet fall in 4 miles.
[b] 400 feet fall in 9 miles.
[c] 200 feet fall in 5 miles.
[d] 200 feet fall in 8 miles.

HYDRAULIC DEVELOPMENT.

DITCH AND PIPE LINES IN ALASKA.

No ditch project of any considerable magnitude has yet been undertaken in the Yukon-Tanana region. About half a dozen short ditches have been built on tributaries of Birch, Minook, Patterson, and Baker creeks, but none in the Fairbanks district have advanced beyond the stage of preliminary investigation. It is probable, however, that in the next few years large waterways will be constructed either for hydraulicking or, more likely, for generating hydro-electric power. Engineers contemplating such work in the interior of Alaska can consider with profit the experiences of ditch builders in Seward Peninsula where hundreds of miles of water conduits have been constructed under a wide range of conditions. Henshaw[a] has described construction methods and difficulties in the Nome and Kougarok region as follows:

Ditches are usually built so as to follow the contour approximately with grades limiting the velocity to about 2 feet per second, which is as high as the material in this section will stand without scour. The ditches are therefore for the most part on slopes, and are constructed by making a cut from 12 to 18 inches deep to grade at the lower bank. This bank is then built up by material from the excavation. The slopes of the banks are from 1:1 to 1½:1, depending on the material.

The work of constructing a ditch is usually divided into three classes—team work, pick-and-shovel work, and rock work. Teams may be used in handling dry soil that contains only medium-sized rock. This is the fastest method, and the compacting of the lower banks by the horses and scrapers makes it much tighter than when the dirt is thrown in loose. Pick and shovel are used in loose rock, in wet soil, and in frozen ground from which the top is removed as it thaws from the surface. Rock must be blasted, unless it is fissured limestone, which may be loosened with the crowbar, or decomposed schist, which yields to the picks. In building through solid rock a shelf is blasted out about 1 foot below grade and wide enough to carry the ditch and the lower bank, which is built of rocks. The bottom and sides are lined with sod about 1 foot thick, and are puddled with clay. In rock slide the method is similar. A good example of this kind of construction was seen on the Grand Central branch of the Miocene system. The ditch was built through a pile of large bowlders, unmixed with any soil or gravel. A trench was made 1 foot deeper and 2 feet wider than the finished ditch. The sides of the trench were lined with a slope wall, laid 1 to 1, to a height of 4 or 5 feet. The outer slope of the lower bank was also rock wall, laid somewhat flatter. The ditch will be lined with sod and will be tight and permanent.

The use of sod is very common and economical and saves much piping and fluming that would otherwise be necessary. The sod in a short time settles and knits together, and thus becomes a very serviceable bank. It will not cut or wear out, and the older it gets the better it becomes. In this way a ditch can be made over perpetually frozen ground where otherwise it would be impossible. Much ditch has to be constructed over loose stones with little or no sediment between them. Such ditches must be lined with sod and all holes must be filled by tamping sod into them as far as possible. This being done, it will be found that the water traveling through the

[a] Water-supply investigations in Alaska, 1906–1907: Water-Supply Paper U. S. Geol. Survey No. 218, 1908, p. 72.

ditch will deposit sediment over the sod and that after a little while it will become tight.

Canvas is also used as a lining to make a ditch water-tight. Willows with the tops left out, so that they may grow, are utilized in embankments with success.

In construction over "glacier," which is the term used for frozen muck mixed with ground ice, the ditch is either built wholly on top of the sod covering or an excavation is made and lined with sod. Ditches over this material are expensive to maintain, owing to the thawing of the ice by the running water.

One of the most interesting pieces of construction over glacier is the flume on the Miocene ditch. This flume is 1,100 feet long and has a width of 8 feet and a depth of 28 inches. It was constructed in 1901, and is now in practically perfect alignment, both horizontal and vertical, and no repairs have been necessary on it. In putting in the foundation, trenches were dug 3 or 4 feet deep in the frozen ground, which was practically all ice. The excavated material was covered to protect it from thawing. A sill was laid in the bottom of the trench and the uprights fastened to this sill. The excavated material was then replaced in the trenches and froze again into the original condition. Sod was carefully placed over the trench. The uprights were then sawed off to grade and the flume constructed on them.

Inverted siphons are built across deep ravines where their use will save expense and reduce loss by seepage. Most of these are riveted steel pipe. Joints are made by lapping the ends from 4 to 6 inches. Siphons must be weighted down and protected by rock to prevent injury by frost and snowslides. During 1906 two siphons were built on the Seward ditch across Clara and Hobson creeks, continuous wood-stave pipes with steel bands being used.

On account of the rapid surface run-off during hard rains, it is necessary to have waste gates at short intervals. The most common waste gates consist either of a flume as deep as the bottom of the ditch, in which the height of the water is regulated by flashboards, or of a long weir, laid on the ground surface, which will spill the water when it reaches a certain level.

Ditch intakes consist of a dam or barrier across the stream, containing one or more waste gates, and head-gates for regulating the flow into the ditch. In order to divert the entire flow of a stream, a bed-rock dam must be built to stop the ground flow through the gravelly beds. Such a dam is made by cutting a trench across the stream bed, extending down to an impervious stratum, and filling it with sod, which is carefully laid and tamped. The dam should be protected from erosion with large flat rocks or riprap.

Frozen ground, inadequate facilities for transportation, and the high cost of help[a] and supplies make ditching very expensive. To the first cost of a ditch should be added the cost of maintenance for the first three years, during which time extensive repairs are necessary. On many ditches these repairs cost as much as the first construction. At the end of three years ditches are, as a rule, in fairly permanent condition and the cost of maintenance is greatly reduced. Such information as could be obtained shows that the cost of a ditch carrying from 1,000 to 2,000 inches, including the first three years' maintenance, is from $5,000 to $10,000 per mile. Owing to dangers from washouts and landslides it is necessary to have the ditch constantly patrolled.

Owing to the frozen condition of the ground it is not practicable to use ditches much before the 1st of July, as the surface does not become fully thawed until that time, and during the thawing period the ground becomes very soft and there is great danger of damage by washouts.

The above discussion was written before Mr. Henshaw had visited the Fairhaven and Candle ditches in the Fairhaven district. The condi-

[a] Laborers receive $5 per day and board; blacksmiths, etc., $6.

tions encountered on these waterways were much more difficult than in the country a hundred miles or so farther south; in fact, there is more difference between some of the ground in the Fairhaven precinct and the slopes of the Nome River Valley than between that of Nome River and the unfrozen soil of temperate latitudes. The following are extracts from the descriptions of the Fairhaven and Candle ditches.[a]

The [Fairhaven] ditch has a grade of 4.2 feet to the mile and was built 11 feet wide on the bottom, 1 foot in cut at the lower side, and with a 4-foot lower bank. The removal of 1 or 2 feet of the upper moss and soil put the bottom of the ditch into ground ice and muck, much of the ice being fairly pure. This material thawed when the water was turned in and a large part of the bottom of the ditch has settled at least 2 feet and has widened in many places to 15 or 20 feet, or more. As the upper bank thawed, the material was thrown against the lower bank to protect it and keep the water from getting under it. Practically the whole of the upper ditch, and at least three-fourths of the lower ditch, including all the upper 6 or 8 miles, is built in frozen ground of this character. Where the lower ditch is built around the steep gulches that carry the eastern tributaries of the Pinnell the northerly slopes of the gulches are covered with muck, but the southerly slopes are made up of a more solid clay and decomposed mica schist. Along the upper ditch lava bowlders are present in the muck from the surface to bed rock. At some places the material encountered was composed of angular fragments of lava with little soil between them. Above and below Snow Gulch, the lowest tributary of Pinnell River which the ditch crosses, there are short pieces of rock work. The rock is much shattered and could have been loosened with picks if it had not been frozen. Much difficulty was experienced in making the rock work water-tight on account of the lack of good sod, as the surface covering is commonly decayed moss or peat containing much fibrous matter with little earthy material to give solidity and will generally float even though saturated with water

The [Candle] ditch is 6 feet wide at the intake, increasing to 9 feet at the lower end. It has a grade of 3.7 feet to the mile, a capacity of 20 to 30 second-feet, and an elevation at the penstock of 249 feet above Kiwalik River. A cut of 9 inches was made on the lower side; this gave a low ditch bank in places where the ground was solid, but in the frozen muck the ditch bottom has settled 1 to 2 feet. The material encountered varied greatly. Near the upper end there were 2 miles of decomposed mica schist; below Burnside Creek there was some rocky ground with too little sediment to make the ditch tight without a great deal of work. Repair work in such places was difficult on account of the general lack of good sod. The portions of the ditch built over the muck gave the least trouble in building. A berm 1 foot wide was left on the lower bank between the cut and fill, and formed a protection for the inside of the bank when the bottom settled.

FAIRBANKS DISTRICT.

GENERAL CONDITIONS.

In the Fairbanks district mining has been carried on either by "open cuts" or by "drifting," as best suits the local conditions. The upper portions of the creeks usually favor the "open-cut" method, as the bed rock ranges only from 8 to 20 feet befow the surface. In the lower reaches, where the pay streak is 50 to 250 feet underground, with 25 to 200 feet of overburden, "drifting" seems

[a] Henshaw, F. F., Mining in the Fairhaven precinct: Bull. U. S. Geol. Survey No. 379, 1909, pp. 359, 367.

the only solution. The work being underground, where protection from severe weather is assured, this portion of the camp is active in winter as well as in summer. The pay gravel is hoisted to the surface and dumped in large piles, where it awaits the spring break-up for sluicing, when high water follows the melting of the accumulated snow. (See Pl. III.)

In the Fairbanks district little work has been done as yet toward constructing ditch lines from larger drainage areas for additional water supply. Present developments are confined to small ditches, which convey water to mines in their immediate vicinity on the creeks from which they draw their supply. The camp lies in three drainage basins, or valleys, separated by high dividing ridges, and in order to supply the producing creeks in one valley with water by ditch line from another the ditch must have a high elevation, which throws its intake so far into the headwaters that there is only a small drainage area from which to draw the supply.

PROPOSED DITCH LINES.

On account of its elevation, the upper Chatanika drainage basin has been more carefully considered as a possible source of water for a ditch line to the mining camps than any other drainage area within a reasonable distance of the Fairbanks district. The supply from this stream, however, would require more than 100 miles of ditch, difficult to construct and maintain, and would, by reason of its low head, benefit only a small number of producing creeks.

Numerous surveys and reports have been made favoring the construction of ditch lines from this drainage basin. The first plan proposed a ditch along the left bank of the Chatanika that would deliver water to Pedro Dome at an elevation of about 1,800 feet, which would be necessary in order to supply water to Goldstream and Fairbanks creeks on the other side of the divide. The intake of such a ditch would have an elevation of about 2,000 feet, or 600 feet higher than the mouth of Faith and McManus creeks, where records of stream flow were kept during the seasons of 1907–8. The drainage area above this intake would be about 100 square miles, or about 25 per cent less than at the point where measurements were made. The records kept during the season of 1907 prove conclusively that had the proposed ditch been built it would have had, instead of a daily supply of 125 second-feet, as was estimated, less than half that amount during the greater part of the open season.

During 1907 surveys were made for a proposed ditch with an intake at the junction of Faith and McManus creeks. This ditch would deliver water to the camps at an elevation of about 1,200 feet—much too low to supply water outside of the Chatanika drainage basin. The tables on page 87 show the weekly supply that would have been available for such a ditch during 1907–1908, and the tables on page 102 show the number of days of deficient flow without storage and the amount of storage necessary to have maintained in the ditch a flow of 75, 100, or 125 second-feet, for the same period.

WATER POWER.

Power developments are possible in the Fairbanks district on several streams, as shown by records kept in the Chatanika and Little Chena drainage basins for two seasons, and on Washington Creek in the spring of 1908.

If storage can be provided in the headwaters the Chatanika project is the most feasible. The table on page 100 shows the horsepower (80 per cent efficiency) that could have been developed in 1907 from water supply of the Chatanika at the junction of Faith and McManus creeks and below Poker Creek. This table shows also the duration in days for different rates of flow. The tables on page 102 show the storage that would have been necessary for the maintenance of a daily flow of 100 second-feet near Faith Creek and of about 220 second-feet below Poker Creek, which would furnish 9.1 and 20 horsepower per foot of fall, respectively.

By constructing a ditch for 12 or 15 miles along the Chatanika, diverting water from a point near the junction of Faith and McManus creeks, a head of about 400 feet could be obtained. A daily flow of 100 second-feet under a 400-foot head would develop 3,640 horsepower on the turbines. The plant at Poker Creek would require about 8 miles of ditch, which would give a head of approximately 100 feet and would develop 2,000 horsepower. The power from the upper plant could be transmitted to the lower and the combined development of, say, 5,600 horsepower, could be used for pumping water to the producing creeks.

In the Little Chena drainage basin it is proposed to gather the water from the upper tributaries, at an elevation of about 900 feet, and convey it by ditch line to a point in the lower drainage area, on the right bank of the river, where a fall of nearly 200 feet can be obtained. A portion of the water so collected is to be used in developing electric power for transmission to the producing creeks, and the excess water will be carried by ditch line to Smallwood and Nugget creeks and there used for mining.

Washington Creek has also been considered as a source of power. During 1908 daily records were kept at the junction of Aggie Creek, below which there is a fall of approximately 200 feet in about 8 miles, and topographic conditions are favorable for ditch-line construction. The records, however, indicate an insufficient supply of water for power development, but if storage could be provided it is possible that the minimum daily flow could be brought to a point which would warrant development.

A. HYDRAULICKING ON EAGLE CREEK.

B. HYDRAULIC ELEVATOR ON HOOSIER CREEK.

CIRCLE DISTRICT.

GENERAL CONDITIONS.

Most of the mining in the Birch Creek region, where bed rock lies only 10 to 20 feet below the surface, is carried on by the "open-cut" method. The situation for hydraulicking is more favorable than is that in the Fairbanks or Rampart regions. The camps on Mammoth and Eagle creeks lie on streams of relatively high gradients. Consequently the water supply, though small, can be delivered to the mining property by comparatively short ditch lines, which give high heads for operating.

Up to 1906 practically the only hydraulic development in this district was a small plant on North Fork of Harrison Creek, but this project proved a failure. However, considerable construction work was done in the Birch Creek region during 1908.

EAGLE CREEK.

The ditch started by Berry & Lamb in 1907 was finished in 1908. A short ditch taps Miller Fork of Eagle Creek about 1 mile above its mouth and carries the water around to a storage reservoir on Mastodon Fork. From this point another small ditch carries the water about 2 miles along the left side of Eagle Creek to a pressure box, where a 210-foot head is obtained for hydraulicking. The water is conveyed to the mines through 4,200 feet of pipe line. This ditch was not completed until early in July, and the water from the spring break-up was therefore not utilized. The storage reservoir was not finished until the end of the season.

The method employed at the Eagle Creek plant differs somewhat from the hydraulic methods usually practiced in Alaska. A channel was first ground sluiced along the bed of the creek, and in this the sluice boxes were set. On the side of the sluice box opposite the pipe line an iron back stop was erected. The plan is to elevate the auriferous gravels by use of water direct from the nozzles. This method requires at least two nozzles in operation at the same time—one to wash the gravel against the back stop, from which it falls into the sluice boxes, and the other to furnish at the head of the boxes water sufficient for sluicing. (See Pl. VI, *A*.)

PORCUPINE CREEK.

During the summer of 1908 Berry & Lamb constructed a portion of a ditch that, when completed, will be used for hydraulicking Mammoth Creek flats from the junction of Mastodon and Independence creeks to the junction of Mammoth and Porcupine. The present ditch has its intake on Bonanza Creek at an elevation about 250 feet above the mouth, and follows along the right bank of Bonanza and

Porcupine creeks for about 6 miles to a point opposite Miller House, where, during the winter of 1908–9, a hydraulic plant will be installed for operations next season. The ditch was built by the use of horses and scrapers, is 7 feet wide on the bottom, and has a grade of 5 feet to the mile. The operating head will be about 500 feet. It is proposed during the coming season to extend the intake around to Porcupine Creek and the outlet to the mouth of Mastodon Creek.

RAMPART DISTRICT.

GENERAL CONDITIONS.

Mining in this district, like that in the Birch Creek region, is mostly by the "open-cut" method. On the Minook Creek side it is carried on by hydraulicking, by the use of hydraulic elevators (Pl. VI, *B*), and by splash dams (Pl. VII, *B*). In the Baker Creek group the water is used for ground stripping and washing the gravels that are shoveled to the sluice boxes. (See Pl. VII, *A*.)

The water-supply situation is quite similar to that in the Fairbanks section. Most of the mines are located on small streams, and many of them are near the headwaters. There is in the vicinity of nearly every mine in the district sufficient water for pumping, but, even if the supply at the point of working is sufficient, it is not in position to be used under pressure, and to get sufficient head for hydraulicking or elevating, the water must either be pumped or diverted at such an elevation that the supply available is of necessity small because of the small drainage area above the diversion point. The larger streams have comparatively low gradients, and long conduits are therefore necessary to bring the water to a point where a working head can be obtained. Present data fail to show where any extensive system of ditch construction for carrying water to the mines is warranted.

MINOOK CREEK GROUP.

GENERAL CONDITIONS.

The mines on Minook Creek have a total supply of water larger than those on Baker Creek, but as many are being worked by hydraulic methods, they are perhaps no better off than their neighbors on the south side of the divide. Minook Creek has been considered as a possible source of supply for the mines on its lower tributaries, but from a careful study of the situation in connection with the results of stream measurements in this locality in 1908, it is evident that a ditch line which would carry water to a sufficient elevation must have its diversion point very near the head of the creek, where the drainage area would be utterly inadequate to furnish a supply that would warrant the construction of 10 to 15 miles of ditch. In

A. SHOVELING IN ON THANKSGIVING CREEK.

B. SPLASH DAM IN OPERATION ON LITTLE MINOOK CREEK.

this section, as elsewhere in the Yukon-Tanana region in 1908, the work was very much hampered by lack of water, and during July and August practically nothing was done.

HUNTER CREEK.

On Hunter Creek two hydraulic plants were in operation during 1908. The plant on Discovery claim has 5,200 feet of riveted steel pipe, ranging in diameter from 20 to 14 inches, 2,300 feet of flume, and 200 feet of ditch. The working head is 105 feet, and the delivery about 400 miner's inches. The plant on claim 17 above has 3,300 feet of flume and 3,000 feet of ditch, an available head of 90 feet, and a delivery of 300 inches.

LITTLE MINOOK CREEK.

On Little Minook Creek the overburden is removed by the action of automatic splash dams (Pl. VII, *B*) operating intermittently, the time interval depending upon the stage of the stream. A log retaining dam is constructed, in the center of which is a spillway closed by an automatic gate which revolves about a horizontal axis. The gate has a vertical dimension of 13 above to 6 below this axis, and an outward slope of 2½ inches to 1 foot. On reaching a certain height the water above the gate causes it to swing forward, allowing a sudden rush of water which is directed by means of wing dams against the material to be moved. When the water pressure is removed the gate closes and the process of filling and "splashing" is repeated. It is by far the cheapest method of removing overburden, and the small initial expense and amount of water required make it available where a hydraulic plant would be impossible. Three such dams were in operation on this creek during the summer of 1908.

HOOSIER CREEK.

On Hoosier Creek an hydraulic elevator was in operation a portion of the summer. About 2 miles of 22-inch pipe brought the water from the head of the creek to the elevator on claim 14 above. Here a 200-foot head operated a 12-inch elevator having a 16-foot lift (Pl. V, *B*) and requiring about 17.5 second-feet of water for operating. Definite information is not at hand concerning the details of this plant, but it seemed to be in successful operation when the supply of water was adequate.

BAKER CREEK GROUP.

GENERAL CONDITIONS.

The mines on the south side of the divide in the Rampart district are all comparatively shallow, as in the Minook and Birch Creek regions. "Open-cut" methods are followed, and the auriferous gravels are shoveled into the sluice boxes after the ground has been stripped by water. The benches on Pioneer and Thanksgiving creeks are the principal producers, but considerable preparatory work has been done on Eureka, Omega, Glen, and Sullivan creeks. The Baker Creek mines are less favorably situated than those of the Minook Creek group, owing to their southern exposure which allows the long hot days of spring to rapidly destroy the winter accumulation of ice and snow. They are also located on smaller streams and nearer the headwaters than most of the mines in the Rampart district.

In 1907 Frank G. Manley, of Baker Hot Springs, completed a number of small ditches to convey water for mining the bench gravels on Pioneer and Thanksgiving creeks. Several small ditches have been completed on Eureka, Glen, Gold Run, and Sullivan creeks. Owing to the scarcity of water, however, little work was accomplished during the past summer, except stripping ground to get mining property in shape for shoveling in.

WHAT CHEER BAR DITCH.

What Cheer Bar ditch taps Pioneer Creek near its headwaters, and carries water along the right bank for use on the benches along Pioneer Creek. The ditch is about 4 miles long, 5 feet wide, and has a grade of 5 feet to the mile. The water is used for ground stripping and for washing the gravels that are shoveled into the sluice boxes. For discharge measurements of this ditch, see page 79.

EUREKA CKEEK.

During 1908 Jerome Chute built a small ditch to operate on Eureka Creek above Pioneer Creek. Mr. Chute planned to make, during the winter of 1908–9, a thorough investigation of the possibilities of artesian wells on Eureka Creek.

THANKSGIVING DITCH.

Thanksgiving ditch taps New York and California creeks about one-half mile above their confluence and carries water to mining ground on Thanksgiving Creek. The ditch is 4 miles long, 5 feet wide, and has a grade of $6\frac{2}{3}$ feet to the mile. The water is used for ground stripping and for washing gravels shoveled into the sluice boxes. (See Pl. VII, *B*.) For discharge measurements of this ditch, see page 76.

SULLIVAN CREEK DITCH.

During the early part of the season of 1908 about 1 mile of ditch, having a capacity of approximately 10 second-feet, was constructed. This ditch is used to convey water for "open-cut" work in Tufty Gulch near the mouth. Several other small ditches were under construction.

WATER POWER FOR ELECTRIC TRANSMISSION.

Throughout the entire Yukon-Tanana region mining in general has been carried on by means of the meager water supply from individual creeks and with very little consideration for methods of economy. Fortunately most of the ground that has been worked has been wonderfully rich, and the miner has been able to follow haphazard methods and still obtain a substantial profit. But the camps already demand a greater water supply than the local creeks can furnish, and in the near future the miner will have to work cheaper ground and will be forced to give the water-supply question most careful consideration.

The situation of the present mining camps does not favor procuring an outside water supply by gravity. The region is part of a semiarid belt having an annual precipitation of 10 to 18 inches, and the topography of the country is such that ditch lines from the larger drainage areas, to which it is necessary to look for a supply commensurate with any reasonable development, are not altogether practical. Most of the larger streams are too far away or at too low an elevation to be used on the auriferous gravels.

Pumping seems to offer the most feasible solution of the problem, and the question naturally arises as to the best methods of developing power for this purpose. Steam and water are the only ones worthy of consideration; but the cost of wood for steam power is at present excessive and is constantly increasing, and unless[a] coal is discovered at a place convenient for transmitting electricity to the mines through a central steam plant the development of water power for electric transmission to pumping plants seems more practical. This method of utilizing the water supply would dispense with many miles of ditch construction and would not only furnish the camp with water, but also with power for running the hoist, elevating the tailings, draining the mines, lighting the underground work, pumping water to the sluice box, and in some localities for running the dredge.

The initial step in the location and development of a hydro-electric plant is the determination of daily flow and of the conditions affecting the flow of the stream or streams to be utilized. This is necessary in order to insure the maximum development of the low-water flow and to provide for storage or its equivalent, an auxiliary steam plant, for use during extreme drought. The collection of such data is a part of the work undertaken by the Geological Survey, and in connection with projects for water-power development attention is called to the records of Chatanika and Little Chena rivers and Washington Creek. (See pp. 23–48.) From these records the following table has been prepared.

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[a] The coal deposits in the northern foothills of the Alaska Range south of Fairbanks may prove to be a valuable asset of the region. They are described by L. M. Prindle in Report on progress of investigations of mineral resources of Alaska in 1906: Bull. U. S. Geol. Survey No. 314, 1906, pp. 221-226.

This table gives the horsepower (80 per cent efficiency) per foot of fall 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 amounts given in the columns for "discharge" and "horsepower."

Estimated discharge and horsepower table for Chatanika and Little Chena rivers, 1907–1908; Washington Creek, 1908.

Discharge (second-feet).	Horsepower, 80 per cent efficiency per foot fall.	Days of deficient discharge.						
		Chatanika River near Faith Creek.		Chatanika River below Poker Creek.		Little Chena River and tributaries.		Washington Creek below Aggie Creek.
		June 16–Sept. 30, 1907.	July 13–Sept. 30, 1908.	1907.	1908.	July 22–Sept. 10, 1907.	May 1–Aug. 27, 1908.	May 5–Sept. 4, 1908.
22	2	....	....	....	....	....	....	0
28	2.5	....	....	....	....	....	....	3
33	3	0	....	....	....	....	....	30
44	4	13	....	....	....	....	....	51
55	5	19	....	....	....	....	0	61
66	6	30	....	....	....	0	26	66
77	7	40	....	....	....	3	31	68
88	8	48	2	....	....	7	36	72
99	9	56	4	....	....	13	44	75
110	10	62	19	....	....	15	48	76
132	12	69	37	....	....	23	55	....
154	14	74	57	0	....	35	58	....
176	16	78	58	5	0	42	60	....
198	18	79	65	17	5	45	63	....
220	20	83	66	27	27	48	67	....

It is evident from the above table that a certain amount of storage is necessary for economic development. (See tables on p. 102.) On Chatanika one storage would benefit two developments, the combined minimum power of which would be at least 5,000 horsepower. This could be used for pumping the ample supply at the mines (see p. 87) to an elevation sufficient for mining on the producing creeks tributary to the Chatanika and also for supplying other substations on Fairbanks and Goldstream creeks.

The situation of several other streams in the Yukon-Tanana regions (see table, p. 89) seems to offer opportunities for the development of electric power for transmission to the mining camps, but unfortunately no records have been kept of the flow of these streams, and their drainage areas are so undeveloped that it is very difficult to procure the desired information. The diagram in figure 3 shows considerable similarity in the run-off per square mile of drainage area of the streams for which records have been kept. This diagram and the accompanying table of drainage areas were specially prepared to guide the prospector or investor to the localities most favorable for power development.

In the judgment of those who have observed the stream conditions in the Yukon-Tanana region for several years the run-off reached its lowest point in the season of 1908. The records obtained this year may therefore be considered especially conservative, and it seems probable that they would afford a safe basis for estimates of supplies available for ditch or other water-power development.

STORAGE AND CONSERVATION.

In the Yukon-Tanana region, where for six months in the year the streams are closed by ice and where, except for a surface thaw of 1 to 3 feet during the summer months, the ground is frozen throughout the year from surface to bed rock—10, 20, 30, and in many places more than 200 feet below—it is considered more practical to use the daily flow of a stream during the open season than to attempt to conserve any excessive run-off; but the two-years' records indicate that commercial development of the region will necessitate the adoption of some means of conservation.

During the low-water period, which invariably occurs in July and August, the inadequacy of the water supply of the local creeks forces many operators to discontinue work and the rest to resort to various schemes to provide water for sluicing. The method most commonly practiced—that of returning water to the sluice boxes for a second and even a third use—not only entails extra expense but furnishes an inferior quality of water for sluicing, as the large amount of silt which the water carries so increases its transporting powers that its efficiency in saving the lighter gold is greatly curtailed.

Obviously these difficulties can be overcome only by obtaining an outside supply of water either by pumping or by gravity. The problem of furnishing a supply adequate for the needs of the camps during the open season would seem less difficult if storage could be provided for the run-off incident to the spring break-up. The computed discharge of streams in the Fairbanks district during the months of May and June and the diagram on page 85 give evidence that at this time of year water is abundant. As April and May are months of exceptionally slight precipitation—perhaps the smallest of all the year—the water must come from the melting of the snow and ice accumulated throughout the winter months.

In the spring of 1908 water began to run in the mining creeks and the more open country from the 20th to the 25th of April, and by the 1st of May the larger streams were breaking up. If the resulting run-off of 3 to 5 second-feet per square mile during May and part of June could have been distributed throughout July and August, a supply adequate for any reasonable development would have been at hand. If some practical plan for storing this excessive run-off could be suggested a number of projected developments in this region might be considered as commercial possibilities.

The amounts of storage that would have been necessary to maintain discharges of 75, 100, and 125 second-feet in a ditch diverting water from Chatanika River near Faith Creek and to maintain discharges of 28, 33, and 55 second-feet in a ditch on Washington Creek near Aggie Creek are given in the following tables, together with the number of days of deficient flow for the different ditch capacities:

Storage table for Chatanika River near Faith Creek.

Capacity of ditch (second-feet.	Days of deficient flow.	Net storage required.	
		Second-feet for 1 day.	Acre-feet.
1907.			
75	39	794	1,575
100	54	1,985	3,937
125	63	3,424	6,792
1908.			
75	0	0	0
100	4	46	91
125	20	508	1,008

Storage table for Washington Creek below Aggie Creek.

1908.

Capacity of ditch (second-feet).	Days of deficient flow.	Net storage required.	
		Second-feet for 1 day.	Acre-feet.
28	3	7	14
33	30	125	248
55	61	1,247	2,473

The table for Chatanika River is based on records covering the periods from June 16 to September 30, 1907, and July 13 to September 30, 1908. Storage provided at the head of the Chatanika might be used in connection with power development near Poker Creek, where the river has a fall of 100 feet in 8 miles. The minimum flow of 167 second-feet for five days in 1907 and of 192 second-feet for two days in 1908 indicates a possible development of at least 1,500 horsepower. The table for Washington Creek covers a period from May 5 to September 4, and undoubtedly represents a minimum condition. During this time there were days when the discharge of the streams exceeded the capacity of the proposed ditches. Had storage reservoirs been provided this excess of flow could have been conserved for use during a later low-water period. But the topographic maps of this section show no natural reservoirs which could be used for storage purposes and indicate that, except near the headwaters of the Chatanika, the country is not adapted to artificial reservoirs. Even if natural conditions were more favorable, the high price for labor,[a] the frozen ground, and the great depth to bed rock would make the construction of large dams nearly impossible. For these reasons it seems desirable to seek other means of storage.

Contrary to the general impression, more or less water flows in nearly all streams of the Yukon-Tanana region during the entire winter. While traveling over this section of country in April, 1908, the writer noticed that large "winter glaciers" had invariably been formed where the channels of small streams had become clogged and dammed, ice 12, 15, or even 20 feet thick being a not uncommon sight. Following the line of least resistance, the water flows around and over the obstructions, freezes, and remains until the summer heat melts it—as late as the 1st of July in sheltered spots. It occurred to the writer that some artificial method might be devised to bring about the formation of "winter glaciers" at the heads of streams proposed for development and that such a system would be of great value. Such artificial "winter glaciers," if protected from the sun by moss and brush, could be drawn upon for additional water supply during the low-water period. The method seems particularly applicable to most of the creeks on which records were kept. At the headwaters the creek bottoms are usually covered with a thick coat of willows, which would aid not only in the formation of the "winter glacier," but also in its protection. The matter seems worth considering, and the experiment would certainly be comparatively inexpensive.

Present conditions not only indicate the need of artificial storage, but emphasize the necessity of protecting the natural storage agents—the forests and the prevailing moss covering. Many years of growth have produced but a scanty supply of timber of inferior grade and size, and even casual observation makes it evident that, once destroyed, the forests can not be replaced in hundreds of years. Yet in many a camp the timber is being unnecessarily destroyed, apparently without any regard for the future.

It is admitted that the natural development of the country demands the use of the available timber supply, but there can be no excuse for such indiscriminate burning of extensive timbered areas as has occurred in the prospecting stages in most of the camps. Besides destroying more timber than would supply all legitimate demands, these fires ruin the heavy moss, which is the one great storage agent

[a] Five dollars per day and board for ordinary labor; mechanics, \$7 to \$8 per day and board.

of this region. In some localities this moss has been so badly burned that it no longer protects the frozen muck and ground ice from the summer sun, and the water is liberated so rapidly that the open season has hardly begun when the supply is practically exhausted. As a result a comparatively short period of no precipitation causes a water famine which might have been delayed had the moss remained to distribute the run-off in a more uniform manner and over a longer period. It was noted last spring that the streams first to start and quickest to discharge the storage from the accumulated snow were those in areas where the timber had been removed from the watershed. The operators throughout the district generally concede that on the producing creeks the floods are greater, their duration shorter, and the low-water period lower and longer than when work was first started.

The necessity for use of the timber supply is conceded, but it is evident that the future welfare of this country, as of older and more developed countries, demands the preservation of its forests because of their own especial uses and their influence on the development and conservation of other natural resources.

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